

## Path Analysis on the Relationship Between Bio-psychosocial Factors during Gestational Period and Birthweight, Stimulation and Development in Children Aged 1 to 3 Years in Salatiga

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### ABSTRACT

**Background:** Bio-psychosocial condition during gestational period, such as maternal nutritional status, stress, education, and family income, may have significant impact on fetal growth and development. The purpose of this study was to determine relationship between bio-psychosocial factors during gestational period and birthweight, and the relationship between stimulation and development in children aged 1 to 3 years.

**Subjects and Method:** This was an analytic and observational study with case control design. A sample of 120 children aged 1 to 3 years was selected by fixed disease sampling with case: control ratio= 1:2. The exogenous variables were gestational maternal education and current maternal education. The endogenous variables were gestational family income, gestational maternal stress, current family income, maternal nutritional status, birthweight, stimulation, and child development. The data were collected by a set of questionnaire and analyzed by path analysis on STATA 13.

**Results:** Birthweight  $\geq 2.500$  g ( $b= 0.96$ ; 95% CI =  $-0.15$  to  $1.94$ ;  $p=0.054$ ) and stimulation ( $b= 0.43$ ; 95% CI=  $-0.30$  to  $0.89$ ;  $p=0.067$ ) had direct positive effect on child development. Gestational maternal education, family income, maternal stress, maternal nutritional status, had indirect effect on child development through birthweight. Maternal education and family income had indirect effect on child development through stimulation.

**Conclusion:** Birthweight  $\geq 2,500$  g and stimulation have direct positive effect on child development.

**Keywords:** bio-psychosocial, gestational period, birthweight, stimulation, development

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### BACKGROUND

Poor conditions during pregnancy, such as nutritional deficiencies during pregnancy, maternal stress, insufficient exercise, and inadequate prenatal care, can cause fetal development that is not optimal. Poor fetal development is a risk for health in later life (Wilkinson and Marmot, 2003 in Murti 2011).

Development is the increased ability (skills) in the structure and function of the body that are more complex in a regular pattern and can be predicted as a result of

the maturation process (Soetjiningsih and Gde Ranuh, 2014).

The quality of a child's future is determined by the optimal development and growth of the child. So that detection, stimulation, and intervention of various growth and development deviations are carried out early. The motor skills and intelligence of each child is different. Good motor development in children will make the children more able to adapt and adjust to the school environment. This adaptive ability encourages children to be more able

to make friends with others while doing activities. Normal motor development allows children to play or hang out with their peers. Meanwhile, abnormal motor development will prevent a child from being able to get along with his/her peers even he/she will be isolated or become a marginalized child (Marmi and Rahardjo, 2012).

According to Adriana (2013) factors that influence growth and development in children are internal factors, external factors (prenatal factors, labor factors, postpartum factors). Prenatal factors include nutrition, mechanics, toxins, endoktrin, radiation, psychological. While postpartum factors include nutrition, psychological, social environment, stimulation.

Based on the results of interviews with midwife coordinator of the city health center, she said that monitoring of child development was not implemented because they were more focused on monitoring growth. As a result, there were no data reports on the problem of child development in Salatiga City. Researcher chose the working area of the Tegalrejo and Sidorejo Kidul Health Center in Salatiga City as a place of study by looking at the data on the problem of high malnutrition status in the region.

Children under three years (toddlers) are very energetic and active, full of boundless energy, enthusiastic and curious. Although the speed of growth slows down during this stage, important developmental changes are formed. Improved motor skills allow toddlers to move on their own, explore and test their environment. The rapid development of speech and language has a role in improving thinking and learning abilities that are more complex (Allen and Marotz, 2010).

Many questions about child development that have not been answered until

now. For example, what actually drives the process of biological, cognitive development, and how things that happen in infancy affect childhood.

By looking at the problems of child development and the study on factors related to child development explained by using a bivariate or multivariate analysis model but not analyzed in stages to explain the direct and indirect effects related to child development, the author conducted a study entitled "Path Analysis on the Relationship Between Bio-psychosocial Factors During Gestational Period and Birthweight, Stimulation and Development in Children Aged 1 to 3 Years in Salatiga."

