Prevalence of diffuse parenchymal lung disease patterns on chest x-ray and reported respiratory symptoms among salon hairdressers in the National Capital Region: an analytical cross-sectional study

Kristine Joy V. de Leon[1]; Jose Ronilo Juangco, MD[2]

Abstract

Introduction Exposure to chemical agents in salon products, such as ammonia and formaldehyde, poses significant respiratory health risks for hairdressers. This study aimed to assess the prevalence of Diffuse Parenchymal Lung Disease Patterns (DPLD) observed in chest X-rays of hairdressers in the National Capital Region and to document their reported respiratory symptoms.

Methods An analytical, cross-sectional study was conducted involving 100 hairdressers who underwent plain chest X-ray examinations to identify any of the 12 recognized DPLD patterns. Participants also accomplished a self-administered questionnaire detailing their demographic information, working conditions, health histories and current respiratory symptoms.

Results Thirty nine percent of participants showed DPLD patterns on chest X-rays, primarily fine reticular opacities (69.23%) and coarse reticular opacities (25.64%). Positive associations (RR>1) were linked to over five years of work, lack of PPE, daily exposure to hair iron steam, respiratory symptoms, and salon vapor exposure of exceeding five hours daily. Symptoms reported included shortness of breath (27%) and throat irritation (15%). Logistic regression confirmed a significant link between DPLD and positive respiratory symptoms.

Conclusion This study highlights the risk of structural lung abnormalities and respiratory symptoms among hairdressers, emphasizing the need for improved workplace safety, consistent PPE use and routine medical screenings to reduce occupational health risks.

Key words: Diffuse parenchymal lung disease, interstitial, chest X-rays

Diffuse Parenchymal Lung Disease (DPLD) "previously called Interstitial Lung Disease, includes a heterogeneous group of diseases of the lung parenchyma, the alveolar spaces, the vessels, and the airways."[1] One of the known causes of diffuse parenchymal lung disease is environmental and occupational exposure to mineral dust, organic dust and toxic gasses.[2] Radiologically, DPLD has 12 distinct patterns. Nine covers atelectasis, segmental and lobar opacities, multiple ill-defined opacities, diffuse airspace opacities, fine reticular opacities,

*Correspondence:
Kristine Joy de Leon
Email: deleonk4499@uerm.edu.ph
[1]College of Medicine, University of the East Ramon Magsaysay Memorial Medical Center
[2]Department of Preventive and Community Medicine, University of the East Ramon Magsaysay Memorial Medical Center

coarse reticular opacities, diffuse fine opacities, solitary pulmonary nodule, multiple nodules, and masses. Hyperlucent thorax, solitary lucent defect and multiple lucent defects are the three other issues.[3]

Salon hairdressers have an increased exposure to hair dyes, bleaching agents and hair straighteners with strong chemical ingredients responsible for potential health risks. Ammonia, commonly found among hair dyes to raise the pH during the coloring process, can cause thermal injury and alkali burns in the airway and lung parenchyma, which then lead to structural lung damage.[4] Formaldehyde, another compound found on salon hair straightening treatments[5] can cause toxicity in the respiratory tract in the form of nasal obstruction, pulmonary edema and lung cancer.[6] Persulfates and paraphenylenediamine found in hair dyes increases risk of occupational rhinitis and asthma due to frequent exposure to these irritants and allergens during hairdressers daily work.[7] Chest radiograph findings, specifically DPLD patterns in hairdressers, are unknown, although a larger sample size would improve incidental evidence and support the idea that occupational exposure may pose lung health problems.

The general objective of this study was to determine the prevalence of DPLD patterns on chest X-ray, its reported respiratory symptoms and relationship between DPLD patterns with respect to working conditions, health history, reported respiratory symptoms and other possible risk factors present among salon hairdressers in the National Capital Region.

Methods

This analytical, cross-sectional study underwent approval by the Ethics Review Committee of the UERMMMCI Research Institute for Health Sciences with RIHS ERC Code 1778/C/2024/145. A convenience sampling method was employed for this study. The participants include 1) Filipino; 2) male or female hairdresser; 3) at least 18 years old 4) working in a salon in the National Capital Region; 5) working for at least 1 year in the same salon; 6) with at least 4 working days a week, 7 working hours per day. Those who are only offering home service and working in barber shops were excluded from the study. Pregnant and potentially pregnant individuals were excluded from undergoing the X-ray procedure, as determined through a triage questionnaire.

This study used convenience sampling. Filipino hairdressers who are at least 18 years old, have been working in the National Capital Region salon for at least one year, and working at least four days a week, seven hours a day were eligible. Exclusive home care and barbershop workers were excluded from the study. Pregnant and potentially pregnant people were excluded from the study by triage questionnaire.

