



UNIVERSITI PUTRA MALAYSIA

***BLOOD CHOLINESTERASE LEVEL AND COGNITIVE FUNCTIONING
AMONG PRIMARY SCHOOL CHILDREN NEAR PADDY FIELD IN
TANJUNG KARANG, SELANGOR***

NOOR AISHAH HAMZAH

**Ip
FPSK4 2014 16**

ACKNOWLEDGEMENT

All praise is to Allah SWT for all His blessing of this project can be completed in time. I would like to express my deepest gratitude to my supervisor, Prof. Dr. Zailina Hashim for all her guidance, advice and support throughout this project. My sincere thanks also go to Dr. Saliza Mohd Elias as Final Year Project Coordinator for Bachelor Science (Environmental and Occupational Health) programme.

Thank you and appreciation are also extended to Ministry of Education and Headmasters of Sekolah Kebangsaan Dato Manan and Sekolah Kebangsaan Berjaya for their permission in carrying out the project in their schools. I would also thank to parents and children who involved in this study.

Very special appreciation to my parent and family for their support in term of moral and financial as well as their blessings during my project progressed. To my group member, Khairul Nadiah bt Zainol Abidin for the help and advice.

Finally, my appreciation to all my lecturers in Department of Environmental and Occupational Health and course mates who were involved directly and indirectly throughout my project. Thank you to all.

ABSTRACT

BLOOD CHOLINESTERASE LEVEL AND COGNITIVE FUNCTIONING AMONG PRIMARY SCHOOL CHILDREN NEAR PADDY FIELD IN TANJUNG KARANG, SELANGOR.

NOOR AISHAH BINTI HAMZAH

Introduction: Based on Paddy Statistics of Malaysia 2011, paddy is the third most widely planted crop in Malaysia after oil palm and rubber. In the year 2011, 687,940 hectares were planted with paddy including those that are planted twice a year. The uses of pesticides lead to increase in yields and reduce product prices by partly protecting the plantation from any pest and unwanted plants. The extensive use of insecticide, may affect the human health especially from occupational and environmental exposures. Children are a vulnerable group to exposures of insecticides because of less-developed metabolism and the on-going maturation of their organ systems. Blood cholinesterase activity is the most effective biomarkers to measure the level of exposure for various pesticides. **Objectives:** The purpose of this study is to determine the relationship between blood cholinesterase levels with cognitive functioning of selected primary school children. **Methodology:** 112 primary school children were selected as an exposed group to the pesticides. The inclusive criteria were the children who study and lived near the paddy field. Their parents completed the questionnaire and 0.01mL blood sample of the study respondents were collected from finger prick technique. The blood then was analyzed using Lovibond 412670 AF267 test kit to determine level of blood cholinesterase level. McCarthy Scale of Children's Ability (MSCA) was used to measure the cognitive functioning. **Result:** Highest percentage of respondents had normal (52.7%) exposure. About 92.9% reported with watery eyes of signs and symptoms from pesticide exposure. Most of the respondents were in average level (44.6%) of learning abilities. **Conclusion:** There was a significant relationship between blood cholinesterase levels with cognitive functioning in all scales of study group. No school children reported with borderline and mentally retarded cognitive functioning. Finally, gender, mother's education and blood cholinesterase showed significant influenced in memory and motor scales in MSCA.

Keywords: Pesticides, Human health, Environmental exposure, Biomarkers, Finger prick

ABSTRAK

TAHAP KOLINESTERASE DARAH DAN KEUPAYAAN PEMBELAJARAN DALAM KALANGAN KANAK-KANAK SEKOLAH RENDAH BERHAMPIRAN SAWAH PADI DI TANJUNG KARANG, SELANGOR.

NOOR AISHAH BINTI HAMZAH

Pengenalan: Berdasarkan Statistik Padi Malaysia 2011, padi merupakan tanaman ketiga paling banyak ditanam di Malaysia selepas kelapa sawit dan getah. Pada tahun 2011, 687 940 hektar ditanam dengan padi termasuk yang ditanam dua kali setahun. Penggunaan racun perosak membawa kepada peningkatan dalam hasil dan mengurangkan harga produk dengan sebahagiannya melindungi ladang daripada sebarang perosak dan tumbuh-tumbuhan yang tidak diingini. Penggunaan meluas racun serangga boleh menjejaskan kesihatan manusia terutama daripada pendedahan pekerjaan dan alam sekitar. Kanak-kanak adalah kumpulan terdedah kepada pendedahan racun serangga kerana metabolisme sedang membangun dan kematangan yang berterusan sistem organ mereka. Aktiviti kolinesterase darah adalah penanda biologi yang paling berkesan untuk mengukur tahap pendedahan untuk pelbagai racun perosak. **Objektif:** Tujuan kajian ini adalah untuk menentukan hubungan antara tahap kolinesterase darah dengan keupayaan pembelajaran kanak-kanak sekolah rendah yang terpilih. **Metodologi:** 112 kanak-kanak sekolah rendah telah dipilih sebagai kumpulan terdedah kepada racun perosak. Kriteria inklusif adalah kanak-kanak yang belajar dan tinggal berhampiran sawah padi. Ibu bapa mereka melengkapkan borang soal selidik dan sampel darah 0.01mL daripada responden telah diambil menggunakan teknik cucuk jari. Darah kemudian dianalisis menggunakan Lovibond 412670 ujian AF267 kit untuk menentukan tahap kolinesterase darah. McCarthy Skala Keupayaan Kanak-kanak digunakan untuk mengukur keupayaan pembelajaran. **Keputusan:** Peratusan tertinggi dari responden yang mempunyai tahap pendedahan normal (52.7 %). Manakala 92.9 % melaporkan tanda-tanda dan gejala dengan mata berair akibat pendedahan racun perosak. Kebanyakan responden berada dalam tahap sederhana (44.6 %) untuk kebolehan pembelajaran. **Kesimpulan:** Terdapat hubungan yang signifikan antara tahap kolinesterase darah dengan fungsi kognitif di semua skala kumpulan kajian. Tiada kanak-kanak sekolah dilaporkan dengan fungsi kognitif sempadan dan mental. Akhir sekali, jantina, pendidikan ibu dan kolinesterase darah menunjukkan pengaruh ketara dalam skala ingatan dan motor diMSCA.

Kata kunci: Racun , Kesihatan manusia , Pendedahan alam sekitar , Biomarkers , Cucuk jari

CHAPTER 2: LITERATURE REVIEW

TABLE OF CONTENTS

	Page Number
Declaration	ii
Signature of Supervisor/ Internal Examiner	iii
Acknowledgement	iv
Abstract	v
Abstrak	vi
Contents	vii
List of Tables	x
List of Figures	xi
List of Appendices	xii
List of Abbreviations	xiii
CHAPTER 1: INTRODUCTION	
1.1 Background	1
1.2 Problem Statement	4
1.3 Study Justification	5
1.4 Study Variables	5
1.5 Conceptual Framework	6
1.6 Research Objectives	8
1.7 Research Hypothesis	9
1.8 Definition of Term	10

CHAPTER 2: LITERATURE REVIEW	
2.1 Pesticide	12
2.2 Structure of Organophosphate (OPs) Pesticide	14
2.3 Mechanism of Organophosphate Toxicity	15
2.4 Health Effects on Organophosphate (OPs)	17

CHAPTER 3: METHODOLOGY	
3.1 Study Location	19
3.2 Study Design	21
3.3 Sampling	21
3.4 Study Instrumentation	24
3.5 Data Collection Procedure	29
3.6 Data Analysis	29
3.7 Ethical Approval	30

CHAPTER 4: RESULT	
4.1 Study Location	31
4.2 Socio-demographic Background of Study Respondents	32
4.3 Reported Signs and Symptoms of Study Respondents	35
4.4 Blood Cholinesterase Levels of Study Respondents	37
4.5 Cognitive Functioning by McCarthy Scale of Children's Abilities (MSCA)	39
4.6 Relationship between Blood Cholinesterase Levels with Cognitive functioning among Study Respondents	41

4.7 Selected Variables that Influenced the Blood Cholinesterase Levels of Study Respondents	43
---	----

4.8 Selected Variables that Influenced the Cognitive functioning using McCarthy Scale of Children's Abilities (MSCA) of Study Respondents	44
---	----

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion

5.1.1 Socio-demographic Background	45
------------------------------------	----

5.1.2 Blood Cholinesterase Levels	47
-----------------------------------	----

5.1.3 Relationship of Blood Cholinesterase Levels With Cognitive Functioning	49
--	----

5.1.4 Selected Variables that Influence Blood Cholinesterase Levels among Study Respondents.	51
--	----

5.1.5 Selected Variables that Influenced Cognitive functioning among Study Respondents.	53
---	----

5.2 Recommendations	56
---------------------	----

5.3 Conclusion	57
----------------	----

5.4 Study Limitation	57
----------------------	----

REFERENCES	58
-------------------	-----------

APPENDICES	62
-------------------	-----------

LIST OF TABLES

	Pages
Table 3.1 : Percentage and category of blood cholinesterase standard indicator	24
Table 3.2 : The Tests in Verbal Scale (V)	25
Table 3.3 : The Tests for Perceptual-Performance Scale (P)	26
Table 3.4 : Test for the Quantitative Scale (Q)	27
Table 3.5 : The Motor Scale Tests	28
Table 4.1 : Distribution of socio-demographics information among the study respondents.	32
Table 4.2 : The distribution of house distance, house location, wash hand before eat and play near paddy fields among the study respondents.	33
Table 4.3 : Distribution of reported sign and symptoms of the study respondents.	35
Table 4.4 : Blood cholinesterase levels based on percentage among the study respondents.	37
Table 4.5 : Blood cholinesterase levels among study respondents.	36
Table 4.6 : Levels of Blood Cholinesterase	38
Table 4.7 : McCarthy Scales of Children's Abilities (MSCA) scores among study respondents.	39
Table 4.8 : Distribution of General Cognitive Index (GCI) scores.	40
Table 4.9 : Correlation between blood cholinesterase levels with the cognitive functioning among study respondents.	41

LIST OF FIGURES

Table 4.10	: Selected factors that influenced blood cholinesterase levels among study respondents.	42
Table 4.11	: Selected variable that influenced the Verbal scale of study respondents.	43
Table 4.12	: Selected variables influenced the Motor scale of study respondents.	44



LIST OF AC **LIST OF FIGURES** REVIATIONS

	Pages
Figure 1.1 : Conceptual Framework	7
Figure 2.1 : General chemical composition of organophosphate pesticides	14
Figure 2.2 : The mechanism of Organophosphate poisoning	16
Figure 3.1 : Location of the Sekolah Kebangsaan Dato Manan and Sekolah Kebangsaan Berjaya	20
Figure 4.1 : Distribution blood cholinesterase levels among study respondents	37

LIST OF ACRONYMS AND ABBREVIATIONS

<	Less than
=	Equal to
N	Sample size
n	Number of sample size
p	Significant value
r	Correlation
S.D	Standard deviation
AcH	Acetylcholine
ChE	Cholinesterase
AcHE	Acetyl-cholinesterase
MSCA	McCarthy Scale of Children's Ability
et. al	and others
OP	Organophosphate
SPSS	Statistical Package for Social Science

CHAPTER 1

INTRODUCTION

1.1 Background

Agriculture area takes almost 20 percent of total land area in Malaysia. The land is divided into industrial crops such as oil palm, rubber and cocoa and other crops such as paddy, fruits and vegetables. Based on Statistics of Malaysia 2011, paddy is the third most widely planted crop in Malaysia after oil palm and rubber. In the year 2011, about 687,940 hectares were planted with paddy including those that are planted twice a year. Total production of paddy is used to support Malaysian people food since rice is the staple and security food crop of the country. In fact, Malaysia also imports rice from other countries such as Vietnam, Thailand and India (Paddy Statistics of Malaysia 2011).

Worldwide human population density is estimated to increase about 9.2 billion in 2050 causing rise in the demand for food production by 70 %. Consequences from the high demand of food may cause several hunger and malnutrition issues in certain countries. Therefore, farmers and manufacturers should produce more quantities of food with high quality and safety to ensure enough supply. Globally, an average of 35 % of potential crop yield is lost due to poor management of agriculture (Oerke et al, 2005). It is a major challenge for the agriculture production activities.

In order to make agriculture more productive and sustainable for economic growth, pest management is normally used (Gina et al, 2012). The uses of pesticides lead to increase in yields and reduce product prices by partly protecting the plantation from any pest. Examples of pesticides that are commonly used include algacides, herbicides and insecticides. Based on the United State Environmental Protection Agency (USEPA), all pesticides must be registered with Environmental Protection Agency (EPA) to ensure that their impact is clear on people, non-target species and the environment.

Organophosphates is one of the insecticides mainly used in agriculture on crops as an insecticides, but also used in residential setting for pest control and for public health protection against vector-borne diseases. Organophosphates are used in abundance because of low cost, readily available, less persistent in the environment, and less susceptible to pest resistance (Wessels et al, 2003). Pesticides affect the nervous system by disrupting the enzyme that regulates acetylcholine, a neurotransmitter.

Pesticides were developed during the early 19th century, but their effects on insects, which are similar to their effects on humans, were discovered in 1932. However, pesticides are usually not persistent in the environment (EPA, 2010).

Blood cholinesterase activity is the most effective biomarkers to measure the level of exposure for various pesticides. Serum cholinesterase is a blood test that looks at levels of two substances that help the nervous system work properly. They are called acetylcholinesterase and pseudocholinesterase. Nerves need these substances to send signals. Acetylcholinesterase is found in nerve tissue and red blood cells. Pseudocholinesterase is found primarily in the liver. The mechanism starts with the inhibition of acetylcholinesterase (AChE) causing accumulation of acetylcholine at peripheral and central cholinergic receptors, which may results in overstimulation of the cholinergic system (Dhalla AS, 2013).

