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Influence of Exposure to Counterfeit Petrol on the Mucosal Condition, Hematological and Lipid Profile of Vendors in Benin

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ABSTRACT:

Introduction: The sale of counterfeit petrol is a nationwide phenomenon, perpetrated by individuals who do not utilize any form of protective equipment. The conditions under which this product is sold have the potential to result in adverse health consequences for the sellers.

Objectives: This study aims to evaluate the effects of its exposure on the mucous membranes, hematological parameters, and lipid parameters of the sellers.

Methods: The mucous membranes of 80 vendors and 80 consumers were examined, and their blood was analyzed. The data were collected to examine the exposure effect and the age of the vendors on hematological parameters.

Results: It was found that the proportion of sellers (78.3%) with abnormal mucosa was higher ($p<0.01$) than that of consumers (60%). The observed lesions were bighorn, inflammatory mucosa, congestive mucosa, irregular and pale horns. These lesions were more frequent in the sellers, but the difference was not substantial for most abnormalities. The proportion of vendors with nasal cavity abnormalities (38.2%) was higher ($p<0.05$) than that of consumers (17.9%). The proportion of vendors with a higher-than-average red blood cell count was significantly lower ($p<0.05$) than consumers. Sellers had lower hemoglobin and hematocrit than consumers ($p<0.001$). The proportion of vendors with microcytosis was significantly higher ($p<0.01$) than consumers. Total cholesterol, triglycerides, and HDL-cholesterol levels were not affected by the exposure to counterfeit petrol. On the other hand, the proportion of vendors with an LDL-cholesterol value above the average value was significantly higher ($p<0.05$) than consumers. It was shown that age had a meaningless influence on the consequences of petrol exposure on mucous membranes, hematological and lipid parameters. However, hematological parameters (white blood cells, red blood cells, hemoglobin) were less standard in the 20–30-year-old sellers than in the 20–30-year-old consumers. The sellers, whose age intervals were between 20 and 30 years old, showed more anemia, microcytosis, cytopenia, and thrombocytopenia than the consumers.

Conclusions: Overall, exposure to petrol negatively influences the hematological and lipid profiles of 30-year-old soldiers, especially those aged between 20 and 30 years.

1. Introduction

Hydrocarbons in general and petrol (kpayo) in particular play an Important role in the socio-economic life of Beninese; however, contribute to air pollution. Indeed, the conditions under which petrol is sold encourage pollution due to the constant release of vapors of volatile organic compounds, including benzene, into the atmosphere. Benzene is already recognized as a dangerous substance for human health [1–3]. It is a highly toxic, volatile product with a strong aromatic odor and is easily flammable [1]. In pregnant women, it is capable of crossing the placental barrier and entering the bone marrow of the fetus [4]. It is not the only compound in petrol that acts on human health; other compounds such as toluene, ethylene, and xylene complement its action [5]. Sellers inhale these compounds (including benzene) because they do not protect themselves

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sufficiently at the point of sale [6]. Apart from inhalation, petrol enters the body through the skin (contact when selling) and through the digestive tract when accidentally swallowed during the filling of bottles [6,7]. Once in the body, the compounds in this petrol disrupt the chemical parameters of the blood, which leads to several abnormalities such as anemia, neutropenia, thrombocytopenia, and even pancytopenia or leukemia in exposed persons [8]. Apart from the hematological profile that petrol particles shift, they also act on the mucous membranes with which they are in permanent contact through inhalation and swallowing [9]. The abnormalities caused by petrol compounds are manifested by symptoms that can be observed in sellers, such as fatigue, headaches, drowsiness, nausea, vomiting, eye and throat irritation, back pain, nervous disorders, etc. [5,10]. The reported ailments and symptoms were mainly reported among people working at petrol stations who use adequate sufficient workplaces protection. What about sellers of counterfeit Petrol who do not protect themselves? Assessment of the adverse effect of smuggled petrol to which these sellers of counterfeit petrol are exposed, the sector was first characterized, and the symptoms developed by the sellers were listed [6,7]. The symptoms reported by the vendors are similar to those reported in the literature. Unfortunately, there is no laboratory analysis available to better evaluate these vendor reports. Therefore, this study was undertaken to further contribute to the assessment of the influence of counterfeit petrol on the health of sellers.

2. Objectives

The study's objective is to determine the influence of counterfeit petrol on the mucosal condition, hematological parameters, and lipid profile of vendors in the Benin Republic.

3. Methods

Study area

This work was carried out at the Hospital University Centre of Abomey-Calavi/Sô-Ava in the commune of Abomey Calavi and the Laboratory Bio-Benin. These two centers are located in the Atlantic Department, Abomey-Calavi commune, Calavi center district. The company, called " Laboratory Bio-Benin ", is a multidisciplinary laboratory whose headquarters are located in the Aïtchédji District in the commune of Abomey-Calavi.

Material

The biological material consisted of the blood and serum of the sellers and consumers of petrol. The equipment used to examine the mucous membranes consisted of a clinical examination table.

