ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCE, SCHOOL OF PUBLIC HEALTH

Assessment of Respiratory Symptoms, Pulmonary Function, and Associated Factors among Beauty Salon Workers in Addis Ababa, Ethiopia.

BY

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A Research Thesis Submitted to the Graduate Program of Addis Ababa University, College of Health Sciences, School of Public Health in Partial Fulfillment for the degree of Masters of Public Health in Environmental and Occupational Health specialty

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ASSESSMENT OF RESPIRATORY SYMPTOMS, PULMONARY FUNCTION, AND ASSOCIATED FACTORS AMONG BEAUTY SALON WORKERS IN ADDIS ABABA, ETHIOPIA.

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Acknowledgment

First of all, I would like to express my deepest gratitude to God almighty for giving me his grace, strength, and guidance during this research. I want to thank my advisors, Prof. Abera Kumie and Dr. Samson Wakuma, for their valuable input and guidance during this research.

I would like to thank each of the data collectors for their dedication in collecting the data for this research. I want to thank my family for being there for me with their continuous love, and encouragement. Lastly, I would like to thank the Norwegian Program for Capacity Building in Higher Education and Research for Development (NORHED) for providing the funding that made this research possible.

Acronyms and abbreviations

VOCs – Volatile Organic Compounds

PM – Particulate Matter

PPE – Personal Protective Equipment

PFT – Pulmonary Function Test

FEV_1 – Forced Expiratory Volume in the first second

FVC – Forced Vital Capacity

FEV_1/FVC – Ratio of Forced Expiratory Volume in the first second to Forced Vital Capacity

TLC – Total Lung Capacity

PEF – Peak Expiratory Flow

MVV– Maximal Voluntary Ventilation

WHO – World Health Organization

CO_2 – Carbon Dioxide

TVOCs – Total Volatile Organic Compounds

RH – Relative Humidity

OSHA – Occupational Safety and Health Administration

CI – Confidence Interval

SPSS – Statistical Package for the Social Sciences

BMI – Body Mass Index

RPE – Respiratory Protective Equipment

PPE–Personal Protective Equipment

RPPE–Respiratory Personal Protective Equipment

MSDS–Material Safety Data Sheet

AOR–Adjusted Odds Ratio

COR–Crude Odds Ratio

SD–Standard Deviation

CI–Confidence interval

RM–Respiratory Morbidity

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Abstract

Background: Beauty salon workers in Ethiopia are frequently exposed to occupational hazards, such as volatile organic compounds and particulate matter which contribute to respiratory disorders and impaired lung function. However, there is limited research evaluating the prevalence of these respiratory issues and their impact on lung function concerning occupational exposures in beauty salons across Addis Ababa.

Objective: This study aimed to assess respiratory symptoms, Pulmonary function, and associated factors among beauty salon workers in Addis Ababa, Ethiopia.

Methods: A comparative cross-sectional study was conducted among 155 beauty salon workers and 155 clothing store workers in Addis Ababa, Ethiopia. An ATS-based structured questionnaire was used to assess respiratory symptoms. ATS guidelines were also followed for lung function measurements. An observational checklist was used to assess workplace environmental conditions. Multi-stage sampling was used to select participants with inclusion criteria of being at least 18 years old and having at least 12 months of work experience. Data were analyzed using SPSS. Ethical clearance and informed consent were obtained before conducting the data collection.

Results: The study has found that beauty salon workers had a significantly high prevalence of respiratory symptoms (39.3%) compared to controls. Cough, phlegm, and shortness of breath were the commonly reported symptoms. Beauty salon workers also showed reduced FEV_1, FVC, and FEV_1/FVC ratio values ((mean ± SD: 2,408.6 ± 490.3 ml), (2,933.8 ± 646.3 ml), and (82.49 ± 5.35%) respectively). Factors such as high BMI, longer work experience, and lack of respiratory protective equipment were associated with increased respiratory symptoms and decreased lung function.

Conclusion: Beauty salon workers in Addis Ababa face a higher risk of developing respiratory health problems compared to controls. Contributing factors include volatile chemical pollutants in salons, compounded by inadequate protective measures and poor environmental conditions.

Keywords: Beauty salon workers, respiratory symptoms, pulmonary function, occupational exposure, spirometry.

1. Introduction

Background

Beauty salons are places where different beauty services like hairdressing, makeup, nail care, and body care are provided. Different tools, processes, and products are used for the service provision. Chemicals like hair dyes, nail polishes, and sprays are used. These products contain volatile organic compounds (VOCs) and release particulate matter (1,2). Beauty salon workers are consistently exposed to these harmful substances in their work environment, making them susceptible to different health risks (3).

Among the chemicals used in salons are shampoos, conditioners, hair dyes, nail products, polishes, removers, and cosmetics. These products usually contain harmful VOCs such as benzene, toluene, and xylene which are compounds known to cause various respiratory health issues, including cancer (4,5). In addition to VOCs, PMs and fibers are released during multiple salon processes like hair cutting and styling, nail filing, and gels, further contributing to indoor air pollution in the salons (6).