One of the health effects that are going to be studied in this research is the cognitive functioning among primary school children. Cognitive functioning test reveals learning potential, measures various reasoning skills, and gives insight into the learning styles of individual students by using observable activities and internal process. Cognitive functioning can be tested by using McCarthy Scale of Children's Ability based on certain standard scores.

The purpose of this study is to determine the relationship between blood cholinesterase levels with cognitive functioning of selected primary school children.

1.2 Problem Statement

Rapid symptoms or signs of organophosphate poisoning may be observed within 12 hours of exposure. Organophosphate poisoning includes dizziness, anxiety, restlessness, muscle twitching, weakness, tremor, incoordination, and pulmonary edema. Repeated exposures to OP pesticides can also cause anorexia, weakness, and malaise. Depression of respiration and pulmonary edema are the usual causes of death from OP pesticides poisoning (Lizardi et al, 2008).

Children are vulnerable respondents to exposures of insecticide because of less-developed metabolism and the on-going maturation of organ systems (Sugeng et al 2013). In addition, due to lower body weight and not fully developed enzymatic detoxification mechanism for organophosphate pesticides make the effect on children more chronic (Oulhote, 2013). School children that study and live near paddy field area tend to be exposed to pesticides which affect their cognitive functioning in a long term.

1.3 Study Justification

According to the District and Land Offices of Sabak Bernam, 2011 Tanjung Karang is a main fishing and paddy growing town in Selangor. The agriculture and fishing activities contribute the most to the economic development of the district. About 43,383.625 hectares planted with paddy crops, the main used pesticides is organophosphate. Organophosphate may have serious health effect on the population of Tanjung Karang. Moreover, their residential area is near to the paddy field and also the school is beside the paddy field has increased risk.

The collection of data at the school was started in middle of January 2014 until early March 2014. The children who study and live near the paddy field were the selected respondents in this study because they are at higher risk for pesticides toxicity than adults. In addition, the surrounding area plays an important role because they might get the exposure in particular ways such as frequent hand-to-mouth behavior and outside play (Oulhote et al, 2013).

1.4 Study Variables

The independent variable in this study is blood cholinesterase while the dependent variable is cognitive functioning among primary school children in Tanjung Karang, Selangor.

1.5 Conceptual Framework

Figure 1.1 below shows the conceptual framework of this study that aim to determine the relationship between the exposures to insecticide with the cognitive functioning of the primary school children. The exposure will be assessed by calculating the blood cholinesterase level using Model Lovibond 412670 AF267 test kit.

The main agricultural sectors in Malaysia can be divided into three which are paddy, palm oil and rubber. All the sectors contribute mainly to the economic development of the country. My research target sector is paddy. Paddy farmers used insecticide in the management and control of pests. The specific insecticide use is organophosphate.

The exposure to insecticide will cause various health effects to the community and is through inhalation, direct contact with the skin or accidentally ingestion. All stages of people especially children can receive the impact of exposure like nervous system, endocrine, immune, reproductive, renal, cardiovascular, and respiratory systems.

For the present research, the target population is primary school children aged between 7 to 8.5 years old. The dependent variable being measured is the cognitive functioning of the exposed respondents which are living and studying at the paddy field. They will be assessed by using standardized instrument, McCarthy Scale of Children's Ability (MSCA).

1.6 Research Objectives

1.6.1 General Objective

To determine the relationship between blood cholinesterase level with cognitive functioning of selected primary school children (study respondents) in Tanjug Karang, Selangor.

1.6.2 Specific Objectives

1. To determine the blood cholinesterase levels of the study respondents.
2. To determine the cognitive functioning of the study respondents using McCarthy Scale of Children's Ability.
3. To determine the correlation between bloods cholinesterase levels with cognitive functioning of the study respondents.
4. To determine the reported sign and symptoms among the study respondents.
5. To determine selected variables that significantly influenced the blood cholinesterase levels of the exposed respondents.
6. To determine selected variables that influenced the cognitive functioning of the study respondents.

1.7 Research Hypothesis

1. There is significant relationship between pesticide exposures and cognitive functioning of the study respondents.
2. The gender of respondents significantly influenced the blood cholinesterase levels of the study respondents.
3. The blood cholinesterase levels significantly influenced the cognitive functioning of study respondents.

1.8 Definition of Terms

1.8.1 Conceptual Definition

i. Pesticide

Pesticides are chemical compounds that were used to kill pests such as insects, rodents, fungi and unwanted plants (weeds). It was used in public health to control vectors of disease, such as mosquitoes, and in agriculture to kill pests that damage crops (WHO, 2010).

ii. Primary School Children

Primary school children were characterized by children within 7 to 12 years of age. The school was focused on developing children's knowledge and understanding.

iii. Blood cholinesterase

Cholinesterase were the enzymes that catalyze the hydrolysis of the neurotransmitter acetylcholine into choline and acetic acid, a reaction that allow cholinergic neuron to return to its resting state after activation.

iv. Cognitive functioning

Cognitive functioning involved a process of both observable activity and internal process such as thinking, attitudes and emotions based on an individual's interactional experiences with the environment. Learning might not manifest itself in observable behavior until sometime after the educational program has taken place.

1.8.2 Operational Definition

i. Pesticide

The observable pesticide in this study was insecticide which was organophosphate. The levels of exposure to pesticide were measured by taking the blood cholinesterase level. It is the most effective biomarkers to measure the level of exposure to various pesticides. The mechanism started with the inhibition of acetylcholinesterase (AChE), caused accumulation of acetylcholine at peripheral and central cholinergic receptors resulting in overstimulation of the cholinergic system.

ii. Primary School Children

The inclusive criteria were primary school children aged between 7 to 8.5 years. The pupils lived and studied near the paddy field.

iii. Blood Cholinesterase Measurement

The blood cholinesterase activities were measured by using cholinesterase test kit Model LOVIBOND 412670 AF267 by obtaining 0.01 ml of children's blood through finger prick technique.

iv. Cognitive functioning

McCarthy Scale of Children's Ability was used to measure the cognitive functioning of primary school children. The method consists of 18 separate tests in six definite tests with various objectives.

CHAPTER 2

LITERATURE REVIEW

2.1 Pesticide

A pesticide is any substance or mixture of substances for a wide array of chemicals intended to kill unwanted insects, plants, molds, and rodents (USEPA, 2010). Food, water, and treatment in the home, yard, and school are all potential sources of children's exposure. Exposures to pesticides may be overt or subacute, and effects range from acute to chronic toxicity. In 2008, pesticides were the ninth most common substance reported to poison control centers, and approximately 45% of all reports of pesticide poisoning were for children (Roberts et al, 2012).

Pesticides are the main concern of environmental and occupational hazard in agricultural communities. These chemicals are on purpose designed to be toxic to pest and vectors especially in agriculture, and are used to control weeds, insect infestation and diseases. There are thousands of pesticides registered with the United States Environmental Protection Agency (USEPA, 2010) which are among more than 1000

active ingredients marketed as insecticide, herbicide, and fungicide (Mostafalou and Abdollahi, 2013).

When the pesticide is being sprayed, it will spread by air movement to the neighbouring environment. A few studies show that pesticides can travel up to 750 m from the spraying area (Ward et al., 2006). In 2011, a report made by Elizabeth Grossman found that organophosphate pesticides can easily drift with the wind beyond their intended fields when sprayed on the crops. This transmission may cause severe exposure to the people and may lead to chronic health effects from pesticides. Example of the health effects are cancer, endocrine disruption, and reproductive/developmental toxicity (Sugeng et al., 2013).

Acute organophosphate pesticide poisonings cause substantial morbidity and mortality worldwide (Rosenstock et al, 1991). In outdoor settings, OPs are relatively non-persistent because they are degraded by photo chemical and microbiologic actions. However, when used indoors or as a part of structural treatments, these compounds can remain stable for extended periods of time and can remain potentially available for repeated exposure to both adults and children (Wessels et al, 2003).

2.2 Structure of Organophosphate (OPs) Pesticide

Insecticides are chemicals used to control insect pests that damage or destroy crops or transmit diseases among humans and animals. Organophosphate (OP) compounds are the most widely used groups of insecticides worldwide. OP insecticides are neurotoxins. Neurotoxicity is defined as any permanent or reversible adverse effect on the structure or function of the nervous system. The main mode of action of OPs in humans is inhibition of acetylcholinesterase (Kateryna et al, 2012).

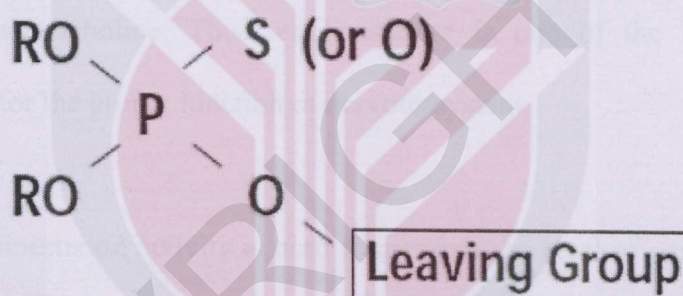


Figure 2.1: General chemical composition of organophosphate pesticides

In these compounds, the OPs are a group of both synthetic and biogenic OP compounds, characterized by the presence of the binding covalent, carbon to phosphorus (C-P) bond. In OPs, this carbon to phosphorus bond replaces one of the four carbons to oxygen to phosphorus bonds of the more common phosphate ester. The direct C-P linkage is chemically and thermally inert, with the result, most of organophosphonate compounds are resistant (Figure2.1) (Kazemi et al, 2012).

2.3 Mechanism of Organophosphates (OPs)

Organophosphate and carbamate are the most widely known acute poisoning. The diagnosis by depressed red blood cell cholinesterase levels (Roberts et al, 2012). In normal transmission of a nervous impulse from nerve to nerve, acetylcholine is released into synapse to excite the receiving neurons. Unless acetylcholine is rapidly broken-down, the receiving nerve is constantly fired resulting in uncoordinated muscle movement, nausea, dizziness, and eventually seizures and unconsciousness. The enzyme acetylcholinesterase is responsible for the expedient breakdown of the neurotransmitter acetylcholine. Thus, cholinesterase is one of the most important enzymes required for the proper function of nervous system.

Blood cholinesterase activity is used to measure the level of pesticide exposure by inhalation, ingestion, eye or skin contact during manufacture, mixing or applications of these chemicals. Anyone exposed to cholinesterase inhibiting pesticides can develop lowered cholinesterase levels (Dhalla et al., 2013).

Examining cholinesterase inhibition as a biomarker of effect is one potential strategy. Acetylcholine (ACh) transmits electrochemical signals across neuronal synapses and neuromuscular junctions and is hydrolyzed by the action of the enzyme AChE. A serine residue in the active site of AChE covalently reacts with ACh. OPs in the oxon form (i.e., phosphate form) can react similarly with the serine residue. Therefore, the serine residue on the phosphorylated AChE is not available to break

down ACh. The toxic effects of OPs result from their ability to inhibit the action of AChE in the nervous system, causing a buildup of ACh, overstimulation the nervous system . OP poisoning is diagnosed by measuring reduced cholinesterase activity in red blood cells (Wessels et al, 2003).

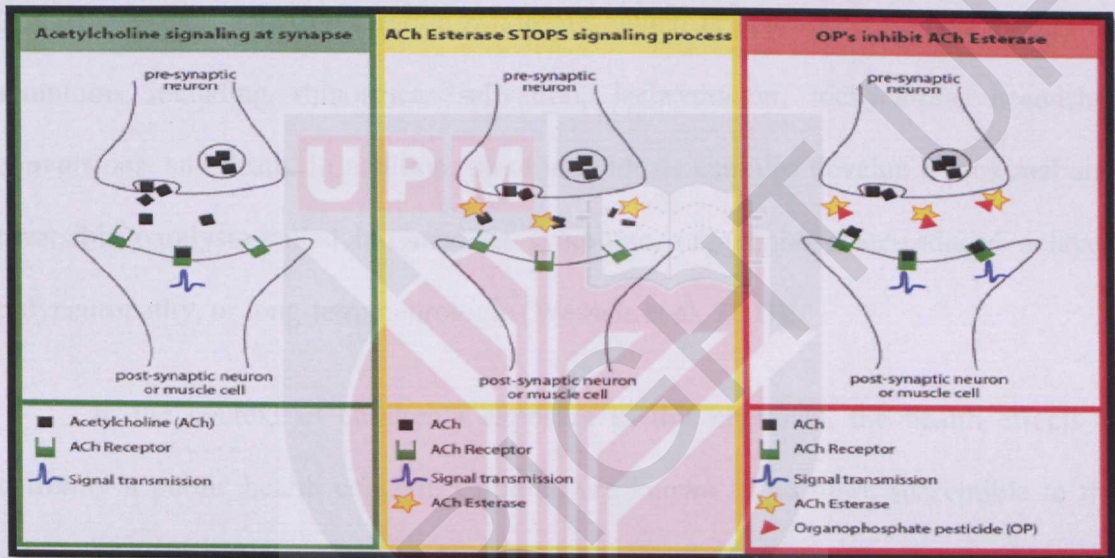


Figure 2.2: The mechanism of Organophosphate poisoning

Monitoring OP concentrations in blood or blood products offers several advantages. The parent compounds can be monitored directly in blood products instead of their metabolites, which are usually measured in urine. Blood measurements provide an estimation of the dose available for the target site, allowing for prediction of dose-response relationships. Furthermore, because blood is a regulated fluid, the blood concentrations of toxicants measured at a specified time interval after exposure will remain the same as long as the absorbed amounts are constant; therefore, no corrections for dilution are necessary.

