Editorial Board

D2S, MS, PhD, Associate Professor Nikola Angelov, Director of the Pre-Doctoral Periodontics Clinic, Loma Linda University School of Dentistry, Department of Periodontics. Loma Linda, CA, 92505, United States
Assist. Prof. Dr. Ramush Beqji, University Clinical Centre of Kosovo, Paediatric Clinic, Albania
Prof. Semra Çavajkula, Department of Epidemiology and Biostatistics, Faculty of Medicine, Sarajevo, Bosnia and Herzegovina
MD Pei-Yi Chu, Diagnostic and research pathologist, Department of Surgical Pathology, Changhua Christian Hospital. Taiwan. Address: 135 Nan-Shiao Street, Changhua 500-06, Taiwan, Province of China
MD, PhD Ivo Donkov, Staff Urologist, Lincoln County Hospital, United Kingdom
Prof. Dr. Aleksandar Dimovski, Institute of Pharmaceutical Chemistry, Faculty of Pharmacy. University "Ss Cyril and Methodius", Skopje, Republic of Macedonia
MD, PhD Andrew J. Dwork, Departments of Pathology and Cell Biology and Psychiatry, College of Physicians and Surgeons of Columbia University; Division of Molecular Imaging and Neuropathology, New York State Psychiatric Institute, Unit 62, 722 West 166th Street, New York, NY 10032, United States
MD, PhD Dimigal G. Eremeev, Molecular Hematology, International Centre for Genetic Engineering and Biotechnology (ICGBE), Rome, Italy
PhD Iva Ivanovska, Harvard Medical School, Department of Genetics, 77 Avenue Louis Pasteur, NR0 b238, Boston, MA 02115, United States
MD, PhD Jerzy Jabłecki, Associate Professor, Division of General Surgery St. Jadwiga of Silesia Hospital, Trzebnica; Head, Subdepartment of Hand Surgery an Replantation St Jadwiga of Silesia Hospital, Trzebnica; Professor, Department of Public Health, State Higher Professional Medical School, Opole, Poland, 55-100 Trzebnica, ul. Prusicka 53, Poland
MD Mehrdad Jalalian Hosseini, Khorasan-e Razavi Blood Center, Mashhad, Iran; Islamic Republic of
PhD Radka Kameva, Department of Medical Chemistry and Biochemistry, Medical University - Sofia, Bulgaria
Prof. Dr. Kostandina Leonida Korneti-Pekevska, Ss Cyril and Methodius University of Skopje, Faculty of Medicine, Skopje, Republic of Macedonia
MD, PhD Branko Malenica, Department of Immunology, Clinical Hospital Center Zagreb, Zagreb University School of Medicine, Zagreb, Croatia
Prof. Dr. Elida Mitevska, Institute of Histology and Embriology, Faculty of Medicine. Ss Cyril and Methodius University of Skopje, Skopje, Republic of Macedonia
MD, PhD Marija Mostarica-Stojkovic, Institute of Microbiology and Immunology, University of Belgrade School of Medicine, Belgrade, Serbia
PhD Vesna Nikolova-Krstevski, Harvard Institutes of Medicine, HIM-201, 4 Blackfan Circle, Boston, MA, 02134, United States
Prof. Dr. Nikola Panovski, Institute of Microbiology and Parasitology, Faculty of Medicine, Skopje, Republic of Macedonia
MD, BIDMC Iva Petkowska, Beth Israel Deaconess Medical CenterRadiology W CC - 3 330 Brookline Ave. Boston, MA 02215, United States
Prof. Dr. Gordana Petrusewska, Institute of Pathology, Medical Faculty, University of "Ss. Cyril and Methodius" – Skopje, Republic of Macedonia
Prof. Enver Roshit, Dean of Faculty of Public Health, Medical University of Tirane, Chief of Epidemiological Observatory, National Institute of Public Health. Address: Rruga e Dibres, Str. 371, Tirana, Albania
MD, PhD Gorazd B. Rosokljia, Professor at Columbia University and member of the Macedonian Academy of Sciences and Arts, United States
Prof. Dr. Aleksandar Siko, University Clinic for Nephrology, Faculty of Medicine. Ss Cyril and Methodius University of Skopje, Skopje, Republic of Macedonia
MD, FESC Gianfranco Sinagra, Department of Cardiology, "Ospedali Riuniti" and University of Trieste, Ospedale Cattinara – Strada di Fiume, 447, 34149 – Trieste, Italy
MD, PhD Rumen Stefanov, Information Centre for Rare Diseases and Orphan Drugs (ICRDDR), Bulgaria; Department of Social Medicine, Medical University of Plovdiv, Bulgaria
Prof. Dr. Vesna Veliky-Stefanovska, Department of Epidemiology and Biostatistics with Medical Informatics, Medical Faculty, UKIM, Skopje, Republic of Macedonia
MD, MBA Milenko Tanasijevic, Director, Clinical Laboratories Division and Clinical Program Development, Pathology Department, Brigham and Women's Hospital, Dana Farber Cancer Institute. Associate Professor of Pathology, Harvard Medical School, United States
PhD Mirko Trajkovski, ETH Zürich, Wolfgang-Pauli-Str. 16/HPT D57, 8093 Zürich-CH, Switzerland
MD, FRPCP Kiril Trpkov, Associate Professor, University of Calgary, Department of Pathology and Laboratory Medicine, Calgary Laboratory Services, 7007 14 st, Calgary SW, Canada
MD, PhD Igor Tulevski, Department of Cardiology, Academic Medical Center, Amsterdam, 1100 DD, T 020 707 2930; F 020 707 2931, Netherlands
PhD Zoran Zdravkovski, Institute of Chemistry, Faculty of Natural Sciences and Mathematics, Ss Cyril and Methodius University of Skopje, Skopje, Republic of Macedonia
Editorial Office
ID Design Press, Rajko Zhitnov No. 48, 1000 Skopje, Republic of Macedonia | Telephone: +389 70 255155. | e-mail: msipiroski@id-press.eu | URL: http://www.id-press.eu/mjms/
Publisher
ID Design Press, Rajko Zhitnov No. 48, 1000 Skopje, Republic of Macedonia
Suboccipital Muscles Injection for Management of Post-Dural Puncture Headache After Cesarean Delivery: A Randomized-Controlled Trial
Mhamed Abdelraouf, Maged Salah, Mohsen Waheb, Ahmed Elshall