There is a study that has found that concentrations of VOCs in hair salons can range from 100 to 1430 $\mu g/m^3$ VOCs averaged 1034.18 ± 299.9 $\mu g/m^3$ and PM_{10} levels averaged 465 ± 340 $\mu g/m^3$ (7). Another study also observed higher VOC concentrations, ranging from <1 ppb to 76,892 ppb, and PM concentrations reaching up to 870 $\mu g/m^3$ (4). Prolonged exposure to these pollutants has been associated with respiratory health problems among salon workers, such as shortness of breath, coughing, phlegm production, chest tightness, and wheezing, as well as a decline in pulmonary function (7,8). More severe conditions like lung and nasal sinus cancers have also been associated with these exposures (7–9). Poor ventilation, inadequate PPE use, and lack of awareness among workers contribute to a higher health risk (10).

In order to protect workers' health from the risks of these chemicals, it is important to implement preventive measures. Improving the working and environmental conditions of beauty salons, careful use of the substances, and raising awareness among salon workers are important (8). It is important to conduct more research to address the current knowledge gaps, to address the full range of affected workers, and the impact on lung function.

Statement of the problem

The beauty service providers provide their services using various chemical products. The majority of the products used like hair dyes, hair conditioners, nail polish, and glue contain harmful chemicals like benzene, toluene, and ethyl-benzene which are harmful to humans and have adverse health impacts (11). Workers are at risk of harmful effects of the components of the products which are further aggravated by other occupational and environmental factors like poor ventilation, poor use of PPE, and closed space (10). These added factors may result in the development of various health problems, with respiratory symptoms and pulmonary disorders being among them.

Even if research is needed to identify the extent of risk to lay out appropriate measures and protect workers' health, the available research available is limited. In Ethiopia, research on occupational respiratory health hazards faced by beauty salon workers is limited. While there is a growing understanding of the risks of chemicals and products used in beauty salons, only a few studies have been conducted in this area. Only one study has assessed the prevalence of respiratory morbidity among beauty salon workers, while another has focused on the concentration of indoor air pollutants in beauty salons (7,9). The available studies don't address the impact of occupational exposures on lung function. Failing to consider lung function assessment presents a significant gap in understanding the full extent of occupational health risks faced by workers in beauty salons (12).

Additionally, available studies that have assessed occupational respiratory morbidity in beauty salons have only focused on hairdressers. Other beauty salon workers who are equally exposed to harmful chemicals and poor ventilation are not included. These include makeup artists, manicurists, pedicurists, and those involved in body care services also at risk of developing respiratory problems (13,14). The exclusion of these workers from previous research leaves an incomplete understanding of the extent and nature of respiratory health hazards across the wider beauty industry.

Rationale and Significance of the Study

Rationale

The beauty salon business in Addis Ababa is growing fast, with around 7,499 registered female beauty salons as of 2024, based on information from the Addis Ababa Trade Bureau. Workers in this sector experience occupational health risks, particularly respiratory health issues, due to their exposure to various chemical substances and substandard working conditions. Despite the industry's size and the potential health risks involved, there has been limited research aimed at thoroughly evaluating the respiratory health of all types of beauty salon workers, including hairstylists, nail technicians, and makeup artists.

This study aims to fill this gap by assessing respiratory symptoms, pulmonary function, and related occupational factors among a diverse group of beauty salon workers in Addis Ababa. By widening the study scope, this study intends to get a clearer understanding of the occupational health risks present in the beauty salon industry. The result will support recommendations for improving workplace safety and the health of workers. That will overall benefit not only the employees but also the wider public health.

Significance

The findings of this study are important for providing clear proof to show the status of respiratory health issues faced by beauty salon workers in Addis Ababa. These results will help state the need for the development of interventions, policies, and strategies to prevent and manage respiratory diseases within this sector. Furthermore, the study will be instrumental in raising awareness among key stakeholders, including policymakers, salon proprietors, and employees, about the long-term health risks linked to prolonged exposure to hazardous chemicals and inadequate ventilation in workplace settings.

The research will enhance the existing knowledge concerning occupational health risks in beauty salons in countries like Ethiopia, where the industry is rapidly growing, yet health and safety regulations remain insufficient.

2. Literature Review

Beauty Salons are among the occupational environments affected by indoor air pollution. According to the EPA, indoor air pollution is "The condition of the air inside and around structures and buildings, with particular attention to its impact on the wellbeing of occupants" (USEPA, 2024). Beauty salons, since they usually operate with minimum regulation, workers are exposed to various hazards amongst which indoor air pollution is the main concern (15). This pollution exposes workers to various health risks, particularly respiratory problems.

Occupational exposure and Environmental risks in beauty salons

Different services are provided by beauty salons including hair washing, drying, cutting, dressing and coloring, manicures, pedicures, facials, makeup application, eyelash extensions, hair removal, and more (7). The services provided are determined by the customers and their wishes might even influence the products utilized during the service provision (16). Workers will provide the services based on their area of expertise or based on the workforce beauty salons have.