One hundred participants were subjected to a plain chest X-ray procedure at posteroanterior position in a stationary X-ray bus with a safe dressing room. The radiologist who assessed the radiographs was provided with a checklist to determine whether any of the 12 main patterns of DPLD are present or absent. In addition, the participants were given a set of questionnaires composed of four (4) parts including demographic profile, working conditions, health history and current respiratory symptoms reported.

Results are summarized in tables to present the sociodemographic profile, work conditions, health history, reported respiratory symptoms and the presence or absence of DPLD patterns. Cross-tabulations between DPLD patterns and the working conditions and health histories of hairdressers were used to determine positive relationships. The statistical significance of the association between variables was determined using the chi-square test and logistic regression.

Results

Table 1 shows the demographic profile of the participants where the majority were between 25-54 age range, mostly females (57%), single (59%) and completed high school (53%).

Table 2 presents the working conditions of the study participants. A large portion of the participants work in a salon in Quezon City (42%), followed by Las Piñas (31%) and Caloocan City (24%). Regarding tenure, 40% of hairdressers have worked in a salon for 10 or more years, 35% for 5 to 9 years. Hair color application was the most commonly performed task (33%), followed by hair rebonding (27%).

Eighty nine percent of participants reported wearing a face mask while performing procedures. Daily exposure to workplace irritants was prevalent, with 83% of individuals exposed to chemical fumes, 54% to air from hair dryers, and 42% to steam from hair irons. Furthermore, 74% of participants are exposed to these irritants for five or more hours each day (Table 3)

Table 1. Sociodemographic profile of the hairdressers

		No. of participants, % (N=100)
Age	18-24	7 (7)
	25-34	27 (27)
	35-44	32 (32)
	45-54	21 (21)
	55-64	12 (12)
	65 and above	1 (1)
Sex	Female	57 (57)
	Male	43 (43)
Marital Status	Single	59 (59)
	Married	38 (38)
	With Live-in Partner	2 (2)
	Separated	1 (1)
Place of Residence	Within NCR	99 (99)
	Outside NCR	1 (1)
Educational Attainment	Pre-school	0 (0)
	Elementary	19 (19)
	High School	53 (53)
	College	20 (20)
	Vocational	2 (2)
	Postgraduate	6 (6)

Table 4 presents the health history of participants, specifically evaluating the presence of risk factors related to having DPLD. Among the participants, 44% reported that they smoke cigarettes and have a history of smoking equivalent to 2.5 pack years (25%) and 5 pack years (18.2%).

A multi-response item is shown in Table 5 regarding the current respiratory symptoms among hairdressers. Twenty seven percent reported having shortness of breath at rest and while doing normal activities while 15% reported having frequent itchy throat.

Despite reported respiratory symptoms, 95% of participants indicated no noticeable changes in their lung or breathing compared to their previous state and they were not currently taking medications for respiratory conditions. Generalized symptoms reported are fatigue (22%) and headache (17%) (Table 6).

Table 7 revealed that 39% of participants have DPLD patterns on their chest X-ray with 55% opacities and 2% lucencies noted among participants.

Most common patterns identified are fine reticular opacities (69.23%) and coarse reticular opacities (25.64%) (Table 8). Most common patterns identified are fine reticular opacities (69.23%) and coarse reticular opacities (25.64%).

Table 2. Working condition - employment

		No. of participants, % (N=100)
Workplace City	Quezon City	42 (42)
	Las Pinas	31 (31)
	Caloocan City	24 (24)
	San Juan	1 (1)
	Valenzuela	1 (1)
	Taguig	1 (1)
Length of Employment	≥ 1 year	8 (8)
	≥ 2 years	17 (17)
	≥ 5 years	35 (35)
	≥ 10 years	40 (40)
Most Common Procedure	Hair color	33 (33)
Performed	Rebond	27 (27)
	Brazilian Blowout	18 (18)
	Shampoo	12 (12)
	Blow Dry	10 (10)
Source of Ventilation	Aircon and Fan	59 (59)
	Air Conditioning	41 (41)

Table 3. Working condition - gas exposure

		n (%)
*Use of Protective Equipment	Face Mask	89 (89)
	Gloves	47 (47)
	Eye Glass	6 (6)
	None	5 (5)
*Salon Vapors	Fumes from Chemicals	83 (83)
	Steam from Hair Iron	42 (42)
	Air from Blower	54 (54)
Length of Exposure to	< 1 hour	13 (13)
Salon Vapors	> 1 hour	13 (13)
	≥ 5 hours	74 (74)