With a high-power, light source model ML4 LED (HEINE, Gilching) for better observation of the mucous membranes, cowherd-type nose specula for exploring the nose, single-use wooden tongue depressors for exploring the oral mucous membranes, and single-use ear specula for examining the ear.

EDTA and dry tubes were used for blood collection. Sysmex XP-100 (Symex, Singapore) was used to determine the hematological profile of petrol sellers and consumers. A Mindray BS 200 automated biochemistry analyzer (Mindray, China) was used to scrutinize the lipid profile of vendors and consumers.

Methodology

Sampling

Data on the influence of counterfeit petrol on mucosal status, hematological parameters, and lipid profile were collected from 80 sellers and 80 consumers. Consumers were considered the non-exposed population, while vendors constituted the population exposed to counterfeit petrol. These people were randomly selected in the commune of Abomey-Calavi. Consumers are people who buy petrol in their motorbikes or vehicle from sellers of counterfeit petrol.

Collection of Data on Mucosal Conditions

Data on the Influence of counterfeit Petrol on the condition of the mucous membranes were collected at the ENT department of Hospital University Centre of Abomey-Calavi/Sô-Ava by an ENT specialist. Consumers and sellers were identified and invited to the hospital for the ENT consultation. There were two consultation phases: an interrogation phase and an examination one. The questioning was focused on looking for rhinological signs in particular and other non-specific complaints. The examination made it possible to assess the mucous membrane and thus detect the presence of lesions. The various lesions sought were

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inflammation, congestion, and the state of the lower and middle turbinates (large, obstructive, congestive). After this initial observation, the permeability of the nasal cavities and the state of their mucosa (purulent, mucopurulent, clear secretion; purulent, mucopurulent posterior rhinorrhea) were examined. Finally, the oral cavity was examined (condition of the tonsils and oral condition) and others (presence of secretion on the posterior pharyngeal wall, lymphoid formations, and the existence of pathology in the neck (anterior cervical thyroid mass or adenopathy). These clinical examinations made it possible to establish the prevalence of specific clinical signs of inflammatory or tumorous pathologies in the exposed and non-exposed populations sampled.

Collection of Data on Hematological Parameters and Lipid Profile of Vendors

Ten (10) ml of blood was collected in two tubes (dry and EDTA) from each respondent (vendors and consumers). The blood collected in the dry tube was used for lipid analysis and the EDTA tube for a blood count.

The blood sample was analyzed to determine the vendor's and consumers' hematological parameters (blood count) and the lipid profile (total cholesterol, HDL cholesterol, LDL cholesterol, and triglycerides). These analyses were carried out at the Hospital University Centre of Abomey-Calavi/Sô-Ava, and the Bio-Benin Laboratory. The specialized biologist interpreted the results of the analyses in blood transfusion, a promoter of the Bio-Benin Laboratory.

Age-based collection of data on mucosal status, hematological parameters, and lipid profile of vendors and consumers

Five (5) age classes were formed for each group (exposed and unexposed). These were 15 to 20 years (≤ 20 years), 21 to 30 years, 31 to 40 years, 41 to 50 years, and 51 to 62 years (>50 years). Therefore, the data were aggregated and processed by age group and for each group.

Statistical Analysis

The collected data were recorded in Excel and analyzed with SAS software (SAS Institute Inc., Cary, NC, USA). The Proc FREQ procedure of SAS calculated the observed frequencies, and the Chi² test specified the difference between the parameters measured in sellers and consumers. The two-tailed Z test made the comparison of relative frequencies between age groups. For each relative frequency, a 95% confidence interval (CI) was calculated according to the formula:

$$IC=1,96\sqrt{((P(1-P))/N)}$$

Where P is the relative frequency and N is the sample size.

4. Results

Comparison of mucosal conditions between vendors and consumers

The proportion of vendors with abnormal mucosa (78.26%) was significantly higher ($p<0.01$) than that of consumers (60%) (Table 1). The mucosal lesions observed were bighorn, inflammatory mucosa, congestive mucosa, irregular and pale horn. These lesions were more commonly reported in vendors, but the difference was insignificant for most of these abnormalities (Table 1). However, the proportion of vendors with inflammatory mucosa (65.20%) was significantly higher ($p<0.05$) than that of consumers (43.58%). No consumer showed irregular and pale horns.

The nasal cavities of vendors (38.24%) showed more ($p<0.05$) abnormalities than those of consumers (17.95%). The abnormalities observed in the nasal cavity were mucopurulent secretions, rhinitis, poor oral status, and tonsils. The frequency of these abnormalities was higher in vendors than in consumers for all abnormalities except rhinitis and tonsils. Mucopurulent secretions were not reported in consumers, whereas 14.7% of sellers had this abnormality.

