

## Loglinier Model on Immunization of Baduta

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**Abstract.** This study aims to analyze the relationship between the type of immunization and the province of origin of children under two years of age (BADUTA) in Indonesia in 2020. This study uses a loglinear model approach to analyze DPT-HB-Hib4 and Measles/MR2 immunization data based on gender and home province. Data was obtained from the Directorate General of Disease Prevention and Control of the Indonesian Ministry of Health. Through statistical analysis using IBM SPSS Statistics 22 software, this research found that there is a relationship between the type of immunization and the child's province of origin. The chi-square test results show that there is a significant relationship between the type of immunization and the child's province of origin. Of the several loglinear models tested, the  $(J, VP)$  model is considered the best model based on Goodness-of-fit criteria. Thus, this study concludes that there is a relationship between the type of immunization and the province of origin of children under two years old in Indonesia in 2020.

**Keywords:** Children Under Two Years ; Immunization; Loglinear; Statistics



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## INTRODUCTION

Humans as creatures who are given reason compared to other creatures must always think scientifically in their actions. The tools (tools) for scientific thinking include language, mathematics, logic and statistics. Statistics is a branch of science that studies data (Budiati et al., 2014). In statistics, data is divided into 3, namely based on measurement scale, data source, and collection time. Based on measurement scales, including qualitative data (ordinal and nominal), as well as quantitative data (intervals and ratios). Based on the data source, it consists of primary data and secondary data. Meanwhile, data based on collection time consists of cross sectional, time series and panel.

In analyzing data, both qualitative and quantitative, several appropriate models must be compared, from these models the best model will be selected by using several objective methods (Bedrick & Crandall, 2010). A Loglinier Model can be applied to analyze the immunization status of Baduta based on various factors identified in the research papers. Factors such as knowledge, attitudes, actions, health services, family support, and side effects play a significant role in determining the immunization coverage (Sriwahyuni et al., 2020; Sariatmi & Kusumastuti, 2019; Susanti, 2022). The research highlights the importance of parental knowledge, availability of healthcare facilities, and the role of healthcare workers in ensuring complete basic immunization for children under two years old (Agustina & Dewi, 2022). Additionally, the study emphasizes the impact of side effects and

the need for awareness regarding vaccination benefits to improve immunization rates (Ulfa & Sugiyanti, 2013). By incorporating these factors into a Loglinier Model, a comprehensive understanding of the determinants influencing Baduta immunization can be achieved, aiding in the development of effective vaccination strategies.

A Loglinier Model on immunization can be a valuable tool in understanding and predicting vaccination outcomes. Research has shown that socioeconomic and demographic factors play a significant role in determining childhood immunization rates in the USA (Goh et al., 2020; Lay et al., 2020). Additionally, optimal vaccination strategies can be developed using improved SEIR models, which consider logistic growth for the total population and optimal control problems with various constraints (Crouch & Dickes, 2015). Furthermore, the global stability of disease-free and endemic equilibriums in SEIR models with vaccination immunization has been proven, emphasizing the importance of vaccination in disease control (Thäter et al., 2017). By exploring the effects of vaccination rate, vaccine efficacy, and immune decline on disease transmission through mathematical models like VSEIR, it is possible to predict disease outcomes and assess the impact of different intervention strategies, such as vaccines and protective measures (Elizabet et al., 2015).

So, in qualitative data analysis, generally the models that are often used include logistic regression models and loglinear models. The aim of this research is to apply a scientific approach to data analysis, both qualitative and quantitative, by comparing and deploying appropriate models, such as logistic and loglinear regression, to select the best model.

**METHOD**

The data used by researchers comes from the Directorate General of Disease Prevention and Control, Indonesian Ministry of Health, 2021 in the form of data on advanced immunization coverage of DPT-HB-Hib4 and Measles/MR2 in children under two years of age (BADUTA) according to gender and province in Indonesia in 2020 .

The data obtained is as in Figure 1.

