



Analysis of stunting handling indicators based on SSGI 2022 data in Lampung Province : Multilevel analysis

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ABSTRAK

Latar Belakang: Penerapan intervensi gizi spesifik dan sensitif merupakan upaya yang dilakukan untuk mencegah peningkatan prevalensi stunting di Indonesia. Namun, dalam penerapannya, tidak semua indikator sasaran berjalan dengan optimal dan dapat memengaruhi peningkatan prevalensi stunting.

Tujuan: Menganalisis faktor dominan kejadian stunting pada balita usia 12-23 bulan dari indikator penanganan stunting yang belum optimal di Provinsi Lampung.

Metode: Penelitian ini menggunakan design cross-sectional dengan memanfaatkan data sekunder Survei Status Gizi Indonesia 2022. Variabel penelitian terdiri dari konsumsi tablet tambah darah, menyusui eksklusif, pemantauan pertumbuhan, imunisasi dasar, akses air minum, akses sanitasi, dan kejadian stunting, serta mempertimbangkan heterogenitas pada kluster kecamatan dan kabupaten/kota. Sampel penelitian sebanyak 1.929 balita usia 12-23 bulan yang dipilih secara purposive sampling. Data dianalisis secara univariat dengan table distribusi frekuensi, bivariat dengan uji Chi-Square, dan multivariat dengan uji regresi logistik multilevel.

Hasil: Uji chi-square menunjukkan tidak ada hubungan antara konsumsi tablet tambah darah ibu ($p=0.362$; $OR=1.14$), menyusui eksklusif ($p=0.164$; $OR=0.85$), pemantauan pertumbuhan ($p=0.807$; $OR=1.08$), dan akses sanitasi ($p=0.431$; $OR=1.18$) dengan kejadian stunting. Namun, terdapat hubungan antara pemberian imunisasi dasar ($p=0.008$; $OR=1.39$) dan akses air minum ($p=0.023$; $OR=1.35$). Hasil uji multilevel menunjukkan bahwa tidak terdapat pengaruh pemberian ASI non-eksklusif ($aOR=0,84$; $p>0,05$) pemantauan pertumbuhan tidak rutin ($aOR=1,03$; $p>0,05$), konsumsi tablet tambah darah tidak sesuai ($aOR=1,14$; $p>0,05$), akses sanitasi tidak layak ($aOR=1,10$; $p>0,05$), domisili perdesaan ($aOR=1,03$; $p>0,05$), jumlah community health centers ($aOR=1,00$; $p>0,05$), kontur wilayah pegunungan ($aOR=0,89$; $p>0,05$), dan kontur wilayah perairan ($aOR=0,83$; $p>0,05$) dengan kejadian stunting. Variasi pada level rumah tangga memiliki varians dan efek paling besar pada kejadian stunting dengan ICC 7,63%.

Kesimpulan: Imunisasi dasar tidak lengkap dan akses air minum tidak layak merupakan faktor dominan yang memengaruhi kejadian stunting pada balita usia 12-23 bulan di Provinsi Lampung.

KATA KUNCI: intervensi gizi; data sekunder; stunting; SSGI; balita



ABSTRACT

Background: The implementation of specific and sensitive nutrition interventions is an effort to prevent the increasing prevalence of stunting in Indonesia. However, not all target indicators performed optimally in their implementation, which could affect the increase in stunting prevalence.

Objectives: Analyze the dominant factors of stunting incidence among toddlers aged 12-13 months from suboptimal handling of stunting in Lampung Province.

Methods: This study utilized a cross-sectional design with secondary data from the 2022 Indonesian Nutrition Status Survey. The variables in this study were iron tablet consumption, exclusive breastfeeding, growth monitoring, primary immunization, access to drinking water, access to sanitation, and the incidence of stunting, and considering heterogeneity in subdistrict and regencies/municipalities. The subjects were 1.929 toddlers aged 12-23 months, selected by purposive sampling. Data were analyzed with a frequency distribution table, a Chi-Square test, and a multilevel binary logistic regression test.

Results: Chi-square test showed there was no relationship between iron tablet consumption ($p=0.362$; $OR=1.14$), exclusive breastfeeding ($p=0.164$; $OR=0.85$), growth monitoring ($p=0.807$; $OR=1.08$), and access to sanitation ($p=0.431$; $OR=1.18$) with incidence of stunting. However, there was a relationship between primary immunization ($p=0.008$; $OR=1.39$) and access to drinking water ($p=0.023$; $OR=1.35$). Multilevel test results showed that there was no effect of non-exclusive breastfeeding ($aOR=0.84$; $p>0.05$) not routine growth monitoring ($aOR=1.03$; $p>0.05$), inappropriate iron tablet consumption ($aOR=1.14$; $p>0.05$), inadequate access to sanitation ($aOR=1.10$; $p>0.05$), rural domicile ($aOR = 1.03$; $p>0.05$), number of community health centers ($aOR=1.00$; $p>0.05$) contour of mountain territory ($aOR=0.89$; $p>0.05$), and contour of water territory ($aOR=0.83$; $p>0.05$) with incidence of stunting. Household-level variation had the largest effect on stunting incidence, with an ICC of 7.63%.