2.4 Health Effects of Organophosphate Poisoning

Repeated exposures to OP pesticides can also cause anorexia, weakness, and malaise. Depression of respiration and pulmonary edema are the usual causes of death from OP pesticides poisoning (Lizardi et al, 2007). Individuals exposed to high levels of OPs can develop acute cholinergic syndrome, which is characterized by a variety of symptoms including rhinorrhea, salivation, lachrymation, tachycardia, headache, convulsions, and death. In addition, these individuals can also develop a proximal and reversible paralysis called intermediate syndrome, organophosphate-induced delayed polyneuropathy, or long-term neurologic (Wessels et al, 2003).

In the context of children's exposure to this chemical, the health effects is currently a public health concern. Children are known to be more susceptible to the effects of these exposures, as they have higher rates of metabolism, less mature immune systems, and different patterns of activity (Dalvie et al., 2013). Another study by (London et al., 2012), stated that toxicity is higher in children because the brain is rapidly developing, the dose of pesticides per body weight is likely to be large in children and pupils have a reduced capacity of detoxifying xenobiotics.

Epidemiological and experimental studies have also found that the cognitive areas affected by toxic exposure to OP pesticides are “selective attention latency, symbol digit latency, preferred-hand-finger tapping, alternating hand finger tapping, and continuous performance hit latency” (Rothlein et al., 2006); motor speed and

coordination, sustained attention, information processing speed, visual motor speed, verbal abstraction, attention, and memory (Slotkin et al., 2006).

According to Kofman et al, 2006, the performance of children exposed to OP pesticides would be poorer in different cognitive and behavioral measures than the performance of children exposed to OP pesticides. In addition, high levels of OP pesticide are associated with poor performance on the cognitive measures. Results indicate that there were significant correlations between the concentration levels of OP metabolites the day of the cognitive assessment and the performance of children (Lizardi, 2008).

Cognitive development is influenced by environmental condition surrounding the children. According to Laura et al., 2007, children's cognitive functioning was evaluated by using the McCarthy Scales of Children's Abilities, a standardized assessment of cognition in studies.

CHAPTER 3

METHODOLOGY

3.1 Study Location

The location for this study is Tanjung Karang, Kuala Selangor, Selangor. The study was carried out in two schools which are Sekolah Kebangsaan Dato Manan and Sekolah Kebangsaan Berjaya. Children from these schools were classified as exposed respondents because of school location near the paddy fields less than 300 meters. The selection of respondents were based on the inclusive criteria in which their ages were between 7 to 8.5 years old, attended school and lived near the paddy fields



Source: Google Maps

Figure 3.1: Location of the Sekolah Kebangsaan Dato Manan and Sekolah Kebangsaan Berjaya

3.2 Study Design

This research is a cross-sectional study. The cognitive functioning analysis of the school children was carried out at the school in primary school.

3.3 Sampling

3.3.1 Sample Population

The total number of respondents from both schools that was involved in this study was 112 school children of both genders which were selected based on simple random sampling. The exposed respondents meet the criteria of e: Source: Google Maps that are live and study near the paddy field.

3.3.2 Sampling Frame

The list of students name was obtained from the school office. The inclusive criteria are healthy school children, 7 until 8.5 years old and those who obtained permission from parents or guardian. Children, who are sick, live and study far from paddy field is the exclusive criteria.

3.3.3 Study Sample

Daniel (1999) formula is used to calculate the sample size for the exposed respondents.

$$N = \frac{z^2 p(1-p)}{d^2}$$

Where:

N = sample size

Z = standard score for significant level

p = estimation incident of learning disability for population

d = precision in proportion of one

For 95% significant level = 1.96, d = 0.1

Calculation for exposed respondents:

The value p = 0.253, based on the study by Boyle et al, 2011 (Trend in the prevalence of Developmental Disabilities in US Children);

$$N = \frac{(1.96)^2 (0.253) (0.747)}{(0.1)^2}$$

$$N = 72.6027$$

N = 73, minimum sample size for primary school children respondents.

The value is rounded up to 10% to account and backup any missing data during data collection process. The calculation is as follows:

$$10\% \times 72.6027 = 7.26$$

$$= 7 + 73$$

N = 80 respondents, total respondents.



3.4 Study Instrumentation

3.4.1 Questionnaire

The questionnaire was given to the parents of respondents to be filled up. The background information of the respondents consist of personal information, socio-demographic, daily activities, parent's occupation and information, exposure of history and health status of the children was collected using the questionnaire.

3.4.2 Cholinesterase Test Kit

The exposure to pesticide was measured by using rapid test cholinesterase test kit Model LOVIBOND 412670 AF267. The method required blood samples that easily obtained from finger prick technique. 0.01 ml sample of blood was required.

There are indicator solutions (Bromothymol Blue) and substrate solution (Acetylcholine Perchlorate) reagents in the rapid test kit. The indicator solution is dissolved in 250 ml of deionised water and substrate solution will be dissolved in 50 ml deionised water. Table 1 shows the percentage of the cholinesterase activity in blood. The standard indicator of exposure from pesticide among the children is also presented in Table 3.1.

Table 3.1: Percentage and categories of blood cholinesterase standard indicator

Percentage (%)	Indicator
100 – 75	Normal
74.9 – 50	Over exposure
49.9 – 25	Serious over exposure
24.9 – 0	Very serious and dangerous over exposure

3.4.3 McCarthy Scales of Children's Abilities (MSCA)

The McCarthy Scales of Children's Abilities (MSCA) developed between 1969 and 1970 is a measurement devices designed to measure cognitive and physical development. MSCA was appropriate to be test on preschool and primary grade children aged between 2.5 and 8.5 years old (Hubbs-Tait et al, 2007).

It consists of six composite scale scores: Verbal, Perceptual, Performance, Quantitative, Motor and Memory derived from 18 separate tests which are:

- a. **Verbal Scale (V)** – The test assess child's ability to express him verbally, and also assess the maturity of his verbal concept. The child is asked to respond with one word answer, phrases, and sentences to a variety of items tapping such mental processes as short and long term memory, divergent thinking, and deductive reasoning. The tests in the Verbal Scale are described below in Table3.2.

Table 3.2: The Tests in Verbal Scale (V)

TEST	DESCRIPTION
Pictorial Memory	Child recall names of objects pictured on card
Word Knowledge	The pupils identified common objects and define words
Verbal Memory	The pupils repeated word series and sentences, retells a story read by examiner
Verbal Fluency	The pupils names as many articles as he can in a given category within 20 seconds
Opposite Analogies	The pupils completes sentences by providing "opposites"

- b. **Perceptual-Performance Scale (P)** – This scale consists of a game like tasks which do not require the pupil to speak. The scale assesses the child’s reasoning ability through the manipulation of materials. The child demonstrates such skills as imitation, logical classification, and visual organization in a variety of spatial, visual-perceptual, and conceptual tasks. The tests are shown in Table3.3.

Table 3.3: The Tests for Perceptual-Performance Scale (P)

TEST	DESCRIPTION
BlockBuilding	The pupil copies block structures built by the examiner
Puzzle Solving	The pupil assembles cut-up pictures of common animals and foods
Tapping Sequences	The pupil copies sequences of notes tapped by the examiner on a xylophone
Right-Left Orientation	The pupil demonstrates his knowledge of right and left
Draw-A-Design	The pupil copies geometrical designs
Draw-B-Child	The pupil draws a picture of a child of the same sex
Conceptual Grouping	The pupil classifies blocks on the basis of size, color and shape

- c. **Quantitative Scales (Q)** – This scale measures the child’s facility with numbers and his/ her understanding of quantitative words. The Quantitative Scale aims to assess the child’s number aptitude rather than to explore the upper limit of his computational skills. The tests are in Table 3.4.

Table 3.4: Test for the Quantitative Scale (Q)

TEST	DESCRIPTION
Number Questions	Child answer questions involving number information or basic arithmetical computation
Numerical Memory	He/ she repeats series of digits in the order presented by the examiner and in reverse order
Counting and Sorting	He/ she is asked to count and to sort blocks into equal groups

- d. **General cognitive scale (GC)** – The General cognitive scale is composed of all tests in the V, P and Q scales. Each task is cognitive in nature, and the scale as a whole provides a measure of child’s overall cognitive functioning. The child’s Cognitive Index or GCI shows his cognitive level in relation to other children of his chronological age.

- e. **Memory Scale (Mem).** – Each of the tests in Memory Scale assesses the child’s short-term memory. The Pictorial Memory and Tapping Sequences tests present auditory and visual stimuli simultaneously. The assessment of memory in two modalities, requiring both verbal and nonverbal responses and using a variety of stimuli, affords extensive evaluation of the child on his important ability. Test involved are Pictorial Memory, Tapping Sequence, Verbal Memory and Numerical Memory.
- f. **Motor Scale (Mot).** – The test assesses the child’s coordination as he/she performs a variety of gross and fine motor tasks. A child’s motor Index reflects his developmental level, and is a vital adjusts to the picture of the child as revealed by GCI and scores in the specific cognitive areas. The Motor tests are listed below in Table 3.5.

Table 3.5: The Motor Scale Tests

TEST	DESCRIPTION
Leg Coordination	Child performs motor tasks which involve the lower extremities, such as walking backwards or standing on one foot
Arm Coordination	The pupil bounces a rubber ball, catches a beanbag, and throws a beanbag through a hole in a target
Imitative Action	The pupil copies simple movements, such as folding one’s hands or looking through a tube
Draw-A-Design	(also in P and GC)
Draw-B-Child	(also in P and GC)

3.5 Data Collection Procedure

Before the collection of data, permission to conduct this research at Tanjung Karang, Selangor was obtained from the Ministry of Education. After the approval, consent letters was given to the students to obtain their parents/ guardian's consent to do research.

Then, the respondents was given a set of questionnaire to be filled-in by the parent all the personal information which included the socio-demographic, parental information and health status of the school children.

After adopting all the inclusive criteria, the respondents were tested for blood cholinesterase level using cholinesterase test kit. The cognitive functioning of the school children was assessed by using McCarthy Scale of Children's Ability (MSCA). A group of trained research assistant was help to conduct the test.

3.6 Data Analysis

Statistical Package for Social Science (SPSS) Version 21.0 was used to analyze all the data. The descriptive test was used to calculate mean, median, mode and standard deviation. The normality test was used to obtain further information to achieve study objectives.

3.7 Ethical Approval

The ethical approval was obtained from Research Ethic Committee of Universiti Putra Malaysia. Approval from Ministry of Education and the school itself also was obtained. Lastly, permission from the children's parents/ guardian also was obtained before running any tests.



4.1 Socio-Demographic Information of the Study Respondents

Table 4.1 Distribution of socio-demographic information among the study respondents

Variables	Frequency (n)	Percentage (%)
Age (years)		
Year 1	41	36
Year 2	43	38
Year 3	28	25
Gender		
Male	46	41
Female	66	59
Father's Education		
Primary school	23	21
High school	89	80

CHAPTER 4

RESULT

4.1 Study Location

The study was carried out in two schools in Tanjung Karang area which are Sekolah Kebangsaan Dato Manan and Sekolah Kebangsaan Berjaya. These children were classified as exposed respondents because of school location near the paddy fields less than 300 meters. Total of 112 school children from Year 1 to Year 3 were selected as exposed respondents (77% response rate) to participate in this study. The selection of respondents were based on criteria in which ages were between 7 to 8.5 years old, attend school and lived near the paddy fields. Tanjung Karang is a paddy growing town in Selangor and located in the district of Kuala Selangor which is about 15 kilometers from the town of Kuala Selangor. The local Chinese minority lives in the urban and seaside area, while majority Malays lived in the rural areas and was involved with agricultural activities, particularly rice cultivation.

4.2 Socio-Demographic Information of the Study Respondents.

Table 4.1: Distribution of socio-demographics information among the study respondents.

Variables	Frequency (n)	Percentage (%)
Age (years)		
Year 1	37	33
Year 2	43	38.4
Year 3	32	28.6
Gender		
Male	52	46.4
Female	60	53.6
Father's Education		
Primary school	67	59.8
Secondary school	36	32.1
Tertiary school	9	8.0
Mother's Education		
Primary school	29	25.9
Secondary school	60	53.6
Tertiary school	23	20.5
Fathers' Occupation		
Farmers	74	66.1
Non-farmers	38	33.9
Mothers' Occupation		
Farmers	45	40.2
Non-farmers	67	59.8

Table 4.2: Continuation of socio-demographic information.

Variables	Frequency (n)	Percentage (%)
Transportation to school		
Walk	5	4.5
Bicycle	7	6.3
Motorcycle	76	67.9
Car	24	21.4
Distance from house to school (m)		
<100	10	8.9
>100	21	18.8
500-1000	26	23.2
>1000	55	49.1
House Area		
Near to paddy fields	79	70.5
Far from paddy fields	33	29.5
Wash hand before eat		
Yes	89	79.5
No	23	20.5
Play near paddy fields		
Yes	26	23.2
No	86	76.8

N=112

Table 4.1 and 4.2 shows the distribution of socio-demographic information among study respondents. The highest percentage of participation was from Year 2 (38.4%) and female school children (53.6%). The highest classification of parent's occupation was farmers for father (66.1%) and mother were non farmers (59.8%). Observation from the questionnaires noticed that most of these non farmers among mothers were housewives. About 67.9% respondents were sent to school by their parents by using a motorcycle because the distance from their houses to school were more than 1 km in Table 4.2. The house location near the paddy field was the main location for housing area for the population in the Tanjung Karang area. In addition, awareness of washing hand before eating among children were high and most of them were not allowed to play near the paddy fields area.

4.3 Reported Sign and Symptom of Study Respondents.

Table 4.3: Distribution of reported sign and symptoms of the study respondents.