Beauty salon workers are exposed to hazardous chemicals because of the products used for their work. Chemicals in products released into indoor environments include volatile organic compounds (VOCs) and particulate matter (PM), which have significant health risks. Exposure to these pollutants is shown to impact pulmonary functions, leading to respiratory symptoms and reduced lung function (13). Researches show that prolonged exposure to these kinds of pollutants is related to reduced lung function and quality of life (17).

The occupational environments play a critical role in determining the extent of these health risks. Poor ventilation in salons often leads to the accumulation of harmful pollutants in the air, significantly increasing workers' exposure (18). Studies have shown that in many beauty salons, natural ventilation is insufficient, and artificial ventilation systems are not available. Other factors, such as the size of the salon, the number of workers in the working space, and the types of chemicals used, also contribute to the exposure levels (18).

Considering these environmental and occupational factors is important to decrease health risks for beauty salon workers. Improved ventilation, better workplace standards, and the use of personal protective equipment can help reduce risk and create safer work environments (19).

Beauty Salon Environment in Ethiopia

Beauty salons in Ethiopia usually work in environments with high pollutant levels, which are made even worse by inadequate ventilation systems. A study conducted in Jimma showed that only 35.6% of salons had good ventilation, with most having natural ventilation (57.5%), and only 8% using artificial ventilation. In addition, long working hours worsen health risks, with 56.3% of workers in Jimma reporting workdays more than 10 hours (7). Similarly, in Gonder, 40.7% of workers worked over 8 hours per day, and 61% worked six or more days per week (9).

Pollution level measurements conducted in Ethiopian beauty salons showed alarmingly high indoor pollutant levels. For example, PM_{10} concentrations ranged from 0.25 to 1.25 mg/m ^{3}; and total VOCs passed 750 mg/m ^{3}which was above the WHO recommended limit of 200 μg/m (7). These findings emphasize the urgent need for improved ventilation and occupational safety measures.

Respiratory Symptoms

Beauty salon workers around the world face significant risks of developing respiratory problems due to the chemicals and products they use during their services (1) Exposure to VOCs found in the salon's indoor air has been associated with increased respiratory symptoms among workers (19).

Different studies from many countries show the high prevalence of respiratory problems among beauty salon workers. For example, a study done in South Africa found that 62% of beauty salon workers reported having respiratory issues (11). Similarly, research from Arizona, USA, found that 49.6% of workers had respiratory problems (7), while a study in Iran showed a higher prevalence of 75% (20).

In Ethiopia, the situation is more worrisome. A study conducted in Gonder showed that 33.3% of hairdressers reported respiratory issues, while another study from Jimma showed an even higher prevalence of 89.6% (7,9). These results indicate that Ethiopian beauty salon workers may be at higher risk than other countries.

Comparatively lower prevalence rates have been seen in studies conducted in India with 19% prevalence and in Kazakhstan at 38% (5)(10). A study conducted in Mary Land USA didn't find a significant association between beauty salon work and respiratory symptoms after adjustment, suggesting differences in exposures or reporting across different contexts (21). Researchers suggest

this difference could be due to the smaller sample size used in the study or possibly differences in working conditions.

Common symptoms among beauty salon workers are upper respiratory issues like sore throat, nasal congestion, sneezing, and lower respiratory symptoms like cough, shortness of breath, wheezing, and chest tightness (4, 9,19). These symptoms can worsen with prolonged exposure and may lead to chronic respiratory illnesses if preventive measures are not implemented. Supporting this a study conducted in Palestine found that hairdressers experienced more respiratory symptoms than non-exposed, with symptoms worsening in salons where ammonia levels exceeded 25 ppm (23).

Lung Function in Beauty Salons

Exposure to indoor air pollutants can significantly impact the normal functioning of different human organs and systems. In beauty salons, volatile chemicals from products used get into the human body, affecting respiratory and lung functions (3).

Lung function is typically measured by parameters such as the Forced Expiratory Volume in one second (FEV_1/), Forced Vital Capacity (FVC), and their ratio (FEV_1/FVC). Overall, a ratio of more than 0.70, with both FEV_1 and FVC passing 80% of the predicted values, is considered normal. Similarly, Total Lung Capacity (TLC) is considered normal if it is above 80% of the predicted value, and diffusion capacity is considered adequate if it exceeds 75% of the predicted (17,24).

Several studies conducted showed the impact of beauty salon exposure on lung function. For example, a study conducted among female Palestinian hairdressers found that workers with longer employment periods had a reduction in forced vital capacity (FVC) by -0.014 L (95% CI: -0.026 to -0.001, p=0.04) and forced expiratory volume in one second (FEV1) by -0.031 L (95% CI: -0.052 to -0.010, p=0.005) (24). Similarly, a study conducted in Slovakia reported that less than 10% of hairdressers got to 100% of predicted values for peak expiratory flow (PEF) and Maximal Voluntary Ventilation (MVV), while over 73% of participants passed predicted values for FVC (8). A study in India also found significantly low PEF values among beauty salon workers (10). That strengthens the link between occupational exposure and reduced pulmonary function.