Conclusions: Incomplete primary immunization and inadequate access to drinking water were the dominant factors affecting stunting in toddlers aged 12-23 months in Lampung Province.

KEYWORD: nutrition interventions; secondary data; SSGI; stunting; toddlers

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INTRODUCTION

Disruptions in the First 1000 Days of Life phase will produce difficulties that are lasting and difficult to treat, such as stunting (1). Stunting results from chronic malnutrition and/or recurrent infections that cause children to be stunted according to the PBJU index (2). The prevalence of stunting in Indonesia has decreased from 37.2% (2013) to 21.6% (2022), however it still falls short of the 14% target set in RPJMN 2020-2024 (3). SSGI data (2022) showed that the stunting rate in Lampung Province is the third lowest in Indonesia (15.2%). Still, the prevalence between districts varies widely, with the lowest rate in Central Lampung District (8.7%), the middle rate in West Pesisir District (16.4%), and the highest

rate in Pesawaran District (25.1%). In addition, this prevalence continues to increase with age, with a significant increase from 10.2% (6-11 months) to 15.5% (12-23 months) (3). This achievement can undoubtedly be influenced by non-optimized efforts to deal with stunting due to the need for more policy regulations related to specific and sensitive nutrition interventions (4).

Specific nutrition interventions are activities in the health sector and short-term in addressing the direct causes of stunting through optimizing the 1000 Days of Life period, which is structured into nine target indicators. Meanwhile, nutrition-sensitive interventions in the non-health sector address the indirect causes of stunting, consisting

of eleven target indicators (5). One way the government facilitates monitoring the achievements of implementing integrated nutrition interventions in Indonesia is by designing a Master Situation Analysis (Master Ansit) instrument that is periodically filled in by each relevant Regional Apparatus Organization (6). Master Ansit's data (2022) in three districts in Lampung Province, showed that Central Lampung has 5 (five) suboptimal indicators, West Pesisir also has 5 (five) indicators, and Pesawaran has 8 (eight) indicators (7). The suboptimal indicators of specific and sensitive nutrition interventions in the three districts in Lampung Province are different and vary in percentage. When accumulated, nine indicators of stunting interventions are not optimal and need to be studied further in the three districts. However, of these nine indicators, only six are directly related to individuals and households under five and were also studied in SSGI 2022. These indicators include a history of iron tablets usage during maternal pregnancy, exclusive breastfeeding, toddler growth monitoring, complete primary immunization, access to drinking water, and sanitation (7).

Without any further eat, the non-optimal nutrition intervention indicators may affect the stunting rate in Lampung Province. Research conducted by Sampe et al. (2020) reported that the risk of stunting can increase due to non-exclusive breastfeeding (8). Other studies have also shown that exclusive breastfeeding history is closely associated with the incidence of stunting in Palu City (9). A case-control study by Prakoso et al. (2021) showed that children who does not conduct routine growth monitoring had a 5.04-fold chance of stunting ($p=0.025$) (10). Research by Fentiana et al. (2022) also reported that toddlers aged 0-23 months whose growth is not routinely monitored had a 1.32 times risk of stunting (11). Stunting can also be managed by controlling the risk of infectious diseases by providing basic immunizations to increase body immunity (12). Previous research has found a relationship between primary immunization status and the prevalence of stunting in toddlers (13).

Nisar et al. (2020) found that taking normal iron tablets reduced the risk of stunting by 14% in South Asian toddlers under the age of two (14). Another study by Fentiana et al. (2022) also

reported that handling stunting through iron tablets consumption of at least 90 tablets during pregnancy can reduce the risk of mothers having stunted children (15). According to Olo et al. (2021), the majority of stunted toddlers in rural regions have access to hazardous drinking water (16). The literature study by Adzura et al. (2021) also indicated that clean water is a factor that affects stunting (17). Furthermore, inadequate sanitation, such as a lack of latrines and feces disposal sites, might have an impact on toddlers' nutritional condition by increasing the risk of infectious diseases (18). Research by Astuti (2022) also reported that access to sanitation influenced the prevalence of stunting in Papua and West Papua.