Comparison of Mucosal Conditions by Age Group

The mucous membranes of users under 20 to 30 years of age showed more abnormal appearance than those of sellers. The frequency of users with bighorn, inflammatory mucosa, and congestive mucosa were higher than that of sellers. However, the difference was insignificant. From the age of 30 onwards, the appearance of the sellers' mucous membranes was more

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Table 1: Influence of counterfeit Petrol on mucous membrane conditions of vendors and consumers

Variable	Consumer			Vendors			Chi²
	N	%	CI	N	%	CI	
Mucosal appearance							
Normal	40	40	15.18	69	21.74	9.73	**
Abnormal	40	60	15.18	69	78.26	9.73	**
Mucosal abnormalities							
Large cone	39	53.86	6.92	69	65.20	3.96	NS
Irregular and pale horn	39	0	0.00	69	2.9	3.96	NS
Inflammatory mucosa	39	43.59	15.56	69	65.20	3.96	*
Congestive mucosa	39	5.13	6.92	69	11.59	7.55	NS
The appearance of the nasal cavity							
Normal	39	82.05	14.12	68	61.76	11.55	*
Abnormal	39	17.95	14.12	68	38.24	11.55	*
Mucopurulent secretion	39	0	0.00	68	14.70	7.22	*
Posterior and purulent rhinorrhea	39	10.25	0.00	68	17.64	5.59	NS
Rhinitis	39	12.82	10.49	68	7.35	6.20	NS
Other							
Poor oral health	39	12.82	10.49	68	25	10.29	NS
Tonsils	39	10.26	9.52	68	7.35	6.20	NS
Sinusitis	39	7.69	8.36	68	16.18	8.75	NS

*CI: Confidence Interval, N: sample size, %: case frequency; NS: p>0.05; *: p<0.05; **: p<0.01.*

abnormal than the consumers (table 2). The different abnormalities were also more recorded in the sellers aged over 30 years. Nonetheless, the differences between the frequencies were not significant.

The appearance of the nasal cavities showed minor variation between the different age groups. Consumers in the 20-30 age group had more ($p<0.05$) standard nasal cavities than vendors in the same age group. The frequencies of the different abnormalities recorded for the different age groups in the sellers were higher than in the consumers, but the differences were insignificant.

Influence of counterfeit Petrol on hematological profile and biological abnormalities

The white blood cell count of sellers was not different from that of consumers (Table 3). The proportion of vendors with a higher than average red blood cell count was significantly lower ($p<0.05$) than consumers. Consumers with normal hemoglobin (98.75%) were more numerous ($p<0.001$) than sellers (80%). On the other hand, the frequency of sellers with a lower hemoglobin level than usual was significantly higher ($p<0.001$) than consumers. A higher number ($p<0.001$) of consumers than sellers had an average hematocrit level. A lower level of hematocrit level than average (48.75%) was ($p<0.001$) reported in sellers than in consumers (20.25%). The number of vendors who had a lower mean blood volume than normal was higher ($p<0.05$) than those of consumers. They also had a higher

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number of lower than average mean corpuscular hemoglobin content compared to consumers ($p<0.01$). The same was true for the mean corpuscular hemoglobin concentration. The proportion of consumers with a red cell distribution index above the expected value was significantly higher ($p<0.01$) than sellers. The difference between the proportions of sellers and consumers with normal blood platelets was not significant (Table 3). However, the number of consumers with above normal platelet levels (15%) was significantly higher ($p<0.05$) than that of sellers (5%). The mean platelet volume did not differ significantly between consumers and sellers.

Table 2: Distribution of an ear, nose, and throat indicators of exposed persons by age

Variable	**≤ 20**		**20-30**		**30-40**		**40-50**		**≥50**	
	Vendor	**Consumer**	**Vendor**	**Consumer**	**Vendor**	**Consumer**	**Vendor**	**Consumer**	**Vendor**	**Consumer**
Mucosal appearance										
Normal	4.4±4.8a	12.5±10.4a	5.8±5.5a	12.5±10.4a	2.9±4a	7.5±8.3a	2.9±4a	2.5±4.9a	5.8±5.5a	5±6.8a
Abnormal	7.3±6.1a	17.5±11.9a	14.5±8.3a	20±12.6a	23.2±10a	10±9.4a	23.2±10a	10±9.4a	10.1±7.1a	2.5±4.9a
Mucosal abnormalities										
Large cone	5.8±5.5a	17.9±12a	10.2±7.1a	15.4±11.3a	21.7±9.7a	7.7±8.4a	21.7±9.7a	10.3±9.5a	5.8±5.5a	2.6±5a
Irregular and pale horn	0±0a	0±0a	0±0a	0±0a	1.5±2.8a	0±0a	0±0a	0±0a	1.5±2.8a	0±0a
Inflammatory mucosa	5.8±5.5a	10.3±9.5a	21.7±9.7a	17.9±12a	21.7±9.7a	7.7±8.4a	10.2±7.1a	7.7±8.4a	5.8±5.5a	0±0a
Congestive mucosa	0±0a	0±0a	2.9±4a	5.1±6.9a	1.5±2.8a	0±0a	5.8±5.5a	0±0a	1.5±2.8a	0±0a
The appearance of the nasal cavity										
Normal nasal cavity	9±6.8a	15.4±11.3a	11.9±7.8a	38.5±15.3b	14.9±8.5a	12.8±10.5a	16.4±8.9a	10.3±9.5a	10.5±7.3a	5.1±6.9a
Abnormal nasal cavities	4.5±5.0a	7.7±8.4a	9±6.8a	2.6±5a	17.9±9.2a	5.1±6.9a	9±6.8a	2.6±5a	7.5±6.3a	0±0a
Nasal cavity abnormalities										
Purulent secretion	1.5±2.9a	0±0a	4.4±4.9a	0±0a	4.4±4.9a	0±0a	2.9±4a	0±0a	1.5±2.9a	0±0a
Posterior and purulent rhinorrhea	1.5±2.9a	0±0a	2.9±4a	2.6±5a	5.9±5.6a	5.1±6.9a	5.9±5.6a	2.6±5a	1.5±2.9a	0±0a

