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Level of Awareness and Perceptions about the Health Hazards of Spent-Engine Oil on Exposed Auto-Mechanics around Benin-City Metropolis, Southern Nigeria.

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Summary

Spent engine oil (SEO) is a lubricating oil that has served its purposes in a vehicle, withdrawn and considered a waste. It contains high amounts of the potent harmful chemicals including, heavy metals, PAHs, PCBs, aliphatic and aromatic hydrocarbons which have been established to be detrimental to human health. Most of the auto-mechanics in Southern Nigeria are illiterates and unaware of this information. It was based on this that this research was designed with the aim of establishing the level of awareness of these auto-mechanics. Thirty tests (auto-mechanics) and thirty control subjects (non-mechanics) located around Benin City metropolis were recruited and properly informed about the research. They were made to sign consent forms and questionnaires were administered to collect information about their age, gender, marital status, and religion, period of exposure / work period or length, level of awareness, precautionary mode and factors that will improve the health factors of auto-mechanics. Pearson's Chi square (X^2) was used to analyze the data that were obtained. The response from the questionnaire indicated complaints of pains around thoracic region, skin rashes etc. Unawareness of the detrimental contents of spent engine oil; poor precautionary and sanitary practices can have a detrimental effect on those occupationally exposed to it. Thus, the uses of hygienic protective practices (face and nose mask, clean overall gowns, gloves) are encouraged. There is also need for proper SEO disposal. Auto-

mechanics are encouraged to go for regular medical check-ups.

Key words: Spent engine oil; Awareness; Perception; Auto-mechanics; Benin City

Introduction

Spent engine Oil (SEO) is a lubricating oil that has served its purposes in a vehicle, withdrawn and considered a waste (Ogbe *et al.*, 2006; Anoliefo and Vwioko, 2001; Kojernikova, 1999). Before spent engine, oil is used, it consists of a base lubricating oil (a complex mixture of hydrocarbons, 80 to 90% by volume) and performance additives (10 to 20% by volume). This waste lubricants are commonly being used by auto-mechanics all over Nigeria for other purposes. These used lubricants contain a lot of toxic substances (Vasquez-Duhalt, 1989). However, an important difference between the unused and spent engine oil is the heavy metal content. This difference is of biomedical important as these heavy metals are very harmful to human health and other living organisms. These metals originate from the fuel as additives and from engine wear. SEO contains high concentration of lead, zinc,

cadmium, barium and magnesium along with lower concentrations of iron, sodium, copper, aluminum, chromium, manganese, potassium, nickel, tin, silicon boron and molybdenum (Vasquez-Duhalt, 1989). Concentration of lead in SEO are likely higher than in leaded fuel.

Other major components of SEO include aliphatic and aromatic hydrocarbons (such as phenol, naphthalene, benz (a) anthracene, benzo (a) pyrene, fluoranthene, zinc dithiophosphate, zinc diaryl or dialkyl dithiophosphates (ZDTPs), calcium alkyl phenates, magnesium, sodium and calcium sulphonates, tricresyl phosphate, molybdenum disulfide, heavy metal soap and other organometallic compounds that contain heavy metals, as well as PAHs (Irwin *et al.*, 1997; Hewstone 1994). Studies of SEO on human has revealed that cancer can occur in lungs and skin predominantly following inhalation and dermal exposure (Dauda and Obi, 2000; ATSDR, 1995; Van Donkelaar 1990; IARC 1984; Kirk-Osarthmer 1981). Aromatics with two or more rings are referred to as PAHs, e.g. benzo (a) pyrene and naphthalene.

In a study by Upshall *et al.* (1993), it was observed that SEO may have a density of 0.828g/ml and contain 14% aromatics and 65.4% aliphatics with about twenty-six PAHs compounds representing 0.17% of the oil, or 1.2% of the aromatic fraction. They also noted that the concentration of various PAH is much higher in SEO than in unused oil – the concentrations of dibenz (a,c) anthracene, 4-methyl pyrene, fluoranthene, benz (a) anthracene, benzo (c) pyrene, benzo (g,h,i) perylene, and benzo (a) pyrene, are respectively 36, 49, 253, 720, 1, 112, 4, 770 and 7,226 times higher in SEO compared to unused oil, respectively. Other compounds and molecules that may be found in SEO include toluene,

benzene, xylenes, ethylbenzene, and polychlorinated biphenyls (PCBs).