The non-optimal achievement of stunting handling indicators in Lampung Province can be attributed to a variety of factors, including a lack of maximum policy regulations regarding stunting interventions, a lack of optimization and coordination of OPD in program implementation, a lack of development of program design, quality, and targets, and a lack of government knowledge and capacity-building programs in stunting management (4),(14). In addition, variances in regional characteristics and cultural customs contribute to ineffective stunting management (20).

Lampung Province has very varied regional characteristics, ranging from 8 regencies/municipalities with villages/wards in coastal areas to 3 regencies/municipalities with villages/wards in mountainous areas (21). This variation in regional characteristics can undoubtedly affect the habits of the community and access and affordability to health facilities, schools, and foodstuffs (22). On that basis, it is essential to conduct a study that can analyze the factors that cause stunting in Lampung Province, specifically in children under 12-23 months, by considering heterogeneity at the household and area levels, so that it may be used as a first step in developing follow-up suggestions for future program design.

MATERIALS AND METHODS

This study was a secondary data analysis of the result of the SSGI organized by the Ministry of Health's Health Development Policy Agency in a

cross-sectional manner in 2022. From February to May 2024, the study was conducted on 1.929 children selected by purposive sampling from the Lampung Province of 12-23 months in Lampung Province: Central Lampung, South Lampung, North Lampung, East Lampung, West Lampung, Tulang Bawang, West Tulang Bawang, Mesuji, Tanggamus, Pesawaran, Pringsewu, West Coast, Way Kanan, Metro, and Bandar Lampung. Secondary data for SSGI 2022 was obtained through data request addressed to the Head of the Center for Data and Information Technology of the Ministry of Health of the Republic of Indonesia by attaching a data request form, a letter requesting the use of data, a cover letter from the institution, and a research proposal that authorized through the Ministry of Health's Health Development Policy Agency website.

The incidence of stunting was determined from the calculation of PBIU using WHO Anthro software by entering data on date of birth, date of measurement, and anthropometric data measuring height according to the respondent's measuring position. The calculation result was then categorized into stunting if $< -2SD$ and not stunting if $\geq -2SD$ (23). Iron tablet status was determined by identifying the amount of iron tablets consumed by the respondent's mother during pregnancy, which came from the government or purchased by herself, categorized as appropriate if ≥ 90 tablets and inappropriate if < 90 tablets (24). Breastfeeding status was measured by how long the respondent breastfed before being exposed to food or drink other than breast milk. The results were classified as exclusive breastfeeding if $= 6$ months and non-exclusive breastfeeding if < 6 months (25). Growth monitoring status was determined by identifying the frequency of weighing and measuring the length/height of respondents in the last 12 months, categorized as routine if ≥ 8 times and not routine if < 8 times (26). Primary immunization status was determined from the number of primary immunizations obtained by respondents before 1 year old consisting of 1x HB-0 (Hepatitis B-0), 1x BCG (Bacillus Calmette Guerin), 3x DPT-HB-HiB (Difteri, Pertusis, and Tetanus-Hepatitis-Haemophilus Influenzae tipe B)/DPT HB Combo, 3x IPV (Inactivated Polio Vaccine)/4x OPV (Oral Polio Vaccine) +1x IPV, 1x MR (Measles and

Rubella). The result was categorized as complete if ≥ 9 times and incomplete if < 9 times (19).

Access to drinking water was determined by identifying the source of drinking water used in respondent households, categorized as feasible if it came from a protected source (tap meter/retail, public tap, hydrant, rainwater harvesting, borehole/pump, protected well, protected spring, bottled water, and refill water) and not feasible if it did not come from a protected source. Access to improved sanitation was determined by identifying the ownership of improved sanitation facilities in respondent households. Sanitation was categorized as feasible if the facilities were complete and met the criteria such as having a gooseneck toilet, a septic tank/IPALs, and earth pits (specifically in rural areas, which may be used privately or together, and not feasible if they were incomplete or did not meet the criteria (28). This study's cluster variable (level 2) was regencies/municipalities characteristics. All processed data were subsequently examined with STATA 15 software. Univariate analysis was conducted descriptively using frequency distribution tables. The Chi-Square test was used to analyze the connection between variables with a significance level of < 0.05 . Multivariate analysis using a multilevel binary logistic regression test with level one being the individual (exclusive breastfeeding, growth monitoring, and primary immunization), level two being the household (mother's iron tablets consumption history during pregnancy, access to drinking water, and access to sanitation), level three being the sub-district (domicile), and level four being the regencies/municipalities (number of community health centers and contour of the area). This study received ethical approval from the ethics commission of Dr. Moewardi Hospital with number 367/II/HREC/2024.