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Rhinitis	0±0b	7.7±8.4a	0±0a	0±0a	1.5±2.9 a	5.1±6.9a	1.5±2.9 a	0±0a	5.9±5.6a	0±0a
Other anomalies										
Poor oral health	1.5±2.9a	0±0a	4.4±4.9 a	2.6±5a	5.9±5.6 a	0±0a	7.4±6.2 a	7.7±8.4 a	5.9±5.6a	2.6±5 a
Tonsils	4.4±4.9a	7.7±8.4a	1.5±2.9 a	2.6±5a	0±0a	0±0a	1.5±2.9 a	0±0a	0±0a	0±0a
Sinusitis	1.5±2.9a	2.6±5a	4.4±4.9 a	5.1±6.9a	5.9±5.6 a	0±0a	2.9±4a	0±0a	1.5±2.9a	0±0a

CI: Confidence Interval, intra-class percentages of the same row followed by the same letter do not differ significantly at the 5% level

Table 3. The hematological profiles of sellers and consumers of counterfeit Petrol in the commune of Abomey-Calavi

	Consumer			Vendor			
Variable	**N**	**%**	**CI**	**N**	**%**	**CI**	**Chi²**
White blood cells							
Normal	80	87.5	7.25	80	87.5	7.25	NS
Lower	80	8.75	6.19	80	8.75	6.19	NS
Superior	80	3.75	4.16	80	3.75	4.16	NS
Red blood cells							
Normal	80	87.5	7.25	80	93.75	5.30	NS
Lower	80	0	0	80	2.5	3.42	NS
Superior	80	12.50	7.25	80	3.75	4.16	*
Hemoglobin							
Normal	80	98.75	2.43	80	80	8.77	***
Lower	80	0	0.00	80	16.25	8.08	***
Superior	80	1.25	2.43	80	3.75	4.16	NS
Hematocrit							
Normal	79	79.75	8.86	80	50	10.96	***
Lower	79	20.25	8.86	80	48.75	10.95	***
Superior	79	0	0.00	80	1.25	2.43	NS
Mean corpuscular volume (MCV)							
Normal	79	75.95	9.42	79	58.23	10.88	*
Lower	79	24.05	9.42	79	41.77	10.88	*
Mean Corpuscular Hemoglobin Content (MCHC)							
Normal	79	75.9	9.43	79	54.43	10.98	**
Lower	79	24.05	9.42	79	44.3	10.95	**
Superior	79	0	0.00	79	1.27	2.47	NS
Mean Corpuscular Hemoglobin Concentration (MCHC)							
Normal	79	97.47	3.46	79	87.34	7.33	*
Lower	79	1.27	2.47	79	8.86	6.27	*
Superior	79	1.27	2.47	79	3.8	4.22	NS
Red blood cell distribution index (PDW-SD)							

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Normal	49	24.49	12.04	65	53.85	12.12	**
Lower	49	4.08	5.54	65	0	0.00	NS
Superior	49	71.43	12.65	65	46.15	12.12	**
Plaques							
Normal	80	81.25	8.42	80	88.75	6.92	NS
Lower	80	2.5	3.46	80	6.25	5.30	NS
Superior	80	15	7.91	80	5	4.78	*
Mean Platelet Volume (MPV)							
Normal	79	69.62	10.14	79	69.62	10.14	NS
Lower	79	30.38	10.14	79	29.11	10.02	NS
Superior	79	0	0.00	79	1.27	2.47	NS

*CI: Confidence Interval, N: sample size, %: case frequency; NS: p>0.05; *: p<0.05; **: p<0.01; ***: p<0.001.*

The abnormalities associated with these decreases or increases in hematological parameters are anemia, microcytosis, macrocytosis, leukopenia, hyper-leukocytosis, cytopenia, thrombocytosis, and thrombocytosis (Figure 1). Anemia, hyper-leukocytosis, and cytopenia were only recorded in vendors. The proportion of vendors with microcytosis was significantly higher (p<0.01) than consumers. The frequencies of other abnormalities did not differ significantly between sellers and consumers, but sellers had the highest frequencies of most abnormalities except thrombocytosis.

