Impact Evaluation of Child Labor on Health in Next 7 and 14 Years in Indonesia

F Hamdani[1], E Sulistyaningrum[2]
[1]Statistics Indonesia
[2]Gadjah Mada University

*Corresponding author's email: febrihamdani@bps.go.id

Abstract This study aims to determine the impact of child labor on children's health both in next 7 and 14 years. Using two health indicators, growth in height and lung capacity. Child labor indicator is using child working hours. Three waves of longitudinal data from the Indonesian Family Life Survey (IFLS) are used, IFLS-3, IFLS-4, and IFLS-5. In addition to the child labor variable as the focus of this study, other variables are also used as control. The technique of analysis used is the Instrumental Variable where the head of the household's education as the instrument variable. The robustness check is also performed to ensure the model. The analysis shows that in next 7 years, child labor has less effect on health. Child labor negatively affects height growth but does not affect lung capacity. However, in next 14 years child labor negatively affects health, for both height growth and lung capacity. This is confirmed by the result of the robustness check, where child labor is preponderant in next 14 years than 7 years.

1. Introduction

Child labor is a global problem that occurs not only in Indonesia but also in all countries in the world. Child Labor is often defined as work that deprives children of their childhood, their potential and their dignity, and that is harmful to physical and mental development. It refers to work that: (a) is mentally, physically, socially or morally dangerous and harmful to children; and (b) interferes with their schooling by: depriving them of the opportunity to attend school; obliging them to leave school prematurely; or requiring them to attempt to combine school attendance with excessively long and heavy work according to ILO [1].

Hildayani [2] ideal child development phase, age 6 to 11 years old, is a phase when a child learn about the environment and take charge of responsibilities like adult does. The virtues of this period of age are increased athletic ability, participation in rules-controlled games, able to think logically, mastering the basic skills of reading, writing, and numeracy, also advancement in self-understanding, morality, and friendships.

At the age of 11 to 18 years old is a transition phase to maturity. In this phase, physical development occurs rapidly and puberty leads to sexual maturity. This phase is also called the adolescent phase where it starts by establishing independence from their own and sets their personal values and goals. The main objective in adolescent is defining their identity. Ideal conditions above might not be achieved if the child become a laborer where their time is used to work.

The number of child workers in the Asia Pacific in 2012 is estimated at 77.72 million people with a prevalence of 9.3 percent. However, in 2016 the number dropped to 62.07 million people with a prevalence of 7.4 percent. The number of child laborers in Asia Pacific occupies the second largest after

Africa according to ILO [1]. As for Indonesia, survey on the Child Labor Survey (CLS) held by BPS in 2009 instated that the number of child laborers in 2009 was 1.8 million people or 43.3 percent of working children or 3 percent of the total child population aged 5-17 years.

Child labor can affect health, although there are many other consequences such as education. As children aged younger than 14 years old are forced to work, the minimum consequence is the disruption of their time to go to school or in some cases they may not be able to attend school. This condition is aggravated by the fact that the health of child laborer is worse compared to regular children who are not working according Todaro and Smith [3]. Age 5 to 17 years old is referred to be the periods of human growth and development, both physically and mentally. A working child's physic is more vulnerable than the adults because they are still in a growing phase. Working as a child labor can affect the child's physical health development because the work's done can cause accidents or illness.

Research on the health impact of child labor has been carried out in previous studies. However, not all research results support what Todaro said. Research conducted by Kana, Phoumin, and Seichi [4] on Whether Child Labor has a Negative Effect on Health and Education. Furthermore research by Sundjo et al.[5] on Health Consequences for Child Labor in Cameroon found no correlation between child labor and health. Other research conducted by O'Donnell, Rosati, and Doorslaer[6] on child labor's health, proven from rural area in Vietnam found that child labor has impact on health, nevertheless for women child laborers the risk of disease increases for the next five years. Ahmed and Ray[7] about the health consequences of child labor in Bangladesh. Farther research by Nicolella and Kassouf[8]on the Effects and Child Labor on Children's Health in Brazil. In addition there is also Hurst[9] on Health and Child Labor in the Agricultural Sector. The research mentioned above supports the theory conveyed by Todaro and Smith about the negative effects of child labor on children's health.

