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Prevalence of Respiratory and Non Respiratory Symptoms among Workers Chronically Exposed To Wheat Flour Dust and Other Possible Occupational Hazard in Flour Mill Industry, Calabar, Nigeria.

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Abstract: *Previous studies in Nigeria have attributed the high prevalence of respiratory and non-respiratory symptoms among wheat flour mill workers to wheat dust. Whether toxic gases emitted from wheat flour production may be one of the causative factors has not been investigated. Data were collected from clinical case-notes of 142 flour mill workers (113 males and 29 females) who were exposed to flour mill dust for a period of 3 months to 24 years. Their controls were 327 civil servants (216 males and 111 females) who were not exposed to any known air pollutant. Results showed a significant increase ($p<0.05$ and $p<0.001$) in the prevalence of respiratory symptoms (unproductive cough, chest pain, dyspnoea, sneezing, catarrh and wheezing) among the flour mill workers. There was also a significant increase ($p<0.05$ and $p<0.001$) in the prevalence of non-respiratory symptoms (fever, headache, body pain, anorexia and nausea) among the flour mill workers. The concentration of dust as well as toxic gases notably, hydrogen sulphide (H_2S), nitrogen dioxide (NO_2), hydrogen cyanide (HCN) and ammonia (NH_3) were also significantly higher ($p<0.05$ and $p<0.001$) in the flour mill environment than in control areas. Conclusively, since these gases are known to damage the respiratory system and impair lung function, it is likely that they contributed to the respiratory symptoms observed and not just the conventionally reported flour dust. Hence the respiratory symptoms observed in this study may also be due to the effects of toxic environmental gases and not only by the flour mill dust.*

Keywords: *Chronic-exposure, Flour-dust, Respiratory symptoms, non-respiratory symptoms.*

I. Introduction

The respiratory tract is susceptible to occupational hazards ranging from organic and inorganic dust particles generated from industries during the process of production leading to the release of gaseous chemical, allergenic and carcinogenic compounds.

Flour is a powdery finished product of cereals obtained after the cereals have undergone several reduction processes [1]. These reduction processes leads to the generation of gaseous chemical (CO_2, CO, H_2S, N_2O and NH_4) compounds and organic dust [2][3]. WHO [4] has reported cases of occupational respiratory diseases caused by toxic dust and chemicals, allergenic and carcinogenic agents.

Flour mills are well known for generation and release of dust particles into the air, and are then inhaled during industrial processes, such as packaging, crumbling, cleaning, and even shipping [5]. The intensity of dust one is exposed to becomes very high during the process of mixing and packing in the flour milling sites making personal contact and exposure to these dust very easy [6][7]. In Calabar Nigeria, due to the increase in the number of fast food industries/ eateries and bakeries, the demand for flour has greatly increased. To enable the producers meet up with the increasing demand, the work rate must increase making the flour mill workers to work tirelessly thereby ignoring some preventive measures like masking their nose from the generated flour dust, covering their eyes, ears and even their skin from every possible industrial and occupational hazard and it attendant disorders.

In Nigeria, various studies have shown the role of occupational exposure to environmental pollutants in the prevalence of respiratory and non-respiratory diseases, but whether these diseases or symptoms is consequent upon chronic exposure to flour dust or poisonous gases emitted from the milling environment is not well known, hence the study.

II. Methodology

A total of four hundred and seventy nine (479) subjects working in the flour mill industry Calabar, Nigeria were recruited for the study. The control group consisted of three hundred and twenty seven (337) (216 males and 111 females) civil servants who are working in secretariats in Calabar, Cross River State, Nigeria. The test group is comprised of one hundred and forty-two (142) subjects (113 males and 29 female) who have been working in the flour mill industry, Calabar for a period of at least three months (3 months) and up to twenty years (20 years).

The case notes of both the control and test group were reviewed over an eight (8) year period for respiratory and non respiratory symptoms.

The ambient air in the vicinity of the factory (inside and outside the factory but within the surrounding factory) and control site was analyzed for dust using a dust monitor (Environmental equipment corporation, USA). The equipment is a direct reading particulate monitor that uses infrared electromagnetic radiation to sense air borne particulate matter (forward light scattering). The amount of scattered light is proportional to hazardous dust concentration in the air and its concentration is expressed in milligram per cubic meter (mg/m^3).