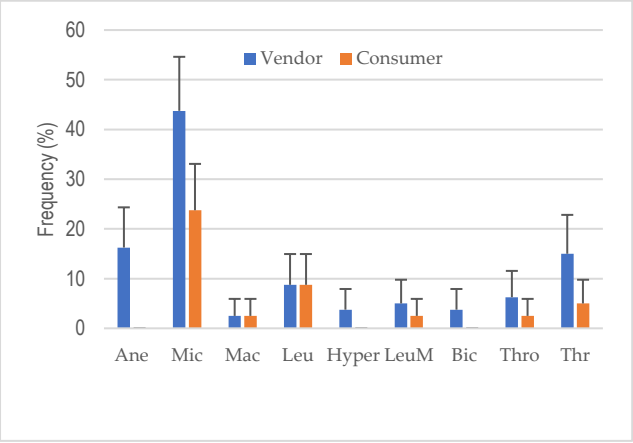

Figure 1. Abnormalities recorded in sellers and consumers of counterfeit petrol (Leu: Leucopenia, Hyper: Hyper-leucopenia; Ane: Anemia, Mic: Microcytosis, Mac: Macrocytosis, Thro: Thrombocytosis, LeuM: Microcytosis Leucopenia, Bic: Bicytopenia)

Influence of vendor and consumer age on hematological profiles and biological abnormalities

Most hematological parameters did not vary according to the age of the exposed individuals (Table 4). However, consumers aged 20-30 years (less exposed) had more normal white blood cells, hemoglobin, hematocrit, and blood platelets than vendors in the same age group (p<0.05). Compared to the sellers, the mean corpuscular hemoglobin concentration was also in the normal range (p<0.05) in the 20-30-year-old consumers. The hematocrit was lower (p<0.05) than the average value of sellers over 40 years of age than in consumers. Sellers in these age groups had lower platelet levels than consumers. The mean corpuscular hemoglobin content and the mean platelet volume below standard were more commonly recorded in sellers aged 30-40 than in consumers of the same age group.

Illnesses associated with the effect of petrol on hematological parameters were more common in consumers than in sellers under 20 years of age. Beyond this age group, petrol sellers experienced more abnormalities than consumers (Figure 2).

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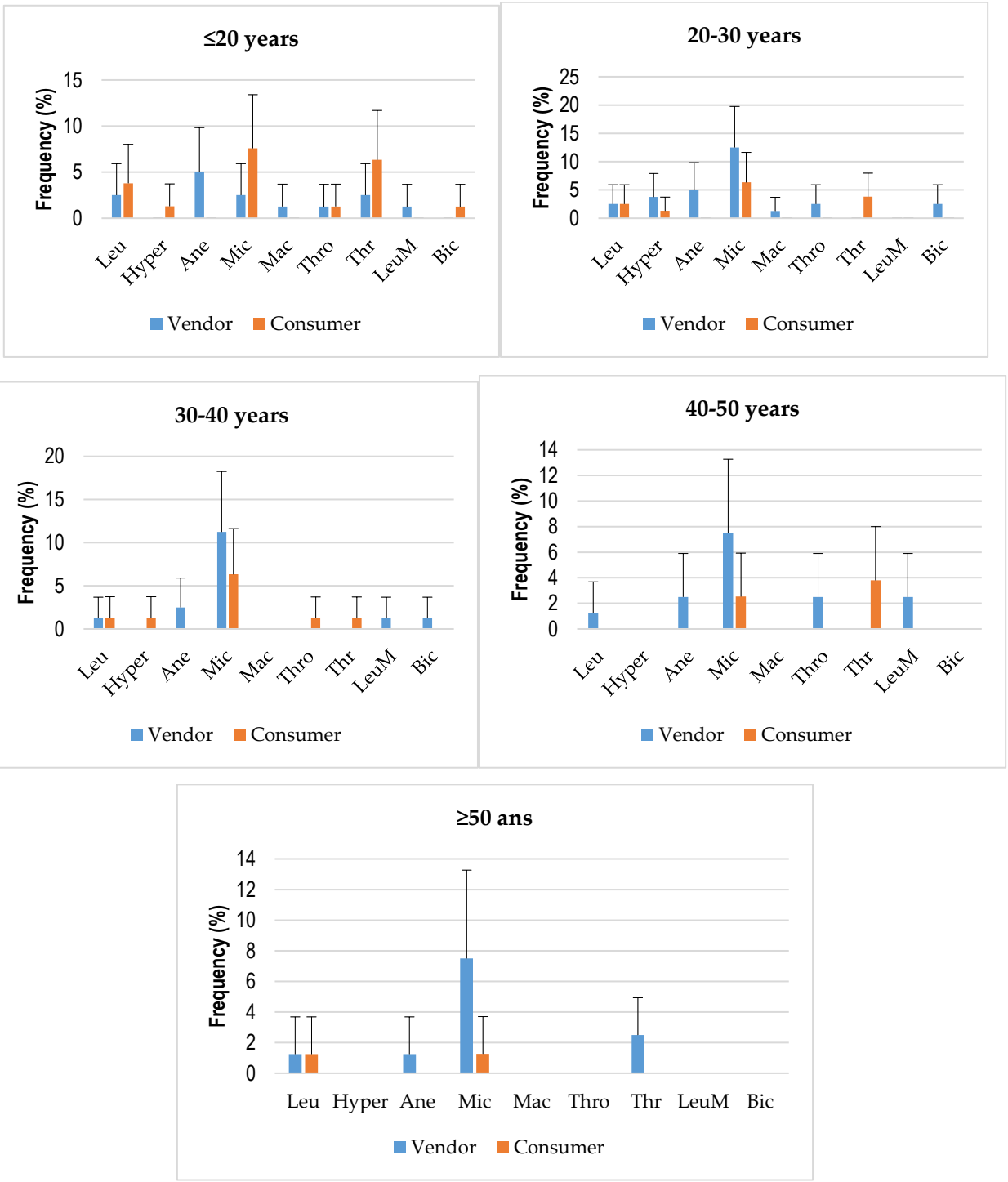