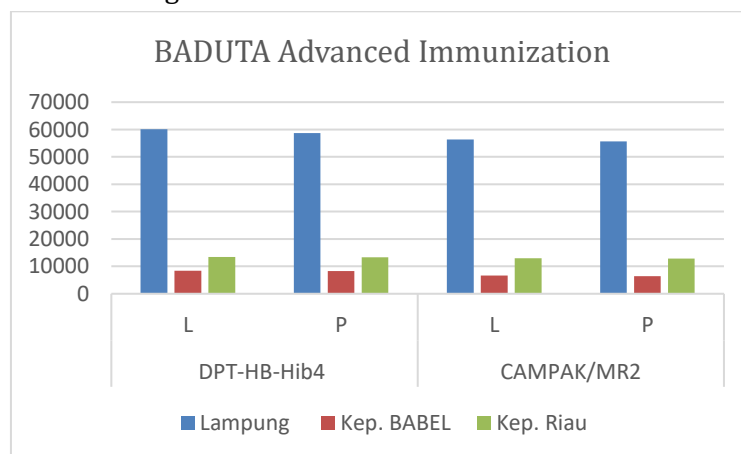


Figure 1. BADUTA Advanced Immunization

In Figure 1. the data obtained there are 3 variables, namely the first variable is gender which is symbolized  $J_i$  with the index value  $i = 1$  for "male" and  $i = 2$  for "female", the second variable is the type of immunization given, symbolized  $V_i$  with the value index  $i = 1$  for

"DPT-HB-Hib4", and  $i=2$  for "Measles/MR2", and the third variable is Provincial Origin which is symbolized  $P_i$  with index value  $i = 1$  for "Lampung",  $i=2$  for " Bangka Belitung Islands" and  $i=3$  for "Riau Islands". In analyzing data on DPT-HB-Hib4 and Measles/MR2 advanced immunization coverage in children under two years of age (BADUTA) according to gender and province in Indonesia in 2020, researchers used a Loglinear model approach which in its application used one of the statistical programs, namely Software IBM SPSS Statistics 22.

The method used in this research can be described as follows:

1. Obtain data on DPT-HB-Hib4 and Measles/MR2 follow-up immunization coverage in children under two years of age (BADUTA) according to gender and province in Indonesia in 2020.
2. apply the data into a loglinear model with the SPSS application.
3. Analyze the relationship between the categorical variables used.
4. Look for loglinear model estimates that match the analyst's hierarchical loglinearity.
5. Look at the Goodness of fit value of each model tested.
6. Evaluate which loglinear model is best by looking at the level of significance and simplicity of the model.

**RESULT AND DISCUSSION**

In this study, the variables used were gender, type of immunization, and province of origin. There are 2 categories for the gender variable, namely male (1) and female (2), then for the type of immunization/vaccine variable there are 2 categories, namely DPT-HB-Hib4 (1) and Measles/MR2 (2), as well as the provincial origin variable. There are 3 categories, namely Lampung (1), Bangka Belitung Islands (2) and Riau Islands (3).

Of the three variables, researchers will analyze the relationship between the type of immunization and the BADUTA child's province of origin involving 313,350 BADUTA respondents in 3 provinces, namely Lampung, Bangka Belitung Islands and Riau Islands. The results of the Descriptive Hypothesis that the researchers analyzed were:

Ho : there is no relationship between type of immunization and provincial origin.

H1 : there is a relationship between type of immunization and provincial origin.

From data processing using IBM SPSS Statistics 22 software, we obtain the following table and histogram:

Tabel 1. Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Vaksin *	313350	100,0%	0	0,0%	313350	100,0%
Provinsi					0	

In this case, it can be seen that the number of our respondents was 313,350 BADUTA.

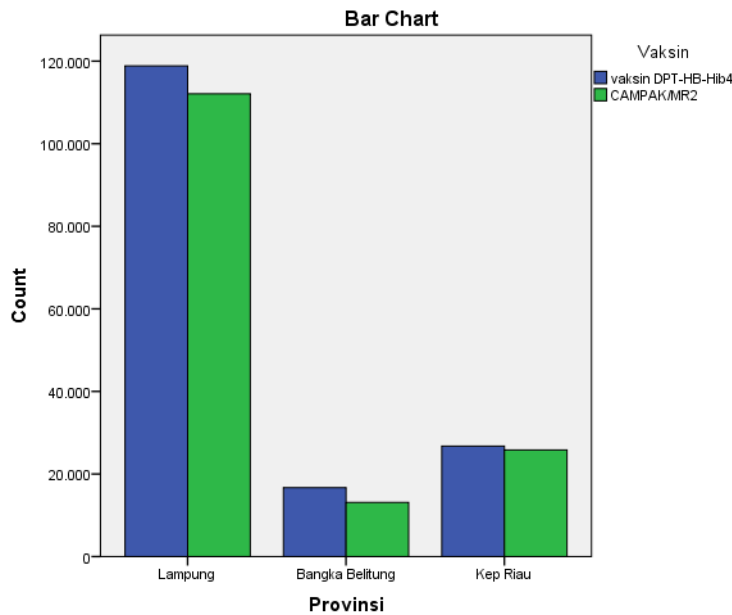


Figure 2. Histogram between types of immunization and province of origin

In the histogram, it can be seen that for each province of origin, the number of participants in the DPT-HB-Hib4 type immunization is more than the Measles/MR2 type immunization, with this fact we tend to reject  $H_0$ , in other words, there is a relationship between the type of immunization and the provincial origin.