Prolonged exposure to high SEO has been reported to cause haematological derangements (Omorowa *et al.*, 2015), liver damage (Omorowa *et al.*, 2015; (Clausen and Rastogi, 1977; ATSDR, 1995), kidney damage (Omorowa *et al.*, 2015; Karahalil *et al.*, 1998; Ellenhorn *et al.*, 1997), skin disorders - *perophigus vulgaris* and *xeroderma pigmentosum*, chronic dermatitis, acne, skin cancer, folliculitis and hyperkeratosis (ATSDR,1995), various forms of cancer (Brostrom *et al.*, 2002; Baer- Dubowska, 1999; ATSDR, 1995), respiratory dysfunctions (ATSDR, 1995; Dautrebande *et al.*, 1951; Dautrebande and Capps, 1950), cardiovascular dysfunction (Clausen and Rastogi, 1977; Dautrebande *et al.*, 1951), and immunosuppression (Burchiel *et al.*, 2001; Klaassen, 2001).

Most of the auto-mechanics in Southern Nigeria are illiterates and unaware of these information about SEO and its health hazards. Even when they are aware, they do not practice good and protective precautionary measures. It was this premise that informed the design of this research with a sole aim of establishing the level of awareness of these auto-mechanics about the negative sides of SEO and also to ascertain whether these group of persons are informed about protective approaches.

We also hope to contribute to the data based on the awareness level, perception and toxicity of SEO so that the environmental researchers, theses auto-mechanics, health-care providers and various stake-holders in government can be better oriented and enlightened towards reducing the possible negative health and environmental effects of spent engine oil.



Materials and Methods

Subjects

The study was carried out within a period of one month. Inclusion criteria included; legal adults (age ≥ 18 years) apparently healthy, occupational exposure to spent engine oil and willingness to offer a written informed consent to participate in the study. All individuals who did not meet the inclusion criteria were excluded from the study. A total of thirty auto-mechanics (subjects) were finally selected for the research made up of mostly male participants as the test subject and few females. Subjects were aged 20 – 60 years. Thirty (30) non-mechanics and healthy students of University of Benin without any history of exposure to spent engine oil were monitored as control. The test (auto-mechanic) and control subjects located around Benin City metropolis were properly informed and enlightened about

the research and made to fill and sign a consent form. They were given questionnaires to fill so as to obtain their level of awareness and perception about spent engine oil and their possible effects.

Questionnaire

A questionnaire was designed to collect information about the age, gender, marital status, and religion, period of exposure / work period or length, level of awareness, precautionary mode and factors that will improve the health factors of auto-mechanics.

Statistical analysis of data

Results were entered into an excel spread sheet prior to analysis and analyzed with the statistical package for social sciences (SPSS) version 16.0, using Pearson's Chi square (X^2) at $p = 0.05$ (95% confidence interval). A $p \leq 0.05$ was regarded as significant.

Results

Table 1: Age Distribution of Subjects and Controls

Participant Groups	Age Groups (Years) n (%)			
	15-20	21-26	27-32	Above 32
Control	0(0)	30 (100.00)	0(0)	0(0)
Test	0(0)	12(40.00)	7(23.33)	11(36.67)

Table 2: Gender Distribution of Subjects and Controls

Participants Groups.	Gender n (%)	
	Male	Female
Control	29 (96.67)	1 (3.33)
Test	28 (93.33)	2 (6.67)

Table 3: Marital Status of Subjects and Controls

Participants groups.	Marital Status n (%)			
	Single	Married	Divorced	Others
Control	30 (100.00)	0 (0)	0 (0)	0 (0)
Test	14 (46.67)	16 (53.33)	0 (0)	0 (0)

Table 4: Distribution of Subjects and Controls based on their Religious Affiliations

Participant Groups	Religious Affiliations n (%).			
	Christian	Islam	African Traditional Religion	Others
Control	30 (100)	0 (0)	0 (0)	0 (0)
Test	30 (100)	0 (0)	0 (0)	0 (0)

1. Duration of working as an auto-mechanic.

H₀: Working duration of the participants had no influence.

H₁: Working duration of the participants had an influence.

Duration (years)	1-2	3-4	5-6	7-8	Above 8
f (%)	2 (6.67)	4 (13.33)	3 (10.00)	3 (10.00)	18 (60.00)

Df=5; Chi square (X^2) value=30.34; $p < 0.05$.

The alternate hypothesis (H^1) is accepted. Thus, the duration of working as an auto-mechanic had a significant influence.