Figure 2: Distribution of abnormalities of hematological parameters according to the age of the sellers (Leu: Leucopenia, Hyper: Hyperleucopenia; Ane: Anemia, Mic: Microcytosis, Mac: Macrocytosis, Thro: Thrombocytosis, Thr: Thrombocytosis, LeuM: Leucopenia Microcytosis, Bic: Bicytopenia)

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Table 4: Influence of age on hematological parameters

Variable	≤ 20		20-30		30-40		40-50		≥50	
	Vendor	**Consumer**	**Vendor**	**Consumer**	**Vendor**	**Consumer**	**Vendor**	**Consumer**	**Vendor**	**Consumer**
White blood cells (n=80)										
Normal	10±6.6a	21.3±9a	18.8±8.6 b	35±10.5a	22.5±9.2 a	13.8±7.5a	23,8±9,3 a	12,5±7,2a	12,5±7,3 a	5±4,8a
Lower	2.5±3.4a	3.8±4.2a	2.5±3.4a	2.5±3.4a	1.3±2.4a	1.3±2.4a	1,3±2,4a	0±0a	1,3±2,4a	1,3±2,4a
Superior	0±0a	1.3±2.4a	3.8±4.2a	1.3±2.4a	0±0a	1.3±2.4a	0±0a	0±0a	0±0a	0±0a
Red blood cells (n=80)										
Normal	13.8±7.6 a	23.8±9.3a	17.5±8.3a	32.5±10.3 b	23.8±9.3 a	12.5±7.2a	25±9,5a	12,5±7,2a	13,8±7,6 a	6,3±5,3a
Lower	2.5±3.4a	1.3±2.4a	0±0a	0±0a	0±0a	0±0a	0±0a	0±0a	0±0a	0±0a
Superior	0±0a	1.3±2.4a	1.3±2.4a	6.3±5.3a	1.3±2.4a	3.8±4.2a	1,3±2,4a	0±0a	0±0a	0±0a
Hemoglobin (n=80)										
Normal	7.5±5.8b	26.3±9.6a	18.8±8.6 b	37.5±10.6a	18.8±8.6 a	16.3±8.1a	22,5±9,2 a	12,5±7,2a	12,5±7,3 a	6,3±5,3a
Lower	5±4.8a	0±0b	5±4.8a	0±0b	2.5±3.4a	0±0a	2,5±3,4a	0±0a	1,3±2,4a	0±0a
Superior	0±0a	0±0a	0±0a	1.3±2.4a	2.5±3.4a	0±0a	1,3±2,4a	0±0a	0±0a	0±0a
Hematocrit (n=80)										
Normal	1.3±2.4b	16.5±8.2a	12.5±7.3 b	34.2±10.5a	16.3±8.1 a	11.4±7a	12,5±7,3 a	11,4±7a	7,5±5,8a	6,3±5,4a
Lower	15±7.8a	8.9±6.3a	6.3±5.3a	5.1±4.8a	8.8±6.2a	5.1±4.8a	12,5±7,3 a	1,3±2,5b	6,3±5,3a	0±0b
Superior	0±0a	0±0a	0±0a	0±0a	0±0a	0±0a	1,3±2,4a	0±0a	0±0a	0±0a
Mean corpuscular volume (MCV) (n=79)										
Normal	8.9±6.3a	17.7±8.4a	16.5±8.2 b	32.9±10.4a	13.9±7.6 a	10.1±6.7a	12,7±7,3 a	10,1±6,7a	6,3±5,4a	5,1±4,8a
Lower	2.5±3.4a	7.6±5.8a	12.5±7.3a	6.3±5.4a	11.3±7a	6.3±5.4a	7,5±5,8a	2,5±3,5a	7,5±5,8a	1,3±2,5a
Superior	1.3±2.5a	0±0a	1.3±2.5a	0±0a	0±0a	0±0a	0±0a	0±0a	0±0a	0±0a
Mean Corpuscular Hemoglobin Level (n=79)										

