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Оригинальная исследовательская статья

Stunting in Iodine-Deficient Areas: How Does It Affect Mental Development in Children Under Two Years Old?

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Summary

Background: Soil, water, and plants that grow in the highlands have a very low iodine content in nature. People living in these areas can suffer from iodine deficiency; in children under 5 years of age, the latter can induce mental and growth disorders.

Objective: To assess correlations between characteristics of children and their mothers and mental development of children under two years of age living in iodine-deficient areas.

Materials and Methods: We conducted a cross-sectional study in rural areas of Magelang Regency involving 46 respondents to find the association between eight independent variables (knowledge, education, occupation and parenting style of the mother, sex, wasting, underweight, and stunting of children) and children' mental development as a dependent variable using logistic regression.

Results: Bivariate analysis showed that mother's knowledge, as well as the child's male sex and stunting correlated with mental development of children under the age of two ($p < 0.05$). Multivariate analysis demonstrated that stunting had a significant effect on child developmental disorders.

Conclusion: Stunted children under two years of age living in iodine-deficient areas are 11.588 times more likely to experience developmental delays than those without stunting.

Keywords: stunting, iodine, mental development

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Задержка роста в районах с дефицитом йода: как это влияет на психическое развитие детей до двух лет?

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Резюме

Введение. Почва, вода и растения, произрастающие в высокогорье, характеризуются очень низким содержанием йода. Местное население может испытывать дефицит йода, способный вызывать нарушения психического и физического развития у детей младше 5 лет.

Цель: оценить корреляции между характеристиками детей и их матерей и психическим развитием детей в возрасте до двух лет, проживающих в йододефицитных районах.

Материалы и методы. Проведено поперечное исследование в сельских районах индонезийского округа Магеланг с участием 46 респондентов для установления связи между восемью независимыми переменными, включая знания, образование, занятость и стиль воспитания матери, а также пол, истощение, недостаточный вес и задержка роста у детей, и психическим развитием детей в качестве зависимой переменной с использованием логистической регрессии.

Результаты. Двумерный анализ показал, что знания матери, а также мужской пол и задержка роста ребёнка коррелируют с психическим развитием детей младше двух лет ($p < 0,05$). Многомерный анализ продемонстрировал, что задержка роста оказывает значительное влияние на нарушения развития у детей.

Заключение. Вероятность задержки развития у детей младше двух лет, проживающих в районах с дефицитом йода, в 11,588 раз выше у детей с задержкой роста, чем без неё.

Ключевые слова: задержка роста, йод, психическое развитие.

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Introduction

Soil, water, and plants growing in highland areas naturally lack iodine. People living in these areas can suffer from iodine deficiency; in children under 5 years of age, the latter can induce mental and growth disorders. The high rate of developmental disorders in children in several countries, especially poor and developing ones, has become a global concern [1]. Several studies provide evidence of the importance of iodine adequacy in the daily diet. Iodine deficiency during the first 1000 days of life impacts the development and growth of the newborn. Pregnancy is seen as a good opportunity to maintain a nutritional status for the health of the baby, especially the adequacy of iodine intake as a micronutrient [2]. Iodine deficiency during pregnancy can cause growth and developmental disorders in offspring.

Magelang Regency is a region with a history of iodine deficiency disorders (IDD) in the past. Residents living in the area are at risk of IDD because the iodine content of the soil and water is very low, especially in the highlands [3]. Since 2015, the government has implemented a program to provide iodized salt for all (universal salt iodization/USI) in order to overcome iodine deficiency. Providing sufficient iodized salt is an effort to meet individual iodine needs. The results of the 2020 research of two different populations of pregnant women showed that iodine intake was sufficient in early pregnancy, but there was a risk of iodine deficiency as gestational age increased. This shows that iodine deficiency in pregnant women living in areas that previously experienced iodine deficiency requires monitoring and supervision to maintain their iodine adequacy [4].

