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What do the clinical and respiratory functional assessments of woodworkers in Parakou, West Africa, reveal?

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ABSTRACT

Background: The prevalence of chronic respiratory diseases is increasing globally. Apart from smoking, other contributing factors include occupational exposures, of which wood dust is thought to play a role. This study aimed to investigate relationships between respiratory symptoms or lung function measurements and exposure to wood dust.

Methods: This was a prospective and comparative cross-sectional study carried out at Parakou, between June and September 2024. Overall, 108 woodworkers (exposed group) and 108 administrative agents from the city hall, the court and five selected banks (control group) were included. Data were collected on upper and lower respiratory symptoms persisting for at least one week in the last 12 months, demographic and occupational-related characteristics, comorbidities, lifestyles, followed by particulate matter (PM) measurements in the workplace and spirometry testing.

Results: The mean ages of participants in exposed and control groups were 40±11 and 38±9 years-old, respectively (*p=0.163*). All were males. Seniority in the profession was longer in the exposed group (18±12 years vs 8±6 years; *p<0.001*). Workplace ventilation was found inadequate in the exposed group (27% vs 0%; p<0.001). In carpentry, *Milicia excelsa* (66%) and *Afzelia africana* (64%) were the types of wood most commonly used. Mean dust levels for PM10, PM2.5 and PM1.0 were 1.4±0.6 mg/m^3, 1.2±0.6 mg/m^3 and 1.2±0.6 mg/m^3, respectively. Cleaning and protection methods for woodworkers included dry sweeping (61%), dust collection devices (7%), personal home-made face-masks (99%), and affiliation to company insurance schemes (12%). No worker had planned check-ups arranged with an occupational physician. Both respiratory symptoms (94% vs 56%; *p<0.001*) and work-related respiratory symptoms (92% vs 19%; *p<0.001*) were more common in the exposed versus control group. Exposure to wood dust (aPR=6.8; 95%CI=4.1-11.4; *p<0.001*) and asthma (aPR=5.4; 95%CI=2.9-10.1; *p<0.001*) were significantly associated with respiratory symptoms, after adjustment for biomass and passive smoking exposure and length in the profession. The exposed group had a higher prevalence of restrictive disorder suggestive pattern on spirometry than the control group (48% vs 20%; *p<0.001*).

Conclusions: Exposure to wood dust adversely affects respiratory function in woodworkers at Parakou, hence the need to raise awareness among these professionals and identify ways to improve their working conditions.

Key words: Wood dust, carpenters, administrative agents, respiratory disorders, Benin

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Introduction

The increasing burden of chronic respiratory diseases globally is a major cause for concern. In 2019, 454.6 million individuals had a chronic respiratory disease worldwide, representing a 39.8% increase compared with 1990 [1]. In the same year, the global number of deaths due to these diseases reached approximately 4 million [1]. Apart from tobacco, which remains the major contributing risk factor for these conditions, other factors such as occupational chemicals and dusts also play an important role [2].

Wood processing is one of the most-at-risk occupational activities for chronic respiratory diseases [3]. Multiple processes, leading to the transformation of this raw material in the manufacture of various types of furniture, generate significant amounts of dust [4]. The dust is a heterogeneous mixture of several components, including wood basic constituents such as cellulose, hemicellulose, lignin, organic residues such as tannins, essential oils, resins, traces of natural minerals or metals, or living organisms such as fungi and bacteria [5]. Additionally, the application of preservatives, painting, and varnishing exposes woodworkers to additives.

The risk of wood dust inhalation is at its highest during dimensioning, with the secondary wood products (flooring, doors, windows) and furniture manufacturing being the large source of employment for cabinetmakers and joiners. Professionals are mostly exposed during sanding, sawing, or drilling [5]. The ultrafine particles, that are produced during machine-based activities, are capable of remaining airborne for several hours. Once inhaled these particles are deposited at all levels of the respiratory tract and may be responsible for allergic, irritative, infectious and toxic inflammatory conditions, leading to respiratory symptoms and disorders [6,7]. Since 1995, wood dust has been classified as a Group I human carcinogen by the World Health Organization and the International Agency for Research in Cancer [8]. In the literature, a strong association has been demonstrated between wood dust exposure and nasal adenocarcinoma and also leukaemia [9,10]. There have also been reports that the prevalence of respiratory symptoms, such as cough, sputum expectoration, chest tightness or wheezing, is significantly higher among woodworkers compared to other workers who have not been exposed [11,12]. Due to their chronic and disabling nature, these symptoms may lead to frequent absenteeism from work, reduced performance or even early retirement [13].