Instrumental Balinese Flute Music Therapy Improves Cognitive Function and Serum Dopamine Level in the Elderly Population of West Denpasar Primary Health Care Center

The Evaluation of the Radiological and Functional Outcome of Distraction Osteogenesis in Patients with Infected Gap Nonunions of Tibia Treated by Bone Transport
Ayush Kumar Singh, Mangal Parihar, Syed Ekhari

The Impact of Upper Limb Training with Breathing Maneuver in Lung Function, Functional Capacity, Dyspnea Scale, and Quality of Life in Patient with Stable Chronic Obstructive of Lung Disease
Amira Permatasari Tarigan, Fannie Rizki Ananda, Pandianman Pandia, Bintang YM Sinaga, Maryaningsih

Investigating Different Dimensions of Nomophobia among Medical Students: A Cross-Sectional Study
Mohammad Darvishi, Majid Noori, Mohammad Reza Nazer, Soheil Sheikhkholeslami, Ebrahim Karimi
Uterine Fibroid Embolization via Transradial versus Transfemoral Arterial Access: Technical Results
Aleksandar Gjoreski, Josif Gjoreski, Andrea Nancheva

Correlation between Serum Brain-Derived Neurotrophic Factor Level and Depression Severity in Psoriasis Vulgaris Patients
Muhammad Sjahir, Irma Damayanti Roesyanto-Mahadi, Elmeida Effendy

Sero Conversion of Viral Hepatitis among End Stage Renal Disease Patients on Hemodialysis in Kashmir: Results of a Prospective Study
Ibrahim Masoodi, Charanjit Singh, Imtiyaz Ahmad Wani, Muzafar Maqsood Wani, Tousif Irshad Ahmed, Rayees Yousuf Sheikh

The Correlation between Hemoglobin Concentration during Pregnancy with the Maternal and Neonatal Outcome
Sarma Nursani Lumbanrja, Muhammad Rizki Yaznil, Dewi Indah Sari Siregar, Adriani Sakina
Open Access Macedonian Journal of Medical Sciences

Country: Macedonia - SIR Ranking of Macedonia

Subject Area and Category: Medicine, Medicine (miscellaneous)

Publisher: ID Design Press

Publication type: Journals

ISSN: 18579655

Coverage: 2014-ongoing

Join the conversation about this journal
High Serum Lead Levels Increase the Incidence of Cognitive Impairment of Public Fueling Station Operators

Anak Agung Ayu Putri Laksmidewi, Gede Suputra, I Putu Eka Widyadharma

Department of Neurology, Medical Faculty of Udayana University, Sanglah Hospital, Denpasar, Indonesia

Abstract

BACKGROUND: Air pollution due to lead contained in motor vehicle fuel is inhaled for a long period causing cognitive impairment. Cognitive disorders in general fuel station operators are found in developing countries as a negative impact of environmental pollution.