RESULTS AND DISCUSSIONS

The results of the univariate analysis reported in **Table 1**. showed that the number of male (49%) and female (51%) toddlers is nearly equal, this is because the research respondents were purposely chosen from the general community, so the quantity of each gender category cannot be equalized. Majority of respondents live in rural areas (56.6%) because Lampung Province has

more regencies (13 regencies) than municipalities (2 municipalities) (21). **Table 1.** also showed that the majority of respondents had fathers (50.3%) and mothers (52%) with low education (< Junior High School (JHS)). In addition, it was found that most respondents had fathers who worked as farmers, laborers/fishermen (43.1%), mothers who worked (71.8%). This could happen because Lampung Province is an area that has a large plain and is surrounded by oceans, so it has potential in the fields of agriculture and marine (22). Parents with a low level of education are more likely to be resistant to acquiring new information, which can affect the creation of knowledge, attitudes, and behaviors (29). The average net income of

informal workers in Lampung Province with the highest level of education finished, junior high school, is only IDR 1,662,380, indicating that the bulk of family income among the study's respondents was low (22). In addition, **Table 1.** also showed that just a few respondents had health insurance (29.5%). Low family income has an impact on health insurance ownership because of the requirement to pay in installments, which reduces family intake (30). One of the reasons many people did not have health insurance was that they did not know how to enroll (31). Based on the study results in Table 2. it was found that the prevalence of stunting among respondents reached 16.6%.

Table 1. Characteristics Respondents based on Sociodemographic

Category	n=1.929	%
Gender		
Males	946	49.0
Females	983	51.0
Residence		
Urban	837	43.4
Rural	1092	56.6
Father's Education		
Low (< JHS)	936	50.3
High (≥ JHS)	928	49.7
Mother's Education		
Low (< JHS)	994	52.0
High (≥ JHS)	916	48.0
Father's Occupation		
Not working	17	0.9
PNS/TNI/Polri/BUMN/BUMD	53	2.8
Private employee	136	7.3
Self-employed	618	33.1
Farmer/farm laborer/fisherman	805	43.1
Laborer/driver/ojek/other	238	12.8
Mother's Occupation		
Housewife	538	28.2
Working Mother	1.372	71.8
Health Insurance Ownership		
Yes	559	29.5
None	1370	70.5

Source: SSGI Secondary Data 2022

This prevalence was below the national average of 27.7% (2019), 24.4% (2021), and 21.6% (2022). However, it was higher than the Lampung Province average for all ages, which was 15.2% (2022) (3). **Table 2.** showed that only a small proportion of respondent mothers had consumed iron tablets with the standard amount of ≥ 90 tablets during pregnancy (33%). The most

common reasons for not receiving or consuming iron tablets during pregnancy were not feeling the need (24.1%) and forgetting (19.9%). **Table 2.** also showed that the majority of respondents were not exclusively breastfed during the first 6 months of life (51%), because they had been introduced to foods/beverages other than breast milk from 0–7 days of age (33.2%).

Table 2. reported that most of the respondents had conducted routine growth monitoring in the past year (55.9%). The place most often utilized by respondents to conduct growth monitoring on their toddlers was Posyandu (83.9%). Table 2. also showed that more than half of respondents did not complete primary immunization for a variety of reasons (54%), the majority of reasons why mothers did not provide

complete primary immunization to their children were because they forgot or did not know the schedule (34.1%), the vaccine was not available (21.1%), and the child was often sick or was sick (20.1%). In general, respondents came from households with feasible access for drinking water (73.4%), most of which were sourced from protected dug wells. Also, almost all respondents had feasible access for sanitation (91.8%).

Tabel 2. Characteristics respondents based on research variables

Category	n	(%)
Incidence of stunting		
Stunting	321	16.6
Not stunting	1,608	83.4
Mother's Iron Tablets Consumption		
Inappropriate	1,293	67.0
Appropriate	636	33.0
Reason for not Taking Iron Tablets		
Not given by the officer	69	8.0
Feels no need	209	24.1
Forget	172	19.9
Bored	75	8.7
The taste and smell are unpleasant	136	15.7
Nausea and vomiting due to pregnancy	138	15.9
Others (empty supplies, bored, side effects, consider iron tablets are drugs, do not have money to buy)	67	7.7
Exclusive breastfeeding		
Non-Exclusive	984	51.0
Exclusive	945	49.0
First age of introduction to foods other than breast milk		
0 – 7 days	641	33.2
8 – 29 days	23	1.2
1 – < 2 months	49	2.5
2 – < 3 months	48	2.5
3 – < 4 months	57	3.0
4 – < 5 months	46	2.4
5 – < 6 months	120	6.2
≥ 6 months	945	49.0
Growth Monitoring		
Not Routine	851	44.1
Routine	1,078	55.9
Location of Growth Monitoring		
Clinic/doctor/midwife/nurse	58	3.0
Posyandu	1,618	83.9
Self-checking	28	1.5
Nowhere	212	11
Others (community health centers, hospital, preschool, officer visits)	13	3.6
Primary Immunization		
Incomplete	1,042	54.0
Complete	887	46.0