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## SUBJECT AND METHOD

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### 1. Study design

This was an analytic and observational study with case control design, carried out from 4 October to 2 November 2016 in Salatiga, Central Java.

### 2. Population and sample

The population of the study sources were mothers and toddlers in the working area of Sidorejo Kidul and Tegalrejo Health Center, Salatiga City. A sample of 120 children aged 1 to 3 years was selected by fixed disease sampling with case: control ratio= 1:2.

### 3. Study variables

The exogenous variables were gestational maternal education and current maternal education. The endogenous variables were gestational family income, current family income, gestational maternal stress, maternal nutritional status, birthweight, and child development.

### 4. Data analysis

Path analysis with STATA program was used for data analysis.

**RESULTS****1. Characteristics of Study Subjects**

The characteristics of the study subjects in Table 1 showed an overview in the form of classification, frequency and percentage

from 120 study subjects, with characteristics of maternal age, maternal occupation, number of children age of toddler, ANC, gestational age at delivery, and exclusive breastfeeding.

**Table 1. Characteristics of study subjects**

Characteristics	n	%
<b>Maternal Age</b>		
< 20 year	2	1.7 %
20 - 35 year	104	86.7%
≥ 35 year	14	11.7%
<b>Maternal Occupation</b>		
Unemployed	88	73.3%
Employed	32	26.7%
<b>Number of Children</b>		
< 2	57	47.5%
≥ 2	63	52.5%
<b>Age of Toddler</b>		
12-24 months	71	59.2%
25-36 months	49	40.8%
<b>ANC</b>		
< 8 times	23	19.2%
≥ 8 times	97	80.8%
<b>Gestational Age at Delivery</b>		
≤ 36 months	5	4.2%
> 36 months	115	95.8%
<b>Exclusive Breastfeeding</b>		
Yes	98	81.7%
No	22	18.3%

**Table 2. Frequency distribution of study variables**

Variable	Criteria	Frequency	(%)
Gestational maternal education	<Senior High School	28	23.3
	≥Senior High School	92	76.7
Family income	<Regional Minimum Wage	37	30.8
	≥Regional Minimum Wage	83	69.2
Gestational maternal stress	Not Stress	83	69.2
	Stress	37	30.8
Maternal nutritional status	Maternal MUAC <23.5 cm	22	18.3
	Maternal MUAC ≥23.5 cm	98	81.7
Current maternal education	<Senior High School	27	22.5
	≥Senior High School	93	77.5
Current family income	<Regional Minimum Wage	33	27.5
	≥Regional Minimum Wage	87	72.5
Birthweight	<2,500 g	7	5.8
	≥2,500 g	113	94.2
Stimulation	Good	64	53.3
	Poor	56	46.7
Child development	Deviation	39	32.5
	Doubious	62	51.7
	Normal	19	15.8

Table 1 showed an overview in the form of percentage that from 120 of the study subjects the majority of mothers aged 20 to 35 years were 86.7%, unemployed mothers were 73.3%, number of children  $\geq 2$  were 52.5%, age of children around 12 to 24 months were 59.2%, ANC  $\geq 8$  times were 80.8%, gestational age at delivery  $\geq 36$  months were 95.8%, and exclusive breastfeeding were 81.7%.

## 2. Univariate Analysis

Univariate analysis in Table 2 showed a description of the study variables explained based on criteria, frequency and percentage that of the 120 study subjects, the majority of maternal education during pregnancy was  $\geq$  senior high schools (76.7%), family income at pregnancy  $>$  regional minimum wage (69.2%), current maternal education was  $\geq$  high schools (77.5%), current family income  $>$  regional minimum wage (72.5%), not experiencing stress at pregnancy (69.2%), maternal MUAC  $> 23.5$  cm (81.7%), birth weight  $> 2,500$  g (94.2%), good maternal stimulation (53.3%), and the development of children who experience deviations (32.5%).

## 3. Path Analysis

The results of path analysis with STATA 13 were displayed in the path analysis model in Figure 1 and Table 3. The variables of maternal education, family income, Gestational maternal stress, Maternal nutritional status, birth weight, and stimulation using dichotomous data, while child development using continuous data in the form of a score.