Bacteriological study was done by examining pastes of the flour made with water left in control and test sites for six weeks. This was stained using the eosin and haematoxylin method. The pastes made from water of control and test sites were also cultured and read after 24 hours of incubation. The water from control and test sites was also cultured and the plates read after 24 hours of incubation.

2.1 Statistical Analysis

The data obtained were expressed as mean ± SEM. Analysis of the data was done using Chi square analysis and student's t-test with the aid of a statistical package (SPSS 15.1) and were considered significant at $p<0.05$.

III. Results

3.1 Respiratory symptoms:

A review of case notes of control and test subjects showed an increase in the incidence of respiratory symptoms among the test group compared to their control ($p<0.05$and $p<0.001$). The test group showed higher incidence of unproductive cough, chest pain, dyspnoea, sneezing, catarrh and wheezing than control group (Table 1). However, non productive cough had a higher incidence in the test group than in control group (Table 1).

Table 1: Comparison of respiratory symptoms between test and control groups

Symptoms	Control group	Control Group	Test group	Test group	p-value
	Number of cases	% of the work force	Number of Cases	% of the Work force	
Productive Cough	155	47.99	198	14.17	***
Unproductive Cough	56	17.45	378	27.06	***
Chest pain	19	6.00	182	13.02	***
Dyspnoea	5	1.68	44	3.15	*
Sneezing	11	3.42	128	9.16	***
Catarrh	63	19.62	354	25.34	***
Wheezing	12	3.84	113	8.10	***

Key: *$p<0.05$ vs control, ** $p<0.01$ vs control, ***$p<0.001$
NS= not significant

3.2 Non-Respiratory Symptoms:

There was a higher prevalence of the following non-respiratory symptoms; fever, headache, body pain, anorexia, and nausea among the test group compared to their control ($p<0.05$ and $p<0.001$). However, other non-respiratory symptoms namely: vomiting, abdominal pain, physical trauma and waist pain were higher in the control than in test group. ($p<0.05$ and $p<0.001$), (Table 2).

Table 2: Comparison of Non respiratory symptoms between test and control groups

Symptoms	Control	Group	Test group	=	p-value
	Number of cases	% of the work force	Number of cases	% of the work force	
Fever	422	13.61	594	16.10	*
Headache	353	11.39	524	14.20	*
Body pain	259	8.36	595	63.12	***
Anorexia	83	2.68	368	9.99	***
Nausea	20	0.65	51	1.38	*
Vomiting	78	4.52	8	0.22	***
Abdominal pain	148	4.77	101	2.73	***
Dizziness	87	3.81	128	3.47	NS
Physical trauma	37	2.65	21	0.57	**
Waist pain	93	5.00	24	0.65	***
Malaria	1180	42.49	529	13.84	***
Filarial	2	0.07	3	0.08	NS
Conjunctivitis	15	0.54	24	0.65	NS

Key: * P<0.05 Vs control, ** P<0.01 Vs control, ***p<0.001 Vs control
NS = Not significant

3.3 Suspended particulate matter and hazardous gases:

Comparison of suspended particulate matter (SPM) and some hazardous gases in ambient air from the factory sites and control sites showed a higher concentration of SPM and poisonous gases viz; hydrogen sulphide, nitrogen dioxide, hydrogen cyanide and ammonia. Within the vicinity of the factory i.e., inside the factory and area of about 50 meters outside the factory compared to control sites, (Table 3).

Table 3: Comparison of mean concentrations of H_2S, NO_2, HCN, NH_3, and SPM in control and test sites

	H_2S(ppm)	NO_2	HCN (ppm)	NH_3 (ppm)	SPM mg/m^3
Indoor	1.24	0.50	0.28	1.50	11.00
Sampling	±0.02	±0.03*	±0.18*	±0.36**	±0.06***
Outdoor sampling	0.52 ±0.06	0.30 ±0.06*	0.13 ±0.03*	0.30 ±0.00*	8.10 ±0.06
Control	0.15 ±0.05	0.16 ±0.10	0.02 ±0.00	0.15 ±0.50	0.15 ±0.05

Key: *p<0.05 Vs control, **p<0.01 Vs control, ***p<0.001 Vs control
NS = not significantly different.