The prevalence of respiratory disorders among woodworkers is estimated to range from 5.6% to 18% globally and from 3 to 7% in Africa [14]. In Benin, woodworking, particularly the "joinery and building" branch, occupies an important place in the informal sector, accounting for 6.2% of the craft units [15]. A large proportion of joinery work is still carried out on a cottage-industry basis, under conditions of limited resources. Despite the inherent risks to this exposure, little is known about the respiratory health effects of wood dust among woodworkers in Benin. The present study therefore aimed to fill this gap and investigated whether there was any relationship between wood dust exposure and respiratory symptoms or functional abnormalities in Benin, West Africa.

Patients and Methods

Study type

This was a cross-sectional comparative study, with data prospectively collected between June and September 2024.

Setting

General setting: the study was carried out in Parakou, one of the major cities of Benin, located in the North, with an area of 441 km², and an approximate population density of 579 inhabitants per km² [16]. Parakou is a cosmopolitan city with a high concentration of economic, cultural and administrative activities in the country.

Study sites

The study was carried out in the carpentry workshops, the hall, the courthouse and in the banks of Parakou city. These carpentry workshops are mostly built of temporary materials. The passageways are cluttered with bits of wood and sawdust. Floors, walls and ceilings are often covered with a thick layer of wood dust. Usually, band, circular, radial, miter and scroll saws are used to cut the wood; planers and jointers are used for planning; mortisers, routers, routing machines, wood lathes and multispindles are used for hollowing and profiling; and belt sander and calibrating machines are used for finishing. This process generates significant amounts of wood dust, which the woodworkers, labouring without any personal protective equipment, then inhale.

In contrast, the hall, the courthouse and the banks all have in common an adequate lighting and well-ventilated environment, with open-spaces and well-appointed individual offices. The premises are cleaned on a daily basis by maintenance staff. Employees in these institutions are not exposed to wood dust.

Study population

Two study population groups were formed, depending on whether or not there was occupational exposure to wood dust. The source population of exposed participants included all woodworkers labouring in Parakou city. The control population of un-exposed participants included the administrative staff working in banks, in the city hall and the court. For timeline purposes, both population sources were seen within the interval of three scheduled appointments, otherwise they were not included in the study.

Inclusion criteria of participants in both groups were: i) being aged at least 18 years-old; ii) being non-smokers; iii) providing informed consent; iv) being free of any psychiatric condition; and v) having no contraindications to spirometry.

Matching criteria were an exposed / control ratio equal to 1:1, and by age and gender.

Sampling: participants were included on a voluntary basis. The sample size was calculated with OpenEpi software (https://www.openepi.com/Menu/OE_Menu.htm) using the Fleiss method with a correction factor. With a 95% confidence interval, a study power of 80%, the expected prevalence of any respiratory symptoms in the un-exposed group being equal to 24.3% and that of the wood dust-exposed group equal to 43.2% derived from a study carried out by Bislimovska et *al* [17], with a matching ratio equal to 1:1, the calculated sample size was 108 participants in each exposed and control group respectively, giving an overall sample size of 216 participants.