AIM: This study aims to find out that high levels of lead in the blood increase the risk of cognitive impairment in operators of Public Fuel Filling Stations.

METHODS: This was a case-control study design to determine high lead levels in the blood increasing the risk of cognitive impairment in operators of General Fuel Filling Stations. There were 76 study subjects consisting of 38 case groups and 38 control groups.

RESULTS: Obtained lead levels of all research subjects in normal criteria (1.1–5.58 µg/dL). We used MoCA-ina (a validated Indonesian version of MoCA questionnaire) to evaluate the cognitive function. High lead levels in the blood in the case group were 28 subjects (66.7%) and 14 subjects (33.7%) in the control group. Factors that significantly affected the occurrence of cognitive disorders are work periods of more than 3 years, which are 4 times higher risk of experiencing cognitive impairment (p = 0.021).

CONCLUSION: High lead levels in the blood have a 6 times greater risk of cognitive impairment than subjects with not high blood lead levels and work periods of more than 3 years have a risk of 6 times greater cognitive impairment.

Introduction

Some negative impacts on the environment and health are reported from the industrial sector. One effect of pollution is due to motorised vehicles. Cognitive impairment is a disorder of rational thought processes including the process of remembering, judging, orientation, perception and also paying attention. Disorders of cognitive function are often separated from our observations.

The Public Fuel Station is thought to be one of the places where air pollution occurs from vehicles using fuel which contains heavy metal components such as lead or Pb (plumbum) which are released as lead oxide, which is then inhaled by humans and causes the cognitive impairment. Symptoms of lead toxicity usually correlate with blood lead levels of 25–50 µg/dL in children and 40–60 µg/dL in adults [1]. The policy of standard quality specifications in the use of gasoline types does not fully eliminate the use of lead in 3 types of gasoline in developing countries. Gasoline type 88 (premium) consisting of 88 unleaded types of gasoline with a maximum lead level of 0.013 g/L and for 88 leaded gasoline types with a maximum lead level of 0.3 g/L. Gasoline type 92 (pertamax) with a maximum lead level of 0.013 g/L and gasoline type 95 (pertamax plus) with a maximum lead level of < 0.013 g/L [2].

This toxicity is a result of the ability of lead to replace Ca2+, Mg2+, Fe2+, and Na+ which subsequently affects the basic biological processes of the body, replacing calcium ions, so that it can cross the blood-brain barrier. Lead accumulates and damages immature astroglia cells, interferes with sodium ion concentration and increases the action potential.
cause nerve cells damage and cognitive impairment [3], [4]. The lead that crosses the blood-brain barrier causes various neurological disorders such as behaviour changes, mental retardation, disorders in the prefrontal cortex, hippocampus and cerebellum [5], [6]. Cognitive impairment due to lead poisoning begins with a disruption of heme synthesis which inhibits the synthesis of aminolevulinic acid dehydratase (ALAD) in the cytoplasm and ferrochelatase (heme synthetase and protohememerolysase) in mitochondria. There is an increase in the initial aminolevulinic acid (ALA) urine, followed by an increase in erythrocyte protoporphyrin [7]. Inflammation results in disruption of the blood-brain barrier system and the nervous system as a whole. ALA enters and accumulates in the nerve tissue cause oxidative stress. The discovery of ALA in the nervous system is a neurotoxin and causes hydroelectrolyte changes and damage to nerve cells/apoptosis [8].

A cognitive function is an act of thinking, remembering, learning, and using language. Cognitive functions include attention, memory, consideration, and problem-solving abilities, and executive abilities such as planning, and evaluating [9]. There are several screening instruments for cognitive function disorders such as the Mini-Mental State Examination (MMSE), Clock Drawing Test (CDT), Montreal Cognitive Assessment (MoCA). We used the MoCA-Ina questionnaire (Indonesian version of Montreal Cognitive Assessment questionnaire) which evaluate the visuospatial, naming, memory, attention, language, abstraction, delayed recall and orientation. The MoCA-Ina Kappa value is 0.820 which shows that this questionnaire has a very good inter-rater agreement value [10].