3.4 Bacterial Analysis:

Staphylococcus and Streptococcus species were identified from the flower paste made with water from both the control and test sites. Culture of water samples from the control site grew slight to high quantities of Bacillus species, slight to high quantities of Staphylococcus and only a slight quantity of Streptococcus while in the flour mill environment, only moderate and slight quantities of Staphylococcus and Streptococcus respectively were found, (Table 4).

Table 4: Bacteriological analysis of water sample from control and test sites

Bacterial isolate	Station 1 (Control)	Station 2 (Control)	Flourmill Factory (Test)
Bacillus sp	+	+++	Nil
Staphylococcus sp	+	+++	+
Streptococcus sp	Nil	+	++

+ Slight quantities; ++ Moderate quantities; +++ High quantities

IV. Discussion

An eight-year review of the medical case-notes of the control and test subjects was carried out in this study. From the result obtained, respiratory and some non respiratory symptom were more prevalent in the flour dust-exposed subjects, this is in line with previous studies by [8] where the authors observed a similar increase in the incidence of respiratory symptoms among flour-mill workers. Also we found out that the incidence of unproductive cough was higher in the test group than in control group, while the incidence of productive cough was higher among the control group than in the test group. Bacteriological analysis showed a high quantity of bacterial growth in the control sites. Thus, flour-mill environment may not have been favourable to bacterial growth and this may account for the reduction in the incidence of productive cough in the test subjects. Some of

the non-respiratory symptoms that were higher in the test group when compared to control were fever, headache, body pain, anorexia and nausea. On the other hand, vomiting, abdominal pain, physical trauma and waist pain were more prevalent in the control group than test group. These non-respiratory symptoms may not necessarily be attributed to effect of flour-dust. Hence, the occurrence of these in both the dust-exposed and control groups.

Wheat flour production is associated with production of suspended particulate matter which is inhaled. There was a significantly higher level of suspended participate matter (SPM) in the vicinity of the flour mill than in the control areas. The suspended respirable matter in the vicinity of the flour mill was identified as mainly flour dust while in the control areas, it was mainly non-organic material like sand dust. The respirable matter in both indoor and outdoor areas of the flour-mill was more, than fifty times higher than in the control area sampled, (indoor: 11.00± 0.06mg/m^3; outdoor: 8.10±0.06mg/m^3 and control site: 0.15±0.05mg/m^3) as shown in table 3. So, the respirable matter in the vicinity of Calabar flour mill industry far exceeded the normal permissible exposure limit of 4mg/m^3 [9]. Although the high respirable matter may be a factor in the impairment of respiratory function [10]' there may be other contributory factors which have not yet been reported particularly in Calabar, Nigeria. Poisonous gases were emitted from the mill all the time. These gases were identified in this study as hydrogen sulphide, nitrogen dioxide, Hydrogen cyanide and ammonia. Measurement of these gases showed that their concentrations were higher in both indoor and outdoor of the flour mill environment than in control areas. Although their concentrations did not exceed the permissible limit, however chronic exposure to these gases is dangerous since they are poisonous and have been reported to damage the respiratory system and impair respiratory function [2][3][11]. Therefore, it is likely that poisonous gases are contributory to the impairment of lung function and some of the respiratory symptoms among the flour mill workers.

Culture of water samples from the test and control sites yielded Bacillus species in control sites while Staphylococcus and Streptococcus species were isolated in both the test and control sites. Science daily [12] stated that bacterial infection is not an indicator of poor lung function in adolescents with cystic fibrosis and other factors such as the environment and inflammation may be implicated. Bennett [13] has observed that infection with P.aerugenosa in combination with other factors such as genetic, environmental, nutritional factors as well as inflammation may aid in the aggravation of lung disease in children with cystic fibrosis. Productive cough is an indication of increased bacterial infection. The increase in the prevalence of productive cough in the control area may be attributed to higher concentrations of bacterial infection in control sites than in the flour-mill environment. However, bacterial infection may not be the cause of increase in the incidence of respiratory symptoms among the flourmill workers in this study since the incidence of bacterial infection was lower in the vicinity of the flour mill.

In conclusion, the high incidence of respiratory symptoms in the wheat flour mill workers may not only be attributed to chronic exposure to organic dust, but may be due to exposure to poisonous gases emitted from the flour mill.

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