Data variables and collection

Data on the different variables were collected by a medical student in her last year of training. An individual face-to-face interview was conducted and information was collected on the different variables. The dependent variable was the occurrence of respiratory symptoms for at least one week in the last 12 months. These included upper respiratory symptoms (such as pharyngeal pain, nasal congestion, nasal obstruction, sneezing, rhinorrhoea and epistaxis), and lower respiratory symptoms (such as cough, sputum expectoration, dyspnoea, chest tightness and wheezing). In order to establish the occupational nature of these symptoms, their worsening during working hours followed by their improvement on days-off were also investigated: these were defined as work-related respiratory symptoms. Independent variables were demographic and anthropometric characteristics, comorbidities and lifestyles. Additionally, for the exposed group, occupational-related characteristics were investigated. These included the woods commonly used, number of working hours per day, length of service in the occupation, adequate ventilation defined by opening ≥ 10% of the workshop area, availability of any air extraction system, use of personal protective equipment and social security insurance status. Particulate matter (PM)10, PM2.5 and PM1.0 concentrations in air carpentry workshops were measured using air quality detector. Following the interview, spirometry testing was performed using a daily calibrated portable device. The tests were performed in the morning by the investigator and were interpreted by a pulmonologist, using the Global Lung Initiative 2012 equations references values, the Forced Expiratory Volume in 1 second (FEV_1) and the Forced Vital Capacity (FVC) [18]. An obstructive ventilatory disorder was diagnosed by a measured FEV_1/FVC < Low Limit of the Normal (LLN) and FVC ≥ LLN. A restrictive ventilatory pattern was suspected in case of a measured FEV_1/FVC ≥ LLN and a measured FVC < LLN; and a mixed ventilator disorder was suspected in the presence of both abnormalities. The spirometry was considered normal in the absence of both obstructive and restrictive suggestive pattern disorders [18].

Data analysis

Collected data were double-entered into EpiData software version 2.0.7.7.22. They were then analyzed using Epi info v.7.2.7.0. Comparisons were made between exposed and un-exposed groups. Factors associated with the presence of respiratory symptoms in the last 12 months were investigated by simple logistic regression. Crude prevalence ratios (cPR), their 95% confidence intervals and p-values were determined. Factors that were significant or had a p value < 0.2 were introduced into the multiple logistic regression model to determine adjusted prevalence ratios (aPR), their 95% confidence intervals and p values. Pearson's Chi-square test and Fischer's test (if applicable) and the student test (for comparison of two quantitative variables) were used. The significance level was set at < 5% (P<0.05).

Results

A total of 82 carpentry workshops were visited to recruit the 108 woodworkers representing the exposed group. Similarly, to include the 108 administrative staff of the control group, the city hall with its three districts, the court and five banking establishments were randomly selected and visited.

Characteristics of participants

The mean age of exposed and control participants was 39.66±11.13 and 37.73 ± 9 years-old, respectively (*p=0.163*). All were males. There was a significant difference according to level of education in both groups. The exposed group was significantly more uneducated (*p=0.004*), at primary (*p<0.001*) or secondary (*p<0.001*) level, compared with the control group, that more often included university graduates (*p<0.001*). The exposed group more often used biomass for cooking (37.03% vs. 5.56%; *p<0.001*) and was exposed more to passive smoking (14.81% vs. 2.78%; *p<0.001*) than the control group. Overweight was significantly lower in the exposed group (38.89% vs 22.22%; *p=0.005*) (Table 1).

Occupational-related characteristics

The average length of service in the profession was 17.67 ± 11.9 years, ranging from 2 to 40 years in the exposed group while that of the control group was 8.49 ± 6.38 years, ranging between 2 and 34 years; the difference was significant (p<0.001). The declared working time per day was comparable in both groups, and was estimated to be at least 8 hours in 98.5% in each group. Ventilation of the workplace was found inadequate in the exposed group (26.85% vs 0%; p<0.001).

In the specific case of the exposed group, the types of wood that were commonly used were *Milicia excelsa* or African teak (65.64%) and *Afzelia africana* (63.85%). The mean dust levels were 1.40±0.61 mg/m^3 for PM10, 1.22±0.56 mg/m^3 for PM2.5 and 1.15±0.58 mg/m^3 for PM1.0. Overall, 73.27%, 70.30% and 56.44% of woodworkers were exposed to a concentration of PM10, PM2.5 and PM1.0 particles higher than 1 mg/m^3. The main declared cleaning method for the woodworkers was dry sweeping (61.11%) followed by wet sweeping (31.48%). Eight (7.41%) participants worked in shops where a dust collection system was available; and 107 (99.07%) used a homemade mask as personal protective equipment. Overall, 13 (12.40%) woodworkers were affiliated to a company insurance for their retirement, of whom 53.85% had up-to-date

Table 1. Socio-demographic, clinical characteristics, comorbidities and lifestyle of the study population, Parakou, June – September 2024.