Classification	Frequency (n)	Percentage (%)
Difficulty Breathing		
Yes	3	2.7
No	104	92.9
Not sure	5	4.5
Watery Eye		
Yes	4	3.6
No	104	92.9
Not sure	4	3.6
Running Nose		
Yes	27	24.1
No	82	73.2
Not sure	3	2.7
Headache		
Yes	36	32.1
No	71	63.4
Not sure	5	4.5
Excessive Sweating		
Yes	8	7.1
No	98	87.5
Not sure	6	5.4
Cough		
Yes	60	53.6
No	52	46.6
Not sure	0	0

N=112

Based on Table 4.3, there were reported sign and symptom for difficulty breathing, watery eye, running nose, headache, excessive sweating, and cough. Between of these classifications, difficulty in breathing and watery eye was the highest percentage of 92.9% respectively. However, 53.6% respondents were having cough in the past 3 months. These symptoms might happen because of pesticide exposure used in the agricultural activity but further examinations by doctors were important to confirm the symptoms.



4.4 Blood Cholinesterase Level of Study Respondents.

Table 4.4: Blood cholinesterase levels based on percentage among the study respondents.

Variables	Mean	Median	Standard deviation
Blood Cholinesterase levels (%)	66.295	75.00	14.7081

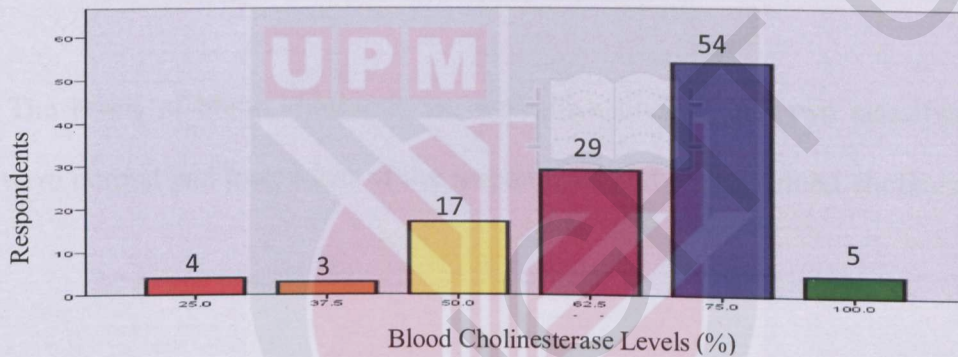


Figure 4.1: Distribution blood cholinesterase levels among study respondents

Table 4.5: Blood cholinesterase levels among study respondents.

Variables	Frequency (n)	Percentage (%)
Blood Cholinesterase Levels		
Normal (75-100%)	59	52.7
Over exposure (50-74.9%)	46	41.1
Serious over exposure (25-49.9%)	7	6.3
Very serious and dangerous over exposure (0-24.9%)	-	-

N=112

Blood was obtained through finger prick technique. The purpose of taking blood is to measure the exposure level to pesticides. After the blood samples were being analyzed, it was categorized into four exposure classification as shown in Table 4.5. Most of the respondents had (52.7%) normal exposure, while another 46 respondents (41.1%) over exposed to pesticide and the remaining 6.3% of the respondents had serious over exposure. None of the respondent was exposed very seriously and dangerously.

The levels of blood cholinesterase were then divided into two classifications which were normal and low. Most of the respondents had normal blood cholinesterase levels.

Table 4.6: Levels of Blood Cholinesterase

Variables	Frequency (n)	Percentage (%)
Blood Cholinesterase Levels		
Normal	59	52.7
Low (Exposed)	53	47.3

4.5 Cognitive Functioning by McCarthy Scales of Children's Abilities (MSCA)

Table 4.7: McCarthy Scales of Children's Abilities (MSCA) scores among study respondents.

Variables	Range	Mean	Median	SD
Verbal	54-74	60.84	60.00	4.365
Perceptual-Performance	47-76	61.44	61.00	5.359
Quantitative	35-80	63.23	63.00	6.818
General Cognitive Index	81-137	106.73	104.50	14.423
Memory	43-76	57.65	56.50	7.193
Motor	35-75	50.50	47.00	8.681

N=112

McCarthy Scale of Children Ability (MSCA) test was used to determine the cognitive functioning among the primary school children aged between 7 to 8.5 years old. It consists of 18 tests that were grouped into 5 scales which are Verbal, Perceptual-performance, Quantitative, Memory and Motor scales. The Verbal, Perceptual-performance, and Quantitative were grouped into General Cognitive Index (GCI).

4.5.1 General Cognitive Index (GCI)

Table 4.8: Distribution of General Cognitive Index (GCI) scores.

Variables		Frequency (%)
General Cognitive Index Scores	Classification	
≥ 130	Very superior	8 (7.1)
120-129	Superior	16 (14.3)
110-119	Bright normal	28 (25.0)
90-109	Average	50 (44.6)
80-89	Dull normal	10 (9.0)
70-79	Borderline	-
≤ 69	Mentally retarded	-

N=112

General Cognitive Index scores were obtained from the sum number of scale index of three tests which are Verbal, Quantitative, and Perceptual-performance. There were 7 categories for the GCI scores namely, very superior, superior, bright normal, average, dull normal, borderline and mentally retarded. GCI was used as indicator for the IQ of respondents if it was affected due to pesticide exposure. From Table 4.6, it showed that most of the respondents were in average level (44.6%). Eight (7.1%) out of 112 respondents scored in very superior while only 9 % were in dull normal level of GCI scores.

4.6 Relationship between Blood Cholinesterase Level with Cognitive functioning among Study Respondents.

Table 4.9: Correlation between blood cholinesterase levels with the MSCA test among study respondents.

Test Items Scale	Blood Cholinesterase (%)	
	r	p
Verbal	0.395	0.001***
Perceptual-performance	0.345	0.001***
Quantitative	0.262	0.005**
General Cognitive Index	0.502	0.001***
Memory	0.210	0.026*
Motor	0.549	0.001***

Spearman-rho test

***Significant at $p < 0.001$

**Significant at $p < 0.01$

*Significant at $p < 0.05$

Table 4.8 shows that there were significant relationships between blood cholinesterase levels with cognitive functioning in all scales which are Verbal ($p=0.001$), Perceptual-performance ($p=0.001$), Quantitative ($p=0.005$), General Cognitive Index ($p=0.001$), Memory ($p=0.026$) and Motor ($p=0.001$). The motor ($r=0.549$) shows a moderate positive correlation with the blood cholinesterase levels.

4.7 Selected Variables that Influenced The Blood Cholinesterase Levels among Study Respondents.

Table 4.10: Selected factors that influenced blood cholinesterase levels among study respondents.

Variables	B	S.E.	P.R	p-value	95% C.I.
Gender	0.576	0.576	1.916	0.166	0.787-4.020
Father's education	-0.869	0.869	4.181	0.041*	1.037-5.482
Mother's education	-0.101	0.366	0.075	0.783	0.442-1.852
House area	-0.282	0.453	0.388	0.533	0.310-1.833
Wash hand before eat	-0.755	0.518	2.121	0.145	0.170-1.298
Play near paddy fields	0.219	0.496	0.195	0.659	0.471-3.293
Distance from house to school	0.143	0.210	0.464	0.496	0.765-1.740
Constant	-0.290	0.892	0.106	0.745	

N=112

B: Regression Coefficient

S.E: Standard Error

95% C.I: 95% Confidence Interval

*Significant at $p < 0.05$

Logistic Regression test was carried out and the result shows that father's education had significant regression with the blood cholinesterase levels ($p=0.041$).

4.8 Selected variable that influenced the cognitive functioning using McCarthy Scales of Children's Abilities (MSCA) of study respondents.

Logistic Regression was carried out to determine the factors that influenced the cognitive functioning of study respondents. Among all the 6 scales, only Verbal and Motor scale showed significant regression with the predictor factors of cognitive functioning. From Table 4.11, blood cholinesterase levels shows significant regression with the Verbal scale of study respondents ($p=0.008$).

Table 4.11: Selected variable that influenced the Verbal scale of study respondents.

Variables	B	S.E.	P.R	p-value	95% C.I.
Gender	-0.116	0.420	0.076	0.783	0.391-2.030
Father's education	0.478	0.358	1.781	0.182	0.799-3.254
Mother's education	-0.339	0.330	1.061	0.303	0.373-1.359
House area	0.138	0.471	0.086	0.769	0.456-2.892
Wash hand before eat	0.766	0.520	2.165	0.141	0.776-5.963
Play near paddy fields	-0.500	0.504	0.984	0.321	0.226-1.629
Blood cholinesterase levels	1.135	0.425	7.132	0.008*	1.352-7.153
Constant	-0.673	0.758	0.789	0.374	

N=112

B: Regression Coefficient

S.E: Standard Error

95% C.I: 95% Confidence Interval

*Significant at $p<0.05$

Table 4.12: Selected variables influenced the Motor scale of study respondents.

Variables	B	S.E.	P.R	p-value	95% C.I.
Gender	-1.460	0.557	6.870	0.009*	0.078-0.692
Father's education	0.450	0.427	1.112	0.292	0.679-3.622
Mother's education	-1.103	0.441	6.262	0.012*	0.140-0.787
House area	0.388	0.559	0.482	0.488	0.493-4.412
Wash hand before eat	0.446	0.655	0.465	0.496	0.433-5.643
Play near paddy fields	-0.831	0.618	1.806	0.179	0.130-1.463
Blood cholinesterase levels	-3.076	0.606	25.760	0.001*	6.608-71.115
Constant	-0.120	0.886	0.018	0.893	

N=112

B: Regression Coefficient

S.E: Standard Error

95% C.I: 95% Confidence Interval

*Significant at $p < 0.05$

Form the result shown above, gender, mother's education and blood cholinesterase level had significant regression with the Motor scale of study respondents. Gender ($p=0.009$), mother's education ($p=0.012$) and blood cholinesterase level ($p=0.001$).

CHAPTER 5

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion

5.1.1 Socio-demographic Information

Set of questionnaires were given to the parents of selected school children with consent to obtain the socio-demographic background and permission. The total respondents involved in this study were 112 primary school children aged between 7-8.5 years old. The confounders that might affect the result of this study were age, gender, parent's education levels, and housing area. Generally, all of the respondents lived in the paddy field area. Permission from the Ministry of Education and principals of selected schools were obtained before data collection. Written consent from parents also obtained before the blood samples were collected for blood cholinesterase analysis. The inclusion criteria for the selected respondents were those who were healthy and lived in the paddy fields areas.

Protecting children from the potential effects of pesticides is one of our most important responsibilities. Pesticides have widespread uses and may affect children's health in a variety of settings. They are at greater risk from pesticide exposure because they are active and like to explore their environment, which were potentially contaminated. Poisoning occurs mostly by voluntary ingestion, inhalation, or by absorption through the skin (Vinay et al, 2011). Based on Pesticide Action Network (PAN) North America, children drink 2.5 times more water, eat 3-4 times more food, and breathe 2 times more air. They therefore absorb a higher concentration of pesticides than adults.

Epidemiologic evidence demonstrates associations between early life exposure to pesticides and pediatric cancers, decreased cognitive function, and behavioral problems (Roberts et al, 2012). Response to OPs can occur within minutes with mild symptoms such as headache, dizziness, nausea, vomiting, pupillary constriction, and excessive sweating, tearing, and salivation. More severe cases develop muscle weakness and muscle twitches, changes in heart rate, and bronchospasm and can progress to convulsions and coma (Tracey et al, 2004).

5.1.2 Blood Cholinesterase Levels

Organophosphate and carbamate are the most widely known acute poisoning. (Roberts et al, 2012). Organophosphate poisoning induces irreversible inhibition of acetylcholinesterase, the important enzymes that catalyzes the hydrolysis of neurotransmitter agent acetylcholine (Fukuto et al, 1990). Organophosphates phosphorylate the serine hydroxyl group of acetylcholine, leading to accumulation of acetylcholine at the cholinergic synapses which disrupted the neural transmission. If this blockade is not reversed within 24 hours, large amounts of acetylcholinesterase are permanently destroyed (Wille mijin et al, 2011).

Acetylcholinesterase is found in red blood cells as well as in nicotinic and muscarinic receptors. To determine the severity and/or the elimination time of OPs poisoning, one should measure cholinesterase in blood, either by measuring plasma pseudocholinesterase (PCE) or by measuring the cholinesterase in erythrocytes (Wille mijin et al, 2011). Acetylcholinesterase is found in nerve tissue and red blood cells and pseudocholinesterase is found primarily in the liver (Dhalla et al, 2013). The lower the blood cholinesterase levels, indicates high exposure to organophosphate pesticide exposure. However, from Table 4.5 in result part, most of the respondents were in normal levels of pesticide exposure.

The clinical presentations and outcome of OP poisoning depend on the dose, the route of entry, and the time between poisoning and start of treatment. The clinical features of OP poisoning are as follows (Vinay et al, 2011):

- (i) Acute cholinergic crisis, which manifests within 24 to 72 hours due to accumulation of acetylcholine at muscarinic and nicotinic sites and accumulation in CNS leading to headache, giddiness, seizure, and altered sensorium;
- (ii) Intermediate syndrome, which manifests after 24 to 96 hours due to prolonged activity of acetyl choline at nicotinic receptors resulting in weakness of ocular, neck, limb, and respiratory muscles.

Cholinesterase Test Kit Model LOVIBOND 412670 AF267 showed four different classifications for blood levels. It was classified based on the exposure levels which are normal (100-75%), over-exposure level (75-50%), serious over exposure level (50-25%), and serious and dangerous over-exposure level (25-0%). From the results obtained, the majority of study respondents were classified in normal exposure to pesticides. There were significant correlations between the blood cholinesterase levels with the score of the scales in the MSCA.

5.1.3 Relationship of blood cholinesterase levels with learning abilities.

Results showed that there were significant correlations between blood cholinesterase levels with cognitive functioning in all scales.