This study aims to find out that high levels of lead in the blood increase the risk of cognitive impairment in operators of Public Fuel Filling Stations.

Methods

The study was conducted at the South Denpasar regional gas station from December 2017 to January 2018. All research subjects were gas station operators in the city of South Denpasar who fulfilled the inclusion and exclusion criteria, then performed cognitive function assessment using the MoCA-Ina questionnaire and blood sampling for lead level for each study subjects

Observational, analytical research method using a case-control design to determine high lead levels in the blood increases the risk of cognitive impairment in gas station operators. Measurements were made using the AAS method (Atomic Absorption Spectrophotometry) at Prodia Laboratory. Values of blood lead levels are grouped into high and not high levels of lead which are distinguished by the results of Receiver Operating Characteristic (ROC) procedure statistics and Area Under Curve (AUC). Data were presented on a nominal categorical scale, high lead levels when ≥ 2.45 µg/dl and not high lead levels < 2.45 µg/dl. Multivariate analysis was performed to determine the risk factors for cognitive function disorders such as working period which is categorised into a work period of 1-3 years and a work period of more than 3 years, and the use of masks as protective devices while working.

The data were analysed statistically by the comparative hypothesis test of 2 unpaired groups, namely bivariate analysis using Chi-square because the independent variables and dependent variables were nominal. If the observed/expected value is < 5, the Fisher exact test is used, and the multivariate analysis uses logistic regression analysis because the dependent variable is the nominal categorical variable. The level of significance is expressed as p < 0.05 with a 95% confidence interval.

Results

The research subjects were gas station operators in the city of South Denpasar that met the inclusion and exclusion criteria, a total of 76 subjects. The study subjects were divided into cognitive impairment (cases) and did not experience cognitive impairment (control). The results of examination of blood lead levels in all samples included in the normal criteria range from 1.1 to 5.58 µg/dL, with a mean ± SD of 2.56 ± 0.86 with 95% CI 2.35-2.749 (normal value less than 10 µg/dL). The characteristics of the research subjects consist of several variables summarised in Table 1 below.

Table 1: Characteristics of Subjects

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cognitive Impairment n (%)</th>
<th>No Cognitive Impairment n (%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Adult 20 (64.8)</td>
<td>14 (41.2)</td>
<td>0.166</td>
</tr>
<tr>
<td></td>
<td>Men 10 (45.5)</td>
<td>12 (54.5)</td>
<td>0.613</td>
</tr>
<tr>
<td>Working period ≥ 3 year</td>
<td>16 (72.7)</td>
<td>6 (27.3)</td>
<td>0.011</td>
</tr>
<tr>
<td>1 - 3 year</td>
<td>22 (40.7)</td>
<td>32 (59.3)</td>
<td></td>
</tr>
<tr>
<td>Gloves wearing</td>
<td>Without going 38 (50)</td>
<td>38 (50)</td>
<td>0.442</td>
</tr>
<tr>
<td></td>
<td>Wearing masker not routinely 9 (42.9)</td>
<td>12 (57.1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wearing masker routinely</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood lead levels</td>
<td>High 28 (66.7)</td>
<td>14 (33.3)</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Not High 10 (29.4)</td>
<td>24 (70.6)</td>
<td></td>
</tr>
</tbody>
</table>

MoCA-Ina = Montreal Cognitive Assessment-Indonesia.

The overall lead blood level of the research subjects in the normal range, then performed the statistical method of the ROC and AUC procedure to determine the ability to examine blood lead levels that cause cognitive impairment, AUC value was 83% with 95% CI ranging from 73.5-92.6%. Statistically, this
AUC value of 74.9% shows the strength of a relatively high diagnostic value. The results of the ROC coordinates indicate that the cut off level of the lead of 2.45 µg/dL used in this study had a sensitivity value of 73.7% and a specificity of 63.2%. Figure 1 below shows the results of the ROC and AUC.

Figure 1: Results of the ROC procedure for lead levels against cognitive impairment

Research data on blood lead levels were grouped into two, namely high blood lead levels (≥ 2.45 µg/dL) and lead levels not high in the blood (< 2.45 µg/dL).

Bivariate analysis was performed to determine the relationship between high lead levels in the blood (independent variables) and cognitive function disorders (dependent variables), the hypothesis test used was risk estimate and Chi-square test. It was found that high blood lead levels had a higher risk of cognitive impairment than subjects with not high lead levels (OR 4.80; 95% CI 1.8-12.75; p < 0.001), shown in Table 2.