**multi-response item*

Table 4. Health history

		No. of participants, % (N=100)
Cigarette Smoking	Yes	44 (44)
	No	55 (55)
	No, Vape only	1 (1)
Pack Years	≤ 1	7 (7)
	1.25 - 5	31 (31)
	≤ 10	4 (4)
	≤ 20	1 (1)
	≤ 30	1 (1)
	None	56 (56)
History of Pneumonia	Yes	1 (1)
	No	99 (99)
History of PTB	Yes	1 (1)
	No	99 (99)
History of Connective	Rheumatoid Arthritis	4 (4)
Tissue Disorders	None	96 (96)
*Medications for the	Antibiotics	6 (6)
Last 6 months	NSAIDs	10 (10)
	Paracetamol	10 (10)
	Steroids	1 (1)
	Heart Medications	4 (4)
	Chemotherapy Drugs	0 (0)

**multi-response item*

Table 5. Current respiratory symptoms

	Yes n (%)	No n (%)
Itchy throat	15 (15)	85 (85)
Runny Nose	9 (9)	91 (91)
Sneezing	9 (9)	91 (91)
Colds	8 (8)	92 (92)
Chest Tightness	5 (5)	95 (95)
Sore Throat	5 (5)	95 (95)
Dry Cough <8 weeks	5 (5)	95 (95)
Chest Pain	3 (3)	97 (97)
Productive Cough <8 weeks	3 (3)	97 (97)
Shortness of Breath at Rest	3 (3)	97 (97)
Shortness of Breath (Normal Activities)	24 (24)	76 (76)

Table 6. Other symptoms (Last Two Weeks)

	Yes n (%)	No n (%)
Fatigue	22 (22)	78 (78)
Headache	17 (17)	83 (83)
Fever	6 (6)	94 (94)
Weight Loss	3 (4)	97 (97)
Change in Appetite	2 (2)	98 (98)
Changes in Breathing	5 (5)	95 (95)
Taking Lung Medication/s	5 (5)	95 (95)

Table 7. Diffuse parenchymal lung disease patterns on chest X-ray

		No. of participants, % (N=100)
DPLD Presence	Present	39 (39)
	Absent	61 (61)
*DPLD Patterns	Opacities	55 (55)
	Lucencies	2 (2)

**multiple patterns*

Table 8. Specific DPLD patterns

		n (%)
DLPD Patterns	Atelectasis	2 (2)
	Segmental and Lobar Opacities	5 (5)
	Multiple ill-defined Opacities	7 (7)
	Diffuse Airspace Opacities	2 (2)
	Fine Reticular Opacities	27 (27)
	Coarse Reticular Opacities	10 (10)
	Diffuse Fine Opacities	0 (0)
	Solitary Pulmonary Nodule	0 (0)
	Multiple Nodule and Masses	2 (2)
	Hyperlucent Thorax	2 (2)
	Solitary Lucent Defect	0 (0)
	Multiple Lucent Defects	0 (0)
	None	61 (61)
Other Findings	Crowding of Lung Markings due to Hypoaeration	9 (15.4)
	Probable Pulmonary TB	4 (6.84)
	Pleural Thickening	3 (5.1)
	Probable Pleural Effusion	1 (1.7)

Table 9 shows positive associations (RR>1) between DPLD and several factors: employment duration over five years, lack of PPE use, daily exposure to hair iron steam for more than an hour, presence of respiratory symptoms and chemical exposure exceeding five hours per day.

Other characteristics tested for association with having DPLD patterns are listed in Table 10.

The factor that has a statistically significant relationship with DPLD based on logistic regression is those with positive respiratory symptoms (Table 11)

Discussion

Hairdressers and DPLD

A notable proportion of hairdressers (39%) who participated in this study exhibited diffuse parenchymal lung disease (DPLD) patterns on plain chest X-ray. Among the patterns identified, the most common is fine reticular opacities (69.23%) followed by coarse reticular opacities (25.64%). Reticular opacities on chest X-ray is a collection of interlacing net-like linear opacities[8] The most common cause is a chronic progressive scarring of the pulmonary interstitium or an idiopathic pulmonary fibrosis (IPF).[9] Inhalation of specific gasses, fumes and vapors may account for 26% of cases of IPF.[10] The finding is consistent with a case control study which suggested that hairdressing, along with other occupational exposures, has a potential risk for IPF.[11]

This study examined how hairdressers' working circumstances affect DPLD. The data show that 82.05% had worked for over five years. This suggests that hairdressers with long working experience may have structural lung problems (RR>1). DPLD pattern is also positively associated with not using PPE at work, such as face masks. The associations are not well-established in the present literature, thus future longitudinal studies may study these possible DPLD risk variables to strengthen the assumption.