This difference in result is not only on affecting or not but also in the period of time. In short-term, which is around five to six years, there are differences in outcomes between child labor and health. In a short-term research by O'Donnell, Rosati and Doorslaer[6]; Beegle, Dehejia and Gatti[10] discovered that there is correlation between child labor and health. Nevertheless, Nicolella and Kassouf [8] discovered the correlation between child labor and health in long-term.

The difference between the results of the research above is interesting to be discussed how the results might be in Indonesia. This study using the Indonesia Family Life Survey (IFLS) data. This study aims to determine the impact of child labor on children's health both in 7 and 14 years later. The instrumental variable method is used in the research. Instrumental variable method is used because there is a reverse causality between child labor's working hours and health.

This research is expected to provide benefit to various parties. Providing the information on the characteristics of child labor, the average number of working hours of child labor and others, so that it can helps policy makers to solve child labor problems. Providing empirical evidence to policy makers about the impact of child labor on child workers and how much impact child labor has in the next 14 years on health of the children.

2. Method

This evaluation study of the impact of child labor in next 7 and 14 years on health uses micro data, the Indonesia Life Family Survey (IFLS). Three waves of data from the Indonesian Family Life Survey (IFLS) are used, IFLS-3, IFLS-4, and IFLS-5. IFLS-3 was held in 2000, IFLS-4 was held in 2007, and IFLS-5 was held in 2014. The IFLS-3 used as the base of the research on whether in 2000 the children chosen as the survey sample were child laborers or not (seen from the working hours). About seven years later known how the impact of health on them using the IFLS-4 data. In addition, for next 14 years on health, using the IFLS-5 data. Using two health indicators as explained in chapter II. In addition, robustness checks are also performed to ensure the models are made correctly.

The population in this study is all individuals of all ages that are in the IFLS data. The sample of this study is the children, as children that has been defined in chapter II is someone aged between 5 to 17 years old. Data selection done by considering various aspects, it was found that the sample in this study (number of children) in 2000 was 10,024 people. This study uses the same individuals in the three waves of IFLS. As a result of the design, there will be a reduction in the number of individuals observed. This might happen due to the possibility that the individual has form his own household or moved out of

town, as for that individual cannot be interviewed on the next IFLS. In addition, the use of other control variables also reduced the amount of the sample when the regression is performed.

IFLS is a longitudinal survey. Therefore, the same household will be interviewed in subsequent surveys. This survey uses a three-stage sampling in which the first stage is taking samples in the provincial level. The second stage is taking the enumeration area (census block) randomly and in each enumeration area a household sample is taken. In the first phase 13 provinces are selected which included 83 percent of the population by considering effectiveness on cost and socio-cultural diversity. The variables used in this study are summarized in the table 1

Table 1. The operational definitions of the variables used

No	Variable	Category	Explanation
(1)	(2)	(3)	(4)
Outcomes Variable (Health)			
1.	Height Growth (2000 – 2007/2014)		Formula for calculating height growth: $\frac{TB_{2007/2014} - TB_{2000}}{TB_{2000}} \times 100\%$ (percentage)
2.	Lung Capacity		Average individual lung capacity in 2007 and 2014 in cubic centimeters (cc)
3.	self health assessment (health status)	0 = poor 1 = fair 2 = good 3 = excellent	Used on the robustness check
Variable of Interest			
4.	Children's working hours last week (Working hour)		The definition of child labor according to SPA BPS 2009
Instrument Variable			
5.	Duration on education of the head of the household (The head of the household's education)		Used as Instrument variable on the first stage of regression (in years)

Note: the control variables are males, existing of smoking member of the households, city, per capita expenditure, number of households members, housing scores, father height and mother height

Two kind of data analysis technique methods are used in this study, instrumental variable and ordered probit.

2.1. Instrumental Variable

The instrumental variable method is used because there is a reverse causality between child labor's working hours and health. Children's working hours can affect health and vice versa. In addition, endogeneity problem might happen when there are other variables outside the model affecting the independent variable—child labor. If there is no such problem, then the OLS, Ordinary Least Square, regression estimation method will be more appropriate to use according to Wooldrigde[11]. The stages in analyzing using instrumental variable are :

2.1.1. First stage regression

First stage regression is done by doing a regression between other variables (z) with the variables of interest. The z variable in this study is the education of the head of the household and the operational variable is the duration of education in formal schools. In other words, the education of the head of the household variable only affects the child's health variable through child labor. Therefore, first stage regression must be done between the child labor variable and the education of the head of the household variable as in the following model:

$$\widehat{Child\ Labor}_i = \alpha_0 + \alpha_1\ Household\ head\ education_{\ i} + \gamma_j S_{ji} + \varepsilon_i \tag{1}$$

In order to proceed to the second stage, the duration of education of the head of the household regression must significantly affect child labor.