A comparative study further showed a higher prevalence of lung function reduction among exposed workers. Restrictive, obstructive, and mixed patterns were more common in the exposed group than the unexposed (20). Moreover, a decrease in FEV1/FVC ratio value of under 70% and a decrease in PVs of PEF in subjects indicated chronic bronchitis (8).

These findings collectively indicate the significant impact of occupational exposure on lung function among beauty salon workers and the need for preventive interventions.

Factors associated with respiratory symptoms

Workers' personal and behavioral factors play a significant role in determining their likelihood of developing respiratory health problems. Among the factors influencing the development of respiratory symptoms are BMI, work experience, gender, and use of RPE (25).

BMI has been notably associated with respiratory function further aggravated by occupational factors as well (26). Individuals who are overweight are 3 times more likely to experience respiratory issues compared to those who are physically fit (10). Similarly, work experience has a notable impact; hairdressers with 3 to 5 years of experience are three times more likely to develop respiratory symptoms than those with 2 or fewer years of experience, emphasizing the importance of prolonged exposure. Moreover, gender differences contribute to being more susceptible. As women are often engaged in domestic cooking, they are more exposed to indoor air pollution, which further increases their risk (9).

A study also showed that hairdressers working near main roads were over two times more likely to show respiratory symptoms (9). Greater age was also found be to associated with respiratory symptoms in a Norwegian study where workers older than 40 years reported more respiratory (27).

In addition to these factors, smoking is strongly associated with respiratory symptoms. This is particularly true among beauty salon personnel making it another critical concern (28). Furthermore, the use of PPE significantly reduces the risk of developing respiratory symptoms. However, workers who fail to use PPE are susceptible to the harmful impact of PM and VOC. In our country, a study conducted in Ethiopia showed that workers not using PPE are five times more likely to experience respiratory symptoms (7).

Overall, beauty salon environments expose workers to many different harmful chemicals, VOCs being among the most concerning because of their significant health risks. Factors such as poor ventilation, long working hours, and frequent exposure to these chemicals increase their adverse effects on workers' respiratory health. Various studies highlight the urgent need for improved occupational health standards in beauty salons, including the implementation of adequate ventilation systems and the use of protective equipment to minimize exposure risks (13,19).

Additionally, implementing specific control measures can further improve worker safety. These include proper labeling of chemicals used in salons to ensure informed usage, shifting employees to reduce long exposure, and encouraging the consistent use of Personal Protective Equipment (PPE). Such interventions are essential to creating a healthier and safer working environment for beauty salon employees (29).

Conceptual Framework

This conceptual framework shows the relationships between individual and occupational factors, exposure to indoor air pollutants, and respiratory health outcomes among beauty salon workers. It is developed based on previous research done on occupational exposure and respiratory outcomes. The framework shows how individual factors (e.g., BMI, smoking, PPE use) and work-related conditions (e.g., ventilation, working hours) affect lung function status and health of workers. This serves as a baseline to understand exposure ways and identify areas for intervention.