Tabel 2. Chi-Squares Test

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	235,861 <sup>a</sup>	2	,000
Likelihood Ratio	236,516	2	,000
Linear-by-Linear Association	1,867	1	,172
N of Valid Cases	313350		

In the Chi-square test, it can be seen that the Chi-square statistical value is 235.861 with an independent degree of 2 and a P-Value <0.001. Because the P-Value value is smaller than the real level  $\alpha=0.05$ , then reject  $H_0$ . So it can be concluded that at the real level  $\alpha=0.05$  there is a relationship between the type of vaccine and the province of origin.

Inferential hypothesis results using loglinear models

$H_0$ : there is an interaction between vaccine type and province of origin.

$H_1$ : there is no interaction between vaccine type and province of origin

In this case the researcher used the Goodness-of-fit test on the log-linear model of immunization data, the model to be built and the test values are shown in the table:

For each model tested using goodness-of-fit, it can be studied that model (J,V,P), model (J,V,P,JP), model (J,V,P,JVP), and model (J ,V, P,JV) has a P-Value of 0.000 ( $p < 0.001$ ). This P-value is smaller than the real level  $\alpha=0.05$  so reject  $H_0$  (there is no interaction between vaccine type and province of origin).

Meanwhile, in the (J,V,P,JP,JV,VP) model, (J,V,P,JV,VP) model, and (J,V,P,VP) model, the P-Value value is (0.267), (0.588), and (0.673). So it can be concluded that we accept  $H_0$  (there is no interaction between vaccine type and province of origin). Of the three models, the model (J, V, P, VP) is the best according to the G2 criteria, and the P-Value is greater than the other two models.

The estimated parameters in the (J,V,P,VP) model are:

Table 3. Parameter Estimates<sup>c,d</sup>

Parameter	Estimate	Std. Error	Z	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Constant	9,457 <sup>a</sup>					
[J = 1]	,017	,004	4,891	,000	,010	,024
[J = 2]	0 <sup>b</sup>	.	.	.	.	.
[V = 1]	,035	,009	4,065	,000	,018	,053
[V = 2]	0 <sup>b</sup>	.	.	.	.	.
[P = 1]	1,468	,007	212,721	,000	1,455	1,482
[P = 2]	-,676	,011	-63,067	,000	-,697	-,655
[P = 3]	0 <sup>b</sup>	.	.	.	.	.
[V = 1] * [P = 1]	,023	,010	2,380	,017	,004	,042
[V = 1] * [P = 2]	,204	,015	14,038	,000	,176	,233
[V = 1] * [P = 3]	0 <sup>b</sup>	.	.	.	.	.
[V = 2] * [P = 1]	0 <sup>b</sup>	.	.	.	.	.
[V = 2] * [P = 2]	0 <sup>b</sup>	.	.	.	.	.
[V = 2] * [P = 3]	0 <sup>b</sup>	.	.	.	.	.

From the table above, the estimated value of the non-linear model will be obtained:

$$\text{Log } \mu_{ijk} = \lambda + \lambda_i^J + \lambda_j^V + \lambda_k^P + \lambda_{jk}^{VP},$$

With value is  $i = 2, j = 2$ , dan  $k = 3$ , so get it

$$\text{Log } \mu_{ijk} = \lambda + \lambda_1^J + \lambda_2^J + \lambda_1^V + \lambda_2^V + \lambda_1^K + \lambda_2^K + \lambda_3^K + \lambda_{11}^{VP} + \lambda_{12}^{VP} + \lambda_{13}^{VP} + \lambda_{21}^{VP} + \lambda_{22}^{VP} + \lambda_{23}^{VP}$$

So the resulting model is,

$$\text{Log } \mu_{ijk} = 9,457 + 0,017 + 0 + 0,035 + 0 + 1,4680 - 0,676 + 0 + 0,023 + 0,204 + 0 + 0 + 0 + 0$$

## CONCLUSION

From each model (JP, JV, VP), model (JV, VP), and model (J, VP) where the P-Value is greater than the real level  $\alpha=0.05$ , there is an interaction between the type of vaccine and the province of origin (VP) then it can be concluded that there is a relationship between the type of immunization and nasal province. The P-Value values for the model (JP, JV, VP), model (JV, VP), and model (J, VP) are (0.267), (0.588), and (0.673), respectively. Apart from that, the Goodness-of-fit / G2 values for the model (JP, JV, VP), model (JV, VP), and model (J, VP) are (2.643), (2.828), and (3.178), respectively. From these two criteria, the best loglinear model is the (J, VP) model.

