Exposure to Occupational Hazard: Hypogonadism and Dyslipidemic Assessment of Exposed House and Automobile Painters in Ilorin, North central Nigeria

ABSTRACT

Aims : To investigate the impact of human exposure to the constituents of paint on serum reproductive hormone and Lipid profile among occupationally exposed House and Automobile spray painters in Yakuba district of Ilorin East Local Government area of Kwara State. Nigeria,

Study design: Experimental./Cross sectional

Place and Duration of Study: Yakuba district of Ilorin East Local Government area of Kwara State. Nigeria, 6months; between July 23 and January 2024

Methodology: A total of 120 male participants were recruited for this study with the mean age 33.15±0.86 years. They were grouped according to their job specification;40 automobile painters, 40 House painters and 40 individuals male artisans who are not painters were recruited as the control. Venous Blood samples were collected from both the test and control subjects for the measurement of serum lipids and testosterone using reference techniques.

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Results: Total Cholesterol, Triglyceride, HD and LDL cholesterol were significantly higher ($P<0.05$) in the exposed automobile and house painters than the control groups however, there was no significant difference ($P>0.05$) between the serum lipid values of the automobile and the house painters. The serum testosterone level in both group of exposed painters was statistically similar($P>0.05$).

There was no significant correlation ($P>0.05$) between the frequency of cars or houses painted per month and work experience with the lipid profile parameters and testosterone levels in the occupationally exposed house and automobile painters.

Conclusion: Occupational exposure to some chemical constituents of paint are associated with dyslipidaemia and decrease serum testosterone which may precipitate adverse ill health among the painters.

Keywords: Automobile spray painters, house spray painters, lipid profile, dyslipidaemia

1. INTRODUCTION

Spray painters who work on cars and houses may be at the risk for health problems as a result of their continuous exposure to the chemical components of spray paint. (1-2) The extensive use of cleansers, adhesives, inks and many other mixtures of solvents frequently found in various workplaces may precipitate chronic health effect which constitute concern for people all over the world. Due to ignorance and inadequate education, painters are among the highly and most vulnerably exposed occupational groups in the industrial or commercial field (1).

Among the materials used in spray painting are cellulose thinner (which contains methanol, toluene, xylene, and butanol); hardener (which contains hexane, xylene, isocyanate); clearing agent which contains decadency acid and auto base which contains –N- butyl acetate (2,3). Kang et al., and Emmanuel et.al. (4,5) identified oral, dermal, and inhalation as the unusual routes of exposure to environmental agents. These chemicals constitute health hazards in humans in diverse forms. Short term health effects that spray painting can cause include irritation, contact dermatitis, burns to the skin and eyes, vomiting and diarrhea, irritation to the nose, throat and lungs, headaches, dizziness, nausea and fatigue. (6) The long-term health effects include occupational asthma, allergic contact dermatitis, lung cancer and painter's syndrome' which is chronic inhalation of paints and solvents that causes harm to the central nervous system and blood-forming organs (7,8)

Rikhotso et al., and Che Huey et al., (9,10) reported that 2.9 billion workers worldwide are exposed to dangerous risks at various job-related work yearly with two million deaths linked to occupational diseases and injuries; while occupational diseases and injuries account for 4% decline in gross domestic product (GDP). Recent report (9) revealed that risks are not limited to occupation but are also encountered in the office buildings as well as in

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industries and mines while unchecked exposure of workers to hazard has its negative effects on productivity, quality of work, morale of workers and job satisfaction. These negative impacts can be prevented if antidotes or positive measures are available to alleviate occupational health. Achieving this relief is however difficult due to the low level of policy on occupational safety and health concern in Africa is low when compared to the global practice.

The impact of the hazards associated with the risks of spray painting may be mild or tolerable among the artisans in the developed world because of the regulations and protective guidelines put in place to protect the artisans .However these protective regulations may be missing in the rapidly industrializing , developing and third world countries like Nigeria which still battling with perfecting import and export regulations of most products [11].The exposure to hazards of paints and painting vocation is further compounded by the ignorance and inadequate of education of the house and automobile painters about their occupation and associated job hazards [12] which make them more vulnerable to jo b related illness.

