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Research Article

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Cytomorphological Changes in Sputum Among Woodworkers in Shendi City, River Nile State, Sudan

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Abstract

Background

Sputum cytology examines a sputum (mucus) sample under a microscope to determine whether abnormal cells are present. Sputum is not the same as saliva. Sputum is produced in the lungs and the airways leading to the lungs. Sputum has some normal lung cells in it. Sputum cytology may be done to help detect certain non-cancerous lung conditions. It may also be done when lung cancer is suspected.

Materials and Methods

This comparative cross-sectional study was conducted among woodworkers from December 2022 to February 2024. This study aimed to detect cytological changes in sputum. Eighty sputum samples (40 from cases, another 40 from controls) were taken from woodworkers as cases and healthy nonwood workers individuals as a control group; collected samples were processed through the conventional cytological method.

Results

The most everyday age group among woodworkers ranged from 41 to 60 years old; there was a significant association between cellular changes and carpenter occupation (woodworkers) as the p-value was less than 0.05. Our results showed that carpenter occupation causes cytoplasm atypia more than nuclear atypia. Also, the result indicated a significant statistical difference between cases and controls regarding cellular degeneration changes.

Conclusion

Wood workers' occupation is associated with sputum cellular changes such as cytoplasm atypia and cellular degeneration changes.

Keywords: Sputum, Woodworkers, Cytology, Cytoplasm Atypia

1. Introduction

The lungs are a pair of spongy, air-filled organs located on either side of the chest (thorax). The trachea (windpipe) conducts inhaled air into the lungs through its tubular branches, called bronchi. The bronchi then divide into smaller and smaller branches (bronchioles), finally becoming microscopic, and the bronchioles eventually end in clusters of microscopic air sacs called alveoli [1]. The body produces mucus, phlegm, or sputum to protect

sensitive tissues in the airways. Changes in the phlegm's color, thickness, or quantity may indicate a health problem. Mucus lines protect sensitive surfaces inside the body and help trap and remove small particles of foreign matter that may pose a threat [2]. Sputum cytology examines a sputum (mucus) sample under a microscope to determine whether abnormal cells are present. Sputum is not the same as saliva. Sputum is produced in the lungs and the airways leading to the lungs. Sputum has some normal lung cells in it. Sputum cytology may be done to help detect certain non-cancerous lung conditions.

It may also be done when lung cancer is suspected [3]. Wood is a porous and fibrous structural tissue found in the stems and roots of trees and other woody plants. It is an organic material – a natural composite of cellulose fibers that are strong in tension and embedded in a matrix of lignin that resists compression [4]. Exposure to wood dust has been associated with health issues due to the natural chemicals in wood or substances in the wood, such as bacteria, molds, or fungi. According to the International Agency for Research on Cancer (IARC), Wood dust is considered carcinogenic to humans. IARC states that wood dust causes cancer of the nasal cavity (nose area) and paranasal sinuses (spaces in and around the nasal cavity) and of the nasopharynx (upper part of the throat, behind the nose); wood dust is also associated with toxic effects, irritation of the eyes, nose and throat, dermatitis, and respiratory system effects which include decreased lung capacity and allergic reactions, fine dust that results from the processes such as shaping, routing and sanding are associated with higher exposure levels. Hardwoods generally produce more dust than softwoods when worked in similar conditions.

Dry wood tends to produce more dust; the National Institute for Occupational Safety and Health (NIOSH) notes that the chemicals associated with allergic reactions are usually found in the inner parts of a tree, e.g., the heartwood. The workers most often showing reactions are those who do secondary wood processing (e.g., carpenters, joiners, and finishers) [5]. The first description of respiratory symptoms among woodworkers was performed by the Italian physician Ramazzini in the 18th Century [6]. Recently, the International Agency for Research on Cancer has classified wood dust as a human carcinogen based on many studies from the past 35 years [7]. Furthermore, wood dust is a well-known local irritant often associated with frequent nasal complaints, including nasal obstruction [8-16].

In 1997, a cross-sectional study was initiated in Viborg County, Denmark, to investigate the relationship between wood dust exposure and respiratory diseases [17]. A growing body of research literature has shown a strong association between respiratory health problems and certain occupations [18]. Acute and chronic occupational exposures to chemicals are a significant risk to workers in industrial plants [19]. Previous studies have reported that wood dust exposure has led to adverse symptoms such as cough, malaise, chest pain, dyspnea, and headache in woodworkers [20]. Sputum cytology, as a screening method, could be a practical and widely applicable tool for the early detection of respiratory system abnormalities due to wood dust exposure. It is rapid, accurate, cost-effective, and noninvasive.