	Exposed group		Control group		
	N	**(%)**	**N**	**(%)**	**p-value**
Marital status					
Married	79	(73.15)	84	(77.78)	0.693
Single	28	(25.93)	24	(22.22)	0.583
Widow	1	(0.93)	0	(0.00)	0.500
Level of education					
No education	8	(7.41)	0	(0.00)	0.004
Primary level	46	(42.59)	4	(3.70)	<0.001
Secondary level	46	(42.59)	7	(6.48)	<0.001
High level	8	(7.41)	97	(89.81)	<0.001
Comorbidities					
Asthma	7	(6.48)	4	(3.70)	0.388
Hypertension	2	(1.85)	6	(5.56)	0.200
History of tuberculosis	1	(0.93)	1	(0.93)	1
Allergic rhinitis	0	(0)	1	(0.93)	0.500
History of COVID-19	0	(0)	3	(2.78)	0.125
Type 2 Diabetes mellitus	1	(0.93)	1	(0.93)	1
Lifestyle					
Exposure to biomass	40	(37.03)	6	(5.56)	<0.001
Passive smoking	16	(14.81)	3	(2.78)	0.003
Harmful alcohol consumption	16	(14.81)	4	(3.70)	0.007
Nutritional status*					
Underweight	4	(3,70)	3	(2,78)	0.727
Normal	73	(67,59)	53	(49,07)	0.061
Overweight	24	(22,22)	42	(38,89)	0.005
Obesity	7	(6,48)	10	(9,25)	0.481
Total	108		108		

*Nutritional status based on Body Mass Index (BMI) value in kg/m² : BMI ≤ 18.49 (Underweight); 18.5 ≤ BMI ≤ 24.99 (Normal); 25 ≤ BMI ≤ 29.99 (Overweight); BMI ≥ 30 (Obesity).

contributions. None had a planned check-up with any occupational physician (Table 2).

Respiratory symptoms in the last 12 months

The prevalence of respiratory symptoms in the last 12 months was 93.52% in the exposed group and 55.56% in the control group ($p<0.001$). All upper respiratory tract symptoms, namely sneezing ($p<0.001$), rhinorrhoea ($p<0.001$), nasal congestion ($p<0.001$), pharyngeal pain ($p<0.001$) and epistaxis ($p=0.006$) were significantly more frequent in the exposed group. Regarding lower respiratory tract complaints, apart from chronic dyspnoea ($p=0.125$), symptoms such as cough ($p<0.001$), expectoration ($p<0.001$), chest tightness ($p<0.001$), paroxysmal dyspnoea ($p=0.009$) and wheezing ($p=0.006$) were significantly more common in the exposed group (Table 3).

Work-related respiratory symptoms in the last 12 months

The prevalence of work-related respiratory symptoms in the last 12 months was 91.67% (n=99) in the exposed group and 19.44% (n=21) in the control group ($p<0.001$). All work-related upper respiratory symptoms, such as sneezing ($p<0.001$), rhinorrhoea ($p<0.001$), nasal congestion ($p<0.001$), pharyngeal pain ($p<0.001$) and epistaxis ($p=0.016$), were more common in the exposed group. Regarding work-related lower respiratory symptoms, apart from

Table 2. Occupation-related characteristics of the exposed group, Parakou, June – September 2024 (N=108).

	Value
Type of wood commonly used	
Milicia excelsa n (%)	71 (65.64)
Afzelia africana (%)	69 (63.85)
Senegal mahogany n (%)	9 (8.33)
Gmelina arborea n (%)	4 (3.70)
Dust concentration	
Particulate Matter 10	
Mean ± SD (mg/m^3)	1,40 ± 0,61
Range (mg/m^3)	0,10 - 2,91
Particulate Matter 2.5	
Mean ± SD (mg/m^3)	1,22 ± 0,56
Range (mg/m^3)	0,98 - 2,74
Particulate Matter 1.0	
Mean ± SD (mg/m^3)	1,15 ± 0,58
Range (mg/m^3)	0,16 - 2,34
Cleaning methods	
Dry sweeping n (%)	66 (61.11)
Wet sweeping n (%)	34 (31.48)
Compressor n (%)	5 (4.63)
Vacuum cleaner n (%)	3 (2.78)
Availability of wood dust collection system	8 (7.41)
Personal protective equipment	
A2P3 mask n (%)	1 (0.93)
Homemade mask n (%)	107 (99.07%)
Affiliation to company insurance n (%)	13 (12.04)

SD= Standard Deviation.

chronic dyspnoea (*p=0.123*), other symptoms such as cough (*p<0.001*), expectoration (*p<0.001*), chest tightness (*p<0.001*), paroxysmal dyspnoea (*p<0.001*) and wheezing (*p=0.002*) were more frequent in the exposed group (Table 4).