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Hormones are specific molecule produced by specific endocrine glands and secreted into the blood or other body fluids of other target organs [13]. They act as chemical messenger in the endocrine system to influence specific cells and organs function such as reproduction, metabolism, energy use, storage, water and electrolyte balance. [13]. The major reproductive hormone in males is Testosterone responsible for the maintenance of male sex characteristics and spermatogenesis [14]

Lipids are compounds of naturally occurring esters of glycerol and fatty acids which are solid at room temperature as opposed to oils which are similar esters but liquid at room temperature. Lipid profile consist of Triglycerides, Cholesterol, Low density lipoprotein (LDL), High- density lipoprotein (HDL), Very low-density lipoprotein (VLDL), Intermediate

density lipoprotein (IDL) and Chylomicrons [15] The assay of the lipid profile will identify certain genetic diseases, disorder of lipid metabolism, risks for cardiovascular disease and other diseases [16]

Biochemical assessment of paint workers revealed elevated concentrations of paint compound or their metabolites in both blood urine samples. The infiltration or absorption of this paint components and their related metabolites can be reduced significantly by guided selection and use of personal protective equipment. However, this may be difficult to achieve because painters do not generally wear respirators or gloves, an attitude which exposes painters to occupational hazards. [11,17]

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Some studies have shown that prolonged exposure to toxicant such as paints have deleterious effect on the biochemical indices of the body organs and system of the occupational exposed artisans in the building industry, but there is dearth of reports on the implications of painting job related hazards and the constituents of paints on the reproductive hormones and lipid profile of the automobile and house spray painters in Ilorin, North central Nigeria. This study was undertaken to assess the reproductive hormones and lipid profile indices of painters at the Yakuba town in Ilorin East Local Government area of Kwara State. The outcome of this study may improve the precautionary indices and serve as a guide against occupational hazards in the automobile and house painting industries

2. 0 MATERIAL AND METHODS

2.1 Study design.

This was a random study conducted on 120 adult male house and automobile spray painters grouped in to 5 according to year of practice and exposure to the constituents of paint. The group consists of: Group 1(1- 10 years), Group2(11- 15 years), Group 3 (16-20years), Group 4 (21- 30 years), Group 5 (31- 40 years) with mean age range of 33.15 ± 0.86 years.

The control group (Group 6, non- exposed) were non- painters but professional artisans of different specialization, age and sex matched with the exposed painters. Structured

questionnaire was administered to both the test and control subjects to obtain information on anthropometric indices, demographic data, socio -economic status, frequency and duration of exposure and clinical data (Blood pressure). The painters and control subjects with raised blood pressure or chronically ill were excluded from the study.

2.2 Ethical consideration.

The study was conducted according to the international best practice with respect to the Declaration of Helsinki. The local ethical approval for the study was also obtained from the Health Research Ethics Committee of Kwara State ministry of Health, Nigeria.

2.3 Collection of Blood Samples for Hormone and Lipid Assay.

Ten ml of fasting venous blood was aseptically by taken by Venus puncture from the vehicle and house spray painters at the zonal monthly meeting of the painters at Yakuba town in the Yakuba district of Ilorin East Local Government area of Kwara State. From the ten ml of the blood collected, five ml was dispensed into dipotassium ethylene diamine tetra acetic acid (K^3EDTA) for the determination of Triglyceride (Trig), total cholesterol (T. Chol), High density lipoprotein (HDL), Low density lipoprotein (LDL) while Five ml was dispensed into lithium heparin for testosterone assay.

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The blood was centrifuged at a regulated speed of 3500rpm for 5min to obtain plasma which was separated and feezed until ready for analysis.

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2.4 BIOCHEMICAL ESTMATION.

2.4.1 Lipid profile Analysis

Triglyceride (TG) was assayed by enzymatic methods described by Kawano et al., 2019 (18) while Total cholesterol was estimated using the enzymatic method as described by (18,19) Plasma HDL-C assay was analyzed the by enzymatic method as described by (20).

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2.4.2 Testosterone assay

Testosterone was estimated by enzyme immunoassay by method described by Martínez Escribano et al. (2).

2.4 3 Statistical Analysis

The data obtained was analyzed with the Statistical Package for the Social Sciences (SPSS) version 19. Analysis of variances and Post-hocs Test were used for the comparison of the variables. Relationships between quantitative variables was established with the Spearman's correlation coefficient. Significant values were considered at p-value less than 0.05($p<0.05$).

3.0 RESULTS AND DISCUSSION

3.1 Results

3. 1.2Table 1. Grouping of House and Vehicle Spray Painters and years of exposure

Group	Duration of Exposure	No of Participants
1	**1- 10**	20
2	**11- 15**	20
3	**(16-20**	20
4	**21- 30**	20
5	**31- 40**	20
5	**41-50**	20
6	**Non- painters**	20

Number of participants = 100

Table 1 shows the differential duration of exposure with respect to the years of experience and the number of the painters recruited for the study. The minimum and maximum years of work experience of the subject used for the study were 10 and 50 years respectively. Twenty subject each per group of painters and controls (non-painters) were enlisted for the study.