2. Methodology

This was a comparative cross-sectional study conducted in Shendi town, a location of local significance, located 172km north of the capital, Khartoum, the second part of River Nile state. The collected sputum samples were transferred to the histopathology and Cytology lab at Shendi University, where they were processed and examined. This study, which took place from December 2022 to February 2024, involved 40 woodworkers from Shendi, making the research directly relevant to the local community. Sudanese woodworkers of different ages, free from known chronic pathological illness, were included as the case group; apparently, healthy individuals were included as a control group. Cases and controls were selected based on similar sociodemographic criteria. All woodworkers in Shendi Town who agreed to participate in this study were involved; by the end, the number of participants was 40 woodworkers.

2.1. Study Variable And Method Of Detection

Sputum cellular changes were identified by using conventional cytological method.

2.2. Tools Of Data Collection

Questionnaire sheet was used to record all participants and sample data.

2.3. Sample Collection And Processing

Sputum sample was collected from each participant in the morning right after waking up. Follow these steps: if you wear dentures, remove them before collecting the sample. Rinse your mouth with water. Take about four deep breaths followed by a few short coughs, then inhale deeply and cough forcefully into the disposable new plastic container with screw top cover. Sputum is not the same as saliva, so make sure to get a sample of mucus from deep in your airway. Collecting the sample in the morning, when you first wake up, is generally best [21-42]. A small portion of sputum sample selected was transferred on a plain glass slide. With another clean glass slide, the particle on the glass slide was crushed with a rotary motion. Then, with overlapping horizontal strokes, the material was spread evenly over the slide so as to get a final preparation only slightly thicker than a blood smear. All slides were fixed immediately in 95% ethyl alcohol fixative (for Papanicolaou stain). The first staining solution contains haematoxylin which stains cell nuclei [22,43].

2.4. PAP Stain

Each fixed slide was rehydrated in descending grades of ethanol 2 minutes in each grade, after that slide was stained in Harris's Haematoxylin solution for 1 minutes progressively, then slide was blued in running tap water for 10 minutes, after that slide was dehydrated in ascending grade ethanol 2 minute in each grade, then orange G6 (OG6) was applied onto slide for 3 minutes followed by rinsed in 95% ethanol for 2 minutes, then eosin azure 50 (EA50) solution was applied onto slide for 3 minutes followed

by rinsed in 95% ethanol for 2 minutes, after that slide was rinsed in absolute ethanol, dried at room temperature, cleared in xylene and mounted in Disterene A Plasticizer and Xylene (DPX).The smear then screened under light microscope [23].

2.5. Data Analysis

After examination of the sections, the results of the laboratory investigation as well as the demographic data from the patient's records were processed using the Statistical Packages for Social Sciences (SPSS) computer program. Frequency, mean, and chi-square test values were calculated at <0.05 and considered statistically significant.

3. Results

This study included 40 (50%) samples from woodworkers as a case group versus 40 (50%) samples from apparently healthy nonwood workers as a control group. Our result showed that 35% of the participants were in age <40 Years old, 37.5% Were in age 41-60 Years old, and 27.5% were in >60 years old. Our result showed that 32.5% of the participants were smokers, and 67.5% were non–smokers. Our result showed that 35% of the participants worked for <10 Years, 37.5% worked for 11-20 years, and 27.5% worked for >20 years. The cellular changes were present in 38 (47.5%) woodworkers, while the control group (non-wood workers represented 6(7.5%); the P value was 0.001 (Table 1).

Study group	**Cellular changes**			***P. value***
	Present	**Absent**	**Total**	
Cases	38	2	40	0.001
Controls	6	34	40	
Total	**44**	**36**	**80**	

Table 1: Presence Of Cellular Changes Among Sputum Samples

The nuclear atypia was present in 7(8.8%) woodworkers, while the control group (non-wood workers) represented 3(3.8%); the *P value* was 0.176 (Table 2).

Study group	**Nuclear atypia**			***P. value***
	Present	**Absent**	**Total**	
Cases	7	33	40	0.176
Controls	3	37	40	
Total	**10**	**70**	**80**	

Table 2: The Incidence of Nuclear Atypia Among Sputum Samples

The cytoplasmic atypia was present in 36 (45.0%) woodworkers, while the control group (non-wood workers) represented 4(5.0%); the *P value* was 0.001 (Table 3).

Study group	**Cytoplasmic atypia**			***P. value***
	Present	**Absent**	**Total**	
Cases	36	4	40	0.001
Controls	4	36	40	
Total	**40**	**40**	**80**	

Table 3: The Occurrence of Cytoplasmic Atypia Among Sputum Samples

The Flammatory condition comprised 5(6.3%) among woodworkers, while the control group (non-wood workers) represented 1(1.3%), with an A *P value* of 0.09 (Table 4).

Study group	**Inflammation**			***P. value***
	Present	**Absent**	**Total**	
Cases	5	35	40	0.09
Controls	6	34	40	
Total	**11**	**69**	**80**	

Table 4: The Prevalence of Inflammation Among Sputum Samples

The degeneration condition comprised 5(6.3%) among woodworkers, while the control group (non-wood workers) represented 0 (0.0%); the *P value* was 0.02 (Table 5).