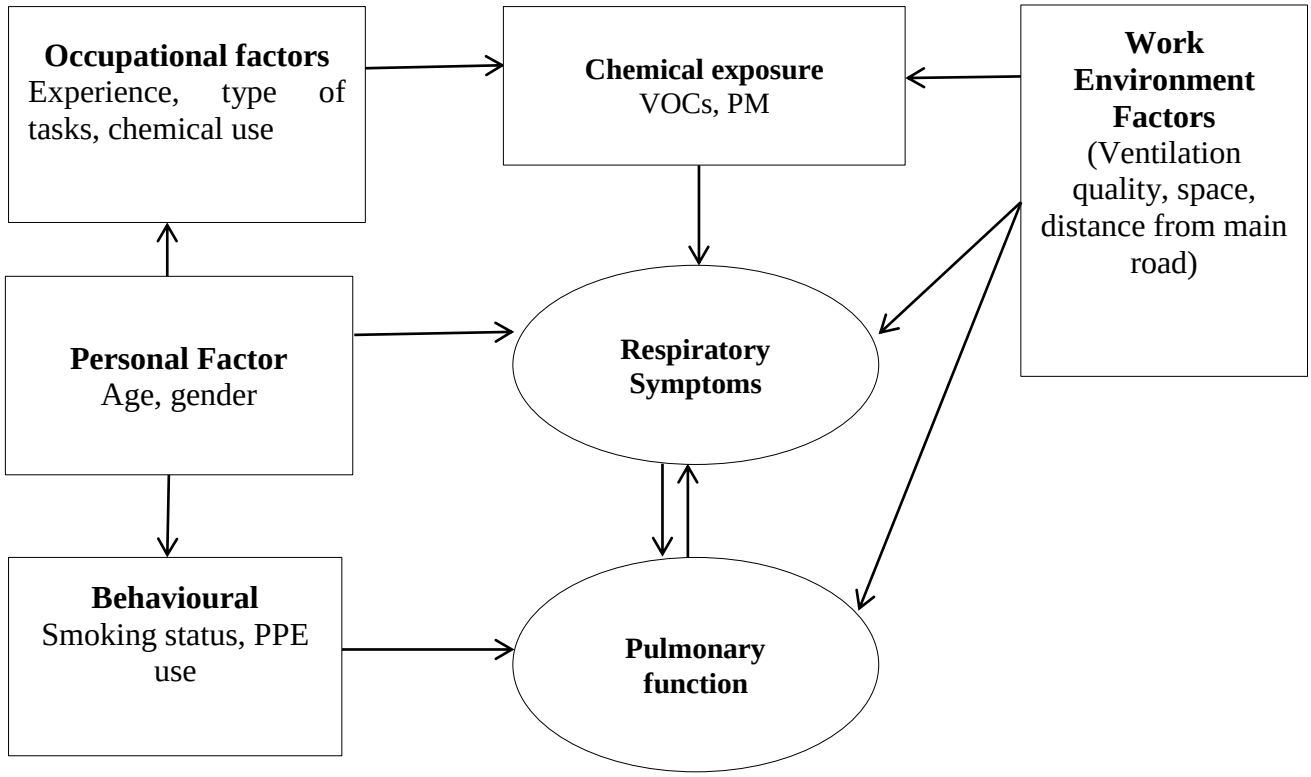

Figure 1: Conceptual framework to show the relationship between different variables and the development of respiratory symptoms and their impact on pulmonary function. (Source: Authors design based on literature review)

3. Objectives

General Objective:

This study aims to assess respiratory symptoms, pulmonary function, and associated factors among beauty salon workers in Addis Ababa, Ethiopia.

Specific Objectives:

1. To determine the prevalence of respiratory symptoms among Beauty salon workers and the unexposed group in Addis Ababa.
2. To determine the Pulmonary Function of Beauty salon workers and the unexposed group in Addis Ababa.
3. To determine the factors affecting the development of respiratory symptoms among beauty salon workers in Addis Ababa.

4. Methods and Materials

Study area

The study was conducted in Addis Ababa, the capital city of Ethiopia. The capital is divided into 11 sub-cities and its population in 2024 is estimated to be 5,703,630 (UN World Urbanization Project). As of 2024, there are 7,499 female beauty salons in the city registered under the Addis Ababa Trade Bureau catering to the needs of clients. The salons provide a variety of services including hairdressing, nail care, and cosmetic skin care.

The beauty salons included in this study are located in 2 sub-cities, Bole and Yeka subcities. The sub-cities have a large number of beauty salons and were chosen to ensure diversity and the socioeconomic status of the beauty salons and workers. Bole is a relatively modern area, while the Yeka sub-city has a mix of both middle- and lower-income populations, allowing the study to capture any variations in working conditions and respiratory health outcomes across different settings.