Table 3 showed the results of calculations using STATA 13, obtained path coefficient value (b) between birth weight with child development (b= 0.96; 95% CI= -0.15 to 1.94; p= 0.054), stimulation of mothers with child development (b= 0.43; 95% CI= -0.30 to 0.89; p= 0.067), family income at pregnancy with maternal nutri-

tional status (b= 1.02; 95% CI= -0.11 to 2.06; p= 0.052).

Maternal education during pregnancy with maternal nutritional status during pregnancy (b= 0.39; 95% CI= -0.68 to 1.46; p= 0.475), stress at pregnancy with nutritional status during pregnancy (b= -0.43; 95% CI= -1.45 to 0.58; p= 0.405), nutritional status during pregnancy with birth weight (b= 3.59; 95% CI= 1.41 to 5.78; p= 0.001), current maternal education with maternal stimulation (b= 0.65; 95% CI= -0.23 to 1.53; p= 0.150), current family income with maternal stimulation (b= 0.47; 95% CI= -0.38 to 1.31; p= 0.279).

Maternal education during pregnancy with child development through maternal nutritional status during pregnancy and birth weight (b= 0.39; 95% CI= -0.68 to 1.46; p= 0.475); (b= 3.59; 95% CI= 1.41 to 5.78; p= 0.001); (b= 0.96; 95% CI= -0.15 to 1.94; p= 0.054), family income during pregnancy with child development through maternal nutritional status and birth weight (b= 1.02; 95% CI= -0.11 to 2.06; p= 0.052); (b= 3.59; 95% CI= 1.41 to 5.78; p= 0.001); (b= 0.96; 95% CI= -0.15 to 1.94; p= 0.054), maternal stress with child development through maternal nutritional status during pregnancy and birth weight (b= -0.43; 95% CI= -1.45 to 0.58; p= 0.405); (b= 3.59; 95% CI= 1.41 to 5.78; p= 0.001); (b= 0.96; 95% CI= -0.15 to 1.94; p= 0.054), maternal nutritional status with child development through birth weight (b= 3.59; 95% CI= 1.41 to 5.78; p= 0.001); (b= 0.96; 95% CI= -0.15 to 1.94; p= 0.054), maternal education with child development through stimulation (b= 0.65; 95% CI= -0.23 to 1.53; p= 0.150); (b= 0.43; 95% CI= -0.30 to 0.89; p= 0.067), current family income with child development through stimulation (b= 0.47; 95% CI= -0.38 to 1.31; p= 0.279); (b= 0.43; 95% CI= -0.30 to 0.89; p= 0.067).