Table 2: Bivariate analysis of lead levels in the blood with cognitive impairment

<table>
<thead>
<tr>
<th>Serum Lead Level</th>
<th>MoCA-Ina Cognitive Impairment</th>
<th>Total n (%)</th>
<th>OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>MoCA-Ina Cognitive Impairment</td>
<td>28 (86.7)</td>
<td>14 (33.3)</td>
<td>42 (100)</td>
</tr>
<tr>
<td>High</td>
<td>MoCA-Ina No Cognitive Impairment</td>
<td>10 (29.4)</td>
<td>24 (70.6)</td>
<td>34 (100)</td>
</tr>
<tr>
<td>*OR = odds ratio; CI = confidence interval; MoCA-Ina = Montreal Cognitive Assessment-Indonesia.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bivariate analysis was performed to determine the relationship of age (independent variable) with cognitive impairment (dependent variable). Based on Pearson Chi-Square linear by linear data analysis for trends, p = 0.166, there is a significant relationship between age and cognitive impairment (OR 1.905; 95% CI 0.762-4.764), shown in Table 3 below.

Table 3: The relationship between adolescence and adulthood to cognitive impairment

<table>
<thead>
<tr>
<th>Age</th>
<th>MoCA-Ina Cognitive Impairment</th>
<th>Total n (%)</th>
<th>OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>MoCA-Ina Cognitive Impairment</td>
<td>18 (42.9)</td>
<td>24 (57.1)</td>
<td>42 (100)</td>
</tr>
<tr>
<td>Adolescence</td>
<td>MoCA-Ina No Cognitive Impairment</td>
<td>20 (50.0)</td>
<td>20 (50.0)</td>
<td>40 (100)</td>
</tr>
<tr>
<td>*OR = odds ratio; CI = confidence interval; MoCA-Ina = Montreal Cognitive Assessment-Indonesia.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gender did not affect the occurrence of cognitive impairment (p = 0.613), and cognitive impairment increased linearly with age (p = 0.011). The results of the analysis are shown in Table 4.

Table 4: Effect of sex and working period of gas station operators on the occurrence of cognitive disorders

<table>
<thead>
<tr>
<th>Variable</th>
<th>MoCA-Ina Cognitive Impairment</th>
<th>Total n (%)</th>
<th>OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>MoCA-Ina Cognitive Impairment</td>
<td>10 (23.3)</td>
<td>12 (26.6)</td>
<td>22 (100)</td>
</tr>
<tr>
<td>Women</td>
<td>MoCA-Ina No Cognitive Impairment</td>
<td>18 (45.2)</td>
<td>24 (54.8)</td>
<td>42 (100)</td>
</tr>
<tr>
<td>Working period &gt; 3 years</td>
<td>MoCA-Ina Cognitive Impairment</td>
<td>6 (23.1)</td>
<td>24 (76.9)</td>
<td>30 (100)</td>
</tr>
<tr>
<td>Working period 1-3 years</td>
<td>MoCA-Ina No Cognitive Impairment</td>
<td>12 (60.0)</td>
<td>8 (40.0)</td>
<td>20 (100)</td>
</tr>
<tr>
<td>*OR = odds ratio; CI = confidence interval; MoCA-Ina = Montreal Cognitive Assessment-Indonesia.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It was found that the use of masks when working did not have a statistically significant effect on the incidence of cognitive disorders. This indicates that the use of personal protective equipment, especially masks, does not play a protective role in the incidence of cognitive disorders (p = 0.442). The results of the analysis are shown in Table 5 below.

Table 5: Effects of mask use when working on cognitive impairments

<table>
<thead>
<tr>
<th>Masker Wearing</th>
<th>MoCA-Ina Cognitive Impairment</th>
<th>Total n (%)</th>
<th>OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearing masker routinely</td>
<td>MoCA-Ina Cognitive Impairment</td>
<td>29 (62.7)</td>
<td>17 (37.3)</td>
<td>46 (100)</td>
</tr>
<tr>
<td>Wearing masker not routinely</td>
<td>MoCA-Ina No Cognitive Impairment</td>
<td>9 (42.9)</td>
<td>12 (57.1)</td>
<td>21 (100)</td>
</tr>
<tr>
<td>*OR = odds ratio; CI = confidence interval; MoCA-Ina = Montreal Cognitive Assessment-Indonesia.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results of the bivariate analysis showed that the age, working period and blood lead levels were statistically significant for the incidence of cognitive impairment and the working period variable statistically with a value of < 0.25. The results of variable high blood lead levels (p = 0.001) and the working period (0.021) were statistically significant. Table 6 below shows the results of the analysis.