Level of Awareness

2. History/awareness of any previous disorders.

H₀: Pains in the chest region is not the most common disorders.

H₁: Pains in the chest region is the most common disorders

Disorder	<i>f</i> (%)
Pains in the chest region	9 (30)
Swollen legs or face	7 (23.33)
Pains in the lower abdominal region while urinating	4 (13.33)
Rashes on the surface of the skin	5 (16.67)
No response	5 (16.67)

Df=4; Chi square (X^2) value=2.68; $p > 0.05$.

The, null hypothesis is accepted. Apart from pains in the chest region, other disorders are common among the auto-mechanic volunteers.

3. Awareness of the content of spent engine oil, as well, knowledge of its deleterious effects on health and well-being.

H₀: The volunteers do not have good knowledge of the content of spent engine oil and are not aware of its negative impacts on health and well-being.

H₁: The volunteers have good knowledge of the content of spent engine oil and are not aware of its negative impacts on health and well-being.

Response	<i>f</i> (%)
Yes	11 (37.78)
No	19 (62.22)

Df=1; Chi square (X^2) value=5.38; $p < 0.05$.

The null hypothesis is accepted. The volunteers are not aware of the content of spent engine oil and its negative impacts on health and well-being.

Use of protection and health safety precautions

4. Use of precautionary measures for protection against work hazards.

H₀: Volunteers do not use precautionary measures because they believe these measures do not confer protections against the hazards attributed to their kind of work.

H₁: Volunteers use precautionary measures because they believe these measures confer protections against the hazards attributed to their kind of work.

Response	f (%)
Yes	21 (68.33)
No	9 (31.67)

Df=1; Chi square (X^2) value=8.07; $p < 0.05$.

The alternate hypothesis is accepted. The auto-mechanic volunteers use precautionary measures as they believe these measures confer protections against the hazards attributed to their kind of work.

5. Most common precautionary measures employed by the test volunteers.

Response	f (%)	
	Yes	No
Wearing over all gown	30 (100) ^α	0 (0) ^β
Use of hand gloves	30 (100) ^α	0 (0) ^β
Disposal of auto-mechanic wastes	0 (0) ^α	30 (100) ^β
Recycling of spent engine oil	0 (0) ^α	30 (100) ^β
Constant medical check ups	0 (0) ^α	30 (100) ^β
Total	60 (40)	90 (60)

Let alpha-superscript (^α) represent good precautionary practice and beta-superscript (^β) represent bad precautionary practice, by these auto-mechanic volunteers.

H⁰: ^βAuto-mechanic volunteers do not carry out good precautionary practices.

H¹: ^αAuto-mechanic volunteers do carry out good precautionary practices.

Df=1; Chi square (X^2) value=6.0; $p < 0.05$.

Thus, the null hypothesis is accepted indicating that the auto-mechanic volunteers do not carry out good precautionary practices.

Factors that will improve health status of the workers

6. What suggestions can you give to reduce effects of spent engine oil on workers?

Response	f (%)	
	Yes	No
Workers should be educated on the harmful effects of the workshop environment	30 (100) ^α	0 (0) ^β
Proper cleaning and washing of hands after handling tools	30 (100) ^α	0 (0) ^β
Washing of hands before eating or drinking	30 (100) ^α	0 (0) ^β
Workers should use protective equipment to protect their body from exposure	30 (100) ^α	0 (0) ^β
Total	120 (100)	0 (0)



Let alpha-superscript (^α) represent good practice that will improve health status of workers and beta-superscript (^β) represent bad practice that will not improve health status of the workers.

H₀: ^β Auto-mechanic volunteers are not in support of good factors and practices that will improve their health status.

H₁: ^α Auto-mechanic volunteers are in support of good factors and practices that will improve their health status.

Df=1; Chi square (X^2) value=120.0; p< 0.05.

Thus, the alternate hypothesis is accepted. Auto-mechanic volunteers are in full support of good factors and practices that will improve their health status.