Category	n	(%)
Reason for Incomplete Immunization/No Immunization		
Forget/not knowing the schedule	355	34.1
Don't know Posyandu schedule	68	6.5
Posyandu closed	6	0.6
Transportation difficult	12	1.2
Child is often get sick/is currently sick	210	20.1
Vaccine not available	220	21.1
Family not allowed	46	4.4
Fear of heat/fever	67	6.4
Fear of contracting COVID-19	12	1.2
Religious beliefs	17	1.6
There is no immunization service according to the schedule in the KIA book	17	1.6
Cost of immunization is expensive/unaffordable	1	0.1
Access to Drinking Water		
Not feasible	514	26.6
Feasible	1,415	73.4
Drinking Water Source		
Bottled Water	272	14.1
Refillable water	286	14.8
Protected dug well	732	37.9
Borehole well	228	11.8
PDAM (Local Water Supply Utility)	112	5.8
Public hydrants, water terminals, PAH (Rainwater Reservoir), retail, surface water, etc.	299	15.6
Access to Sanitation		
Not feasible	159	8.2
Feasible	1,770	91.8

Source: SSGI Secondary Data 2022

Table 3. showed the Chi-Square test's bivariate analysis results. Chi-square test showed that there was no relationship between iron tablet consumption ($p=0.308$; $OR=1.14$), exclusive breastfeeding ($p=0.189$; $OR=0.85$), growth monitoring ($p=0.507$; $OR=1.39$), and access to sanitation ($p=0.431$; $OR=1.18$) with incidence of stunting. Two variables are substantially linked with stunting, there are primary immunization ($p=0.008$; $OR=1.39$) and access to drinking water ($p=0.023$; $OR=1.35$).

Based on **Table 4**, it is known that stimulant consumption of iron tablets < 90 tablets during maternal pregnancy ($p=0.362$; $OR=1.13$), non-exclusive breastfeeding ($p=0.164$; $OR=0.83$), non-routine growth monitoring ($p=0.807$; $OR=1.03$), and access to feasible sanitation ($p=0.751$; $OR=1.07$) were not factors that influenced the incidence of stunting ($p > 0.05$). However, the factors that influenced the incidence

of stunting at level one were incomplete immunization ($OR = 1.35$; $p = 0.021$) and unfeasible access to drinking water ($OR = 1.38$; $p = 0.020$). Based on **Table 4**, it is also known that the level households have the most significant variance and ICC values, amounting to 7.47%.

Based on the results of the study, it was reported that non-exclusive breastfeeding history did not affect the incidence of stunting ($p > 0.05$) (**Table 3, 4**). The same analytical results were also shown by Asprika's (2023) study conducted on toddlers in Musi Rawas Regency (32). However, these results contradict the research of Agustia et al. (2020), who reported that toddlers who were not exclusively breastfed were 4 times more likely to suffer from stunting compared to toddlers who were exclusively breastfed (33). The difference in results in this study can be triggered by other factors, such as particular conditions in infants, namely low birth weight or premature birth.

Table 3. Bivariate analysis of indicators of stunting management in toddlers aged 12-23 months in Lampung Province

Category	Incidence of Stunting				OR 95% CI (Lower-Upper)	Chi-Square Test P-value
	Stunting		Not stunting			
	n=321	%	n=1,608	%		
Individual Level Variables						
Exclusive breastfeeding						
Non Exclusive	153	47.7	831	77.8	0.85	0.189
Exclusive	168	52.3	777	22.2	(0.666 – 1.090)	
Growth Monitoring						
Not Routine	147	45.8	704	43.8	1.08	0.507
Routine	174	54.2	904	56.2	(0.846 – 1.389)	
Primary Immunization						
Incomplete	195	60.7	847	79.3	1.39	0.008*
Complete	126	39.3	761	20.1	(1.081 – 1.791)	
Household Level Variables						
Mother's Iron Tablets Consumption						
Inappropriate	223	69.5	1070	66.5	1.14	0.308
Appropriate	98	30.5	538	33.5	(0.877 – 1.498)	
Access to Drinking Water						
Not feasible	102	31.8	412	25.6	1.35	0.024*
Feasible	219	68.2	1,196	74.4	(1.031 – 1.765)	
Access to Sanitation						
Not feasible	30	9.3	129	12.1	1.18	0.431
Feasible	291	90.7	1,479	87.9	(0.751 – 1.810)	

*significant, p-value < 0,05, OR: Odds Ratio, CI: Confident Interval

These conditions require infants to be given additional food to meet their caloric needs and prevent malnutrition, which will increase the risk of stunting in the long run.