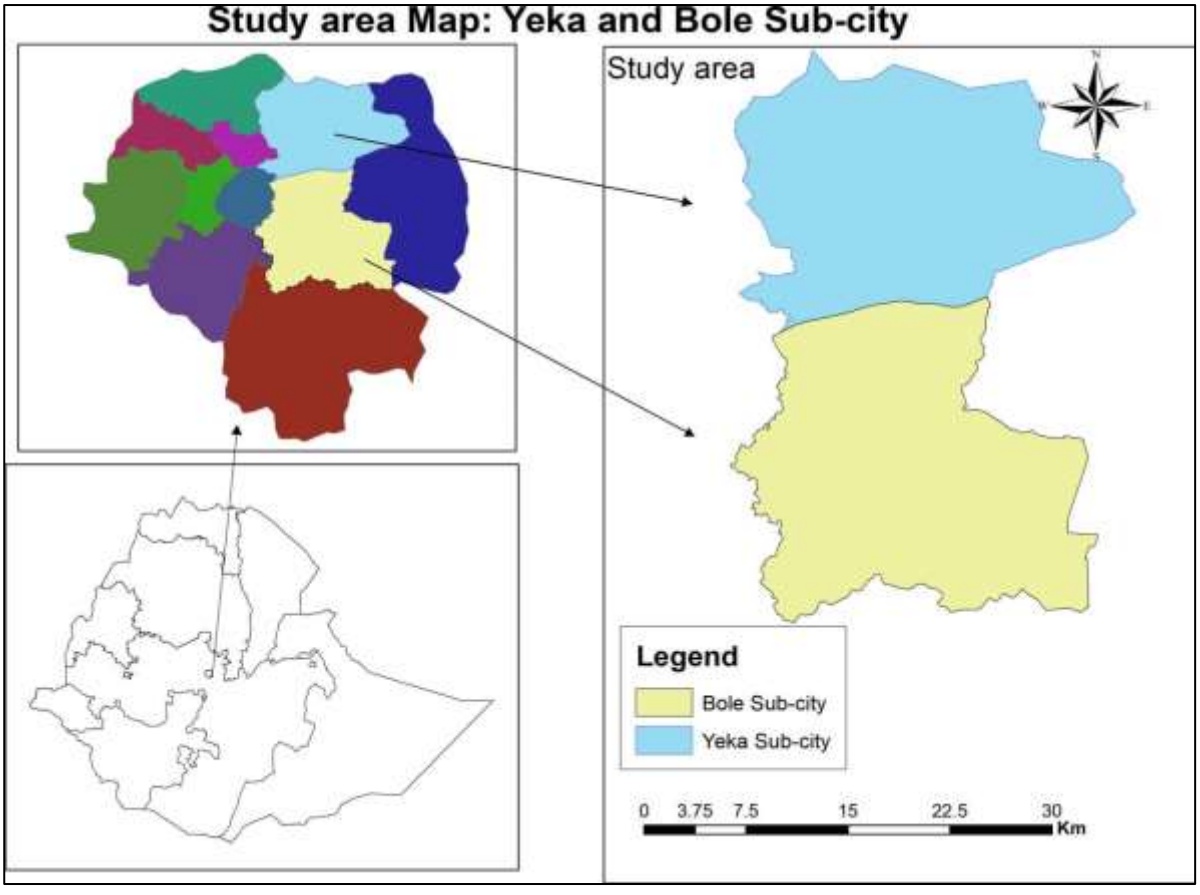

Figure 2: Map of the location of the eleven sub-cities in Addis Ababa, Ethiopia.

Study Design and Period

A comparative cross-sectional study was used to assess the prevalence of respiratory symptoms, testing for pulmonary function, and determining associated factors among beauty salon workers in Addis Ababa. The study was conducted from March to April 2025.

Source Population and Study Population

Source population

Workers from all beauty salons in the selected sub-cities were the source population for our study group. For the non-exposed group, the source population was all clothing store sales workers in stores of the selected sub-city.

Study Population

All eligible beauty salon workers from the chosen salons in the three selected sub-cities of Addis Ababa participated in the study. The non-exposed groups were eligible clothing store sales workers in stores from the same sub-cities.

Inclusion and exclusion criteria

For beauty salon workers

Inclusion criteria

Female beauty salon workers who are:

- Above 18 years of age
- Having worked in beauty salons for at least 12 months were included

Exclusion Criteria

- Workers with diagnosed asthma, chest injury, tuberculosis, or other respiratory illnesses.
- Workers in beauty salons located near the garage, furniture work, and other polluting point sources were excluded.

For non-exposed group

Inclusion criteria

Clothing store sales workers who are:

- Above 18 years of age
- Having worked in clothing stores for at least 12 months was included

Exclusion Criteria

- Clothing store workers who had previously worked in beauty salons were excluded.

Exclusion criteria for both

- Participants who had eye surgery, open chest or abdominal surgery, stroke, or heart attack specifically in the past three months were excluded from the spirometer test.

Sampling technique

Three-stage stratified sampling technique was used in this study. First, out of 11 subs-cities 2 sub-cities were purposefully selected based on their high number of beauty salons and socio-economic diversity to ensure representativeness. Within each selected sub-city, beauty salons were selected through simple random sampling. All workers in the chosen salons who met the inclusion criteria were invited to participate. For the control group, clothing stores were selected using the same approach, and workers meeting the inclusion criteria were invited to participate.