Exposure to environmental contaminants may develop neurodevelopment disorders such as attention-deficit/hyperactivity disorder (ADHD), mental retardation, or autism of the fetus or young child. A child's brain is vulnerable to adverse impacts from some environmental toxicants during its developmental process. Studies by Tracey et al (2004) showed that exposure to lead during childhood reduces intelligence and affects cognitive development.

Students learn by using their central nervous system, assisted by a healthy body, adequate nutrition, positive sense of well-being, and a clean environment. Pesticide exposure, however, deprived a student of a clean environment, can undermine or destroy the student's health, and may directly affect the student's central nervous system. Learning then becomes another casualty of pesticides.

In general, human health research demonstrates that pesticide poisoning can lead to poor performance on tests including intellectual functioning, academic skills, abstraction, flexibility of thought, and motor skills; memory disturbances and inability to focus attention; deficits in intelligence, reaction time, and manual dexterity; and

reduced perceptual speed. Increased anxiety and emotional problems have also been reported (Brien M.O., 1991).

Organophosphate and carbamate pesticides act as neurotoxins by inhibiting acetylcholinesterase and create a buildup of acetylcholine, which causes nervous system dysfunction. Acute exposures to organophosphate pesticides have been shown to cause apparently permanent intellectual damage. Moreover, low-level, nonchronic exposure has been shown in some cases to lead to behavioral effects before inhibition of acetylcholinesterase is measurable (Brien M.O., 1991).

Chronic toxicity identified in epidemiologic studies include adverse birth outcomes including preterm birth, low birth weight, and congenital anomalies, pediatric cancers, neurobehavioral and cognitive deficits, and asthma. The evidence base is most robust for associations to pediatric cancer and adverse neurodevelopment. Multiple case-control studies and evidence reviews support a role for insecticides in risk of brain tumors and acute lymphocytic leukemia (Roberts et al , 2012).

5.1.4 Selected variables that influence blood cholinesterase levels among study group.

Logistic Regression test were used to determine which selected variables significantly influenced the blood cholinesterase levels. From the result obtained, father's education showed significant regression with the blood cholinesterase levels of respondents. There were also other variables that can influence bloods cholinesterase levels such as gender, mothers' education, distance from house to school, house area, wash hand before eat and play near paddy fields.

Father's educations were divided into primary, secondary and tertiary school levels. The highest percentage was primary school levels and from the result obtained, it is the most influenced factor that affects the blood cholinesterase levels. It was supported by father's occupation that most of them are paddy farmers. Exposure to pesticides to the children may occur through the take-home exposure pesticide residue on clothing and footwear of agricultural workers who exposed to pesticides the most at their work area. This residue can be accidentally ingestion when there is no proper hand washing before eat.

Besides, another factor that may influence was the house near the work area. These areas are the place where the pesticides sprayed to the crops. Therefore, the exposure level of the population living were assumed to be high. They also may be exposed while playing near this area. Parents should not allow their child to play near the paddy fields.

When the pesticide is being sprayed, it will spread by air movement to the neighbouring environment. A few studies show that pesticides can travel up to 750 m from the spraying area (Ward et al., 2006 and Quandt et al., 2004). In 2011, a report made by Elizabeth Grossman found that organophosphate pesticides can easily drift with the wind beyond their intended fields when sprayed on the crops. This transmission may cause severe exposure to the people and may lead to chronic health effects from pesticides. Example of the health effects are cancer, endocrine disruption, and reproductive/developmental toxicity (Sugeng et al., 2013).

The prevalence of many childhood diseases varies by race/ethnicity and family income. For example, children of lower-income families are more likely to have had an asthma attack in the previous 12 than children from higher-income families (Tracey et al, 2004).

5.1.5 Selected variables that influenced cognitive functioning among study group.

Cognitive functioning among study respondents were measured by using McCarthy Scales of Children Abilities (MSCA). Logistic Regression tests were used to determine the selected variables that influenced each of the scales. From the result obtained, blood cholinesterase had significant regression with Verbal and Motor scale. Other confounding factors that affect the cognitive functioning in McCarthy Scale of Children Abilities (MSCA) among respondents were gender and mother's education.

Pesticide exposure is associated with deficits in cognitive function. Sheep dippers and nursery workers exposed to Ops showed worse performance on one or several tests of cognitive function. Pesticide exposure is also associated with deficits in psychomotor function (Alavanja et al, 2004). Furthermore, lead, mercury, and PCBs all have been found to have adverse effects on intelligence and cognitive functioning. Any contaminant with such effects has potential to increase the incidence of mental retardation in an exposed population (Tracey et al, 2004).

Clinical manifestations are of delayed in sensory-motor polyneuropathy (distal weakness, parasthesia, ataxia, diminished or absent reflexes). The symptoms usually begin 2-5 weeks after exposure to the chemical, and may last for years. Apart from these neural syndromes, OP pesticides can also cause chronic neurotoxicity and behavioural impairment in some patients (Paudyal et al, 2008).

Part of the brain that associated with the learning process (Savannah et al, 2014):

- **Frontal Lobe:** The frontal lobe (located behind the forehead) controls personality, but also problem solving, memory, language, judgment and impulse control. The left side of this lobe is more language based, while the right focuses on processes that do not require language. Damage to this area of the brain may affect critical thinking and problem solving skills.
- **Temporal Lobe:** The temporal lobe has many functions in learning, such as organizing information, memory and speech. It has controls in memory retrieval, visual memory and factual memories.
- **Hippocampus:** The hippocampus is involved in the formation of new memories. It does this by creating concepts, and organizing experiences into them. This helps identify contexts of actions and events, and organization of these into a storage system that makes sense to the brain.

From Table 4.12, gender and mother's education as a confounding factor significantly influenced the motor function of the children. Mother's educations are important in developing the child's brain as they are developing. The highest education background of the parents that involved in this study had a secondary school level. The boys more active and often playing out-door compared to girl and this influencing blood cholinesterase level and cognitive functioning. The higher exposure of pesticide among boys because they might play near paddy field.

Motor nerves carry messages from the brain and spinal cord to muscles, and make the muscles contract. It is important for major body movement such as walking, maintaining balance, coordination, jumping, and reaching. Students with poor motor development may have difficulty with activities such as writing, sitting up in an alert position, sitting erect to watch classroom activity, and writing on a blackboard (Ann et al, 2014).

Part of the brain that involved with motor functions is cerebellum. Cerebellum or also known as little brain is located at the back brain underlying occipital and temporal lobes of cerebral cortex. About 50% of neuron located in this part (. In addition to movement disorders, cerebellar patients also demonstrate subtle cognitive deficits, such as an impaired ability to estimate time intervals. Therefore damage to the nerve cell will disturbed the learning process of children (James, 2014).

5.2 Recommendations

Exposure prevention approaches is the best and important ways of decreasing the chronic health consequences of pesticide exposure among young children. Some of the recommendations are as follows:

1. Children may be exposed to pesticides used in and around their homes through rodent control products, cleaning products, lawn and garden products, insect repellents, and pet products. Parent or guardian should ensure all this pesticide based products were stored in proper place that reach out of children.
2. Besides, a child's diet can still be a potential source of pesticide exposure. Proper choices of food free from pesticide dietary risk and ensure proper hand washing before meals are important to reduce the accidental ingestion of pesticides residue.
3. Another important prevention is the parents should not allow their children to play outside house area especially near the paddy field where pesticide used is the most.
4. Lastly, seek the medical treatment as early possible time when the children is ill especially related to pesticide exposure sign and symptoms such as difficulty breathing, watery eyes, headache and excessive sweating.

5.3 Conclusion

As a conclusion, there was a significant relationship between blood cholinesterase levels with cognitive functioning in all scales of study group. High percentage of school children is having normal blood cholinesterase levels. None of the respondent are exposed to a very serious and danger exposure. The IQ among respondents based on GCI scores ranges from very superior to dull normal is in small frequency. No school children reported with borderline and mentally retarded cognitive functioning. The father's education level had significant regression with the blood cholinesterase levels. Finally, gender, mother's education and blood cholinesterase level had significant regression cognitive functioning in McCarthy Scale of Children Abilities (MSCA) among respondents.

5.4 Study Limitation

In addition to my research, time constraint is the main barriers in completing my research. Time allocated which is 4 weeks for each student to collect data is not enough because involved many steps such as giving questionnaires, time to conduct the test and collect blood samples. Besides, money also important as the study area is far from college and money spend on token of appreciation for each respondent.

REFERENCES

- Alavanja, M. C., Hoppin, J. A., & Kamel, F. (2004). Health effects of chronic pesticide exposure: cancer and neurotoxicity. *Annu. Rev. Public Health, 25*:155-197.
- Ann, L., (2014). Learn about Fine Motor Skills and How to Improve Them. Available from <http://learningdisabilities.about.com/od/df/p/finemotorskills.htm>. (May 16, 2014)
- Boyle, C. A., Boulet, S., Schieve, L. A., Cohen, R. A., Blumberg, S. J., Yeargin-Allsopp, M., ... & Kogan, M. D. (2011). Trends in the prevalence of developmental disabilities in US children, 1997–2008. *Pediatrics*, peds-2010.
- Dalvie, M.A., M.B. Sosana, A. Africa, E. Cairncross, L. London. (2013). Environmental monitoring of pesticide residues from farms at a neighbouring primary and pre-school in the Western Cape in South Africa. 466–467.
- Dhalla, A.S, Sharma, S., (2013) Assessment of serum cholinesterase in rural Punjabi sprayers exposed to a mixture of pesticides. *Toxicology International 2013.20*:154-159.
- Elizabeth, G., (2011) From the Fields to Inner City, Pesticides Affect Children's IQ Report.
- Gina, W. and David, Z. (2012). Pest management in food systems: An economic perspective. *Annual Review of Environment and Resources, 37*:223-245.
- Hubbs-Tait, L., Kennedy, T. S., Droke, E. A., Belanger, D. M., & Parker, J. R. (2007). Zinc, iron, and lead: relations to head start children's cognitive scores and teachers' ratings of behavior. *Journal of the American Dietetic Association, 107*(1):128-133.
- James, K., (2014). Disorders of the Motor System. Available from: <http://neuroscience.uth.tmc.edu/s3/chapter06.html>.
- Jensen, H. K., Konradsen, F., Jørs, E., Petersen, J. H., & Dalsgaard, A. (2010). Pesticide use and self-reported symptoms of acute pesticide poisoning among aquatic farmers in Phnom Penh, Cambodia. *Journal of toxicology, 2011*.
- Kateryna, B., Maureen, D., Louis P., John W.E., (2012). Environmental exposure to organophosphorus and pyrethroid pesticides in South Australian preschool children: A cross sectional study. *Environment International, 48*:109–120.
- Kazemi, M., Tahmasbi, A.M., Valizadeh, R., Naserian, A.A., Soni, A., (2012) Organophosphate pesticides: A general review. *Agricultural Science Research Journals, 2*(9):512-522.

- Kofman, O. R. A., Berger, A., Massarwa, A., Friedman, A., & Jaffar, A. A. (2006). Motor inhibition and learning impairments in school-aged children following exposure to organophosphate pesticides in infancy. *Pediatric research*, 60(1): 88-92.
- Kenneth, D.K., Michael, R.K., (2013). Organophosphate Toxicity Clinical Presentation. Available from: <http://emedicine.medscape.com/article/167726-clinical#a0217>. (December 12, 2013)
- Laura, R.A., Barr, W.B., & Burton, L.A. (2007). Effect of patient occupation/education variables on the choice of neuropsychological assessment instruments. *Applied Neuropsychology*, 14: 247-254.
- Lizardi, P.S., O'Rourke, M.K., & Morris, R.J. (2008). The effects of organophosphate pesticide exposure on Hispanic children' cognitive and behavioral functioning. *Journal of Pediatric Psychology*, 33(1): 91-101.
- London, L., Beseler, C., Bouchard, M. F., Bellinger, D. C., Colosio, C., Grandjean, P., ... & Stallones, L. (2012). Neurobehavioral and neurodevelopmental effects of pesticide exposures. *Neurotoxicology*, 33(4): 887-896.
- Lucio, G.C., (2006). Current issues in organophosphate toxicology. *Clinica chimica acta*, 366(1): 1-13.
- Maryse, F.B., Chevrier, J., Kim, G.H., Kogut, K., Vedar, M., Calderon, N., Trujillo, C., Johnson, C., Bradman, A., Barr, D.B., Eskenazi, B., (2011) Prenatal exposure to organophosphate pesticides and IQ in 7-year old children. *Environmental health perspectives*, 119:1189-1195.
- Mostafalou, S., & Abdollahi, M. (2013). Pesticides and human chronic diseases: evidences, mechanisms, and perspectives. *Toxicology and applied pharmacology*, 268(2):157-177.
- Naing, L., Winn, T., & Rusli, B. N. (2006). Practical issues in calculating the sample size for prevalence studies. *Archives of Orofacial Sciences*, 1(1): 9-14.
- O'Brien, M. (1991) "Are pesticides taking away the ability of our children to learn?" *Journal of Pesticide Reform Winter*, :4-8.
- Oerke, E. C. (2006). Crop losses to pests. *The Journal of Agricultural Science*, 144(01): 31-43.
- Paudyal, B. P. (2008). Organophosphorus poisoning. *Journal of Nepal Medical Association*, 47(172).
- Pejabat Daerah/ Tanah Sabak Bernam, Profil Daerah. Available from: <http://www.selangor.gov.my/sabakbernam/main>.