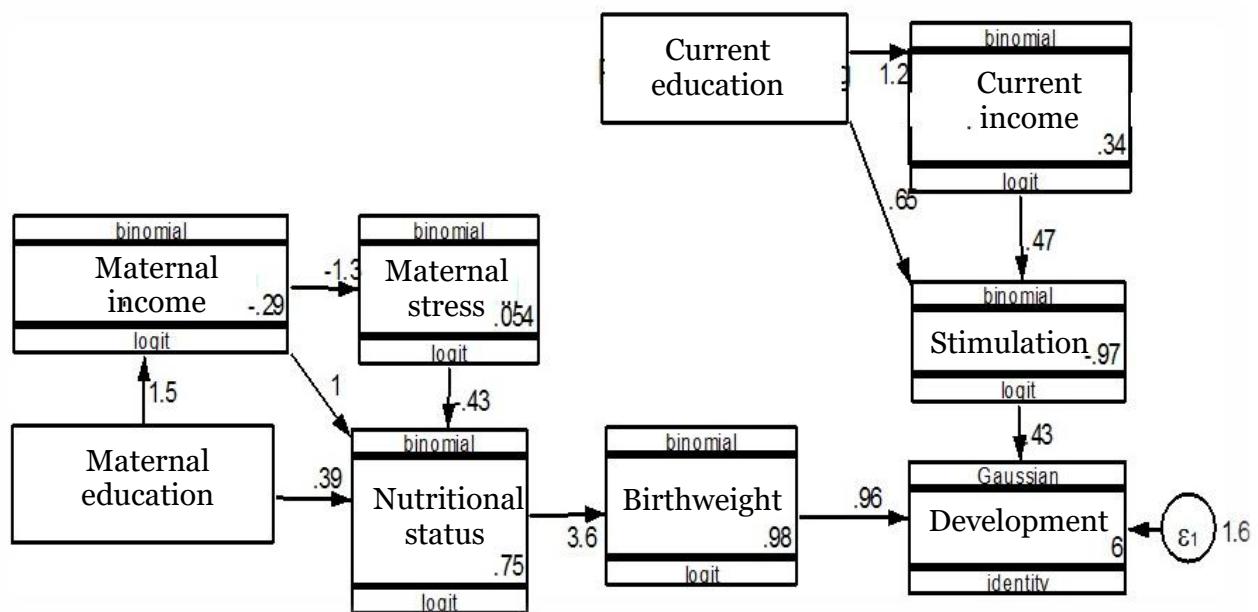


Figure 1. Fit model and estimation of path analysis

Table 3. The result of path analysis on the relationship between bio-psychosocial factors and birthweight, stimulation and development in children aged 1-3 years

Dependent Variable		Independent Variable	Path Coef.	SE	95% CI		p
					Lower Limit	Upper Limit	
<b>Direct Effect</b>							
Development	←	Birthweight ≥ 2,500 g	0.96	0.49	-0.15	1.94	0.054
Development		Good stimulation	0.43	0.23	-0.30	0.89	0.067
<b>Indirect Effect</b>							
Family income	←	Gestational maternal education > Senior High School	1.51	0.46	0.61	2.39	0.001
Family income	←	Current maternal education > Senior High School	1.20	0.36	0.50	1.90	0.001
Stress	←	Family income at pregnancy > Rp. 1,450,000	-1.34	0.42	-2.17	-0.51	0.002
Nutritional status	←	Family income at pregnancy > Rp 1,450,000	1.02	0.53	-0.11	2.06	0.052
Nutritional status	←	Gestational maternal education > Senior High School	0.39	0.55	-0.68	1.46	0.475
Nutritional status		High stress	-0.43	0.52	-1.45	0.58	0.405
Birthweight	←	Maternal MUAC ≥23.5 cm	3.59	1.11	1.41	5.78	0.001
Stimulation	←	Current education ≥ Senior High School	0.65	0.45	-0.31	1.56	0.150
Stimulation		Current family income ≥Rp 1,450,000	0.47	0.43	-0.38	1.31	0.279
N Observation = 120							
Log likelihood = 557.64							

## DISCUSSION

### 1. The relationship of birth weight to child development

There was a direct relationship between birth weight and child development but it was statistically only close to significant. The results of Chapakia's study (2016) supported the results of this study that birth weight affected children's development. A study by Carrasco et al., (2016) also supported the results that babies with short height had an average low language skills and babies with birth weight on average were associated with psycho-motor development.

The study results of the relationship between birth weight and child development were close to significant, presumably because of many things that affected child development included maternal education, family income, stress in pregnancy, maternal stimulation and provision of nutritional intervention in children. It was also supported by a study of Sally et al., (2014) which stated that nutritional interventions and stimulation provides benefits for a child's development.

### 2. The relationship of mother's stimulation to child development

There was a direct relationship between birth weight and development but it was statistically close to significant. Yousafzai et al.'s (2016) study also supported the results of the study that children who received responsive stimulation had significantly higher cognition, language, and motor skills than children who did not receive responsive stimulation.

However, the results of study on maternal stimulation and child development were only close to significant. This was presumably because many things affected children's development. It was also supported by the study of Sally et al., (2014); Carrasco et al., (2016) that giving

nutrition intervention and birth weight to children was related to child development.

### 3. The relationship of maternal education to family income

There was a direct relationship between maternal education and family income and it was statistically significant.