## REFERENCE

- Agustina, M. Q., & Dewi, M. K. (2022). Hubungan Pengetahuan Orang Tua, Ketersediaan Sarana Fasilitas Kesehatan dan Peran Petugas Kesehatan Terhadap Pelaksanaan Imunisasi Dasar Lengkap Pada Baduta: The Relationship between Parental Knowledge, Availability of Health Facilities and the Role of Health Workers in the Implementation of Complete Basic Immunization for Toddlers. *SIMFISIS: Jurnal Kebidanan Indonesia*, 1(4), 178-184.
- Bedrick, E. J., & Crandall, W. K. (2010). Model selection criteria for loglinear models. *Australian and New Zealand Journal of Statistics*, 52(4), 439-449. <https://doi.org/10.1111/j.1467-842X.2010.00593.x>
- Budiati, D., Wilandari, Y., & Suparti. (2014). Analisis Hubungan Antara Lama Studi, Jalur Masuk Dan Indeks Prestasi Kumulatif (IPK) Menggunakan Model Log Linier [The Comparison Analysis between study period, entry pathways, Grade Point Average (GPA) using Linier Log Model]. *Jurnal Gaussian*, 3(1), 41-50.
- Carriquiry, A. L., & Fienberg, S. E. (2014). Loglinear Model. *Wiley StatsRef: Statistics Reference Online*, 1-23
- Crouch, E., & Dickes, L. A. (2015). A prediction model of childhood immunization rates. *Applied health economics and health policy*, 13, 243-251.
- Elizabeth, Crouch., Lori, Dickes. (2015). A Prediction Model of Childhood Immunization Rates. *Applied Health Economics and Health Policy*, doi: 10.1007/S40258-015-0157-6
- Goh, L. K., Sow, C. F., & Ja'afar, S. (2020). Implementation Of An Immunisation Project For The Refugees Using The Logic Model. *Malaysian Journal of Public Health Medicine*, 20(3), 125-133.
- Huang, L. O., Infante-Rivard, C., & Labbe, A. (2017). Analysis of case-parent trios for imprinting effect using a loglinear model with adjustment for sex-of-parent-specific

- transmission ratio distortion. *Human Genetics*, 136(8), 951–961. <https://doi.org/10.1007/s00439-017-1824-5>
- Lay, Khim, Goh., Chew, Fei, Sow., Safurah, Jaafar. (2020). Implementation of an immunisation project for the refugees using the logic model. *Malaysian Journal of Public Health Medicine*, doi: 10.37268/MJPHM/VOL.20/NO.3/ART.604
- Minozzo, M., & Fruttini, D. (2004). Loglinear spatial factor analysis: An application to diabetes mellitus complications. *Environmetrics*, 15(5), 423–434. <https://doi.org/10.1002/env.675>
- Powers, D. A., & Xie, Y. (2000). Loglinear Models for Contingency Tables. *Statistical Methods for Categorical Data Analysis*, 87–146. <https://doi.org/10.1016/b978-012563736-7/50004-5>
- Sriatmi, A., & Kusumastuti, W. (2019). Immunization punctuality in the achievement of complete basic immunization for babies age 12-22 months in Semarang. *Journal of Public Health for Tropical and Coastal Region*, 2(1), 1-10.
- Sriwahyuni, S., Firdaus, M. R., & Alawiyah, T. (2020, February). Factors Related to the Provision of DPT Immunization in Baduta in the Meureubo Puskesmas Working a West Aceh Regency 2018. In *4th International Symposium on Health Research (ISHR 2019)* (pp. 185-191). Atlantis Press.
- Susanti, N., Natassa, J., Purba, C. V. G., & Alamsyah, A. (2022). Determinan Vaksinasi Campak pada Baduta di Kelurahan Kuala Lahang Kabupaten Indragiri Hilir: Measless Vaccination Determinations in Baduta of Kuala Lahang Sub District of Indragiri Hilir Regency. *Media Kesmas (Public Health Media)*, 2(1), 271-279.
- Thäter, M., Chudej, K., & Pesch, H. J. (2017). Optimal vaccination strategies for an SEIR model of infectious diseases with logistic growth. *Mathematical Biosciences & Engineering*, 15(2), 485-505.
- Ulfa, M., & Sugiyanto, S. (2013). Model matematika untuk kontrol campak menggunakan vaksinasi. *Jurnal Fourier*, 2(2), 81-89.