7. What are the roles you think government may play to reduce the hazardous effects of spent engine oil on workers?

Response	f (%)	
	Yes	No
Government should make and enforce proper policies to reduce the adverse effects of spent engine oil	30 (100) ^α	0 (0) ^β
Government should encourage research into the effects of degree of exposure to SEO	30 (100) ^α	0 (0) ^β
Compliance to the use of safety equipment in the workshop by workers should be enforced	30 (100) ^α	0 (0) ^β
Encouragement of regular medical checkup for workers and at a subsidized rate	30 (100) ^α	0 (0) ^β
Government should create an agency that will recycle spent engine oil	30 (100) ^α	0 (0) ^β
Total	150 (0)	0 (0)

Let alpha-superscript (^α) represent the auto-mechanic volunteers that believe government intervention with regards to policies formulation, implementation and support are vital, while beta-superscript (^β) represent auto-mechanic volunteers that believe government intervention with regards to policies formulation, implementation and support are not vital.

H₀: ^β Auto-mechanic volunteers are not in support of government interventions.

H₁: ^α Auto-mechanic volunteers are in support of government interventions.

Df=1; Chi square (X^2) value=150.0; p< 0.05.

Thus, the alternate hypothesis is accepted. Auto-mechanic volunteers are in support of government intervention.

Discussion

Most of the auto-mechanics in Southern Nigeria are illiterates and unenlightened about the toxic chemical components in SEO and the health hazards these substances pose to health and the environment. Even when they are aware about these, they do not practice good and protective precautionary measures. Thus, this research was targeted towards establishing the level of awareness of these auto-mechanics about the negative side effects of SEO and also to ascertain whether this group of persons are informed about protective approaches.

Among the potent harmful chemicals in SEO include, heavy metals, PAHs, PCBs, aliphatic and aromatic hydrocarbons, etc. These substances have been reported to cause haematological derangements (Omorowa *et al.*, 2015), liver damage (Omorowa *et al.*, 2015; ATSDR 1995; Clausen and Rastogi, 1977), kidney damage (Omorowa *et al.*, 2015; Karahalil *et al.*, 1998; Ellenhorn *et al.*, 1997), skin disorders (ATSDR 1995), various forms of cancer, especially of the skin (Brostrom *et al.*, 2002; Baer- Dubowska 1999; ATSDR 1995; Rom 1992), respiratory dysfunctions (ATSDR 1995; Dautrebande and Capps, 1950; Dautrebande *et al.* 1951), cardiovascular dysfunctions (Clausen and Rastogi 1977; Dautrebande *et al.*, 1951) and immunosuppression (Burchiel *et al.*, 2001; Klaassen 2001).

The heavy metals present in SEO can accumulate in body tissues, especially the bone marrow and liver, and affect metabolic process (Brown and Mikkelsen, 1990). This suggest why the study by Omorowa *et al.* (2015) showed a significant increase in packed cell volume, hemoglobin concentration, neutrophil count and lymphocyte count. PAHs exert their

adverse effects on rapidly growing or dividing tissues, such as the bone marrow blood forming elements (ATSDR, 1995).

Most of the auto-mechanics in Southern Nigeria, Benin City, are illiterates and unaware of these information about SEO. Thus, it was based on this that this research was designed with the aim of establishing the level of awareness of these auto-mechanics. A total of sixty persons were recruited for the study, with thirty of them being auto-mechanics (test subjects) around the Benin City metropolis. Forty percent (40%) of the auto-mechanics were between the ages of 21 years and 26 years (early 20s) and 36.7% were above 32 years. We made an observation that most of the auto-mechanics between 21 to 26 years were school drop-outs with or without a secondary school certificate (SSC) either as a result of financial incapacitation or as apprentice under the supervision of their parents. Only 6.7% of the auto-mechanics were females. However, 60% of the test subjects had worked as auto-mechanics for over eight years and 13% for about three to four years. It was observed that the duration of working as an auto-mechanic had a significant influence ($X^2 = 30.34$; $p < 0.05$) on this group of persons – they stayed out of school earlier than expected and had longer period of exposure to SEO (Omorowa *et al.*, 2015).

These auto-mechanics confirmed ($X^2 = 2.68$; $p > 0.05$) that apart from pains in the chest region, other disorders are common among the auto-mechanic volunteers – swollen legs (boils, rashes, inflammatory reactions around joints, bolus formation, varicose veins, etc., were prominent), pains in the lower abdominal region while urinating especially around the pelvic and posterior thoracic regions indicative of possible renal inflammation (glomerulo-nephritis, stones formation, etc.) and skin rashes (boils, broken



epidermis, poor skin hair texture, etc.). Omokhodion and Osungbade (1996) in their survey reported that musculoskeletal disorders were the major complaints with lower back pain making up to 54% and hand dermatitis 25%.