2.1.2. Second stage regression

If the results of the first stage regression is significant, then it can proceed to the second stage regression where the regression model is as follows:

$$Health_{ij} = \beta_0 + \beta_j\ \widehat{Child\ Labor}_i + \gamma_j S_{ji} + \mu_i \tag{2}$$

2.1.3. Endogeneity test

Endogeneity test is done to see whether the independent variable (x) has a relationship with other variables outside the model (u). The endogeneity test used is the Wu-Haussman test. If there is a relationship between other variables outside the model, then the use of instrumental methods is appropriate. The endogeneity test is as follows:
1. H_0 = exogenous variable
   H_1 = endogenous variable
2. α = 5%
3. Reject H_0 `if p−value ≤ α`

The expected result is rejecting H_0 so that the use of instrumental variable is appropriate. If the test results do not reject H_0 then it is more appropriate to use OLS as a method for estimating β_1 (Wooldrigde 2016, 514)

2.1.4. Relevance test

Relevance test is important because the use of instrumental variable (z) must be strongly correlated with independent variable (x). The relevance test follows the F distribution. As we said before, weak instrument variable increasing bias. The relevance test is as follows:
1. H_0 = Weak instrument variable
   H_1 = Strong instrument variable
2. α = 5%
3. Reject H_0 `if p−value ≤ α`

In the relevance test expected result is to reject H_0, meaning that the instrument variable used is strong. This means that the z variable can explain the variation of x variable.

2.2. Ordered probit

Probit regression model is used when the dependent variable of the model is categorical, because the response of the response variable is categorical. Therefore, a cumulative distribution function (CFD) must be used.

$$F(S_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{S_i} e^{\frac{-z^2}{2}}\, dz \tag{3}$$

$$F(S_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\beta_1 + \beta_2 X_i} e^{\frac{-z^2}{2}}\, dz \tag{4}$$

Probit used in this research uses more than two categories. There are four categories: poor, fair, good and excellent. Regression with ordered probit only interprets the direction and significance does not interpret the values of β_1 according to Cameron and Trivedi[12]. This regression is used for robustness check as a control of the model used on the main variable. The Probit Model used is as follows:

$$Health_i = \theta_0 + \theta_1\ Child\ Labor_i + \gamma_j S_{ji} + \mu_i \tag{5}$$

3. Results And Evaluation

3.1. The impact of child labor in next 7 and 14 years later

3.1.1. First Stage of Regression

Table 2 explains the output of data processing for the first step regression between the head of the household's education and working hours of child labor.

Table 2. First stage regression tables of children's working hours for height growth in next 7 and 14 years.

Dependent Variable=working hour	Parameter Estimation	
	7 years	**14 years**
the head of the household's education	-0.2029612*** (0.0355288)	-0. 3009813*** (0.0554112)
Control variable added	Yes	Yes
N	3927	2532

Control variables are males, existing of smoking member of the households, city, per capita expenditure, number of households members, housing scores, father height and mother height
Significance levels are, respectively, 0.5% (***), 1% (**) and 5% (*).
Sources: IFLS-3, IFLS-4 and IFLS-5

The parameter estimation result shows that the head of the household's education variable significantly affects children's working hours as well as its direction, where the longer the head of the household's education in formal education will reduce the working hours of child labor by 0.20 hours. This is in line with previous research on working hours of child labor by Dimeji and Carter [13]. Results that did not differ from the first stage regression for lung capacity indicator, in which the duration on education of the head of the household significantly affect the children's working hours. These results indicate that the regression can be proceed to the second stage.

As well as the next 7 years regression, the first stage regression in next 14 years shows no different from next 7 years. The regression result shows that the duration on education of the head of the household in formal schools significantly affect children's working hours in a negative direction. The negative direction means that the higher the duration on education of the head of the household in formal schools, the lower children's working hours. Meanwhile, the coefficient shows that on average the increase of one-year duration on education of the head of the household in formal education will reduce children's working hours by 0.30 hours (ceteris paribus).

3.1.2. Second Stage of Regression

Second stage regression can only be done if the first stage regression is significant. This second stage regression provides answers whether there is a relationship / impact between child labor and health indicators and how much if there is a relationship / impact. The results of regression with instrumental variables will be compared with OLS regression to get a comparison.