The World Health Organization (WHO) recommends monitoring iodine sufficiency in pregnant women at the population level by measuring median urine iodine concentration. Iodine deficiency is defined as a median urinary iodine concentration <150 μg/L [5]. The results of the 2023 survey showed that the median urinary iodine concentration in Magelang Regency in the highlands > 600 meters above sea level was 152 μg/L (borderline), and 49 % of pregnant women did not have guaranteed daily iodine adequacy of 150 μg/L [6]. In addition, the results of the 2023 congenital hypothyroid screening survey found two cases of congenital hypothyroidism (0.05 %) [7]. This means that where a case of congenital hypothyroidism is found in an area, the area is declared an IDD area. The results of other studies on child development also show that as many as 84.6 % in the highlands experience developmental disorders [8].

Stunting is a condition caused by long-term malnutrition. Malnutrition in mothers during pregnancy and in children under two years of age significantly impacts stunting. Evidence suggests that non-exclusive breastfeeding is associated with stunting [9]. Furthermore, factors contributing to stunting in children in Indonesia include low household socioeconomic status, premature birth, short births, and low mother's education [9].

Development and physical growth of under-two-year-olds are inextricably linked since growth influences child development. Such children have a high risk of delayed mental development, which is influenced by several factors such as mother's knowledge, stimulation, and parenting. Sociodemographic assessment is important to recognize children at high risk of cognitive developmental delay [10]. Wasting is a state of malnutrition that is immediately apparent in children aged < 5 years. Wasting causes recurrent illness, impaired physical growth such as being underweight, and impaired mental development such as impatience. Malnutrition and wasting have long-term effects that include poor health and work performance, stunted growth, and inability to study. The World Health Organization urges that by 2025, nations should cut undernutrition, including child wasting, to less than 5 % [11].

In addition, inappropriate parenting patterns account for lower cognitive development of children compared to those who experience good parenting. This is the basis for the importance of efforts to improve providing good parenting [12]. Babies who are born stunted and remain stunted until the age of three years, tend to have lower cognitive development than stunted newborns who are able to reach normal height by this age [12].

Many children under the age of five suffer from developmental delays, which can have a major impact on their ability to reach their full potential in life [13]. These results emphasize that children with growth and developmental disorders require focused interventions and efficient implementation techniques. The government should implement policies that focus on providing better access to health and education services for children [14].

The study *aims* to assess correlations between characteristics of children and their mothers and mental development of children under two years of age living in iodine-deficient areas.

Materials and Methods

Data source

This case study was conducted in November 2024 in a rural area experiencing iodine deficiency. The study location was Pesidi Village, Grabag District, Magelang Regency, Central Java, Indonesia. Forty-six samples were selected according to the inclusion criteria. This village was recorded as having the highest number of stunting cases based on the 2023 Indonesian Nutritional Status Survey. To maintain data quality, the team worked on common understanding of the questionnaire, editing, coding and tabulation, data cleaning, and data analysis. Independent variables regarding respondent characteristics were collected through interviews using a standardized questionnaire. Children development was evaluated using the Bayley Infant Development Scale.

Dependent and Independent Variables

Mental development is the dependent variable, while knowledge, education, occupation and parenting style of the mother, as well as sex, wasting, underweight, and stunting of children are independent variables.

Data Analysis

The initial analysis of this study used the chi-square test for bivariate comparisons. In the final stage, we used binary logistic regression. We used IBM SPSS 21 for statistical analysis.

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Ethical Clearance

Ethics approval was provided by the Health Research Ethics Committee at the Faculty of Public Health of the Diponegoro University, No. 323/EA/KEPK/-FKM/2024. Written informed consent was obtained from all respondents in the survey.

Results

Table 1 shows the results of the bivariate test between independent and dependent variables pertaining to children. Stunting and sex were the two factors that significantly correlated with mental development, while the others did not.

Table 2 shows the results of the bivariate test between independent and dependent variables pertaining to mothers. Their knowledge appeared to be the only factor that significantly correlated with mental development of children.