Tables 3 and **4** show that non-routine growth monitoring did not affect the incidence of stunting in respondents ($p > 0.05$). In line with this study, Hadi et al. (2022) also reported no significant relationship between the history of visits to Posyandu and the incidence of stunting (34). These results were inversely proportional to the research conducted by Prakoso et al. (2021) and Fentiana et al. (2022), who reported that non-routine growth monitoring affects the incidence of stunting in toddlers (10),(11). The difference in results in this study may occur due to the lack of knowledge and skills of Posyandu cadres, suboptimal monitoring and evaluation, and limited facilities and infrastructure for monitoring growth at Posyandu (35). The analysis supported these results in **Table 2**, which reported that most respondents had

conducted routine growth monitoring in the past year, with the implementation of growth monitoring most often used by respondents being Posyandu..

The results of bivariate analysis showed that primary immunization history was strongly associated with the incidence of stunting in children aged 12-23 months in Lampung Province ($p=0.008$; $OR=1.39$) (Table 3). When analyzed multivariately by considering the characteristics of regencies or cities in Lampung Province, it is known that toddlers with incomplete primary immunization have a 1.35 times higher risk of stunting ($p = 0.021$; $OR=1.35$) (Table 4). This result was relevant to the research of Mulyani et al. (2020), which reported that toddlers with incomplete primary immunization had a 1.2 times higher chance of experiencing stunting (36). The same thing was also shown by Fajariyah and Hidajah's (2020) research conducted on toddlers aged 2–5 years in Indonesia ($p = 0.01$; $OR = 1.78$) (37).

Table 4. Multivariate analysis of indicators of stunting management with the incidence of stunting in toddlers aged 12-23 months in Lampung Province

Variabel	Aor	CI 95%		p-value
		Lower	Upper	
Fixed Effect				
Individual Level Variables				
Non-exclusive breastfeeding	0.83	0.655	1.074	0.164
Not routine growth monitoring	1.03	0.800	1.330	0.807
Incomplete primary immunization	1.35	1.046	1.754	0.021*
Household Level Variables				
Inappropriate iron tablets consumption	1.13	0.866	1.481	0.362
Not feasible access to drinking water	1.38	1.052	1.813	0.020*
Not feasible access to sanitation	1.07	0.697	1.646	0.751
Sub-district Level Variables				
Domisili perdesaan	1.03	0.778	1.368	0.832
Regencies/Municipalities Level Variables				
Number of community health centers	1.00	0.972	1.018	0.675
Contour of mountainous area	0.89	0.402	1.965	0.771
Contour of water area	0.83	0.469	1.467	0.520
Random Effect				
Constant		0,152		
Varians (SE) between regencies/municipalities		0,054 (0,048)		
Varians (SE) between sub-districts		0,056 (0,085)		
Varians (SE) between households		0,162 (0,289)		
ICC of regencies/municipalities (%)		1,50		
ICC of regencies/municipalities and sub-districts (%)		3,09		
ICC of regencies/municipalities, sub-districts, and households (%)		7,63		

aOR: adjusted Odds Ratio, SE: Standard Error, ICC: Intraclass Correlation Coefficient, LR: Likelihood Ration, CI = Confident Interval, *significant at $p < 0.05$ level

Primary immunization is the activity of administering vaccines containing viruses or bacteria that have been killed or weakened to reduce the risk of infectious diseases (12). Vaccines that enter the body will activate cellular immunity by expressing antigens to T cell subsets and humoral immunity by binding to B lymphocytes to form long-term protection by producing memory cells and producing antibodies (38). If the risk of infection decreases, it will lead to a decrease in the risk of malnutrition due to inadequate intake, which will have an impact on the growth and development of the child's brain (36,39). Based on the results of the analysis in

Figure 1. it was reported that the immunization coverage decreased significantly when IPV1, IPV2, IPV3, and Measles and Rubella (MR) vaccines were administered.

According the results of the univariate analysis, less than half of the studied respondents have performed primary immunization completely (46%) (**Table 2**). According to research by Arpen and Afnas (2023), the provision of primary immunization to toddlers could be influenced by several factors, such as knowledge, attitudes, education, and perceptions of mothers, family support, and the role of health workers (40). Mothers who have low education will increase the

possibility of mothers having inappropriate knowledge, attitudes, and behaviors (29). Not only that, the role of good health workers, such as reminding mothers of the schedule of immunization and providing education related to the importance of immunization, can certainly cause mothers to have a positive perception so that mothers will provide complete primary immunization to their toddlers (40,41). This is supported by the characteristics of respondents (**Table 1**) who have fathers and mothers with low education, and the most common reason for incomplete primary immunization in respondents was because the mother forgot or did not know the schedule (**Table 2**). The results of this study showed that there was no significant effect between iron tablet consumption < 90 tablets and the incidence of stunting ($p > 0.05$) (**Table 3,4**). This result aligns with previous research, which reported no association between Fe tablet consumption compliance and stunting (43),(44).