Table 6: Multinomial logistic regression on the variables of age, working period and lead levels in the blood with the incidence of cognitive disorders

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>S.E.</th>
<th>Wald</th>
<th>DF</th>
<th>OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.962</td>
<td>0.632</td>
<td>66.3</td>
<td>0.889</td>
<td>0.021</td>
</tr>
<tr>
<td>Adult</td>
<td>0.151</td>
<td>0.645</td>
<td>0.055</td>
<td>0.869</td>
<td>0.814</td>
</tr>
<tr>
<td>Working period &gt; 3 years</td>
<td>1.742</td>
<td>0.756</td>
<td>5.309</td>
<td>0.001</td>
<td>0.021</td>
</tr>
<tr>
<td>High Lead</td>
<td>1.792</td>
<td>0.552</td>
<td>10.546</td>
<td>6.090</td>
<td>0.001</td>
</tr>
<tr>
<td>Serum level</td>
<td>1.792</td>
<td>0.552</td>
<td>10.546</td>
<td>6.090</td>
<td>0.001</td>
</tr>
<tr>
<td>*OR = odds ratio; CI = confidence interval; S.E. = standard error; DF = degree of freedom; MoCA-Ina = Montreal Cognitive Assessment-Indonesia.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Based on the equations above, high lead levels in the blood as a risk factor for cognitive impairment are 6 times greater than not high blood lead levels and work periods > 3 years as a risk factor for cognitive impairment 6 times greater than the working period of 1-3 year independently.

Discussion

The majority of the research subjects were in the teenage age category (55.3%), this was by the demographic characteristics of Indonesia, the majority of which were dominated by productive age. Female sex (71.1%) was obtained more than men because in this study many men were excluded because of active smoking. The working period is obtained for 1-3 years (71.1%) more than the working period; this is due to several new gas stations standing around 1-5 years. In the case group (52.7%) and controls (47.3%) who were not routinely using masks while working for the past 1 month, the data shows that there is still a lack of discipline in the use of masks when working, caused by a lack of comfort when using masks.

This result is by previous studies which stated that the use of Personal Protective Equipment (PPE) was very influential and able to protect themselves from lead exposure (p = 0.038). The duration of working for 1-3 years was found to be the highest in the case group (71.1%); statistically, the duration of work affected the incidence of cognitive disorders.

The results of this study indicate that gender does not affect the occurrence of cognitive dysfunction, and there is a tendency for an increase in the incidence of cognitive impairment with age, so it was assumed that the incidence of cognitive impairment increases with age, regardless of factors in blood lead levels. This is probably because most of the age in this study sample tended to be in the age of adolescents so that statistically the apparent value was not significant with the opinions of previous studies. The results of this study found that the use of masks when working did not statistically affect the incidence of cognitive disorders; this indicates that the use of personal protective equipment, especially type 2 ply masks, does not play a protective role in the incidence of cognitive disorders.

Obtained subjects with high lead levels in the blood had a much greater risk of suffering cognitive impairment compared to subjects with not high blood lead levels. Lead can cause prominent abnormalities in the nervous system, in the form of slowness in action, decreased function of memory and concentration, depression, headaches, vertigo (dizziness), tremor (abnormal movement with rapid frequency), stupor (decreased consciousness), coma, convulsions, psychomotor disorders, mild intelligence disorders and personality changes. While the alkyl lead forms a special form of abnormalities in the central nervous system, with manifestations including insomnia, nightmares, and in severe cases can be schizophrenic. The strength of this study is that not many researchers have examined lead levels as a risk factor for cognitive impairment in gas station operators in Indonesia. This study cannot determine the length of exposure to lead that causes cognitive impairment and cannot determine the increase in minimum lead levels that cause cognitive impairment. Further studies are needed to determine these variables.

In conclusion, high lead levels in the blood have a 6 times greater risk of cognitive impairment compared to subjects with not high blood lead levels and work periods > 3 years have 6 times greater risk of experiencing cognitive disorders compared to 1-3 years of the work period. Blood lead levels and years of service are independent risk factors for the occurrence of cognitive impairments in oil refuelling station operators.

References