The Application of Factor Analysis to Determine the Dominant Causes of the Low Birth Weight Babies in East Nusa Tenggara (ENT) Province

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Abstract: A research was carried out to determine dominant factors that affect the low birth weight babies in East Nusa Tenggara (ENT) province Indonesia. The district Timor Tengah Selatan (TTS) was selected as the target region for the research as this area has the highest number for the case**.** Samples were taken purposively targeting the mothers whose babies have low birth weights. The data were collected using questioners with 12 questions that have Likert Scale attributes ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). *Factor Analysis* method was employed to examine the variables involved in the research. The result shows that from the 12 variables that were grouped in 4 factors; internal diseases, environment, birth defects and respiratory infection, the greatest threat to the low birth weight babies in ENT is internal diseases with the percentage of variance is almost 40%.

1 INTRODUCTION

To develop a healthy society, there is a need to integrate science and technology in order to promote and improve health, to prevent diseases and to recover and rehabilitate from illnesses. Social economic problems are factors that are believed to relate health issues in general and more particular to the health of mothers and children. Therefore, health is one of the indicators of the human welfare in any country in the globe including Indonesia and East Nusa Tenggara Province as one of its provinces.

ENT has a massive problems with regard to the health of mothers and children and as it has relatively high number of them died. The lack of nutrition, health awareness, geographical obstacles and lowincome families are believed to be the factors that worsened the problems of the death of mothers and children. One of the sub-districts that has this big problem is the Timor Tengah Selatan (TTS).

The death of babies is one of the indicators of the health level of a nation. This is in agreement with the one of the MDGs that aims at reducing the number of babies died which was 23 in 1000 births in 2015 in Indonesia).

There are two causes for the death of babies; direct and indirect factors. Direct factors refer to those brought by the birth babies such as low birth weights and infections after births, whereas indirect factors such as social and economic factors, health services, condition of pregnant mothers and environment. Deaths caused by maternal problems are relatively high (Muchemi et al., 2015).

In Indonesia, the number of babies died during and after delivery process, the first year and the first five years is considered relatively high. Statistic shows that 19 babies died in 1000 births during neonatal period, whereas at the age of 2 to 11 months, there were an average of 15 deaths per 1.000 births and 10 deaths per 1.000 children at the age group of 1–5 years (Yayasan Kesehatan Perempuan (YKP) - MAMPU, 2017).

In ENT there was a fluctuate number of newborn babies died during the period of 2011 – 2014. The data shows that the number was 1210 in 2011, 1450 in 2012, 1286 in 2013 and 1.280 in 2014. These numbers constitute about 12.8, 51.1, 13.6 and 14 in 1000 life births respectively. Compared to other sub-districts in the ENT province, TTS has the highest number of mortal babies which is 17 deaths in 1000 life births (Dinas Kesehatan Prov. NTT, 2017).

To overcome such problems, root causes should be identified. Identification of root causes has

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definitely solved part of the problems. Having been able to identify factors that cause the death of babies, we will be able to control and improve such factors which in turn reduce the number of death babies.

The study was aiming at identifying all factors that may cause the death of babies in ENT and then finding the main factors that pose the greatest threat to the problem using Factor Analysis Method.

2 RESEARCH METHOD

The research about the determinant factors of the low birth weight babies (LBWB) was conducted through several steps including observing causes that cause the death of babies, analysing the factor analysis model, interpreting the factor models and finally forming the dead babies equation models.

This research was conducted in Timor Tengah Selatan (TTS) District in the province of ENT. The population of the research was all mothers who have babies (below 5 years old) whereas the samples were those mothers whose babies died. The samples were taken using purposive sampling technique after observation was undertaken to identify the number of mothers with babies below 5 years. Research instrument in the research was questioners with ordinal Likert scale that consists of 12 questions containing the attribute strongly disagree (1) to strongly agree (5).

Factor Analysis method was employed to analyse the data in this research. The collected data was examined. When the data was incomplete then the particular observation data was not included in the modelling (Kline, 1994).

2.1 Basic Concept of the Factor Analysis

Factor analysis is a multivariate statistical method that used to analyse the relation between independent variables to be then grouped in a lesser number of variables (Johnson & Wichern, 2002). These variables are not divided into dependent and independent variables but the analysis is set to be conducted in the manner of independence among them.

The research was initiated by data exploration, modelling factors equation, examining the factors that cause the death of babies (initial factors) in TTS and finding the new factors that contain a number of initial factors that formed after the Factor analysis and finally finding the factors that cause the death of babies. The end stage of the research is the interpretation of the model.

In short the research stages were including data collecting and screening, data exploration or description and data analysis.

