

Relationship of Pesticides Exposure with Intelligence Quotient of Elementary School Students at Bandungan Agriculture Area, Semarang Regency

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Abstract: *Pesticides can affect all people's lives and living things. Those may apply on both aquatic biota and environmental ecosystems throughout the world through the food chain, even farmers and families who are using pesticides or are living close to people who use pesticides. The derivation of cognitive performance and behavior in children, as a risk population live in agriculture and expose to pesticides, is one of the effects of pesticide poisoning. This research aims to determine the correlation of pesticide exposure history with IQ (Intelligence Quotient) students from Bandungan 02 Elementary School around the horticulture farming area and Flower Plantations in Bandungan District, Semarang Regency. The research used cross sectional design with 36 subjects total sampling. Data collection uses questionnaires and field observations. The results showed that 44.4% had a low IQ and 55.6% had a normal IQ. Variables that have relation include child involvement in agricultural activities ($p=0,022$; $CI95\%=1,202-6,293$; $RP=2,75$), children's play habits in the agricultural area ($p=0,048$; $CI95\%=1,072-5,640$; $RP=2,459$), the presence of pesticides in the house ($p=0,048$; $CI95\%=1,072-5,640$; $RP=2,459$), and length of exposure ($p=0,040$; $CI95\%=1,066-6,757$; $RP=2,648$). The conclusion of this research, there is a correlation between children's involvement in agricultural activities, children's play habits in the agricultural area, the presence of pesticides in the house, and length of exposure with IQ status of Bandungan State Elementary School 02 students in the area of horticulture and flower plantations in Bandungan District, Semarang Regency.*

Keyword: *Pesticide exposure, IQ, elementary school students*

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I. Introduction

Pesticides are chemical substances that function to reduce the population of Organisme Pengganggu Tanaman (OPT). The use of pesticides is identical to agriculture, where vegetables are generally susceptible to Organisme Pengganggu Tanaman (OPT), therefore, the use of chemical pesticides cannot be separated from the farmers.^{1,2,3} Pesticides provide not only positive benefits to agriculture, but also have a negative impact. Acute exposure to high doses of pesticides can be poisoning.^{4,5}

Except farmers who are directly involved with pesticides, one of the population groups vulnerable to exposure to pesticides is children who live in agricultural areas. Children living in agricultural areas have a higher risk of being exposed to pesticides. This is related to their involvement in agricultural activities. These activities include helping parents who work as farmers and help them during the harvest season.^{6,7} Pesticide poisoning is very dangerous especially for children who are in the initial critical stages of brain and nervous system development. Due to they have a body that are still in their development, children have less natural defenses and can develop into a more serious effect if exposed to excessive pesticides.⁸

The performance of children exposed to organophosphate pesticides is worse in cognitive and behavioral measurements than children who are not exposed. In addition, high levels of organophosphate pesticides are associated with poor performance in measuring cognitive function. There is a significant correlation between the concentration of pesticide metabolites and children's cognitive performance. Early chronic exposure of children living in agricultural areas causes inhibition of cholinesterase. This is almost subtle effect that has a significant effect on learning ability in exposed children, especially their motor performance. Preliminary evidence that children exposed to organophosphates in their early lives experience interference with spatial memory, cognitive learning capacity and motor performance after chronic exposure.^{9,10}

Based on the results of preliminary studies that have been carried out by Bandungan 02 Elementary School located in the horticulture farming area and flower plantations in Bandungan District, Semarang Regency. Based this situation, the results obtained from the average school exam scores that Bandungan 02 Elementary School has a less grade when compared to other elementary schools in Bandungan District.

This results are in line with the majority of the population in Bandungan District who earn a living as horticultural farmers and use more than two types of pesticides at one time, where the type and amount of pesticides mixed are not in accordance with the standard rules for the use of specified pesticides. This situation supports research to find out the history of pesticide exposure with IQ in the area of horticulture and flower plantations for students in Bandungan 02 Elementary School Bandungan District, Semarang Regency.