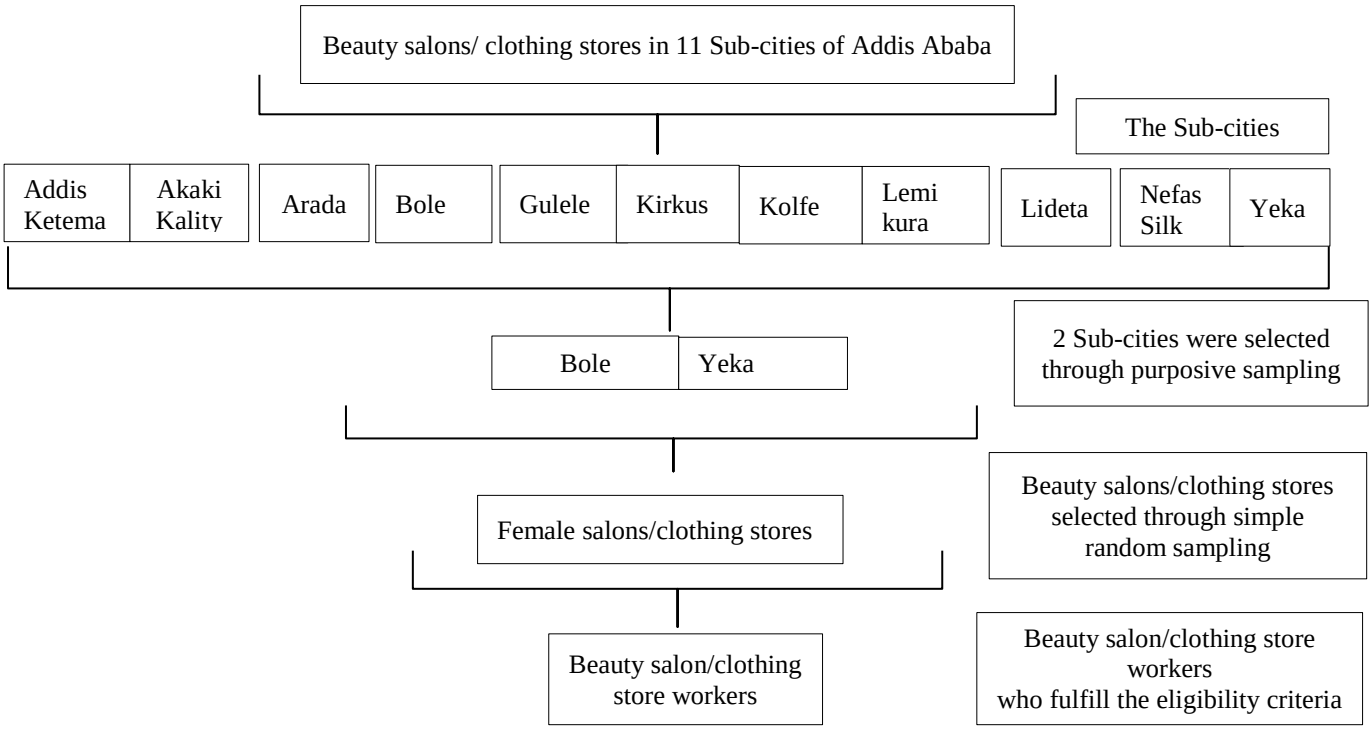

Figure 3: Sampling chart for selecting participants

Sample size determination

1. To calculate the sample size for determining the prevalence of respiratory symptoms among beauty salon workers, we used the prevalence of cough among hairdressers in Gonder, Ethiopia which was 22.8%, and assumed a prevalence of 10% less for the second prevalence (9). We assumed a power of 80% and a significance level of 0.05.

$$n = \frac{(Z\alpha/2+Z\beta)^2 \cdot (p1(1-p1)+p2(1-p2))}{(p1-p2)^2}$$

- n = sample size per group

- Zα/2 = Z-value corresponding to the desired confidence level
- Zβ = Z-value corresponding to the desired power
- p1 = expected proportion for the first population
- p2 = expected proportion for the second population

$$n = \frac{(1.96+0.84)^2 \cdot (0.228\,(1-0.228)+0.128(1-0.128))}{(0.228-0.128)^2} = 225.8$$

After adjusting for a 10% non-response rate the final sample size was 252 and we will have 504 samples in total with a 1:1 ratio.

2. To calculate the sample size for determining the pulmonary function of beauty salon workers, we used the mean and standard deviation of cross-shift FEV1 from a study conducted among cleaners of government hospitals in Addis Ababa (30). Cleaners are exposed to various chemicals as well as PM like beauty salon workers, so we used the mean value from a study done among cleaners. In the study, the mean and standard deviation of Spiro metric indices for the exposed groups was 2.52 ± 0.69 and the assumption of 10% increase and the same standard deviation for control groups was assumed to be 2.772 ± 0.69. We assumed a power of 80% and a significance level of 0.05.
   We will use the calculation below:

$$n = 2 \times (Z\alpha/2+Z\beta)^2 \times \frac{(\sigma1^2+\sigma2^2)}{(\mu1-\mu2)^2}$$

Where:

- n = sample size per group
- Zα/2= Z-value corresponding to the significance level (α)
- Zβ= Z-value corresponding to the power (1 - β).
- σ1\σ2= standard deviations of exposed and control groups respectively
- μ1\μ2= means for the exposed and control groups, respectively

Based on the above formula:

$$n= 2 \times (1.96+0.84)^2 \times \frac{(0.69^2+0.69^2)}{(2.772-2.52)^2}$$

$$n= 2 \times 7.84 \times \frac{0.9522}{0.0635} \approx 236$$

After adjusting the 10% non-response rate the required sample size for assessing pulmonary function among beauty salons will be approximately 260. With a 1:1 ratio for the comparative nature, the total sample size will be 520.

3. To determine the sample size for assessing factors associated with respiratory symptoms, we used the association between work experience and the development of respiratory health problems. Based on a study conducted among paper factory workers in Ethiopia, the prevalence of respiratory symptoms among workers with more than 5 years of working experience was 22.3.% and for the non-exposed was 10.17% (25). We also used a power of 80 % and 0.05 significance level.

$$n = \frac{(Z\alpha/2+Z\beta)^2 \cdot (p1(1-p1)+p2(1-p2))}{(p1-p2)^2}$$

$$n = \frac{(1.96+0.84)^2 \cdot (0.223\,(1-0.223)+0.1017(1-0.1017))}{(0.223-0.1017)^2}$$

$$n = \frac{2.073}{0.01471} \approx 141$$

After adjusting, the sample size was 155 and totally we got 310 participants. Due to time resource availability, we used a sample size of 310 to conduct the study.