Table 3 demonstrates the results of a multivariate analysis of three variables based on the chi-square test's significance. They show that stunting in children under two significantly affects children's mental development. Stunted children in iodine-deficient areas are 11,588 times more likely to experience mental developmental delays than those without stunting.

Discussion

Table 1 shows that more than one-third of the boys but none of the girls experienced mental developmental delay. The relationship between sex and developmental delay was statistically significant. This is in line with other studies showing that boys have poorer verbal skills and mental development than girls [15].

Table 2 shows a significant relationship between mothers' knowledge and children's mental development. With poor mothers' knowledge, nearly 50 % of children experience mental developmental delays. This is in line with the results of other studies showing that child development is related to mothers' developmental stimulation behavior. Good mother's behavior regarding

Table 1. **Correlations between children' characteristics and their mental development**
Таблица 1. **Корреляции между характеристиками и психическим развитием детей**

Variable / Переменная	Mental development / Психическое развитие				*p*
	Delay / Задержка		Normal / Норма		
	n	%	*n*	%	
Sex / Пол					0.003
– Female / Женский	0	0.0	19	100	
– Male / Мужской	10	37.0	17	63.0	
Wasting / Истощение					0.345
– Yes / Да	0	0.00	3	100.0	
– No / Нет	10	23.3	33	76.7	
Underweight / Недостаточный вес					0.294
– Yes / Да	2	40.0	3	60.0	
– No / Нет	8	19.5	33	80.5	
Stunted / Задержка роста					0.012
– Yes / Да	6	46.2	7	53.8	
– No / Нет	4	12.1	29	87.9	

Table 2. **Correlations between mothers' characteristics and child mental development**
Таблица 2. **Корреляции между характеристиками матери и психическим развитием детей**

Variable / Переменная	Mental development / Психическое развитие				*p*
	Delay / Задержка		Normal / Норма		
	n	%	*n*	%	
Mother's knowledge / Осведомленность матери					0.037
– Poor / Плохая	6	40.0	9	60.0	
– Good / Хорошая	4	12.9	27	87.1	
Education / Образование					0.094
– Elementary school / Начальное	4	18.2	18	81.8	
– Junior high school / Неоконченное среднее	2	12.5	14	87.5	
– Senior high school / Среднее	4	50.0	4	50.0	
Occupation / Трудоустройство					0.322
– Employed / Работает	1	50.0	1	50.0	
– Not working / Не работает	9	20.5	35	79.5	
Authoritative parenting / Авторитетный стиль воспитания					0.606
– Yes / Да	3	17.6	14	82.4	
– No / Нет	7	24.1	22	75.9	

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Table 3. **Results of the multivariate analysis of respondents' characteristics and child mental development**
Таблица 3. **Результаты многомерного анализа характеристик респондентов и психического развития детей**

Variable / Переменная	Mental development / Психическое развитие		
	p	AOR	95% CI / ДИ
Sex / Пол			
– Female / Женский	0.998	0.000	0.000 – 0.000
– Male / Мужской	–	–	Ref. / Контр.
Stunting / Задержка роста			
– Yes / Да	0.022	11,588	1,420 – 94,538
– No / Нет	–	–	Ref. / Контр.
Mother's knowledge / Осведомленность матери			
– Poor / Плохая	0.108	0.197	0.027 – 1.424
– Good / Хорошая	–	–	Ref. / Контр.

Notes: AOR, adjusted odds ratio; $p < 0.050$, CI, confidence interval.
Примечания: AOR: скорректированное отношение шансов; $p < 0,050$, ДИ: доверительный интервал.

knowledge, attitudes, actions, and stimulation can improve child development [16]. Other research on the same topic provides suggestions on how to improve mothers' knowledge about how to stimulate child development so that mothers can provide appropriate stimulation to their children [17]. Mothers' knowledge about parenting and child health must be improved, including by providing information about stunting and teaching children good parenting patterns [18]. Other research on stunting also concludes that preventing stunting requires increasing mothers' knowledge and efforts to improve sanitation hygiene to minimize the risk of infection that can affect the nutritional status of toddlers [19]. We all know that stunting is related to child development, so appropriate stunting management will reduce cases of its delay.