II. Material And Methods

This study was an observational study with a cross-sectional study. The population in this study were all 5th graders of Bandungan 02 Elementary School, Bandungan District, Semarang Regency, total of 36 people. The number of samples were determined by the total sampling technique of 36 respondents with the criteria: students of Bandungan Elementary School 02; recorded as 5th graders of the 2018/2019 academic year; residing in Bandungan Village, Bandungan District, Semarang Regency; willing to be the subject during the research took place by signing a written agreement. The research instrument used a questionnaire that was included research questions that lead to research variables. Measuring IQ levels was carried out by the Psychology Team from the UNIKA Center for Applied Psychology Semarang. The variable in this study was the involvement of children in agricultural activities, children's play habits in the agricultural area, the existence of crops around the house, the presence of pesticides in the house, personal hygiene, nutritional status, duration of exposure and exposure period with the dependent variable IQ status. Analysis of statistical data used Chi Square Test with SPSS 20 software.

III. Result

Based on the IQ test results were obtained as many as 16 respondents (44.4%) had a low IQ level while 20 respondents (55.6%) had normal IQ levels. In Table 1 shows that the number of students by sex in grade 5 of SDN Bandungan 02 has the same proportion between men and women. Most of the respondents' parents were farmers with a percentage of 78% with the most recent education status, namely elementary school graduation (72%). Of all the variables studied, 55.6% of children had involvement in agricultural activities, children's playing habits around agricultural land still tended to be 52.8% said to be good, found 75% of respondents who store crops around the house, and as many as 52.8% of respondents did not put pesticides in their homes. For personal hygiene, most of the respondents had good personal hygiene (63.9%), as well as nutritional status where 83.3% of respondents had good nutritional status. The duration of exposure of children with pesticides when playing for more than 4 hours around the farmland was 52.8%, seen from its exposure period 55.6% of children began to be exposed at the time after birth and in the growth period.