- Roberts, J. R., Karr, C. J., Paulson, J. A., Brock-Utne, A. C., Brumberg, H. L., Campbell, C. C., ... & Wright, R. O. (2012). Pesticide exposure in children. *Pediatrics*, 130(6):1765-1788.
- Rosenstock, L., Keifer, M., Daniell, W. E., McConnell, R., & Claypoole, K. (1991). Chronic central nervous system effects of acute organophosphate pesticide intoxication. *The Lancet*, 338(8761): 223-227.
- Rothlein, J., Rohlman, D., Lasarev, M., Phillips, J., Muniz, J., & McCauley, L. (2006). Organophosphate pesticide exposure and neurobehavioral performance in agricultural and nonagricultural Hispanic workers. *Environmental Health Perspectives*, 691-696.
- Savannah, G., (2014). What Part of the Brain Affects Learning? Available from: http://www.ehow.com/about_5494465_part-brain-affects-learning.html
- Slotkin TA.(2006). Developmental neurotoxicity of organophosphates: a case study of chlorpyrifos: In toxicity of organophosphate and carbamate pesticides (San Diego. *Elsevier Academic Press*, 293-314.
- Sugeng, A. J., Beamer, P. I., Lutz, E. A., & Rosales, C. B. (2013). Hazard-ranking of agricultural pesticides for chronic health effects in Yuma County, Arizona. *Science of The Total Environment*, 463, 35-41.
- Tapia, L.R., Antonia, L., Fernando, S.S., (2005). Chronic neuropsychological sequelae of cholinesterase inhibitors in the absence of structural brain damage: two cases of acute poisoning. *Environmental health perspectives*, 762-766.
- Tracey, J.W., Daniel, A.A., Amy, D.K., Onyemaechi, N., Gregory, G.M., Bradford, J.H., (2004) Trends in environmentally related childhood illnesses. *Pediatrics*, 113(Supplement 3), 1133-1140.
- U.S EPA (U.S. Environmental Protection Agency). (2010).Protecting Children Where They Learn. Available from <http://www.epa.gov/pesticides/health/children-learn.html>.
- U.S EPA (U.S. Environmental Protection Agency). (2010).Protecting Children Where They Learn. Available from <http://www.epa.gov/pesticides/health/children-live.html>.
- U.S EPA (U.S. Environmental Protection Agency). (2010). Pesticides Must Registered with EPA. Available from <http://www2.epa.gov/safepestcontrol/pesticides-must-be-registered-epa>.
- Ward, M. H., Lubin, J., Giglierano, J., Colt, J. S., Wolter, C., Bekiroglu, N., ... & Nuckols, J. R. (2006). Proximity to crops and residential exposure to agricultural herbicides in Iowa. *Environmental health perspectives*, 893-897.

Wessels, D., Barr, D. B., & Mendola, P. (2003). Use of biomarkers to indicate exposure of children to organophosphate pesticides: implications for a longitudinal study of children's environmental health. *Environmental Health Perspectives*, 111(16): 1939.

Willemijin, V.H., Said, H.I., (2011) Accidental organophosphate insecticide intoxication in children: a reminder. *Int J Emerg Med*, 4(1), 32.

World Health Organization (WHO), (2010). Pesticides. Available from <http://www.who.int/topics/pesticides/en/>.

Zailina, H., Junidah, R., Josephine, Y., & Jamal, H. H. (2008). The influence of low blood lead concentrations on the cognitive and physical development of primary school children in Malaysia. *Asia-Pacific journal of public health*, 20(4), 317-326.



Ref: JRM/2014/00001-13/UKM/PAPEP
Date: 17 March 2014

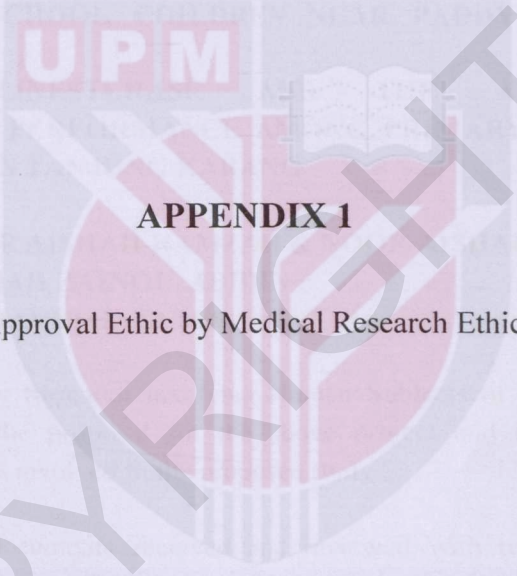
Dr. David Basma
Department of Environment & Occupational Health,
Faculty of Medicine and Health Sciences,
Universiti Putra Malaysia,
Seremban, Negeri Sembilan

Dear Sir,

RESEARCH PROJECT "EFFECTS OF BLOOD GLUCOSE AND LIPID PROFILE
AMONG PRIMARY SCHOOL CHILDREN IN NEAR PAPER MILL TOWN
KAWAN, L. BLOOD GLUCOSE AND LIPID PROFILE AMONG CHILDREN WITH
NEUROBEHAVIORAL DISORDERS IN NEAR PAPER MILL TOWN CHILDREN
AT GEPATRY FIELD"

APPENDIX 1

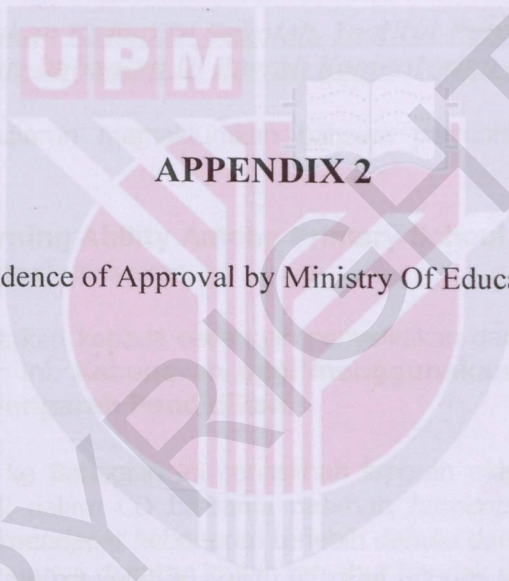
(Evidence of Approval Ethic by Medical Research Ethic Committee)

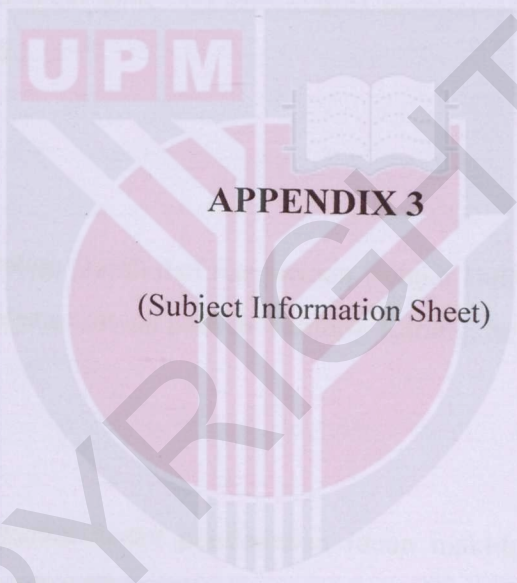


Ref. Kand : KP(BPP01)603/5/31.D- 15(27)
Tarikh : 08 Januari 2014

APPENDIX 2

(Evidence of Approval by Ministry Of Education)





APPENDIX 3

(Subject Information Sheet)



HELAIAN PENERANGAN RESPONDEN

Sila baca maklumat berikut dengan teliti. Sekiranya anda mempunyai sebarang pertanyaan, sila kemukakan kepada penyelidik.

1. TAJUK KAJIAN

Paras Kolinesterase Dalam Darah dan Keupayaan Belajar Dalam Kalangan Kanak-Kanak Sekolah Rendah berdekatan sawah padi di Tanjung Karang, Selangor.

2. PENGENALAN

Kajian ini adalah berkaitan kesan pendedahan racun makhluk perosak dan tumbuhan yang digunakan di sawah padi berhampiran sekolah terhadap keupayaan belajar dalam kalangan kanak-kanak di Tanjung Karang, Selangor. Racun yang biasa digunakan di kawasan sawah padi ialah racun serangga dan racun rumpai yang berfungsi untuk membunuh makhluk perosak dan rumpai yang mengganggu tanaman. Pada masa yang sama, semburan bahan kimia ini juga boleh memberi impak negative kepada kesihatan manusia terutama kanak-kanak. Kanak-kanak merupakan golongan yang berisiko tinggi terhadap pendedahan racun yang digunakan kerana sistem pertahanan badan dan anggota badan sedang berkembang. Simptom-simptom yang kerap ditunjukkan ialah peluh yang berlebihan, masalah pembelajaran, masalah tidur dan penafasan serta tangan gatal dan kemerahan.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Ibubapa atau penjaga kepada kanak-kanak hanya perlu menandatangani surat kebenaran menjalankan ujikaji terhadap anak mereka sekiranya berminat. Anda hanya perlu menandatangani borang peserta responden setelah membaca dan memahami huraian ini. Borang peserta mestilah dikembalikan kepada penyelidik sebelum apa-apa kajian dijalankan ke atas anak anda. Selepas itu, satu siri ujian akan dijalankan oleh penyelidik. Hanya ikut arahan yang diberikan oleh pengkaji.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Kajian ini hanya akan dijalankan keatas kanak –kanak yang memenuhi ciri-ciri yang diperlukan untuk menjadi responden. Antara yang tidak dibenarkan untuk mengambil bahagian ialah kanak-kanak yang berumur kurang dari dua tahun dan lebih dari 8 tahun, serta kanak-kanak yang mempunyai masalah kesihatan seperti kecacatan mental dan fizikal yang boleh mengganggu keputusan ujikaji.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANAK/ JAGAAN SAYA SEBAGAI PESERTA?

Antara faedah yang diperolehi oleh peserta kajian ini adalah peserta akan mendapat maklumat dan pengetahuan mengenai pendedahan racun yang digunakan dengan kesan yang diperolehi terhadap keupayaan kanak-kanak. Hasil daripada kajian ini, ibubapa mendapat lebih kesedaran tentang bahaya racun perosak dan seterusnya mengambil langkah berjaga-jaga dalam melindungi anak-anak mereka.

b) KEPADA PENYELIDIK?

Maklumat dan hasil daripada kajian ini dapat membantu penyelidik mengumpul bukti pendedahan racun kepada kesihatan kanak-kanak di Malaysia. Selain itu, hasil kajian ini juga dapat membantu penyelidik dalam mempromosikan kesihatan untuk mengekalkan taraf kesihatan kanak-kanak. Akhir sekali, kajian ini menyelesaikan salah satu tugas sebagai pelajar tahun akhir.

6. ADAKAH IA BERISIKO?

Sebanyak 0.01mL darah kanak-kanak akan diambil melalui jari responden menggunakan teknik 'finger prick' untuk menguji tahap kolinesterase dalam darah. Selain itu, kanak-kanak akan menjalankan semua ujian yang berkaitan dengan keupayaan belajar. Semua proses pengambilan adalah mengikut prosedur yang ditetapkan dan akan dijalankan dengan selamat.

7. ADAKAH MAKLUMAT DAN IDENTITI ANAK/ JAGAAN SAYA KEKAL RAHSIA?

Semua maklumat responden adalah rahsia dan sulit untuk tatapan umum. Tiada maklumat individu dari semua aspek akan dibincangkan.

8. SIAPA YANG PERLU SAYA HUBUNGI SEKIRANYA SAYA MEMPUNYAI SOALAN TAMBAHAN SEPANJANG PENYELIDIKAN INI?

Sebarang masalah atau soalan yang berkaitan dengan penyelidikan ini, boleh diajukan kepada penyelidik, Noor Aishah binti Hamzah untuk berjumpa secara langsung atau hubungi di talian berikut; 013-3249221. Terima kasih atas kerjasama yang diberikan.

Sila tandatangan di sini sekiranya anda telah membaca dan memahami kandungan halaman ini _____

BORANG KESEHAHAN IBU BAPA PENJAJA

TAJUK KAJIAN

Persepsi Risiko/Faktor Dalam Dunia Kerja Terhadap Kesihatan Mental dan Persepsi Risiko/Faktor Terhadap Rendahnya Kesihatan Mental pada Pekerja Karang, Selangor

Penyaji: Nur Amnah Binti Haniffa

Saya
menyatakan

APPENDIX 4

(Informed Consent)





**JAWATANKUASA ETIKA UNIVERSITI UNTUK
PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA**

BORANG KEBENARAN IBU BAPA/ PENJAGA

TAJUK KAJIAN:

Paras Kolinesterase Dalam Darah dan Keupayaan Belajar Dalam Kalangan Kanak-Kanak Sekolah Rendah berdekatan sawah padi di Tanjung Karang, Selangor.

Penyelidik: Noor Aishah binti Hamzah

Saya..... No Kad Pengenalan.....
beralamat.....
.....dengan ini secara sukarela bersetuju membenarkan *anak / jagaan saya
..... menyertai penyelidikan tersebut di atas *(klinikal/percubaan ubat-
ubatan/rakaman video/kumpulan sasaran/temuduga/ soal selidik).

Saya telah diberi penjelasan secara menyeluruh mengenai penyelidikan ini dari segi metodologi, risiko dan komplikasi (seperti yang tercatat dalam Helaian Penerangan). Saya memahami bahawa *anak / jagaan saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan. Saya juga memahami bahawa sebarang maklumat yang berkaitan identiti *anak / jagaan saya akan dirahsiakan.

Saya* berminat / tidak berminat untuk mengetahui keputusan kajian yang **melibatkan** *anak / jagaan saya.