Table 3 explains the output of data processing for the second step regression between working hours of child labor and height growth and Lung Capacity in the 7 years later.

Table 3. Second stage regression table for indicators of height growth and lung capacity in the 7 years later.

Variable	Instrumental Variable=household head education		OLS	
	Height Growth	Lung Capacity	Height Growth	Lung Capacity
(1)	(2)	(3)	(4)	(5)
working hour	-1.072***	0.365	-0.433***	1.072
	(0.307)	(1.892)	(0.0252)	(0.652)
Control variable added	Yes	Yes	Yes	Yes
N	3927	3646	3927	3646
R-sq	.	0.306	0.109	0.309

Control variables are males, existing of smoking member of the households, city, per capita expenditure, number of households members, housing scores, father height and mother height
Significance levels are, respectively, 0.5% (***), 1% (**) and 5% (*).
Sources: IFLS-3, IFLS-4 and IFLS-5

The result of the second stage shows the impact of children's working hours on two health indicators with the t-test at the 5% level indicate that children's working hours in the past significantly affects the children's height growth. One hour increase of the children's working time in a week on average will reduce the children's height growth by 1.072 percent (ceteris paribus). Nonetheless, the result shows children's working hours does not significantly affect lung capacity in next 7 years.

Table 4 explains the output of data processing for the second step regression between working hours of child labor and height growth and Lung Capacity in the 14 years later.

Table 4. Second stage regression table for indicators of height growth and lung capacity in next 14 years

Variable	Instrumental Variable= household head education		OLS	
	Height Growth	Lung Capacity	Height Growth	Lung Capacity
(1)	(2)	(3)	(4)	(5)
working hour	-1.651***	-3.795*	-0.433***	0.200
	(0.378)	(1.533)	(0.0318)	(0.133)
Control variable added	Yes	Yes	Yes	Yes
N	2532	2590	2532	2590
R-sq		0.379	0.135	0.539

Control variables are males, existing of smoking member of the households, city, per capita expenditure, number of households members, housing scores, father height and mother height
Significance levels are, respectively, 0.5% (***), 1% (**) and 5% (*).
Sources: IFLS-3, IFLS-4 and IFLS-5

The result of the second stage shows the impact of children's working hours on health indicator with the t-test at the 5% level indicate that children's working hours in the past significantly affects the children's height growth. One hour increase of the children's working time in a week on average will reduce the children's height growth by 1,651 percent (ceteris paribus).

Result shown by the t-test at the 5% level indicates that in next 14 years children's working hours in the past significantly affects lung capacity. One hour increase of the children's working time in a week on average will reduce the children's lung capacity by 3,795 cc (ceteris paribus). In Chapter II explained that the normal inspiratory and expiratory capacity is 350cc, meaning that reduction in lung capacity in next 14 years is 1.08 percent if there is an increase in children's working hours.

3.1.3. Endogeneity test

Endogeneity test used is the Wu-Hausman test. Endogeneity test is performed for all health indicators which use instrumental variable method. The decision to accept or reject the null hypothesis is made based on the p-value result given by the test. The null hypothesis in this test is the child working hour variable which is an exogenous variable. The null hypothesis is rejected if the p-value is less than 0.05. Test result for both indicators in next 7 and 14 years can be seen in Appendix 1. In next 7 years the endogeneity test result shows that the null hypothesis for height growth is rejected but the null hypothesis for lung capacity is not rejected. This means that there is an endogeneity problem on child labor's height growth, while for child labor's lung capacity there is no endogeneity problem. Therefore, it is more appropriate to use regression with OLS rather than instrumental variable. However, the regression with OLS shows that children's working hours had no significant effect on lung capacity (see Table 3).

In next 14 years, the endogeneity test result is rejecting the null hypothesis for both health indicators (Appendix 1). Meaning, there is an endogeneity problem for both child labor's health indicators. Therefore, it is more appropriate to use regression with instrumental variable.

3.1.4. Relevance Test

The null hypothesis in this test is the instrument variable which is weak. To gain unbiased estimation result, in this test the researcher wants the decision obtained is to reject the null hypothesis. The null hypothesis is rejected if the p-value is less than 0.05. The result indicates that the instrument variables used are strong (see Appendix 2). This is because the p-value is less than 0.05, so the decision taken is to reject the null hypothesis for all health indicators both in next 7 and 14 years. The conclusion is the education of the head of the household is strongly correlated with working hours of child labor, so that the education of the head of the household is suitable to use as an instrument variable.