Picture 1. Map of Research Location

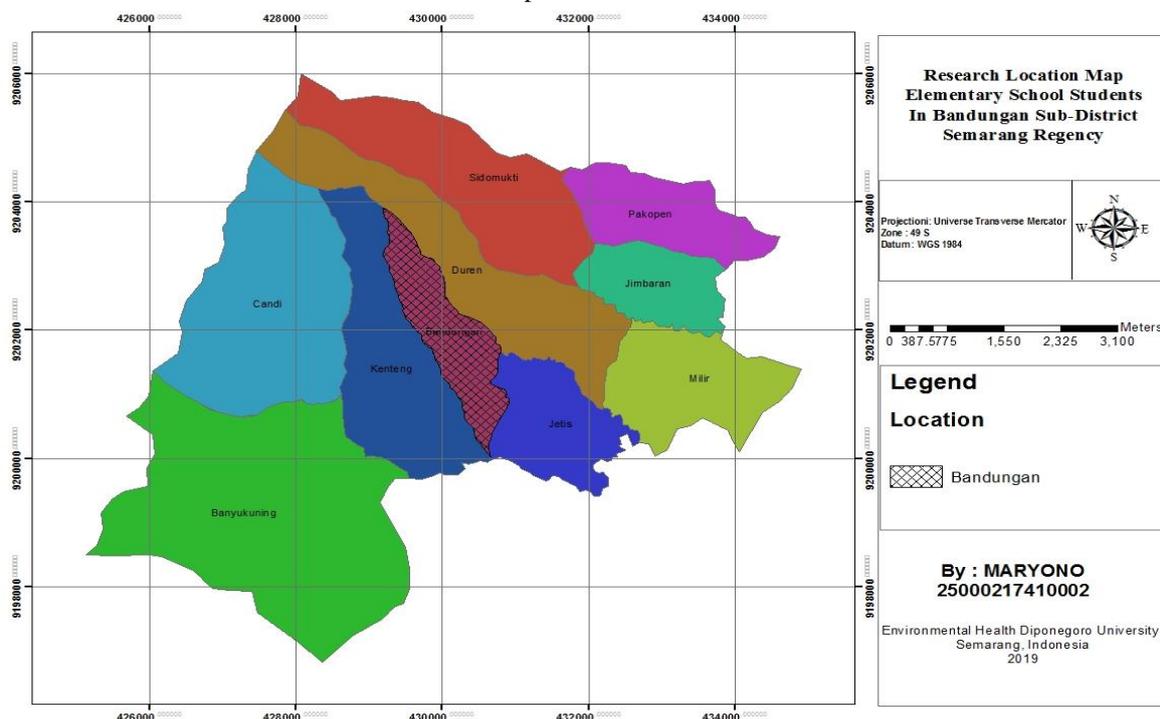


Table 1. Distribution of Frequency Research Variables

Variables	Total (N)	Percentage (%)
<i>Gender</i>	Male	18
	Female	18
<i>Parent's Occupation</i>	Corporate employees	5
	Entrepreneur	2
	Farmer	28
	Laborer	1
parent education degree	Not completed in primary school	5
	Elementary school graduate	26
	Junior High School graduate	4
	High school graduate	1
Children Involvement in Agricultural Activities	Yes	16
	No	20
Children's Play Habits in Agricultural Area	Bad	17
	Good	19
Existence of Harvest's Crop Around the House	Yes	27
	No	9
Presence of Pesticide In the House	Yes	17
	No	19
Personal hygiene	Bad	13
	Good	23
<i>Nutritional Status</i>	Bad	6
	Good	30
<i>Length of Exposure</i>	≥ 4 hours	19
	< 4 hours	17
<i>Exposure Period</i>	Since in the womb	16
	After birth	20
<i>IQ status</i>	Low	16
	Normal	20

Based on table 2, the summary tabulation of bivariate analysis of each variable were tested by chi-square test to find out whether it has a relationship with the IQ level of grade 5 students at SDN Bandungan 02. Among all of the variables studied, there are only 4 variables that are significantly related because they have a p-value <0.05, namely the involvement of children in agricultural activities (p=0,022; CI95%=1,202-6,293; RP=2,75), children's play habits (p=0,048; CI95%=1,072-5,640; RP=2,459), the presence of pesticides in the house (p=0,048; CI95%=1,072-5,640; RP=2,459), and length of exposure (p=0,040; CI95%=1,066-6,757; RP=2,648).

Table 2 Summary of Bivariate Analysis Tabulations

Variables	p-value	CI95%	RP
Involvement of children in agricultural activities	0,022	1,202-6,293	2,75
Children's play habits	0,048	1,072-5,640	2,459
Crops near house	*0,245	0,652-8,352	2,333
Pesticide in the house	0,048	1,072-5,640	2,459
Personal hygiene	0,057	1,111-4,656	2,275
Nutritional Status	*0,672	0,216-2,359	0,714
Length of Exposure	0,040	1,066-6,757	2,684
Exposure period	0,107	0,965-4,498	2,083

IV. Discussion

In this study the respondents were 5th grade students at SDN Bandungan 02 Bandungan Subdistrict who had measured IQ, of which 44.4% of them were stated to have a low IQ. Based on table 2 shows that a low IQ level in grade 5 students at Bandungan 02 Elementary School in Bandungan Subdistrict is related to children's involvement in agricultural activities (p=0,022; CI95%=1,202-6,293; RP=2,75). The risk value obtained is equal to 2,75 (RP>1), so that children's involvement in agricultural activities is a risk factor for students' low IQ. The value of Rp. 2.75 means students who have a history of involvement in agricultural activities have a risk chance of having a low IQ of 2.75 times greater than students who do not have a history of involvement in agricultural activities. These results are in line with research conducted by Puspitasari (2014) which shows a relationship between children's involvement in agricultural activities and the occurrence of goiter in elementary school student. Pesticide exposure to goiter is very influential because the presence of pesticides in the body can interfere with thyroid function, where hypothyroidism that occurs in children can cause growth disorders such as body size that does not match age (midget) and low Intelligence Quotient (IQ) even to retardation mentally. From the interview results, it was found that 44.4% of students had a history of involvement in agricultural activities, which included activities to help parents for harvesting crops, cleaning