Saya setuju/tidak bersetuju untuk imej/gambar/rakaman video/ rakaman suara berkaitan dengan anak/ jagaan saya digunakan dalam apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

*potong yang tidak berkenaan

Tandatangan.....
(Ibubapa / Penjaga)

Tandatangan.....
(Saksi)

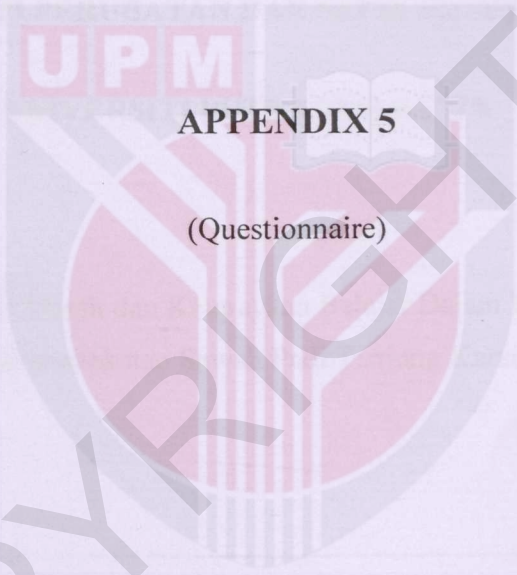
Tarikh:.....

Nama:.....
No. K / P :.....

Saya mengesahkan bahawa saya telah menjelaskan kepada ibu bapa responden / penjaga sifat dan tujuan penyelidikan yang tersebut di atas .

Tarikh.....

Tandatangan.....
(Penyelidik)



APPENDIX 5

(Questionnaire)



UPM
UNIVERSITI PUTRA MALAYSIA

ID Responden:

--	--	--

JABATAN KESIHATAN DAN PEKERJAAN
FAKULTI PERUBATAN DAN SAINS KESIHATAN
UNIVERSITI PUTRA MALAYSIA

Paras Kolinesterase Dalam Darah dan Keupayaan Belajar Dalam Kalangan Kanak-Kanak
Sekolah Rendah berdekatan Sawah Padi Tanjung Karang, Selangor.

Alamat Responden: _____

No. Telefon (R): _____

(HP): _____

ARAHAN SOALAN

1. Borang soal selidik ini mengandungi empat (4) bahagian iaitu:

Bahagian A: Maklumat peribadi kanak-kanak dan keluarga

Bahagian B: Pengetahuan tentang racun serangga

Bahagian C: Maklumat kawasan perumahan

Bahagian D: Maklumat taraf kesihatan kanak-kanak

2. Anda diminta menjawab semua soalan yang ada di dalam buku soalan ini.

3. Untuk menjawab, anda perlulah menandakan (√) pada ruangan kotak yang disediakan.

4. Borang soal selidik ini hendaklah diserahkan semula kepada pengkaji setelah selesai menjawab semua soalan.

Bahagian A: Maklumat Peribadi Kanak-kanak dan Keluarga

1. Umur: _____ tahun
2. Tinggi kanak-kanak: _____ cm Berat kanak-kanak: _____ kg
3. Tarikh lahir: _____
4. Bilangan adik-beradik: _____ (orang)
5. Tahun persekolahan: _____
6. Jantina:
 Lelaki Perempuan
7. Bangsa:
 Melayu Cina India Lain-lain
8. Tahap pendidikan bapa:
 Sekolah rendah Sekolah menengah Institusi/ Universiti
9. Tahap pendidikan ibu:
 Sekolah rendah Sekolah menengah Institusi/ Universiti
10. Pekerjaan bapa:
 Pesawah Bukan pesawah
11. Pekerjaan ibu:
 Pesawah Bukan pesawah
12. Adakah anak anda diberikan susu badan sejak lahir?
 Ya Tidak
13. Jika Ya, sila nyatakan tempoh penyusuan: Dari _____ hingga _____

14. Tempoh kanak-kanak tinggal di alamat sekarang: _____ tahun _____ bulan

15. Adakah antara ahli keluarga yang merokok sejak awak lahir?

Bapa Ibu Ahli keluarga lain

16. Apakah jenis aktiviti (hobi) yang biasa anda lakukan?

Sila nyatakan: _____

17. Ketika bermain diluar rumah, adakah anak anda memakai seperti berikut:

Sila pilih satu jawapan sahaja. Tandakan (√) di kotak yang disediakan.

Media / Kekerapan	Selalu	Kadang-kadang	Tidak pernah
Kasut			
Selipar			
Tudung/ topi			
Baju lengan panjang			
Baju lengan pendek			
Seluar panjang			
Seluar pendek			
Lain-lain (Nyatakan:.....)			

18. Adakah anak anda membasuh tangan dengan betul setiap kali sebelum makan?

Ya Tidak

19. Berapa kerap anak anda mandi dalam sehari?

Sekali sehari
 2 kali sehari
 > 3kali sehari

20. Adakah kanak-kanak dibenarkan bermain di kawasan ladang kelapa sawit?

Ya Tidak

Bahagian B: Pengetahuan tentang Racun Serangga

19. Adakah anda mempunyai keluarga bekerja di ladang kelapa sawit?

Ya Tidak

20. Adakah anda faham apa itu racun serangga?

Ya Tidak

21. Adakah anda menggunakan sebarang racun makhluk perosak di rumah anda?

Ya Tidak

22. Di manakah anda menyimpan racun makhluk perosak yang telah digunakan?

Bilik stor

Belakang rumah

Lain-lain (nyatakan: _____)

Bahagian C: Maklumat Kawasan Perumahan

23. Apakah kenderaan yang digunakan oleh anak anda untuk ke sekolah?

Nyatakan: _____

24. Jarak lokasi sekolah dari rumah

< 100 meter dari rumah

> 100 meter dari rumah

> 500-1000 meter dari rumah

>1000 meter dari rumah

25. Sila pilih lokasi kawasan perumahan anda

Berdekatan dengan ladang kelapa sawit

Berdekatan dengan jalan raya

Berdekatan dengan kawasan perumahan

Berdekatan dengan hutan

Bahagian D: Maklumat Taraf Kesihatan Kanak-kanak

Berikut merupakan soalan-soalan mengenai taraf kesihatan anak anda, sila pilih YA atai TIDAK.

Sekiranya anda ragu-ragu sila tandakan TIDAK

26. Dalam masa 3 bulan yang lepas, pernahkah anak anda mengalami masalah kesihatan berikut (Sila tanda / di tempat yang berkaitan)

Simptom	Ya	Tidak	Tidak Pasti
Susah bernafas			
Mata berair			
Hidung berair			
Pening kepala			
Peluh berlebihan			
Batuk			

27. Apabila berlaku simptom-simptom yang dihuraikan di atas, pernahkah anda berjumpa dengan doktor perubatan?

Ya Tidak

- Borang soal selidik tamat -

Terima kasih atas kerjasama yang anda berikan.

Sekian.

Record Form

NAME _____ AGE _____ SEX _____

HOME ADDRESS _____

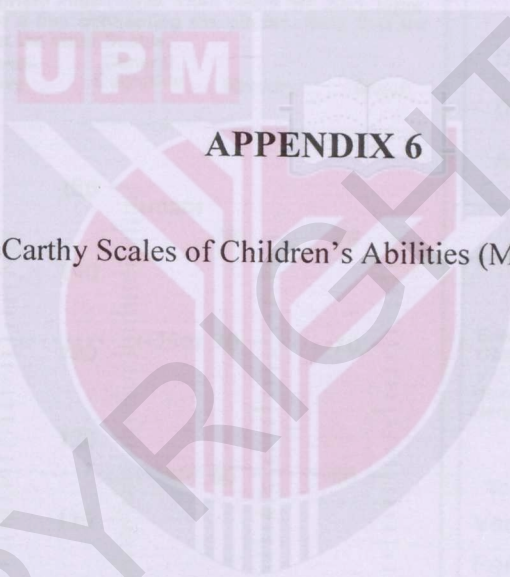
NAMES OF PARENTS OR GUARDIAN _____

SCHOOL _____ GRADE _____

PLACE OF TESTING _____ REASON _____

REFERRED BY _____

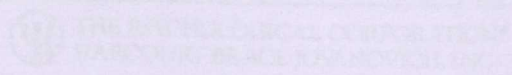
MSCA PROFILE



APPENDIX 6

(McCarthy Scales of Children's Abilities (MSCA) Form)

COPYRIGHT UPM



McCARTHY SCALES OF CHILDREN'S ABILITIES

Record Form

NAME _____ AGE _____ SEX _____

HOME ADDRESS _____

NAMES OF PARENTS OR GUARDIAN _____

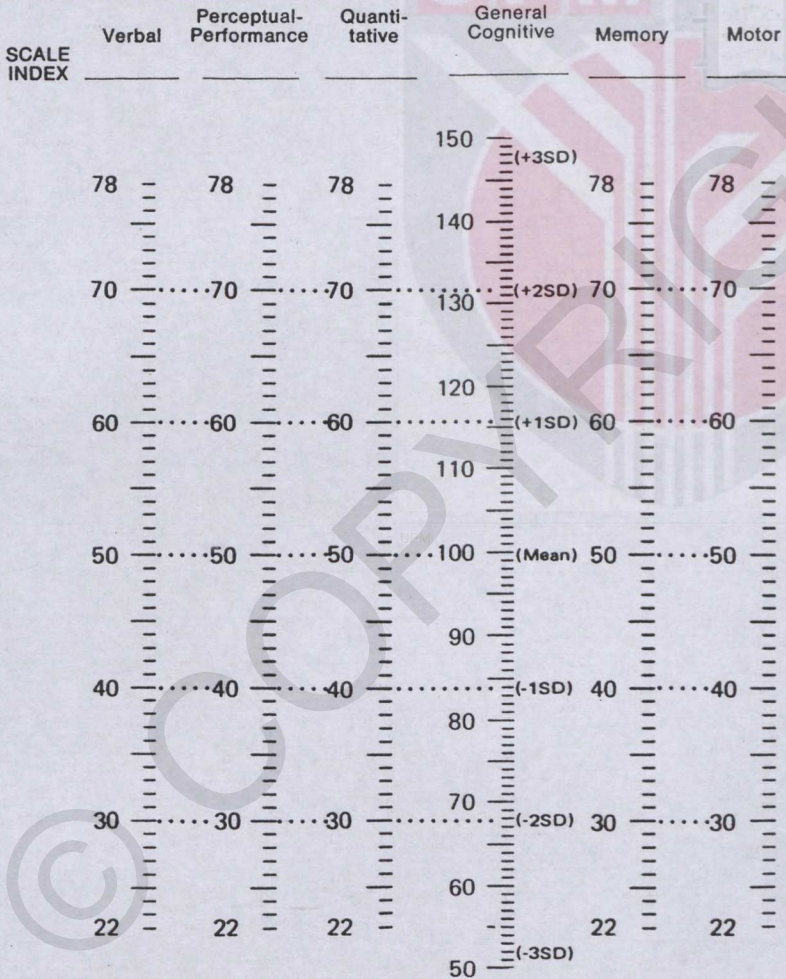
SCHOOL _____ GRADE _____

PLACE OF TESTING _____ TESTED BY _____

REFERRED BY _____

MSCA PROFILE

Enter the 6 Scale Indexes on the appropriate lines below. Then circle the mark representing the index for each Scale. Draw a line connecting the circles. Note that the values for GC are different from those for the other Scales.



Year Month Day

Date Tested _____

Date of Birth _____

Age _____

COMPOSITE RAW SCORES AND SCALE INDEXES

Enter the composite raw scores from the back cover. Obtain the composite raw score for GC by adding $V+P+Q$. Determine the corresponding Scale Indexes from Table 16. (See page 151 of manual for detailed directions.)

Scale	Composite Raw Score	Scale Index
Verbal (V)	_____	_____
Perceptual-Performance (P)	_____	_____
Quantitative (Q)	_____	_____
General Cognitive: Add composite raw scores $V+P+Q$	_____	GCI _____
Memory (Mem)	_____	_____
Motor (Mot)	_____	_____

LATERALITY

(Enter information from Laterality Summary on page 5.)

Hand _____

Eye _____



THE PSYCHOLOGICAL CORPORATION®
HARCOURT BRACE JOVANOVICH, INC.

Copyright © 1972, 1970 by The Psychological Corporation.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the publisher.

"The Psychological Corporation" and the "PSI" logo are registered trademarks of The Psychological Corporation.

All rights reserved under the Berne Convention.
Printed in the United States of America.

76-152AS 9-188731

1. BLOCK BUILDING Discontinue after failure on both trials of 2 consecutive items.

	Score		Best Score (0-3)
	Trial 1 (0-3)	Trial 2 (0-3)	
1. Tower			(0-2)
2. Chair			(0-2)
3. Building			(0-2)
4. House			(0-3)
Total			Max. = 10

Test 1

AGE 5
START →

2. PUZZLE SOLVING Discontinue after 3 consecutive failures.

	Time Limit	Performance Time	Circle Obtained Score*																	
1. Cat	30"		0	1																
2. Cow	30"		0	1																
3. Carrot	30"		0	1	2															
4. Pear	60"	(0"-60")	0	1	2	3	4	5												
5. Bear	90"	(0"-90")	0	1	2	3	4	5	6	7	8	9								
6. Bird	120"	(0"-120")	0	1	2	3	4	5	6	7	8	9								
Total			Max. = 27																	

*For items 4-6, bonus points for quick performance are given only if the child completes the puzzle perfectly.

× 1/2 = Test 2
(Round half-scores up)

3. PICTORIAL MEMORY

Exposure Time	Response Time	Response	Score
Allow 10"	Allow 90"	Button <input type="checkbox"/> Fork <input type="checkbox"/> Paper Clip <input type="checkbox"/> Horse <input type="checkbox"/> Padlock <input type="checkbox"/> Pencil <input type="checkbox"/>	(0-6)

Test 3

4. WORD KNOWLEDGE Discontinue if score on Part I is less than 6. Discontinue Part II after 4 consecutive failures on that part.