3.1.3 Table2. Lipid profiles and Testosterone levels in different groups of house spray painters and the controls.

Parameters	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Total cholesterol (mmol/L)	5.48±0.08	5.42± 0.17	5.62 ±.0.48	5.64. ± 0.26	5. 38±0.64	3.05±0.07
Triglyceride (mmol/L)	1.29±0.07	1..38±0.08	1.53±0.10	1.47±0.13	1.34±0.12	1.03±0.05
High density lipoprotein - Cholesterol mmol/L)	1.11±0.04	1.08±0.07	0.96±0.06	0.97±0.07	0-95±0.08	0.90±0.04
Low density lipoprotein Cholesterol mmol/L)	3.86±0.08	3.97±0.14	4.35±0.19	3.92±0.12	3.84±0.10	1.68±0.07
Testosterone g/ml)	3.42±0.38	3.71±0.42	3.85±0.80	3.96±0.46	4.07±0. 42	6.96±0.35
Level of Significance	P<0.05		P<0.05		P<0-05	

Table 2 shows Mean ± S.E.M. of the lipid profile indices and testosterone in the different group of occupationally exposed spray house painters and non-exposed group (control). The plasma lipid profile parameters in the exposed house painters were statistically higher($p<0.05$) when compared with the control group. However, the occupationally exposed painters had significantly reduced ($p<0.05$) mean serum testosterone level when compared with the non-exposed group (control).

3.1.4 Table 3: **Lipid profiles and testosterone is different groups of automobile spray painters and the controls.**

Parameters	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Total Cholesterol (mmol/L)	5.68±0.12	5.74±0.15	5. 86±0.16	6. 15± 0.13	5.95±0.18	3.05±0.07
Triglyceride (mmol/L)	1.32±0.08	1.41± 0.08	1.55 ±0.10	1.62±0.13	1. 54±0.09	1.03±0.05
High Density Lipoprotein-Cholesterol (mmol/L)	1.12±0.07	1.10±0.05	1.09±0.07	0.98±0.06	0.98±0.07	0.90±0.04
Low Density Lipoprotein Cholesterol (mmol/L)	3.96±0.16	4.33±0.13	4.36±0.21	4. 37±0.18	3.94±0.13	1.68±0.07
Testosterone ng/ml)	4.04±0.38	4.45±0.40	4.59±0.42	4.70±0.43	4.75±0.48	6.96±0.35
Level of Significance	P<0.05		P<0.05		P<0-05	

Table 3 compares the Mean ± S.E.M of testosterone and lipid profile indices in the automobile painters and controls. The occupationally exposed automobile painters had significantly lower ($p<0.05$) mean serum testosterone than the non -exposed control and non- painters, while the plasma lipid profile indices in the exposed automobile painters were statistically higher compared with the control group ($p<0.05$).

3.1.5 Table 4. Lipid profiles and Testosterone value in different groups of House and Automobile spray painters.

Parameters	Group 1		Group 2		Group 3		Group 4		Group 5	
	House painters	Vehicle Painters	House painters	Vehicle painters	House painters	Vehicle Painters	House painters	Vehicle Painters	House painters	automobile painters
Total ccholesterol (mmol/L)	5.48±0.08	5.68±0.12	5.42± 0.17	5.74±0.15	5.62 ±.0.48	5. 86±0.16	5.64. ± 0.26	6. 15± 0.13	5. 8±0.64	5.95±0.1
Triglyceride (mmol/L)	1.29±0.07	1.29±0.08	1..38±0.08	1.39± 0.08	1.53±0.10	1.53±0.10	1.47±0.13	1.62±0.13	1.34±0.12	1. 54±0.09
High Density Lipoptotien-Cholesterol (mmol/L)	1.11±0.04	1.12±0.07	1.08±0.07	1.10±0.05	0.96±0.06	1.09±0.07	0.97±0.07	0.98±0.06	0-5±0.08	0.98±0.0
Lowdensity Lipoprotein-Cholesterol (mmol/L)	3.86±0.08	3.96±0.16	3.97±0.14	4.33±0.13	4.35±0.19	4.34±0.21	3.92±0.12	4. 37±0.18	3.84±0.10	3.94±0.13
Testosterone ng/ml)	3.42±0.38	4.04±0.38	3.71±0.42	4.45±0.40	3.85±0.80	4.59±0.42	3.96±0.46	4.70±0.43	4.07±0. 42	4.75±0.48

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Table 4 Compares the serum lipid profile indices and testosterone in both House and Automobile spray painters. The serum lipid profile indices and testosterone in both spraying painters are statistically comparable ($p>0.05$)

3.1.6 Table 5 Correlation of frequency of the cars and houses painted per month and work exposure with the biochemical parameters in the occupationally exposed house and automobile painters.