The difference in results reported in this study may occur due to other triggers, such as the ability of respondents to meet their iron and folic acid adequacy appropriately, even if only from their daily intake (45). This result is supported by data in **Table 1**. which shows that the majority of respondents have parents who work as farmers, with one type of vegetable that is widely grown being spinach, as well as fishermen with fish or seafood catches (22). The habit of Lampung people who like to consume traditional seruit food can also help fulfill Fe needs, this happens because seruit comes from a mixture of fish, chili sauce, and tempoyak which is eaten with green vegetable stew (46). The high consumption of fish in Lampung Province is also supported by data from the Central Bureau of Statistics 2022, which reports that fish is the third-highest food purchased by the people of Lampung Province, after rice and vegetables (21).

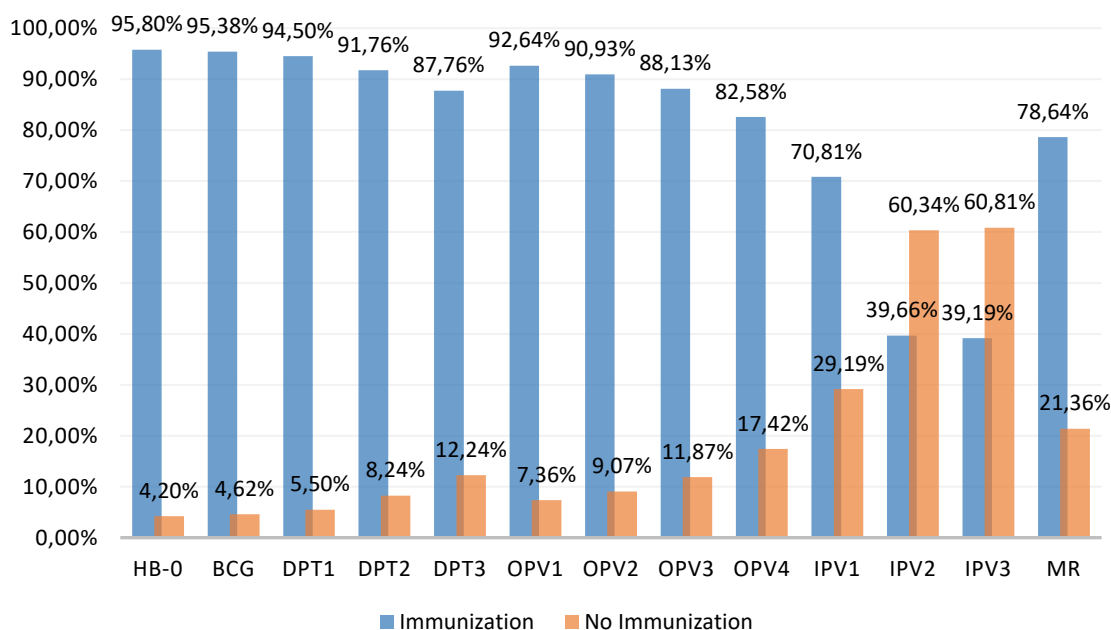


Figure 1. Distribution of Respondents based on Immunization History

In general, respondents came from households with feasible access for drinking water (73.4%), most of which were sourced from protected dug wells. The results of bivariate analysis showed that respondents access to drinking water was associated with the incidence of stunting ($p = 0.024$; $OR=1.35$), while the results of multivariate analysis with the level of two

regencies and cities showed that access to drinking water was the dominant factor influencing the incidence of stunting in Lampung Province ($p = 0.020$; $OR = 1.38$) (**Tables 3, 4**). This means that toddlers with inadequate access to drinking water will have a 1.38 times higher risk of stunting. A literature study by Olo et al. (2021) reported that most toddlers living in rural areas with inadequate

access to drinking water were stunted (16). This result was in line with the results of the univariate analysis, which reported that most of the study respondents lived in rural areas (**Table 1**).

Drinking water that is not feasible for consumption will increase the risk of infectious diseases, both in pregnant women and toddlers. The body's defense system that is experiencing infection will experience an increase in pro-inflammatory cytokines, TNF α , IL-1 (especially IL-1 β), and IL-6, which play a role in suppressing endochondral ossification and inhibiting growth through decreased chondrocyte proliferation (47). In addition, the consumption of drinking water with inadequate access will increase the potential for pathogen contamination that will cause diarrhea, dysentery, cholera, and other gastrointestinal infections (48).