3.2. Robustness Check

Robustness check is used to test the validity of the model that has been obtained. This test is to convince researchers that the conclusions drawn are correct. This Robustness check uses the ordered probit regression used because this regression independent variable is categorical data about tiered independent health assessment. Table 5 explains the output of data processing ordered probit regression between working hours of child labor and health status in 7 and 14 years later.

Table 5. Ordered probit regression working hours of children to health status for the 7 and 14 years later

Variabel	Health status	
	7 years	**14 years**
(1)	**(2)**	**(3)**
Working Hours	-0.00183	-0.00304*
	(.00126)	(0.00144)
Control variable added	Yes	Yes
N	7781	4249
R-sq	.	.

Control variables are male, urban, existing of smoking member of the households, house score, number of the household members, per capita expenditure
Significance levels are, respectively, 0.5% (***), 1% (**) and 5% (*).
Sources: IFLS-3, IFLS-4 and IFLS-5

It can be concluded that in next 7 years there is no correlation between children's working hours and health status. The minus sign on the coefficient indicates the greater working hours of child labor, the probability of becoming healthier is going to zero. Meaning, the children is getting unhealthy. In contrast to next 7 years, in next 14 years there is significant correlation between child labor and health status. The minus sign on the coefficient indicates the greater working hours of child labor, the chance of becoming healthier is going to zero.

4. Conclusions

Based on the discussion, it can be concluded as follows:

1. In next 7 years, children's working hours negatively significant affect children's growth, but do not significantly affect lung capacity.
2. In next 14 years, children's working hours negatively significant affect children's health. This is shown by the higher children's working hours, both child's growth and lung capacity decreases.

From both two points above child labor is hazardous for children's future. This is because the impact of child labor on health cannot be seen in the next 7 years, but will only be seen in next 14 years. This may not be realized by children or parents of the children, as they thought there is no effect on health caused by their current activities. Thus, there are effects of child labor on health the government should prohibit child labor activities and children exploitation in any kind of form. This study found that the factor of household head's education significantly affect the working hours of children so to reduce the work hours of child laborers can be done by educating the head of the household about the dangers affect by child labor through counseling and conference to their parent or household heads.

5. Appendices

1. Result of Endogeneity Test (Wu-Hausmann)

H_0 = exogenous variable

H_1 = endogenous variable

Dependent Variable	7 years		14 years	
	Height Growth	Lung Capacity	Height Growth	Lung Capacity
F table	3,843834	3,844018	3,845150	3,845067
F calculate	4,81448	0,138765	15,592	8,89706
Decision	Reject H_0	Not Reject H_0	Reject H_0	Reject H_0
Conclusion	endogeneity occurs	no endogeneity	endogeneity occurs	endogeneity occurs

2. Result of Relevance Test

H_0 : Weak instrument variable

H_1 : Strong instrument variable

Dependent Variable	7 years		14 years	
	Height Growth	Lung Capacity	Height Growth	Lung Capacity
F tabel	3,843834	3,844018	3,845150	3,845067
F calculate	32.6336	30.5495	29.5042	30.5841
Decision	Reject H_0	Reject H_0	Reject H_0	Reject H_0
Conclusion	strong instrument variable	strong instrument variable	strong instrument variable	strong instrument variable

3. Robustness Check

Variable	Health Assessment	
	7 years	**14 years**
(1)	**(2)**	**(3)**
working hour	-0.00183	-0.00304*
	(.00126)	(0.00144)
male	0.130***	0.167***
	(0.0279)	(0.0359)
urban	-0.0825*	0.00440
	(0.0287)	(0.0363)
house score	0.00863	0.0213
	(0.00936	(0.0143)
number of the household members	-0.0140*	-0.00228
	(0.00461)	(0.00545)
existing of smoking member of the households	-0.115***	-0.0669
	(0.0306)	(0.0410)
per capita expenditure	-0.000647	-0.00114
	(0.000548)	(0.00097)
_cons1	-3.140***	-2.409***
	(0.124)	(0.129)
_cons2	-1.414***	-1.039***
	(0.0812)	(0.116)
_cons3	0.0953***	0.829***
	(0.0803)	(0.116)
N	7781	4249
R-sq	.	.

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