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Normal	6.3±5.4a	15.2±7.9a	15.2±7.9 b	31.7±10.3a	13.9±7.6 a	13.9±7.6a	15,2±7,9 a	10,1±6,7a	3,8±4,2a	5,1±4,8a
Lower	8.9±6.3a	10.1±6.7a	3.8±4.2a	7.6±5.8a	11.4±7a	2.5±3.5b	10,1±6,7 a	2,5±3,5a	10,1±6,7 a	1,3±2,5b
Superior	1.3±2.5a	0±0a	0±0a	0±0a	0±0a	0±0a	0±0a	0±0a	0±0a	0±0a
Mean corpuscular hemoglobin concentration (MCHC) (n=79)										
Normal	12.7±7.3 a	24.1±9.4a	17.7±8.4 b	39.2±10.8a	21.5±9.1 a	15.2±7.9a	22,8±9,3 a	12,7±7,3a	12,7±7,3 a	6,3±5,4a
Lower	2.5±3.5a	0±0a	0±0a	0±0a	3.8±4.2a	1.3±2.5a	1,3±2,5a	0±0a	1,3±2,5a	0±0a
Superior	1.3±2.5a	1.3±2.5a	1.3±2.5a	0±0a	0±0a	0±0a	1,3±2,5a	0±0a	0±0a	0±0a
Plaques (n=80)										
Normal	12.5±7.3 a	17.7±8.4a	16.3±8.1 b	35.4±10.5a	25±9.5a	13.9±7.6a	23,7±9,3 a	8,9±6,3b	11,3±6,9 a	6,3±5,4a
Lower	1.3±2.4a	1.3±2.5a	2.5±3.4a	0±0a	0±0a	1.3±2.5a	2,5±3,4a	0±0a	0±0a	0±0a
Superior	2.5±3.4a	6.3±5.4a	0±0a	3.8±4.2a	0±0a	1.3±2.5a	0±0a	3,8±4,2a	2,5±3,4a	0±0a
Mean Platelet Volume (VPM) (n=79)										
Normal	12.7±7.3 a	20.3±8.9a	13.9±7.6 b	27.9±9.9a	11.4±7a	12.7±7.3a	20,3±8,9 a	6,3±5,4b	11,4±7a	2,5±3,5b
Lower	3.8±4.2a	5.1±4.8a	5.1±4.8a	11.4±7a	12.7±7.3 a	3.8±4.2b	5,1±4,8a	6,3±5,4a	2,5±3,5a	3,8±4,2a
Superior	0±0a	0±0a	0±0a	0±0a	1.3±2.5a	0±0a	0±0a	0±0a	0±0a	0±0a

CI: Confidence Interval, N: sample size, %: frequency of cases; intra-class percentages in the same row followed by the same letter do not differ significantly from the 5% level.

Influence of counterfeit Petrol on the lipid profile of sellers and consumers

Total cholesterol and HDL cholesterol levels did not differ significantly between vendors and consumers, but consumers with values within the norms were the most numerous (Table 5). The proportion of vendors with LDL cholesterol levels above the standard value was significantly higher ($p<0.05$) than consumers. Triglyceride levels did not differ significantly between consumers and vendors.

Different lipid levels were more observed ($p<0.05$) in the normal ranges in consumers under 20 years of age than in sellers. Above this age, the age difference between consumers and sellers was no longer significant, but sellers' values were higher than consumers'.

Table 5. Lipid profile of sellers and consumers of counterfeit petrol

Variable	**Consumer (n=15)**		**Vendor (n=42)**		**Chi²**
	%	**IC**	**%**	**IC**	
Cholesterol Total					
Normal	60	24.79	57.14	14.97	NS
Lower	33.33	23.86	30.95	13.98	NS
Superior	6.67	12.63	11.9	9.79	NS
High Density Lipoprotein					

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(Cholesterol HDL)					
Normal	86.67	17.20	83.33	11.27	NS
Lower	13.33	17.20	16.67	11.27	NS
Low Density Lipoprotein (Chlosterol LDL)					
Normal	86.67	17.20	69.05	13.98	*
Superior	13.33	17.20	30.95	13.98	*
Triglycérides					
Normal	46.67	25.25	59.52	14.85	NS
Lower	40	24.79	35.71	14.49	NS
Superior	13.33	17.20	16.67	11.27	NS

*CI: Confidence Interval, N: sample size, %: case frequency; *: p<0.05*

5. Discussion

Influence of counterfeit Petrol on the mucosal condition of vendors

Sellers showed more abnormal mucous membranes than consumers because they were more exposed to petrol. This high presence of mucosal abnormalities is due to the daily contact of the mucosa with petrol through inhalation and swallowing [6,11,12]. Thus, petrol is deposited on the mucous membranes, irritating and damaging them [13,14]. The lesions observed in the mucosa of these vendors are the bighorn, the inflammatory mucosa, the irregular and pale horn, and the congestive mucosa. The damage to the nose (bighorn, irregular, and pale horn) is due to the inhalation of petrol through the nostrils [12,15,16]. This inhalation leads to an initial deposition of petrol particles in the turbinate, causing the abnormalities observed. The mechanism of action of these particles is not yet reported in the literature. This mechanism may be explained by a localized inflammatory reaction leading to a bighorn. When exposure lasts, the particles further irritate and deform the turbinate, making it irregular and pale. Nose irritation has already been reported in several studies on prolonged exposure to petrol among petrol sellers [12,15]. The compounds in petrol that cause these reactions are toluene, benzene, and xylene [16].