PART I. PICTURE VOCABULARY Card	Response	Score
1. Apple <input type="checkbox"/> Tree <input type="checkbox"/> House <input type="checkbox"/> Woman <input type="checkbox"/> Cow <input type="checkbox"/>		(0-5)
2. Clock		(0-1)
3. Sailboat		(0-1)
4. Flower		(0-1)
5. Purse		(0-1)
Total (Part I)		Max. = 9

PART II. ORAL VOCABULARY Discontinue Part II after 4 consecutive failures.

Response	Score (0-2)
1. Towel	
2. Coat	
3. Tool	
4. Thread	
5. Factory	
6. Shrink	
7. Expert	
8. Month	
9. Concert	
10. Loyal	
Total (Part II)	Max. = 20

For age 5, start at the indicated item. If items 1 and 2 of Part II are passed, give 9 points for Part I. (See manual.)

+ =
Part I Part II Test 4

AGE 5
START →

AGE 5
START →

5. NUMBER QUESTIONS <small>Discontinue after 4 consecutive failures.</small>			
	Right Answer	Response	Score (0-1)
1. Ears	Two		
2. Noses	One		
3. Heads	One		
4. Toys	Three		
5. Balloons	Two		
6. Candy	Six		
7. Pennies	Seven		
8. Apples	Twelve		
9. Crayons	Six		
10. Ball	Eighty		
11. Secret	Four		
12. Cookies	Three		
Total			Max. = 12

$$\times 2 = \boxed{}$$

Test 5

6. TAPPING SEQUENCE					
	Tapping Order	Score			Best Score (0-2)
		Trial 1 (0-2)	Trial 2 (0-2)	Trial 3 (0-2)	
1.	1-2-3-4				
Continue only if child plays item 1 correctly, and discontinue after 2 consecutive failures on items 2-8.					Score (0-1)
2.	1-3-4				
3.	2-4-1				
4.	4-1-2-3				
5.	2-3-1-4				
6.	1-4-3-2-3				
7.	4-2-3-1-2				
8.	1-2-4-3-2-1				
Total					Max. = 9

Test 6

7. VERBAL MEMORY <small>Discontinue Part I after 3 consecutive failures. If child earns 8 or more points (out of 30) on Part I, give Part II.</small>	
PART I. WORDS AND SENTENCES	
	Score
1. toy - chair - light	(0-3)
2. doll - dark - coat	(0-3)
3. after - color - funny - today	(0-4)
4. around - because - under - never	(0-4)
Do NOT stress the <u>underlined</u> words in items 5 and 6.	
5. The <u>boy</u> said <u>good-bye</u> to his <u>dog</u> every <u>morning</u> <u>before</u> he went to <u>school</u> .	(0-7)
6. The <u>girl</u> <u>typed</u> a <u>pretty</u> <u>pink</u> <u>ribbon</u> on her <u>doll</u> <u>before</u> she <u>went</u> <u>out</u> .	(0-9)
Total (Part I)	
Max. = 30	

$$\times \frac{1}{2} = \boxed{} \text{ (Round half-scores up)}$$

Test 7, Part I

PART II. STORY <small>Give Part II if child earned 8 or more points (out of 30) on Part I.</small>		Score (0-1)
	Response	
1. Term used for Bob		
2. Term used for the woman		
3. Term used for the letters		
4. Bob walking to store		
5. Bob saw woman		
6. Wind blew letters		
7. Bob shouted, "I'll get them for you!"		
8. Bob was careful		
9. Bob picked up letters		
10. Woman was happy		
11. Woman thanked Bob		
Total (Part II)		Max. = 11

Test 7, Part II

8. RIGHT-LEFT ORIENTATION Administer only to children aged 5 and above. Discontinue after failure on 5 consecutive items.

	Score (0-1)
1. Show me your right hand.	
2. Which is your left ear?	
*3. Touch your right eye with your left hand.	
4. Put your chin in your left hand.	
5. Cross your left knee over your right one.	
6. Show me Roger's left knee.	
7. Show me Roger's right elbow.	
*8. Show me Roger's left foot with your right hand.	
*9. Put your right hand on Roger's right shoulder.	

*Enter score for each part separately. Both parts must be failed for the item to be considered a failure.

Total **Max.=12**
Test 8

9. LEG COORDINATION Discontinue after item 5 if both trials of items 1-5 are failed.

	Score		Best Score	Notes
	Trial 1	Trial 2		
1. Walking backwards	(0-2)	(0-2)	(0-2)	
2. Walking on tiptoe	(0-2)	(0-2)	(0-2)	
3. Walking a straight line	(0-2)	(0-2)	(0-2)	
4. Standing on one foot	(0-2)	(0-2)	(0-2)	
5. Standing on other foot	(0-2)	(0-2)	(0-2)	
6. Skipping	(0-3)	(0-3)	(0-3)	

Total **Max.=13**
Test 9

10. ARM COORDINATION Give Part II even if Part I is failed. Discontinue Part II if all 3 trials of item 1, Part II, are failed. Give Part III even if Part II is failed.

PART I. BALL BOUNCING				Best Score	Preferred Hand
Trial 1		Trial 2			
Number of Bounces	Score	Number of Bounces	Score	(0-7)	R L B
(0-15)	(0-7)	(0-15)	(0-7)		

Number of Bounces	Score
15	7
12-14	6
9-11	5
6-8	4
3-5	3
2	2
1	1
0	0

(Part I)

PART II. BEANBAG CATCH GAME Give Part II even if Part I is failed. Discontinue Part II if all 3 trials of item 1 are failed.

	Trial	Score (0-1)	Preferred Hand
1. Both hands	1		
	2		
	3		
2. Preferred hand	1		R L
	2		
	3		
3. Other hand	1		
	2		
	3		
Total (Part II)		Max. = 9	

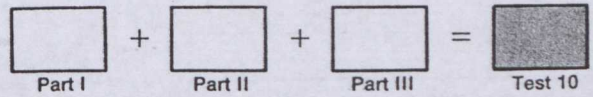
PART III. BEANBAG TARGET GAME Give Part III even if Part II is failed.










	Trial	Score (0-2)	Preferred Hand
1. Preferred hand	1		
	2		
	3		
2. Other hand	1		
	2		
	3		
Total (Part III)		Max. = 12	

11. IMITATIVE ACTION

	Score (0-1)	Eye Used
1. Cross feet		
2. Fold hands		
3. Twiddle thumbs		R L
4. Sight through tube		
Total	Max. = 4	

Test 11



12. DRAW-A-DESIGN consecutive failures.		Discontinue after 3	
	Pass-Fail	Score	Preferred Hand
1. 		(0-1)	R L B
2. 		(0-1)	R L B
3. 		(0-1)	R L B
4. 		(0-2)	R L B
5. 		(0-2)	R L B
6. 		(0-3)	R L B
7. 		(0-3)	R L B
8. 		(0-3)	R L B
9. 		(0-3)	R L B

Total **Max.=19**
Test 12

13. DRAW-A-CHILD		Administer only if child earned 1 or more points on Test 12.	
	Score (0-2)	Preferred Hand	Child's Comments
1. Head		R L B	
2. Hair			
3. Eyes			
4. Nose			
5. Mouth			
6. Neck			
7. Trunk			
8. Arms and hands			
9. Attachment of arms			
10. Legs and feet			

Total **Max.=20**
Test 13

LATERALITY SUMMARY

HAND DOMINANCE

Test 10, Part I	Ball bouncing	R	L	B
Test 10, Part II, item 2	Beanbag catch	R	L	
Test 10, Part III, item 1	Beanbag throw	R	L	
Tests 12 & 13, all items	Drawing	R	L	B
Totals		R	L	B

HAND DOMINANCE

Check one: (See pages 148-149 of manual.)

- Dominance Established (Right-Handed)
 Dominance Established (Left-Handed)
 Dominance Not Established
 Not Scorable

EYE USED IN SIGHTING (Test 11, item 4)

Check one: (See page 149 of manual.)

- Right
 Left
 Not Scorable

14. NUMERICAL MEMORY Discontinue Part I after failure on *both* trials of any item. If child earns 3 or more points on Part I, give Part II and discontinue after failure on *both* trials of any item.

PART I. FORWARD SERIES			Score (0-2)	PART II. BACKWARD SERIES			Score (0-2)
	Trial 1	Trial 2			Trial 1	Trial 2	
1.	5-8	4-9		1.	9-6	4-1	
2.	6-9-2	5-8-3		2.	1-8-3	2-5-8	
3.	3-8-1-4	6-1-8-5		3.	5-2-4-9	6-1-8-3	
4.	4-1-6-9-2	9-4-1-8-3		4.	1-6-3-8-5	6-9-5-2-8	
5.	5-2-9-6-1-4	8-5-2-9-4-6		5.	4-9-6-2-1-5	3-8-1-6-2-9	
6.	8-6-3-5-2-9-1	5-3-8-2-1-9-6					
			Max.=12	Total (Part II)			Max.=10
Total (Part I)							× 2 =

Test 14, Part I

Test 14, Part II

15. VERBAL FLUENCY

	Time Limit	Record Responses Verbatim	Score (0-9)
1. Things to eat Examples: bread potatoes	20"		
2. Animals Examples: cat bear	20"		
3. Things to wear Example: shoes	20"		
4. Things to ride Example: bus	20"		
Total			Max.=36

Test 15

16. COUNTING AND SORTING If child passed 9 or more items on Test 5, give full credit on Test 16. Otherwise, administer Test 16 and discontinue after 4 consecutive failures.

	Score (0-1)
1. Takes 2 blocks	
2. Takes 3 more blocks	
3. Answer: 5	
4. Puts 2 blocks on each card	
5. Answer: 2	
6. Puts 5 blocks on each card	
7. Answer: 5	
8. Point: 2nd block from left	
9. Point: 4th block from right	
Total	Max.=9

Test 16

17. OPPOSITE ANALOGIES	
	Score (0-1)
1. The sun is <i>hot</i> , and ice is _____.	
2. I throw the ball <i>up</i> , and then it comes _____.	
Continue only if child answers at least one of items 1 and 2 correctly, and discontinuē after 3 consecutive failures on items 3-9.	X
3. An elephant is <i>big</i> , and a mouse is _____.	
4. Running is <i>fast</i> , and walking is _____.	
5. Cotton is <i>soft</i> , and rocks are _____.	
6. A lemon is <i>sour</i> , and candy is _____.	
7. Feathers are <i>light</i> , and stones are _____.	
8. Syrup is <i>thick</i> , and water is _____.	
9. Sandpaper is <i>rough</i> , and glass is _____.	
Total	Max. =9

18. CONCEPTUAL GROUPING				Discontinue after 4 consecutive failures.
				Score
1. Little, big				(0-1)
2. Red, yellow, blue				(0-1)
3. Square, round				(0-1)
	Number Right	Number Wrong	Right Minus Wrong	X
4. Square blocks	(0-6)	(0-6)	(0-6)	(0-2)
5. Big yellow blocks	(0-2)	(0-10)	(0-2)	(0-2)
6. Big round red block				(0-1)
7. Small blue square				(0-1)
8. Large blue square				(0-1)
9. Large yellow circle and small yellow square				(0-2)
Total				Max. =12

Total × 2 =
 Test 17

NOTES:



COPYRIGHT

COMPUTATION OF COMPOSITE RAW SCORES

1. Enter the *weighted raw scores* which are in the shaded boxes on pages 2-7 of the record form. For each test, enter the score in the box(es) bearing that test's number. (For example, the score for Test 3 is entered in 2 boxes.)
 2. Sum the scores in each of the 5 columns. Enter the totals in the *composite raw score* boxes at the foot of the page.
 3. Transfer the *composite raw scores* to the front cover. (Open the booklet and turn it over so that the front and back covers are side by side.) Enter the scores in the Composite Raw Score column in the box labeled "Composite Raw Scores and Scale Indexes."
- (For more detailed directions on the completion of the record form, see Chapter 7 of manual.)

WEIGHTED RAW SCORES

	V	P	Q	Mem	Mot
1. Block Building		1 <input type="text"/>			
2. Puzzle Solving		2 <input type="text"/>			
3. Pictorial Memory	3 <input type="text"/>			3 <input type="text"/>	
4. Word Knowledge, I+II	4 <input type="text"/>				
5. Number Questions			5 <input type="text"/>		
6. Tapping Sequence		6 <input type="text"/>		6 <input type="text"/>	
7. Verbal Memory, I	7I <input type="text"/>			7I <input type="text"/>	
" " , II	7II <input type="text"/>			7II <input type="text"/>	
8. Right-Left Orientation (Ages 5 and over ONLY)		8 <input type="text"/>			
9. Leg Coordination					9 <input type="text"/>
10. Arm Coordination, I+II+III					10 <input type="text"/>
11. Imitative Action					11 <input type="text"/>
12. Draw-A-Design		12 <input type="text"/>			12 <input type="text"/>
13. Draw-A-Child		13 <input type="text"/>			13 <input type="text"/>
14. Numerical Memory, I			14I <input type="text"/>	14I <input type="text"/>	
" " , II			14II <input type="text"/>	14II <input type="text"/>	
15. Verbal Fluency	15 <input type="text"/>				
16. Counting and Sorting			16 <input type="text"/>		
17. Opposite Analogies	17 <input type="text"/>				
18. Conceptual Grouping		18 <input type="text"/>			
COMPOSITE RAW SCORE	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	V	P	Q	Mem	Mot

UPM

APPENDIX 7

(Data Collection Pictures)



MSCA test to children – The children was doing Test 13: Draw-A-Child



Blood sample was taken from children finger using finger prick technique

UPM

APPENDIX 8

(Blood Cholinesterase Levels Analysis Pictures)



The solution mixed with blood and stand for few minutes to reach 100% activity color



Match the color of comparator to the nearest match found