Several studies have shown a significant correlation between mothers' education and child development, such as the study by Demirci and Kartal [20]. Other studies have also shown that children of uneducated parents are at higher risk of stunting and developmental disorders [21, 22]. Our findings demonstrated no relationship between maternal education and children's mental development, possibly due to the limited sample size. However, children of mothers with low levels of education had a slightly higher rate of developmental delays compared to those whose mothers had secondary education. Meanwhile, children of highly educated mothers experienced developmental delays at the same proportion. In terms of maternal employment, 20 % of children whose mothers were unemployed experienced developmental delays. This indicates that mothers who are not working still face the risk of having children with developmental delays, even though they may have more time to care for and stimulate their children. Maternal employment status affects child development, and so do other factors, including parenting skills and the child's nutritional status.

Table 1 also shows the relationship between stunting and child development. Nearly 50 % of stunted toddlers experience delayed mental development. Several studies have shown that stunting is significantly related to children's mental development, including achievements in personal, social, and motor development [8]. Additionally, this study found no correlation between child development and underweight or wasting.

Table 2 shows no significant relationship between authoritative parenting and child development. Developmental delays were experienced by 17.6 % of children with authoritative parenting and 24.1 % of children with non-authoritative parenting. Authoritative parenting is a democratic parenting style in which parents establish rules and guidelines and provide support and guidance to the child. Child development is influenced by genetic and environmental factors, including the family. The family has an important role in child development because the family is the smallest unit in achieving optimal child growth and development. In the process of raising children, each parent has a different parenting style [23]. Effective parenting and early stimulation can optimize child growth and development [24]. Other research results show that there is a positive and statistically significant relationship between growth and development stimulation and the development of children aged 1 to 3 years [25]. Other research also shows that stimulation is positively related to the results of neurodevelopment in infants. Stimulation can reduce the risk of developmental delays in infants with low birth weight [26]. Other research findings show the importance of improving nutrition, stimulation and optimal care at home to improve child development in infants with low birth weight [27, 28].

The results of the logistic regression are presented in Table 3. They show that stunted children have an 11.588 times greater risk of experiencing mental developmental delays compared to those who are not stunted. Similar research on children aged 1–3 years also shows that stunted ones have a 2.98 times higher risk of experiencing developmental delays compared to those with normal body weight [29]. Research in Semarang Regency also demonstrated that stunting is associated with a 9.3 times higher risk of experiencing developmental delays [30]. Meanwhile, research results in rural areas in Wonosobo Regency show that 70 % of stunted children experience developmental disorders [31].

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Strengths and Limitations

This study is to investigate the relationship between mental development and characteristics of stunted children under two years old from iodine-deficient areas. On the other hand, this study has limitations, namely not examining iodine levels in urine and breast milk, and using a minimum sample size setting, so the analysis is less than optimal. Research with a larger sample may have better results.

Conclusion

Stunted children under two years old living in iodine-deficient areas are 11.588 times more likely to experience developmental delays than those without stunting.

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REFERENCES / СПИСОК ЛИТЕРАТУРЫ