According to the Encyclopaedia of Occupational Health and Safety (1998), Health and Safety Executive (1991a) and Health and Safety Executive (1991b), acute musculoskeletal injuries (intervertebral disk rupture, hernia etc.), skin diseases and conditions (various types of dermatitis, skin sensitization, eczema, oil acne, etc.), eye irritation, dizziness, nausea, breathing problems, headaches, etc., mesothelioma, haematological changes, increased risk of cancer, increased risk of organic brain damage, acute eye and mucous membrane irritation, headaches, breathing difficulties, chest tightness etc., gastrointestinal disturbances are very common amongst auto-mechanics.

We observed that 16.7% of the auto-mechanics in our survey did not give any reply as to whether they have observed any disorders due to SEO exposure. On physical observation of the 30% that confirmed chest pain, there was an increased phlegm or sputum formation indicative of immunological response along the respiratory tract.

Nineteen percent (19%) of the auto-mechanics claimed that they are not aware of the content of SEO and its negative impacts on health and well-being ($X^2 = 5.38$; $p < 0.05$), while 68.3% of the auto-mechanics claimed that they use precautionary measures ($X^2 = 8.07$; $p < 0.05$) as they believe these measures confer protections against the hazards attributed to their kind of work. The latter raised a level of contradiction in our argument in that, if they agreed that protective measures would prevent health

hazards of SEO, how come they are not aware that SEO is toxic to health and well-being? However, a significant 37.8% of the auto-mechanics did agree that SEO is harmful to health ($p < 0.05$), thus the need for precautionary measures against exposure to SEO. Then question then arises, if they have been practicing protective measures against SEO exposure, then how come 83.33% confirmed that they have had and/or still have health disorders suggestive of exposure to SEO? We then concluded that it is either they did not open up fully in their response or that they are most likely not practicing genuine protective measures as they claimed. Lack of orientation and knowledge are other culprits in that, what they claimed to be protective measures against SEO exposure may not be good enough.

We queried about the most common precautionary measures that these auto-mechanics employ during work process. We observed that, 100% claimed that they wear over all gowns and hand gloves which is commendable. But the state of these overall gowns and hand gloves "are an eye sore". We noticed, on observation during working hours that they wear were either immersed with SEO or dripping of it. They were also torn with spaces to allow for possible contact of the SEO with the body. SEO requires a whole lot of detergents to wash off. Whether these auto-mechanics wash their hands properly at the close of work is another point of argument. All (100%) of the auto-mechanics agreed that they do not properly dispose of or recycle SEO. In fact, in some of the workshops we visited, there were visible sinks or collection points into which these auto-mechanics empty the withdrawn SEO. These sinks were noticeably filled to the brim and some had cracked outlets so that some of the SEO spilled into the soil which definitely is the cause of the absence of

plant life around most of the workshops we visited. All (100%) of the auto-mechanics agreed that they do not visit health care facilities for checkups. In summation, 60% of the auto-mechanics do not carry out good precautionary practices ($X^2 = 6.0$; $p < 0.05$).

When the auto-mechanics were asked to make suggestions about measures that can be taken to improve their health status and minimize exposure to SEO, 100% said they should be educated on the harmful effects of SEO, that proper cleaning and washing of hands after handling tools should be employed and that the workers should use protective equipment and artifacts to minimize exposure to SEO ($X^2 = 120.0$; $p < 0.05$). It is recommended that government should make and enforce proper policies to reduce the adverse effects of spent engine oil and encourage research into the effects of degree of exposure to SEO. They also advised that strict compliance to the use of safety equipment in the auto-mechanic workshops should be enforced by appropriate law enforcement agencies and that the area of SEO recycling should be considered by relevant bodies. While they agreed to the need for constant medical checkups, they solicited for subsidized medical schemes – health insurance policies – that will address their medical needs as low-income earners ($X^2 = 150.0$; $p < 0.05$).

In conclusion, the result of this study has revealed that SEO could alter body metabolic processes (Omorowa et al., 2015). Thus, awareness should be intensified about the detrimental effects of SEO exposure. Protective measures by these auto-mechanic against SEO exposure should be encouraged and indiscriminate disposal should be discouraged. Strict laws must be made to guide against the indiscriminate disposal of SEO while the existing laws on pollution should be reviewed

with the aim of being made more effective and complementary with the present trend. Recycling measures, treatment measures for SEO and methods of SEO disposal should be adopted and encouraged.

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Conflict of Interest

None declared

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