The results of the study were supported by Maryanti and Septikasari (2009) that in education there was a learning process, so that individuals actively developed the potential and skills needed by themselves. These skills could be used by individuals to get decent work, so that socio-economic and educational conditions were related to each other.

Dwiandana and Setiawina's (2013) study also supported the results of study that education and type of work had a positive and partially significant effect on family income.

### 4. The relationship of family income during pregnancy to the maternal stress during pregnancy

There was a direct relationship between family income and maternal stress during pregnancy and it was statistically significant. The results of the study were supported by Pinel (2009) that when the body was exposed to threatening, the result was a set of changes in physiological changes which were generally called stress responses.

The study of Brittain et al., (2015), also supported the results of this study that pregnant women who had a BDI-II score (measuring stress) indicating depression, one of which was influenced by low socio-economic.

### 5. The relationship of family income during pregnancy to maternal nutritional status

There was a direct relationship between family income and maternal nutritional status, but it was only close to statistically

significant. The results of the study were supported by Almatsier et al., (2011), which stated that family income was associated with poverty, lack of hygiene, health problems and meeting the nutritional needs of pregnant women because food intake during pregnancy determined the nutritional status of pregnant women.

The results of this study were also supported by the study of Liu et al., (2015), that family income had a positive relationship with folic acid intake of pregnant women. The study results on the relationship of family income to maternal nutritional status which was close to significant, allegedly due to several factors that influenced maternal nutritional status. Supported by AUSA and JAFAR's (2013) study, there was no significant relationship between family income and the incidence of chronic energy deficiency.

#### **6. The relationship of maternal education at pregnancy to maternal nutritional status**

There was a direct relationship between maternal education and maternal nutritional status but it was not statistically significant. Maternal education influences the attitude of women to their health. The higher their education, the easier they are to receive information so that more knowledge is possessed. Education is needed to get information such as things that support health, so that it can improve the quality of life, especially food that must be consumed to meet nutritional needs during pregnancy (Maryanti and Septikasari, 2009; Maulina (2010).

The results of the study were supported by the study of Liu et al., (2015) that the level of education had a positive relationship with folic acid intake of pregnant women. The results of the study on the relationship of maternal education to maternal nutritional status were not signi-

ficant, allegedly due to other factors affecting the maternal nutritional status. The results of AUSA and JAFAR (2013) study showed that there was no significant relationship between education and the incidence of chronic energy deficiency.

#### **7. The relationship of maternal stress during pregnancy to maternal nutritional status**

There was a direct relationship between maternal stress during pregnancy and maternal nutritional status but it was not statistically significant.

The results of the study were supported by Kalat (2010) that stress occurred for a long time would trigger the secretion of the hormone cortisol which increases blood sugar and increases metabolism. These changes had the reward of reducing the activity of the immune system.

The results of the study on the relationship of maternal stress during pregnancy to maternal nutritional status were not significant, allegedly due to other factors affecting the maternal nutritional status. Handayani and Budianingrum's study (2011) showed that the birth intervals, education and knowledge of mothers are related to the maternal nutritional status at pregnancy.

#### **8. The relationship of maternal nutritional status to birthweight**

There was a direct relationship between maternal nutritional status and birthweight and it was statistically significant. The results of the study were supported by Adriani and Wirjatmadi (2012) that pregnant women with chronic energy deficiency would be at risk of delivering babies with LBW. LBW babies had a risk of death, malnutrition, impaired growth and developmental disorders.

A study by Yongky et al., (2009) also supported the results of this study that the

maternal nutritional status at pregnancy affected birth weight.

#### **9. The relationship of current maternal education to maternal stimulation**

There was a direct relationship between maternal education and maternal stimulation but it was not statistically significant. The results of the study were supported by Marmi and Raharjo (2012) which stated that a high maternal education status would be easier to accept direction to improve child development.

Ariani's (2013) study supported the results of this study that there was a relationship between maternal education and the ability to stimulate gross motor development. The results of the study on the relationship of maternal education to maternal stimulation were not significant, allegedly due to several factors may influence the stimulation performed by the mother. Ariani (2013) stated that maternal stimulation is not only associated with maternal education but also has a relationship with maternal age, work and socio-economic family.