2.2 Variables

There were 12 variables used in the research. They were, invasive pneumococcal disease, diarrhea, tetanus or postnatal infections., child abuse. birth defects, measles, tuberculosis, meningitis, sudden infant death syndrome (SIDS), severe respiratory infection, malaria and low birth weight.

3 RESULTS AND DISCUSSION

3.1 General Description

3.1.1 Samples Characteristics

Table 1: Percentage of Sample characteristics on Sex Basis.

Sex	Percentage (%)
Females	53.38
Males	47.62
Total	100.00

Table 1 shows that the respondents were dominated by females. This is most likely because of the males normally work in their farm in the morning when the interview was undertaken. It's also because the interviewer served by the same sex.

3.1.2 Characteristics of Respondents on Age

Parents of babies died were 19 - 37 years old.

Table 2: The Number of Respondents on Age Basis.

Age (y.o)	Percentage (%)
19-25	52.38
26-32	33.33
33-39	14.29
Total	100.00

Table 2 shows that the highest percentage of the parents from group of 19 – 25 y.o followed by 26-32 y.o and the lowest number was from the age group 33-39 y.o. This number confirms that the younger the age of the parents the more likely to have their babies die. Physical and emotional maturity is one of

the determinant factors to handle postnatal situation (Jordan et al., 2018).

3.1.3 The Characteristic of Respondents on Education Level Basis

Table 3: The Number of Respondents on education level basis.

Respondents' Status	Percentage(%)
Not married	33.33
Married	66.67
Total	100.00

Table 3 shows that the biggest proportion of parents whose babies died was from the primary school group. The limitation in awareness as well as knowledge on the health of expectant mothers, babies' health, nutrition and many other factors for babies before and after births can be the biggest concern for the death of the babies. Even though this result may not be in line with the of the study conducted by (Rosenthal, 2014) which concluded that mothers' education level did not affect child's rearing.

3.1.4 The Characteristics of Respondents on Marital Status Basis

Table 4: The Number of Respondents based on Marital Status.

Respondents' Status	Percentage (%)
Not Married	33.33
Married	66.67
Total	100.00

Table 4 shows that 33,33% of the respondents were not married. This implies that 33% of women were single parents in handling the whole process starting from pregnancy, give births and postnatal process. Psychological pressure and stress can be the factors of the death of the babies (Lamming, 2013).

3.2 Factor Analysis

Factor analysis is started with the determination of the communal values that describe how the proportion of variance of initial variables can be explained or determined by the existing factors. The communal values are displayed in Table 5.

Table 5: Communal values.

Variable	Initial	Extraction
Lungs Infec.	1.000	0.931
Diarhea	1.000	0.682
Tetanus	1.000	0.847
Child abuse	1.000	0.700
Birth defetcts	1.000	0.634
Measels	1.000	0.461
TB	1.000	0.882
Meningitis	1.000	0.882
SIDS	1.000	0.898
Resp. Infec.	1.000	0.827
Malaria	1.000	0.574
Low BW	1.000	0.648

From Table 5 it's clearly seen that almost all the variables have communal values extraction greater than 0.5 except that of measles. This shows that the relation between variables and factors is relatively high which implies that the used variables have obtained good factors. Communal values are the sum of the square of each factor. For example; the communal value for lungs infection (X_1) = $(0.958)^2$ + $(-0.064)^2$ + $(0.070)^2$ + $(-0.070)^2$ = 0.93166 or 0,931 which means that about 93.1% variance of X_1 can be explained from the formed factors. Similar manner applies to the other variables. From Table 5, we can also observe that only variable Measels (X_6) has the communal value under 0.4 whereas lungs infection has the highest communal value followed by the variable SIDS.

Table 6: Matrix Component.

Variables	Component			
	1	2	3	4
Lungs infec. (X1)	0.958	-0.064	0.070	-0.070
Diarhea (X2)	0.441	-0.231	0.388	-0.533
Tetanus (X2)	0.907	-0.110	0.077	-0.078
Child abuse (X4)	0.314	-0.300	-0.689	0.190
Birth Defects (X5)	0.775	-0.067	-0.122	0.122
Measels (X6)	0.363	-0.530	0.220	0.013
TB (X7)	0.898	0.265	-0.011	-0.070
Meningitis (X8)	0.898	0.265	-0.011	-0.070
SIDS (X9)	0.182	0.859	-0.257	-0.249
Resp. Infec. (X10)	0.264	0.091	0.578	0.644
Malaria (X11)	0.532	-0.241	-0.332	0.351
LBW (X12)	0.100	0.732	0.133	0.291