Interestingly, this study found that those who are exposed to salon vapors for more than five hours per day and those with exposure to steam from hair iron for more than an hour daily appeared to have an increased risk of developing DPLD patterns on chest X-ray (RR>1). Hair ironing is usually done after application of rebonding and brazilian keratin treatment agents, as well as after hair coloring, to fix the agent and style the hair. Two things can be

Table 9. Positive associations with DPLD patterns

Characteristic	With DPLD Pattern	Without DPLD Pattern	RR	p-value
>5 Years Employed	32	43	1.524	0.1929
No	7	18	(0.8286 to 3.116)	
Not Using PPE	5	0	2.794	0.0041
Using PPE	34	61	(1.521 to 3.721)	
>1hr Hair Iron Steam Exposure	21	18	1.723	0.0333
No	15	33	(1.043 to 2.895)	
Respiratory Symptoms	19	20	1.486	0.1111
No	20	41	(0.9118 to 2.399)	
>5hrs Salon Vapors Exposure	30	44	1.1712	0.5941
No	9	17	(0.6454 to 2.125)	

Table 10. Other characteristics associated with having DPLD patterns

Characteristic	With DPLD Pattern	Without DPLD Pattern	RR	p-value
Female	23	34	1.084	0.7498
Male	16	27	0.6656 to 1.809	
Hair color	13	20	1.015	0.9548
No	26	41	0.5899 to 1.661	
Rebond	12	15	1.202	0.4972
No	27	46	0.6931 to 1.948	
Shampoo	6	6	1.333	0.4050
No	33	55	0.6481 to 2.234	
Blow Dry	4	6	1.029	0.9455
No	35	55	0.4191 to 1.930	
Brazilian Blowout	4	14	0.5206	0.1070
No	35	47	0.2050 to 1.123	
Fumes from Chemicals	32	51	0.9363	0.8400
No	7	10	0.5432 to 1.869	
Steam from Hair Iron	21	21	1.611	0.0550
No	18	40	0.9899 to 2.632	
Air from Blower	24	30	1.363	0.2265
No	15	31	0.8297 to 2.299	
>1hr Exposure	36	51	1.793	0.2070
No	3	10	0.7779 to 5.182	
Smoking	17	28	0.9444	0.8207
No	22	33	0.5708 to 1.537	

Table 11. Logistic regression of selected factors

Factors	OR	95% CI	p-value
>5 Years Employment	1.60	-0.5746 to 1.5203	0.3762
>5 hrs Salon Vapors Exposure	0.93	-1.1244 to 0.9714	0.8862
>1 hr Hair Iron Steam Exposure	1.21	-0.7291 to 1.1143	0.6821
With Respiratory Symptoms	5.19	0.3122 to 2.9818	0.0156

inferred from this result: 1) the steam from hair iron produces the actual respiratory damage or 2) ironing the hair after application of chemicals may result in chemical reactions which aggravate formation of toxic gasses. The stimulus for DPLD is generally believed to be inhalation of inorganic gasses. This toxin exposure injured the pulmonary parenchyma leading to recruitment and activation of inflammatory and immune responses and fibroblast recruitment, hence fibrosis.[12]

Hairdressers and Respiratory Symptoms

Some of the hairdressers reported experiencing shortness of breath at rest and during normal activities (27%), as well as frequent throat irritation (15%). Among those with respiratory symptoms, almost half exhibited DPLD patterns on chest X-rays, with positive relationship on logistic regression. This finding aligns with another study that found respiratory symptoms, such as shortness of breath, to be significantly more common in hairdressers than in a reference group.[13] The same study also reported a significant reduction in lung function parameters—including vital capacity, FVC and FEV1—in hairdressers, supporting another notable observation from chest X-rays: 15% of participants showed hypoaerated lungs, evident as crowding of lung markings.

Conclusion

The findings of this study indicate that the prevalence of diffuse parenchymal lung disease among hairdressers is 39%, which corresponds to a similar prevalence rate of 39% for respiratory symptoms within this population. The primary factor most strongly associated with diffuse parenchymal lung disease is the presence of respiratory symptoms. Additionally, the analysis identified other factors with statistically significant positive associations, including the non-use of personal protective equipment (PPE) and the inhalation of steam from hair iron. While the duration of employment and daily exposure exceeding five hours were also correlated with the disease, these associations did not reach statistical significance.

Recommendation

According to this study's data, salons can improve employee safety and decrease the occurrence of diffuse parenchymal lung disease by implementing these recommendations:

Employers must mandate the use of personal protective equipment to reduce the risk of respiratory symptoms and related pulmonary diseases.

Implement frequent training sessions to inform staff about the hazards inherent in their work environment, especially about the inhalation of steam during hair ironing procedures over one hour and other potentially detrimental tools.

Salons must track employee exposure durations and contemplate instituting procedures to restrict daily exposure to hazardous situations, especially for hairdressers over five hours.

Regular health screenings for personnel displaying respiratory symptoms should be instituted to enable early detection and intervention for diffuse parenchymal lung disease.

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