1. Improving early childhood development: WHO guideline. Geneva: World Health Organization; 2020. Accessed August 6, 2025. https://iris.who.int/bitstream/handle/10665/331306/9789240002098-eng.pdf
2. Scott JA. The first 1000 days: A critical period of nutritional opportunity and vulnerability. *Nutr Diet*. 2020;77(3):295-297. doi: 10.1111/1747-0080.12617
3. Li Z, Kim R, Vollmer S, Subramanian SV. Factors associated with child stunting, wasting, and underweight in 35 low- and middle-income countries. *JAMA Netw Open*. 2020;3(4):e203386. doi: 10.1001/jamanetworkopen.2020.3386
4. Kusrini I, Farebrother J, Mulyantoro DK. Adequately iodized salt is an important strategy to prevent iodine insufficiency in pregnant women living in Central Java, Indonesia. *PLoS One*. 2020;15(11):e0242575. doi: 10.1371/journal.pone.0242575
5. WHO. Iodine deficiency [Internet]. 2013. Accessed August 6, 2025. Available at: https://www.who.int/data/nutrition/nlis/info/iodine-deficiency
6. Iodine Adequacy Surveillance Report for Magelang Regency, Central Java, Indonesia, 2023. Accessed August 8, 2025. (In Indonesian.) https://labkesmasmagelang.go.id/projects/surveilans-gaki-di-kota-magelang/
7. Health Office. Health Profile of Magelang Regency, Central Java, Indonesia 2023. (In Indonesian.) Accessed August 8, 2025. https://dinkes.magelangkab.go.id/wp-content/uploads/2025/07/profil-kesehatan-kabupaten-magelang-2023.pdf
8. Paramesti HR, Indarjo S. Tumbuh kembang balita stunting usia 1-3 tahun melalui skrining Denver II. *HIGEIA.* 2024;8(1):111-123. (In Indonesian.) doi: 10.15294/higea.v8iI.64144
9. Beal T, Tumilowicz A, Sutrisna A, Izwardy D, Neufeld LM. A review of child stunting determinants in Indonesia. *Matern Child Nutr*. 2018;14(4):e12617. doi: 10.1111/mcn.12617
10. Kenyhercz F, Kósa K, Nagy BE. Perinatal, neonatal, developmental and demographic predictors of intelligence at 4 years of age among low birth weight children: A panel study with a 2-year follow-up. *BMC Pediatr*. 2022;22(1):88. doi: 10.1186/s12887-022-03156-x
11. Gilano G, Hailegebreal S, Sako S, *et al*. Understanding child wasting in Ethiopia: Cross-sectional analysis of 2019 Ethiopian Demographic and Health Survey data using generalized linear latent and mixed models. *JMIR Public Heal Surveill.* 2023;9:e39744. doi: 10.2196/39744
12. Ernawati F, Pusparini, Hardinsyah, Briawan D, Safitri A, Prihatini M. Effect of low linear growth and caregiving with poor psychosocial aspects on cognitive development of toddlers. *J Nutr Sci Vitaminol (Tokyo)*. 2020;66(Suppl):S76-S81. doi: 10.3177/jnsv.66.S76
13. Dabar D, Das R, Nagesh S, Yadav V, Mangal A. A community-based study on growth and development of under-five children in an urbanized village of South Delhi. *J Trop Pediatr.* 2016;62(6):446-456. doi: 10.1093/tropej/fmw026
14. Olson L, Kinnear M, Chen B, *et al*. Socioeconomic factors account for variability in language skills in preschoolers with autism spectrum disorders. *J Dev Behav Pediatr*. 2021;42(2):101-108. doi: 10.1097/DBP.0000000000000870
15. Rinaldi P, Pasqualetti P, Volterra V, Caselli MC. Gender differences in early stages of language development. Some evidence and possible explanations. *J Neurosci Res*. 2023;101(5):643-653. doi: 10.1002/jnr.24914
16. Triharini M, Pradanie R, Sari DP. Motoric stimulation related to fine motoric development on child. *J Ners.* 2009;4(1):56-61. doi: 10.20473/jn.v4i1.5014
17. Sukamti S, Aticeh, Fauziah. Stimulasi dini pada pola asuh berdampak positif terhadap perkembangan anak bawah dua tahun. *J Ilmu dan Teknol Kesehat.* 2014;2(1):27-35. (In Indonesian.) Accessed August 6, 2025. https://ejurnal.poltekkesjakarta3.ac.id/index.php/jitek/article/view/118
18. Atamou L, Rahmadiyah DC, Hassan H, Setiawan A. Analysis of the determinants of stunting among children aged below five years in stunting locus villages in Indonesia. *Healthcare (Basel)*. 2023;11(6):810. doi: 10.3390/healthcare11060810
19. Darmawan A, Basry NR, Wahyuddin W. Mother's knowledge and hygiene sanitation against stunting in toddlers. *J Ris Kesehat*. 2022;11(1):1-6. doi: 10.31983/jrk.v11i1.8060
20. Demirci A, Kartal M. The prevalence of developmental delay among children aged 3–60 months in Izmir, Turkey. *Child Care Health Dev*. 2016;42(2):213-219. doi: 10.1111/cch.12289
21. Wake SK, Zewotir T, Lulu K, Fissuh YH. Longitudinal trends and determinants of stunting among children aged 1–15 years. *Arch Public Heal.* 2023;81(1):60. doi: 10.1186/s13690-023-01090-7
22. Suciyanti D, Wangge G, Fahmida U, Supali T. Stunting among children in rural area of Indonesia: Five-year follow-up study. *Curr Dev Nutr*. 2021;5(Suppl 2):187. doi: 10.1093/cdn/nzab035_095
23. Ayun Q. Pola asuh orang tua dan metode pengasuhan dalam membentuk kepribadian anak. *J Inov Pendidik Guru Raudhatul Athfal.* 2017;5(1):102. (In Indonesian.) doi: 10.21043/thufula.v5i1.2421
24. Nurjannah. Design and guidelines for early stimulation to optimize toddler development in maritime communities in Kelurahan Lapulu Abeli Puskesmas working area in Kendari City. *Med Leg Updat*. 2020;20(4):609-613. doi: 10.37506/mlu.v20i4.1886