Study group	Degenerative changes			*P. value*
	Present	**Absent**	**Total**	
Cases	5	35	40	0.021
Controls	**00**	**40**	**40**	
Total	**5**	**75**	**80**	

Table 5: Indication Of Cellular Degenerative Changes Among Sputum Samples

4. Discussion

This study, conducted in the unique setting of Shendi town, focused on the sputum of woodworkers between December 2022 and February 2024. Our aim was to determine the cytological patterns of cells in the sputum smears of the woodworkers in this specific location. Sputum samples were collected in disposable sterile containers from woodworkers individuals as cases under study compared to non-wood workers as a control group. Our result showed that most of the participants were of adult age; according to the WHO, the commonest woodworkers were younger, and this may be due to hard work that needs strong people. No other published data correlated the frequency of age among woodworkers. Also, most of our participants were non-alcoholic, and a small number of them were smokers and snuff-takers.

Our study revealed unique findings regarding cellular changes in sputum among woodworkers. The results indicate a strong relationship between exposure to wood dust and cellular modifications such as cytoplasmic atypia, especially hyperkeratosis, which indicates nonspecific infection or inflammation. *This Strong association* was demonstrated by a P value of 0.001. Additionally, our results show substantial statistically significant differences between cases and controls regarding degenerative cellular changes, which comprise the pyknotic nucleus and nucleated cells, as the p-value was 0.021. Furthermore, 5 candida infections are detected among cases but not in controls; all sputum from participants are free from malignant formation, and few of them (7 of cases and 3 of controls) are present with nuclear atypia, the chronic inflammatory process is present in sputum among participants (5 of cases and 6 of controls). All these cellular changes among woodworkers are due to natural chemicals and microorganisms in the wood that affect the human body, especially the lungs, due to prolonged inhalation of these substances. Literature also indicated that acute and chronic occupational exposures to chemicals are lethal for workers in industrial plants [19]. Wood dust is considered carcinogenic to humans, according to the International Agency for Research on Cancer (IARC).

IARC states that wood dust causes cancer of the nasal cavity (nose area) and paranasal sinuses (spaces in and around the nasal cavity) and of the nasopharynx (upper part of the throat, behind the nose); wood dust is also associated with toxic effects, irritation of the eyes, nose and throat, dermatitis, and respiratory system effects which include decreased lung capacity and allergic reactions, fine dust that results from the processes such as shaping, routing and sanding are associated with higher exposure levels. Hardwoods generally produce more dust than softwoods when worked in similar conditions. Dry wood tends to produce more dust; the National Institute for Occupational Safety and Health (NIOSH) notes that the chemicals associated with allergic reactions are usually found in the inner parts of a tree, e.g., the heartwood.

The workers most often showing reactions are those who do secondary wood processing (e.g., carpenters, joiners, and finishers) [5]. Recently, the International Agency for Research on Cancer has classified wood dust as a human carcinogen based on many studies from the past 35 years [7]. Furthermore, wood dust is a well-known local irritant often related to frequent nasal complaints, including nasal obstruction [8-16]. In 1997, many scientists initiated a cross-sectional study in Viborg County, Denmark, to investigate the relationship between exposure to wood dust and respiratory diseases; they summarized that there was a relation between exposure to wood dust and respiratory illnesses [17]. An emerging body of research literature, including studies from [18], has shown a strong association between respiratory health problems and certain occupations, such as woodworkers. This body of literature is growing and contributing to understanding the health risks associated with wood dust exposure. No similar work was found on the net websites, so we compared our results to those found in the published articles we found.

5. Conclusion

Working in wood industries can cause cellular changes in sputum, such as cytoplasmic atypia and degenerative cellular changes. Exposure to wood dust can cause nuclear atypia. Inflammation and infection, such as candidiasis in sputum, can occur due to exposure to wood dust.

Recommendations

Health education programs play a crucial role in empowering the population with knowledge about the harmful effects of wood dust, enabling them to make informed decisions about their health. With its simplicity and high accuracy, sputum cytology smear provides woodworkers with a reliable screening method, instilling a sense of reassurance in their health monitoring. It is recommended that individuals only work in the wood industry for a short period due to the potential health risks associated with prolonged exposure to wood dust. This is in line with the principle of minimizing exposure to hazardous substances. People in the wood industry must wear a face mask to reduce the risks of wood dust.

Consent

The patient's written consent has been collected.

Ethical Approval

The study was approved by the Department of Histopathology and

Cytology in Medical Laboratory Sciences at Shendi University and matched to the ethical review committee board. After participants signed a written agreement, sample collection was done, ensuring their informed consent. Permission for the study was obtained from the local authorities, and the study's aims and benefits were explained transparently, with a clear commitment to maintaining confidentiality.

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Conflict of Interest

The authors have declared that no competing interests exist.

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