#### **10. The relationship of current family income to maternal stimulation**

There was a direct relationship of family income to maternal stimulation although it was not statistically significant. The results of the study by Romauli and Vindari (2012) showed that low family income makes mothers and children have limitations to play outside their environment, thus affecting the perspective and narrowing the scope of their relationships.

The results of the study were also supported by a study conducted by Ariani (2013), that there was a relationship between socio-economic conditions and the ability to stimulate gross motor development of infants aged 1 to 12 months.

The results of the study on family income relationship to maternal stimulation were insignificant because they were influenced by other factors. As stated by Ariani (2013), maternal stimulation is not only related to family socio-economic but also related to maternal age, work and education.

#### **11. The relationship of maternal education at pregnancy to child development through nutritional status and birth weight**

There was an indirect relationship between education and child development through nutritional status and birth weight.

The results of the study were supported by Marmi and Rahardjo (2012), that the status of parents' education, the families with higher education would be more receptive to direction to improve children's growth and development.

The results of the study were also supported by the study of Demelesh et al., (2015) that low education influenced the pattern of nutrition intake, pregnancy care, and the risk of delivering low birth weight babies. Sally et al.'s (2014) study, Carrasco et al., (2016) also supported the results of this study that children's birth weight was related to child development.

#### **12. The relationship of family income during pregnancy to child development through nutritional status and birth weight**

There was an indirect relationship between family income and child development through nutritional status and birth weight.

Almatsier et al. (2011) stated that low socio-economic conditions affect the process of pregnancy. The effect is seen in the greater likelihood of maternal death during childbirth or infant mortality at birth, or babies born with low birth weight (LBW).



Demelesh et al., (2015), stated that families with low income have a risk of delivering low birth weight babies. Sally et al. (2014), Carrasco et al., (2016) also supported the results of this study.

### **13. The relationship of maternal stress to child development through birth weight**

There was an indirect relationship between stress during pregnancy and child development through maternal nutritional status and birth weight.

The results of this study were supported by a study of Cheng et al.'s (2016); Christine et al., (2012) that the incidence of stress during pregnancy both from physical activity, financial burden, physical violence or social environment could increase the risk of giving birth to low birth weight, which was a risk factor that harmed mothers and children.

Van den Bergh et al., (2004) supported the results of the study with 14 prospective independent studies showing the relationship between maternal anxiety in pregnancy/stress and cognitive, behavioral, and emotional problems in children.

### **14. The relationship of maternal nutritional status to child development through birth weight**

There was an indirect relationship between nutritional status and child development through birth weight. The results of the study were supported by a study conducted by Yongky et al. (2009) that the maternal nutritional status affected birth weight. According to Carrasco et al., (2016) baby's birth weight is related to the child's development in the future.

### **15. The relationship of current maternal education to child development through stimulation**

There was an indirect relationship between maternal education and child development through maternal stimulation.

The results of the study were supported by Santrock (2007) that a high level of education caused a person to have more access to information, so that it could provide different opportunities for children to get stimulation.

Ariani (2013) showed that there is a relationship between maternal education and the ability to stimulate gross motor development in infants aged 1-12 months. Yousafzai et al. (2016) also stated that children who receive responsive stimulation have significantly higher cognition, language, and motor skills than children who do not receive responsive stimulation.

### **16. The relationship of current family income to child development through stimulation**

There was an indirect relationship between family income and child development through maternal stimulation. Romauli and Vindari (2012), Santrock (2007) states that a person whose job status is higher causes him to have more access than others, and a child who gets stimulation will increase his development.

The results of the study were also supported by Ariani (2013) that there was a relationship between socio-economic conditions and the ability to stimulate gross motor development. Yousafzai et al.'s study (2016) showed that children who receive responsive stimulation have significantly higher cognitive development, language, and motor skills than children who did not receive responsive stimulation.

The results of this study can be concluded that child development is influenced by birth weight and stimulation. Birth weight is influenced by maternal education, family income, maternal stress during pregnancy, and maternal nutritional status. Stimulation is influenced by maternal education and family income.

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