Factors associated with the presence of respiratory symptoms

After bivariate and multivariate analysis, exposure to wood dust (aPR=6.81; 95%CI=4.05-11.42; *p<0.001*) was associated with a significant risk of respiratory symptoms, after adjustment for exposure to biomass, passive smoking, asthma and length of service. Another factor associated with a high risk of respiratory symptoms was asthma (aPR=5.43; 95%CI=2.92-10.12; *p<0.001*), after adjustment for exposure to wood dust and biomass, passive smoking and length of service (Table 5).

Spirometric findings

After spirometry testing, a restrictive disorder suggestive pattern was more frequent in the exposed group compared to the control group (48.15% vs 20.37%; *p<0.001*). Normal spirometry was less common in the exposed group compared with control group (50.93% vs 79.63%; *p=0.009*) (Table 6).

Discussion

There are several strengths to this study, one of the few from a developing country, aiming to determine the influence of wood dust exposure on both the prevalence of respiratory symptoms and functional disorders. First, the prospective nature allowed us to avoid biases due to missing information. Second, the comparison between two groups (one exposed to wood dust and a control group unexposed to wood dust) with matching on precise criteria, reinforced reliability on the findings. Third, with regard to participants, the exclusion of those who were actively smoking during the survey was one of the compulsory conditions for study inclusion, in order to prevent the influence of this major confounding factor on respiratory disorders. Fourth, data were collected in the field and the questionnaire was completed by one well-trained investigator to avoid any inter-individual variability. Fifth, objective measurements were carried out using reliable and validated devices to measure the concentration of harmful particles in the air or lung flows and volumes.

There are also some limitations to the study. The inclusion of participants who were present during the visit periods might have led to the exclusion of those who were absent from their office due to severe morbid conditions. Therefore, we attempted to call those who could not be met during visiting to ensure that their absence was not linked to any disease. We confirmed that no one had any disease. Another limitation related to the data collection technique. Respiratory symptoms were assessed on a self-reported basis, which could have led to information and memory bias.

Table 3. Upper and lower respiratory tract symptoms in the last 12 months in the exposed versus control group in Parakou, June – September 2024.

	Exposed group		Control group		
	n	(%)	n	(%)	p-value
Upper respiratory tract symptoms					
Sneezing	83	(76.85)	24	(22.22)	< 0.001
Rhinorrhea	64	(59.26)	35	(32.41)	< 0.001
Nasal congestion	48	(44.44)	11	(10.19)	< 0.001
Throat pain	37	(34.26)	7	(6.48)	< 0.001
Epistaxis	12	(11.11)	2	(1.85)	0.006
Lower respiratory tract symptoms					
Cough	69	(63.69)	15	(13.89)	< 0.001
Expectoration	64	(59.26)	3	(2.78)	< 0.001
Chest tightness	32	(29.63)	3	(2.78)	< 0.001
Paroxysmal dyspnea	19	(17.59)	6	(5.56)	0.009
Wheezing	12	(11.11)	2	(1.85)	0.006
Chronic dyspnea	3	(3.78)	0	(0.00)	0.125
Total evaluated	108		108		

Table 4. Work-related upper and lower respiratory tract symptoms in the last 12 months in the exposed versus control group in Parakou, June – September 2024.