This increased risk of infection will go hand in hand with increased family expenditure on treatment. According to Erlyn et al. (2021), ownership of health insurance was significantly associated with the incidence of stunting in children under five in Palembang. This was caused by the fact that the more people who had health insurance, the higher the family's opportunity to improve the health status of all family members, including reducing the risk of stunting in children under five (49). In addition, Yogaswara et al. (2021) reported that the low ownership of health insurance for stunted toddlers in Tasikmalaya was due to income below the minimum wage (50). This is supported by the results of the univariate analysis (Table 1) which showed that only a small proportion of respondents have health insurance and the majority of respondents come from families with low income.

The results of the study reported that there was no influence between having access to improper sanitation and the incidence ($p>0.05$) (**Table 3,4**). This result aligns with previous studies that reported that environmental sanitation is associated with the incidence of stunting in toddlers (51,52). However, different results were reported by Sugianti and Putri (2022) and Astuti (2022), who stated that access to adequate sanitation affects the incidence of stunting in children under five (53,54). The difference in results in this study was caused by low family

knowledge and awareness so that even though they had access to proper sanitation, respondents could not utilize the facilities correctly, for example, disposing of toddlers' remaining feces not in the toilet (55,56).

According to the results of the multilevel analysis, the variables at the household level had the most significant effect on the incidence of stunting in children under 12-23 months of age in Lampung Province, with an ICC of 7.63% (Table 4). This can occur because the household-level variables in this study are part of sensitive interventions that tackle the indirect causes of stunting with a contribution of 70.0% (57). Therefore, improvements in handling stunting can be focused at the household level.

In **Table 4**, the sub-district level contextualizes the incidence of stunting in children aged 12-23 months in Lampung Province, which is relatively small, with an ICC value of 3.09%. According to previous research, toddlers living in rural areas are more at risk of stunting than those living in urban areas (58),(59). This is because toddlers living in rural areas have limited access to health services, education, and resources compared to those living in urban areas. Not only that, these limitations are also exacerbated by high rates of poverty and food insecurity, causing nutritional deficiencies in toddlers (60). This result is supported by the analysis in **Table 1**, which reports that most respondents' parents had a low educational background.

Based on the general description of characteristics, it is also known that most respondents come from low-income families and do not have a health insurance card (**Table 1**). However, the results of this study showed that rural residence did not affect the incidence of stunting in children under 12-23 months in Lampung Province ($p>0.05$) (**Table 3,4**).

According to the results of the multilevel analysis presented in **Table 4**, it is known that the kabupaten/kota level variable has the slightest variation. Not only that, the results also shows that the regencies/municipalities level has the smallest ICC value compared to the subdistrict and household levels, which is only 1.5%. This means that the regencies/municipalities factor provides the lowest contextual effect on the incidence of stunting among children under 12-23 months old

in Lampung Province. According to Maria et al. (2020), the number of health centers is the most dominant determinant that affects the incidence of stunting (61). This occurs because the unreachability of Community Health Centers due to inappropriate numbers will impact limited health services, including quality ANC and early learning services for mothers and children (62). However, this study reported that the number of health centers contextually did not affect the incidence of stunting among children under 12-23 months in Lampung Province (**Table 4**).

Based on the results of the analysis, it is known that the contours of mountainous and plain areas do not affect the incidence of stunting in children under 12-23 months in Lampung Province ($p > 0.05$) (**Table 4**). This result is not in line with previous research, which reported that differences in the characteristics of the area of residence affect the incidence of stunting with different risk factors, namely lowlands with the incidence of diarrhea while highlands with a history of exclusive breastfeeding (63).

The strength of this study is that it can explain the factors that cause the high low incidence of stunting in Lampung Province according to the actual SSGI 2022 results, because this study used secondary data that was also taken in the survey. The limitations of this study were the cross-sectional design used. This design can cause bias because all variables are collected at the same time, making it difficult to ascertain whether the independent variable directly affects the dependent variable. In addition, researchers were not able to explore the factors that can affect the success of provide complete primary immunization, such as the knowledge and skills of cadres.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study show that access to drinking water is the most dominating factor determining the frequency of stunting in toddlers aged 12-23 months in Lampung Province. Therefore, it is necessary to optimize the handling of stunting through the provision of primary immunization by promoting activities through counseling and education so that people are more aware of the importance of immunization. In addition, there is a need for cross-sectoral

cooperation to promote the importance of feasible drinking water consumption and optimize the provision of clean water programs in various areas in need.

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