Parameters	N	Duration Of Job		Frequency of cars or Houses painted per month	
		R	P	R	P
Total Cholesterol (mmol/L)	80	0.408	0.094	0.892	**0.015***
Triglyceride (mmol/L)	80	0.044	0.226	0.215	0.140
HDL-cholesterol (mmol/L)	80	0.096	-0.188	0.094	-0.189
LDL= cholesterol (mmol/L)	80	0.323	0.112	0.597	0.060
Testosterone (ng/ml)	80	0.058	0.213	0.019	0.261

Table 5 shows the correlation of testosterone and plasma lipid profile with the duration of job and exposure to the constituents of paints. The table shows that there was no significant correlation between testosterone, plasma lipids and duration of job exposure to the hazardous components of paints.

3.2. Discussion

The health impact of chronic workplace exposure to mixture of solvents is still a worldwide health challenge. This is due to their extensive use as constituents in paints, cleaners, adhesives, inks and many other products commonly found in many workplaces (21,22). Long term heavy solvent exposure is hazardous to the nervous system, hepatic, renal, blood and other body systems. The association between occupational exposure to mixtures of solvents and toxic metals with lipid peroxidation,

reproductive hormones, disruption and suppression of testicular testosterone levels are well-established (2,21,22,23). The findings of this study are suggestive of significant dyslipidaemia ($p<0.05$) among the occupationally exposed house and automobile spray painters when compared with the unexposed group (Tables3&4). The dyslipidaemia is characterized by significant elevation of triglyceride, cholesterol and the lipoprotein cholesterol fractions. The result is comparable with the earlier report of previous related studies (24-25) that established the significant correlation between plasma lipids and its lipoprotein cholesterol fractions and heavy metal contents of paints. However, Oduola et.al (26) reported a non-significant lipid profile values among vehicle painters only in Ile-Ife, south west Nigeria, our findings are at variance with this report.

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This variation might be associated with the dietary habit, severity and frequency of exposure and the use of protective devices between the two study locations. We also compared the lipid profile indices between house and automobile painters, a non - significant difference ($p>0.05$) in the lipid profile concentration was established between the two groups of painters. This might be an indication that both artisans were equally exposed to the potential job hazards of painting and the paint used. Similarly, we observed and recorded an insignificant correlation ($p>0.05$) between; the lipid profile indices, job duration and the number of houses and vehicles painted (Table5). The correlation result suggests that the dyslipidaemia reported among the spray painters in this study may not be occupationally related.

The mean testosterone level among the exposed house and automobile spray painters was significantly reduced ($p<0.05$) when compared to the unexposed control subjects (Tables3&4). The reduced testosterone level among the exposed painters might be attributed to the toxic and addictive chemical contents of the paint coupled with the unhygienic work environment of the exposed paint workers. This result correlates with the previous findings of reduced testosterone level among the painters. Fucic et al., (27), Kiconco et al., (28) and La Merrill et al., (29) attributed the reduced testosterone to the effect of the organic and toxic metal content of paints that inhibits Sertoli and Leydig cells during spermatogenesis. These researchers also attributed the low testosterone level to the increased steroid binding globulin precipitated by the toxic metal, organic solvent and additive contents of paints. The house spray painters are potentially more vulnerably exposed to hazard of paint because of the large surface area of the house painted and longer time spent on the painting compared to the vehicle spray painters who worked on medium surface area with shorter time spent on painting the vehicle.

The comparison of the serum level of testosterone between the occupationally exposed house and automobile spray painters showed no significant difference ($P>0.05$). This might be attributed to the similarity in the exposure of both groups of painters to the same concentration and constituent of the implicated hazardous mixtures of the paint despite the average large surface area and longer time vehicle spray painters spend on painting. Similarly, the relationship between the duration of exposure to paints and the low testosterone level among the two groups of painters was not statistically

significant ($p>0.05$). This may imply that the hypogonadotropic hypogonadism observed among the painters might not be time related, but may be associated with the independent toxicity of the additive chemical components of the paints irrespective of duration of the professional practice (27, 28,29). This might have a negative impact on the fertility status of the painters and thus make them vulnerable to occupationally induced infertility

4. CONCLUSION

Cholesterol and testosterone are essential for steroidogenesis in male reproductive function. This study has demonstrated low testosterone and dyslipidaemia characterized by hyperlipidemia amongst the house and automobile spray painters in Yakuba town in Ilorin East kwara state, Nigeria. The hypogonadism and dyslipidemia can be traced to the exposure of the painters to some toxic components of paints in the course of their routine painting occupational engagements over time. Professional painters are vulnerable to occupational hazards and therefore should come together to collaborate with the relevant government agency with a view to seeking formal preventive policy on the prevention of occupational hazards for all the professional artisans in the building and automobile industries in that community.

CONSENT

Consent forms were administered to the subject before sample collection and sample was collected from the subjects that gave consent.

ETHICAL APPROVAL

The study was conducted according to the international best practice with respect to the Declaration of Helsinki. The local ethical approval for the study was also obtained

from the Health Research Ethics Committee of Kwara State ministry of Health, Nigeria.

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