	Exposed group		Control group		
	n	(%)	n	(%)	p-value
Upper respiratory tract symptoms					
Sneezing	82	(75.93)	17	(15.74)	<0.001
Nasal obstruction	66	(61.11)	10	(9.26)	<0.001
Rhinorrhea	59	(54.63)	8	(7.41)	<0.001
Nasal congestion	46	(42.59)	4	(3.70)	<0.001
Throat pain	37	(34.26)	1	(0.93)	<0.001
Epistaxis	6	(5.56)	0	(0.00)	0.016
Lower respiratory tract symptoms					
Cough	63	(58.33)	2	(1.85)	<0.001
Expectoration	63	(58.33)	0	(0.00)	<0.001
Chest tightness	31	(28.70)	0	(0.00)	<0.001
Paroxysmal dyspnea	18	(16.67)	0	(0.00)	<0.001
Wheezing	10	(9.26)	0	(0.00)	0.002
Chronic dyspnea	3	(2,78)	0	(0.00)	0.123
Total evaluated	108		108		

After obtaining permission of the study participants, their declarations were crosschecked with their colleagues who shared the same carpentry workshop or administrative office. Finally, the generalisability of the findings is limited by focusing the work on one country in West Africa.

Despite these limitations, this study provides some interesting findings. Over nine in ten woodworkers

Table 5. Factors associated with work-related respiratory symptoms after bi and multivariate analysis, Parakou, June – September 2024.

			Bivariate analysis		Multivariate analysis		
	n/N	%	cPR	pvalue	aPR	95%CI	p value
Group							
Control	21/108	(19.44)	1	<0.001	1	4.05-11.42	<0.001
Exposed	99/108	(91.67)	4.71	<0.001	6.81		
Age*	-	-	1.01	0.341			
History of asthma							
No	3/96	(3.13)	1	0.143	1	2.92-10.12	<0.001
Yes	8/120	(6.67)	1.33		5.43		
Past Covid 19							
No	119/213	(55.87)	1	0.528			
Yes	1/3	(33.33)	0.60				
Passive smoking							
No	104/197	(52.79)	1	<0.001	1	0.78-1.35	0.841
Yes	16/19	(84.21)	1.60		1.03		
Biomass exposure							
No	82/169	(48.52)	1	<0.001	1	0.86-1.18	0.972
Yes	38/47	(80.85)	1.67		1.00		
Length in service*	-	-	1.03	<0.001	1.00	0.99-1.01	0.995

cPR=Crude Prevalence Ratio; aPR=Adjusted Prevalence; 95%CI= 95% confidence interval. * In year Past history of TB did not show any association.

Table 6. Findings after spirometry in the exposed versus control group, Parakou, June – September 2024.

	Exposed group		Control group		
	n	(%)	n	(%)	p-value
Normal spirometry	55	(50.93)	86	(79.63)	0.009
Restrictive disorder suggestive pattern	52	(48.15)	22	(20.37)	<0.001
Obstructive disorder pattern	1	(0.93)	0	(0)	0.500

complained of respiratory symptoms that occurred at any time in the last 12 months compared to just over the half of those in administrative institutions. By cross-analyzing our findings, almost all the participants in the exposed group who complained of respiratory symptoms in the last 12 months blamed the workplace where wood dust is known to be highly dominant. In contrast, in the control group, in whom just over the half reported respiratory symptoms, only one in ten linked triggers of symptoms to the workplace.

Both upper respiratory and lower respiratory symptoms were more common in the exposed group. The predominant respiratory symptoms were sneezing, airway obstruction and rhinorrhoea for the upper respiratory tract and cough as well as sputum expectoration for the lower respiratory tract. Exposure to wood dust increased the risk of developing work-related respiratory symptoms by almost sevenfold, after adjustment for other factors such as a history of asthma, biomass and passive smoking exposure and length of service. Another associated factor that was found to increase the risk of work-related respiratory symptoms by five times was a history of asthma. In the region, workers mainly used *Milicia excelsa* and *Afzelia africana* as their principal source of wood. Regarding the working environment, the average dust level was 1.397 mg/m^3, 1.221 mg/m^3, for PM10, PM2.5 and PM1.0, respectively and the majority of woodworkers were exposed to dust levels that exceeded 1 mg/m^3, which is the recommended threshold [19].

The higher prevalence of respiratory symptoms in the exposed compared to the un-exposed group has also been reported from elsewhere. For instance, in one study from Nigeria, the reported prevalence of lower respiratory symptoms was 68% among woodworkers and 10% in the comparison group who were represented by workers at a water bottling plant, and the difference was significant [20]. Nde et al. from Cameroon found a prevalence of lower respiratory symptoms of 51% among woodworkers compared to 26.2% in the control group (*p=0.01*) [21]. The higher prevalence of respiratory symptoms among woodworkers in the current study compared to these other findings may be attributed to our inclusion of both upper and lower respiratory tract symptoms. Moreover, in the study from Nigeria, respiratory symptoms were only assessed for a short three-month period.