agricultural equipment after agricultural activities were completed, and even just playing around in the agricultural area. Most of the activities have been carried out since before entering school age when children are able to walk and are invited to the agricultural area, due to that age if parents have to go to the garden there will be no one to look after the child if left at home. Therefore, most children are exposed to pesticides in the agricultural area almost every day approximately until 12 noon. With the high possibility of the intensity of pesticide exposure in children who are vulnerable to involve in agricultural activities, it increases the likelihood of a derivation of IQ in children.

Based on table 2 shows that there is a significant correlation between children's playing habits in the agricultural area with the child's IQ low ($p = 0.048$; $CI95\% = 1.072-5.640$; $RP = 2,459$). The risk value obtained is 2,459 ($RP > 1$), so that children's playing habits in the agricultural area are a risk factor for the low IQ. The value of Rp. 2,459 means that students who have a history of playing habits in the agricultural area have the risk of having a low IQ of 2,459 times greater than students who do not have a history of playing in the agricultural area. From the interview results obtained 47.2% of students have a history of playing in the agricultural area. This is because the address of the respondent's home is mostly close to the agricultural area and even the Bandungan 02 Public Elementary School is also located in the agricultural area.

Based on table 2 shows that there is a significant correlation between the presence of pesticides in the house with a low IQ ($p=0,048$; $CI95\%=1,072-5,640$; $RP=2,459$). The risk value obtained is 2,459 ($RP > 1$), so that the presence of pesticides in the house is a risk factor for a child's low IQ. The value of Rp. 2,459 means that respondents with pesticides stored in the house have a risk of having a low IQ of 2.459 times greater than respondents who do not store pesticides in their homes. Based on the interviews, 47.2% of respondents kept pesticides in their homes and are not in special places or cabinets, but living rooms and even kitchen rooms. Pesticides that are brought home can cause family members or especially children exposed to pesticides through breathing if the closure and storage process is not right.

Based on table 2 shows that there is a significant correlation between the length of exposure to the child's low IQ ($p = 0.040$; $CI95\% = 1.066-6.757$; $RP = 2.684$). The risk value obtained is 2.684 ($RP > 1$), so the length of exposure is a risk factor for a child's low IQ. The value of Rp. 2.684 means that respondents with a length of exposure > 4 hours have a risk chance of having a low IQ of 2.684 times greater than respondents whose exposure duration is < 4 hours a day. This result is in line with the research conducted by Winnoto (2016), where there was a significant relation between the length of exposure to the child's developmental disorders. From the interviews, 52.8% of respondents were exposed to pesticides for a long time with an average of > 4 hours per day. Exposure to pesticides obtained from various sources such as playing area in agricultural areas, schools in agricultural areas, and involvement of children in agricultural activities during school holidays and helping parents in the agricultural area. Activities that are always happened in the agricultural area every day for a long time will allow the children to breathe in pesticide residues that are present or absorbed by the skin. The longer and carried out continuously, the higher the risk of pesticide poisoning and the risk of lowering the child's IQ. A person who works using pesticides may not work more than 4 to 5 hours in a day of work, if exposed to pesticides from day to day continuously and repeatedly for a long time.

V. Conclusion

There is a relation between children's involvement in agricultural activities ($p=0,022$; $CI95\%=1,202-6,293$; $RP=2,75$), children's play habits ($p=0,048$; $CI95\%=1,072-5,640$; $RP=2,459$), the presence of pesticides in the house ($p=0,048$; $CI95\%=1,072-5,640$; $RP=2,459$), and length of exposure ($p=0,040$; $CI95\%=1,066-6,757$; $RP=2,684$) with the low IQ of 5th grade students at Bandungan 02 Elementary School in Bandungan District, Semarang Regency. In this research the respondents were 5th grade students at SDN Bandungan 02 Bandungan Subdistrict who had measured IQ, of which 44.4% of them were stated to have a low IQ.

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