Table 7: Factor extractions with Main component factors.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.77	39.78	39.78	4.77	39.78	39.78	4.48	37.37	37.4
2	1.92	16.04	55.82	1.93	16.04	55.82	1.87	15.57	52.9
3	1.22	10.22	66.05	1.23	10.22	66.05	1.43	11.95	64.9
4	1.04	8.67	74.72	1.04	8.67	74.72	1.18	9.83	74.7
5	0.93	7.78	82.50						
6	0.77	6.44	88.94						
7	0.54	4.54	93.48						
8	0.44	3.71	97.19						
9	0.19	1.58	98.76						
10	0.11	0.92	99.69						
11	0.04	0.31	100.00						
12	0.00	0.00	100.00						

The analysis is then followed by the factorization which is the most important step in the process. In this research the method employed was *Principal Component Analysis*. The criteria used to determine the number of factors formed is the eigenvalue $\lambda_i \geq 1$. The eigenvalues of the factors are displayed in Table 7.

It can be seen from Table 7, that the eigenvalue for Factor 1 is 4.77 with variance of 39.78 % and factor 2 is 16.04 with variance 1.92. Factor 12 has 0.0 eigenvalue with variance 0.000 %. Only 4 factors have eigenvalues greater than or equal to 1 ($\lambda_i \geq 1$) with communal values 74.72 %. The scree diagram for 12 eigenvalues is displayed in Figure 1.

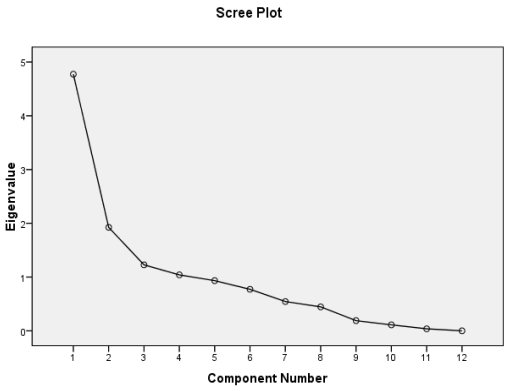

Figure 1: Scree Plot for.12 eigenvalues.

Table 8: Loading factors after varimax rotation.

Variable	Component			
	1	2	3	4
Lungs infec. (X1)	0.939	-0.115	0.162	0.096
Diare (X2)	0.582	-0.363	-0.418	-0.192
Tetanus (X3)	0.890	-0.159	0.151	0.081
Child abuse (X4)	0.152	-0.092	0.783	-0.234
Birth Defects (X5)	0.694	-0.051	0.368	0.120
Measels (X6)	0.330	-0.582	0.056	0.101
TBC (X7)	0.898	0.225	0.131	0.092
Meningitis (X8)	0.898	0.225	0.131	0.092
SIDS (X9)	0.272	0.882	-0.098	-0.194
Resp. Infec. (X10)	0.168	-0.070	-0.057	0.889
Malaria (X11)	0.367	-0.141	0.634	0.132
LBW (X12)	0.095	0.667	-0.099	0.430

Table 8 shows the leading factors after rotation. The results show that Factor 1 consists of variables X_1, X_2, X_3, X_5, X_7, X_8 which is called as internal

diseases (poor areas). Factor 2 composed of variables X_6, X_9 dan X_{12} named as birth defects. Factor 3 is called an environment which consists of X_4 dan X_{11}. Factor 4 consists of variable X_{10} and is called reciptory infection factor.
The analysis then produced the following model

$F_1 = 0.939X_1 + 0.582X_2 + 0.890X_3 + 0.694X_5 + 0.898X_7 + 0.898X_8$

$F_2 = -0.582X_6 + 0.882X_9 + 0.667X_{12}$

$F_3 = 0.783X_4 + 0.634X_{11}$

$F_4 = 0.889X_{10}$

The four models obtained can be used for further analysis by computing the score of each factor on the variables base.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

Based on the multivariate analysis, it can be concluded that there were 4 (four) factors that caused the babies mortality. They were inner diseases, birth defects, environment where the babies born and breath infection. Among these 4 factors, inner disease is determined to be the dominant factor with the variance percentage is 39.78%.

4.2 Recommendation

Things that can be recommended from this research are:

1. Relevant government units should be more active in assisting and giving helps to the mothers about babies (children) rearing and the hygiene of the surrounded environment.
2. Communities are encouraged to improve their knowledge on expecting mothers and babies.
3. Government should encourage the society to have house constructions that provide comfort to babies and their mothers.
4. Nutrition intake and fresh air for babies are very essential particularly for those who live in small spaces with too many people in them.

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