Our finding that all upper respiratory symptoms were significantly more common among woodworkers and were dominated by sneezing and rhinorrhoea, has also been reported from elsewhere [22,23]. We were particularly concerned by the presence of epistaxis in some woodworkers, for whom an Ear Nose and Throat consultation was urgently arranged. In the same vein, lower respiratory tract symptoms were very common among woodworkers, and were dominated by coughing and sputum expectoration, as also reported from other settings [11,20].

Findings from this study show that exposure to wood dust was independently associated with work-related respiratory symptoms compared to the control group. This has also been found by Abateneth et al. in a study from Ethiopia [24]. This is probably due to pathological effects brought on by wood dust, as chronic inflammation in nasal fluid and mucosa, as has been demonstrated by Staffieri et al. [25]. Wood-dust related fibers may also irritate cough receptors in respiratory airways and cause mucus stasis.

The intensity and extent of respiratory symptoms are variable and depend on several factors including for instance dust concentrations, hardness and nature of the wood, concomitant exposure to other factors such as smoking [26,27], and working conditions. In our study, the level of the different particles in wood dust was higher than the accepted threshold for the large majority of woodworkers, results that are similar to those reported from elsewhere where a mean dust level of 1.39±0.38 mg/m^3 was found in woodworker workshops in Nigeria in 2016 [20]. Indeed, Neghab et *al*. reported a much higher average dust level at 2.44 mg/m^3 in woodworking from Iran [28]. The high concentration of wood dust in carpentry workshops may be due to the absence of dust collection devices and poor ventilation in the current study.

We also found a significantly higher rate of low vital capacity in almost half of the exposed group (48.15%), while only a quarter of the control group were found to have this abnormality. This is in line with other reports in the literature. For instance, Ekman et al. from Ghana found a 43.8% prevalence of low vital capacity in the exposed compared to the control group at 19% [29]. Laraqui et al. from Morocco reported a prevalence of 30.1% of low vital capacity in the exposed group and 12.5% in the control group [30]. However, no significant differences were found by Nde et al. in Cameroon, where the prevalence of low vital capacity was 17% and 11.5% in the exposed and the control groups, respectively [21]. There have been reports that exposure to wood dust progressively alters pulmonary function. In a recent systematic review and meta-analysis published in 2024, the estimated mean difference of the forced vital capacity between workers exposed to organic dust and the control group was −0.53 [−0.83 to −0.36] [31]. The presence of fine dust particles in airways and lungs is thought to increase oxidation and inflammatory reaction levels, leading to airway constriction and reduced lung tissue elasticity [32]. Exposure to wood dust has been implicated in the development of pulmonary fibrosis in the literature [33]. The low vital capacity, suggestive of a restrictive disorder pattern that was observed in this study, may likely relate to a progressive decrease in lung compliance due to wood dust exposure. Anyway, this requires further investigation, including plethysmography testing.

All participants with respiratory symptoms or functional disorders were referred to specialists for respiratory care and occupational health consultations. However, other steps are needed to improve the situation. These include the promotion of information and education of workers on the potential risks of wood working; improving working conditions; developing and implementing clear local policy; and conducting effective monitoring in this “informal” sector, making available and accessible individual protective equipment. Woodworkers should also be encouraged to take up social insurance. Regular on-site inspections should be carried out to ensure compliance with safety standards. Medical follow-up should be carried out for workers; and patients with asthma should be advised against practicing this profession until individual and collective protection measures are effective, given the high risk of complaints of work-related respiratory symptoms, as reported in this study.

Conclusion

In Parakou city, exposure to wood dust significantly increased the risk of both upper and lower respiratory symptoms and these were associated with a low vital capacity. Assessment of working conditions highlighted a number of challenges, including poor ventilation, lack of personal protective equipment and dust levels higher than the recommended thresholds, all of these requiring attention and improvement. This study highlighted the need for implementing relevant preventive measures in carpentry workshops in the city to minimize the harmful effects of wood dust on woodworkers and the prevention of subsequent respiratory disorders.

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