https://doi.org/10.35627/2219-5238/2025-33-8-46-51
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25. Hati FS, Lestari P. Pengaruh pemberian stimulasi pada perkembangan anak usia 12-36 bulan di Kecamatan Sedayu, Bantul. *J Ners dan Kebidanan Indones*. 2016;4(1):44-48. (In Indonesian.) doi: 10.21927/jnki.2016.4(1).44-48
26. Upadhyay RP, Taneja S, Strand TA, *et al*. Early child stimulation, linear growth and neurodevelopment in low birth weight infants. *BMC Pediatr*. 2022;22(1):586. doi: 10.1186/s12887-022-03579-6
27. Upadhyay RP, Taneja S, Ranjitkar S, *et al.* Factors determining cognitive, motor and language scores in low birth weight infants from North India. *PLoS One*. 2021;16(5):e0251387. doi: 10.1371/journal.pone.0251387
28. Sudfeld CR, Bliznashka L, Ashery G, Yousafzai AK, Masanja H. Effect of a home-based health, nutrition and responsive stimulation intervention and conditional cash transfers on child development and growth: A cluster-randomised controlled trial in Tanzania. *BMJ Glob Health*. 2021;6(4):e005086. doi: 10.1136/bmjgh-2021-005086
29. Mustakim MRD, Irwanto, Irawan R, Irmawati M, Setyoboedi B. Impact of stunting on development of children between 1–3 years of age. *Ethiop J Health Sci*. 2022;32(3):569-578. doi: 10.4314/ejhs.v32i3.13
30. Wulandari EC, Wijayanti HS, Widyastuti N, Panunggal B, Ayustaningwarno F, Syauqy A. Hubungan stunting dengan keterlambatan perkembangan pada anak usia 6-24 bulan. *J Nutr Coll.* 2021;10(4):304-312. (In Indonesian.) doi: 10.14710/jnc.v10i4.31114
31. Ashar H, Kusrini I, Latifah L. Intervention strategy to increase growth and development for stunted children under two years with developmental delay. *Eur J Mol Clin Med.* 2020;07(10):280-292. Accessed July 22, 2025. https://scispace.com/pdf/intervention-strategy-to-increase-growth-and-development-for-2pvecf7sxu.pdf

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