The effect of petrol on the mucous membranes resulted in abnormalities in the appearance of the nasal cavity. The nasal cavities were more abnormal in vendors than in consumers because they were more exposed to petrol. The abnormalities found were mucopurulent secretions and rhinitis. These mucopurulent secretions have been previously reported in petrol-exposed subjects in the United States [15].

Poor oral health was also a significant anomaly among vendors and may be related to the swallowing of petrol by these vendors [6].

The mucosal abnormalities found did not vary between age groups, indicating that no age group is immune to the mucosal effects of counterfeit petrol. The slight increase in abnormalities seen in sellers over 20 years of age compared to consumers is a consequence of a prolonged exposure effect.

Influence of counterfeit Petrol on the hematological profile of sellers

Exposure does not affect the white blood cell profile of exposed vendors, and this has been found in petrol station workers in Nigeria [17–20] and Sudan [21]. This finding is different from the one made in Nigeria by Opute et al. [22], who reported a lower white blood cell count in people exposed to petrol smoke. This difference indicates that benzene, toluene, and other toxic chemicals in petrol are more concentrated in the smoke than in vapor. In contrast to white blood cells, exposure to counterfeit petrol reduced red blood cell count and hemoglobin in the sellers. This reduction in red blood cell count, hematocrit, and hemoglobin in exposed individuals (mainly vendors) was also observed in Nigeria [17,20], Ethiopia [23], Ethiopia, Iraq [24,25] Brazil [26] and Iran [27]. Dougnon et al. [28] reported the same finding in rats exposed to petrol in Benin. This influence of petrol exposure on red blood cells and hemoglobin levels increases with the duration of exposure [22] and justifies the increase in the proportion of people with lower than average hemoglobin levels in younger people who work more hours per day than older people [7]. The effect of petrol on red blood cell and hemoglobin levels is the basis for the anemia recorded in the salespeople. This effect has already been reported among people exposed to petrol in Benin [29], Nigeria [20,30], and Australia [31]. Anaemia has been reported more in vendor-aged 20-30 years because this age group

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has undergone more changes in hematological parameters. The high presence of anemia in this age group explains the high fatigue reported by vendors in this age group [7]. Sellers had a lower than expected mean blood volume than less exposed people (consumers), as reported in various studies in Nigeria, Ethiopia, Sudan, Pakistan, and China [21–23,32–34]. However, research conducted in Nigeria by Ajugwo et al. [17] and Uko et al. [18] did not show a significant difference in this parameter. Still, the values reported for exposed people (sellers) are above those of unexposed people. This lack of difference is justified by the short exposure period (2 years).

The Influence of petrol on the average blood volume of the salespeople becomes more pronounced as the duration of exposure increases [33]. The negative effect of petrol on the average corpuscle volume is observed after eight years of exposure [33]. The sellers showed lower values of Mean Corpuscular Hemoglobin Content, Mean Corpuscular Hemoglobin Concentration, and Red Blood Cell Distribution Index than the consumers because they had less hemoglobin. The same observation was made among petrol sellers and people exposed to petrol and oil compounds in Nigeria, Sudan, Ethiopia, Iraq, and China [17,20,23,25,32–34]. Apart from anemia, the pathologies caused by petrol exposure in the sellers are microcytosis, hyperleukocytosis, microcytosis leukopenia, cytopenia, and thrombocytopenia. These abnormalities have been previously reported in sellers of hydrocarbons, including petrol and petrol [20,31].

Influence of counterfeit Petrol on the lipid profile of sellers

The HDL cholesterol value was higher in sellers than in consumers. This finding is consistent with what Ataro et al. [35] reported in Ethiopia among vehicle garage workers who are also petrol-exposed individuals. Total cholesterol, triglycerides, and cholesterol levels were not affected by exposure, which differs from Joshi [36] and Ataro et al. [35], who reported higher levels in exposed individuals. However, Mohammed [37] found no difference in total cholesterol levels between exposed and unexposed individuals in Iraq.

Conclusions

The study on the influence of exposure to counterfeit petrol on the state of the mucous membranes, the hematological profile, and the lipid profile of vendors in South Benin shows that petrol degrades the mucous membranes of vendors. This membrane degradation reduces most blood parameters, particularly the rate of red blood cells, hematocrit, and hemoglobin. On the other hand, it causes an increase in lipid parameters in the body. This disruption of blood parameters caused by counterfeit petrol causes abnormalities in sellers, mainly anemia. These influences vary very little with age, but young people seem to be more affected due to their high daily working hours. This work provides a better understanding of the effects of petrol on sellers. Still, it is limited to the upper organs (mucous membranes), and more research is needed on the effect of petrol on the deeper organs, especially the sinuses and lungs.

Ethical Approval

The study was approved by the National Committee of Ethics for Health Research (CNERS).

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