Data collection

Questionnaire

To assess the demographic characteristics, lifestyle factors, and respiratory symptoms of both exposed and non-exposed groups, we utilize a standardized questionnaire. The questionnaire to assess respiratory symptoms was adopted from the American Thoracic Society and it was utilized to capture relevant data from participants (31). This section included issues such as cough, wheezing, shortness of breath, and chest tightness. In addition to assessing respiratory symptoms, the questionnaire assessed demographic data like age, gender, and education level. We also collected data regarding other lifestyle factors influencing respiratory health. The questionnaire items included questions on smoking status, history of respiratory illnesses, and exercise habits.

The questionnaire was entered into the Kobo toolkit. Before proceeding to the main data collection, the questionnaire was pretested on a small portion of workers. After making sure that issues with the questionnaire were resolved we moved on to the data collection. The data was collected by trained data collectors who are health professionals with at least a BSc degree and with prior data collection experience. The data collection for the non-exposed group mirrored that of beauty salon workers.

Spirometer

To assess the pulmonary function of exposed and control group workers, we used a spirometer (Spirobank II) and disposable mouthpiece (Flow MIR disposable turbine) to measure Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 Second (FEV_1) according to American thoracic society spirometer technical standards (32)**.** Trained health professionals with at least a BSc degree in health-related fields performed the tests using a computer-connected spirometer according to standards. All spirometer tests were done on sitting posture and three acceptable maneuvers with repeatable results were retained, and the best values for Forced Vital Capacity (FVC) and Forced Expiratory Volume for one second (FEV1) and their ratio were recorded. Height and weight were measured with a height measuring stand and digital weighing scale to calculate BMI and adjust spirometer results.

Checklist

Work environment assessment was conducted to assess workplace environmental factors using an observational checklist. This checklist covered key aspects of the work environment including type of ventilation system, chemical use handling and storage, personal protective equipment (PPE) use, waste management, and general sanitation.

Operational Definition

Beauty salon workers: Workers employed in beauty salons who are involved in activities such as hair styling, dyeing, nail services, or makeup applications.

Non-exposed group: Workers employed in clothing shops, with no previous experience of working in beauty salons.

Chronic respiratory symptom: If participants reported one or more symptoms of cough, phlegm, wheezing, shortness of breath, or chest tightness caused by their occupation for at least 3 months in the previous 12 months

FEV1: The maximal volume of air exhaled in the first second of a forced expiration from a position of full inspiration

FVC: The maximal volume of air exhaled with a maximally forced effort from a maximal inspiration

Lung function: the ability of the respiratory system to effectively move air in and out of the lungs, as assessed by a spirometer.

Cough: If participants answered "yes" to at least one of the following four questions: Do you usually cough first thing in the morning, cough during the day or night, cough as much as four to six times a day in a week, or cough most days during three consecutive months during the year?

Chest tightness: If participants answered yes to the following questions: Do you usually experience chest tightness while at work or just after work?

Breathlessness: If participants answered yes to the question: Do you usually get troubled by shortness of breath when walking hurriedly on level ground or walking up a slight hill, or get shortness of breath when walking at your own pace on level ground?

Wheezing: If participants answered yes to the question: Does your chest ever sound wheezy or emit a whistling sound?

Smokers: These were participants who currently smoked or had smoked more than 20 packs of cigarettes during their lifetime or more than one cigarette a day for one year.

BMI (Body Mass Index): Calculated as weight in kilograms divided by the square of height in meters (kg/m^2).

Never smoker: participants who had never smoked.

Current smoker: participants who are currently smoking or stopped smoking less than one year ago.

PPE use: The use of one or more respiratory masks, full-face respirators or breathing apparatus

Adequate natural ventilation: If the beauty salon has at least one functioning window or door that was kept open during work hours without obstruction to airflow.

Odor Present: A strong or noticeable chemical smell detected by the data collector at the time of the visit, particularly from hair products, nail polish, or cleaning agents.

Data Management

The data from Kobo was exported to IBM SPSS version 25 for data cleaning and analysis. The raw Kobo data were first reviewed for completeness, missing values and inconsistencies were checked

and identified errors were maintained. Lung function test results were exported into an Excel for organization and then exported to IBM SPSS where it was cleaned, and missing values identified. Checklist responses were entered into an Excel spreadsheet for organization and then exported to SPSS for cleaning and analysis. All cleaned datasets were securely stored on a password-protected computer and backed up on an external drive. The final cleaned data were used for descriptive, bivariate, and multivariate analyses. The principal investigator oversaw the data management process, ensuring the quality and integrity of the dataset.

Data Analysis

Descriptive statistics like frequencies, percentages, means, and standard deviations, were used to summarize the socio-demographic, behavioral, environmental, and occupational characteristics of the participants. For categorical variables, the chi-square test was used to assess differences between beauty salon workers and un-exposed, and independent t-tests were used for continuous variables. For respiratory symptoms, prevalence ratios (PR) with 95% confidence intervals were calculated using a log-binomial model to compare beauty salon workers with controls. Potential confounders like housing type, window availability, cooking fuel type, pet ownership, BMI, and use of RPE were adjusted.

Bivariate logistic regression analyses were performed to identify factors associated with the presence of at least one chronic respiratory symptom. Variables with a p-value < 0.2 in the bivariate analysis were included in a multivariable logistic regression model to adjust for confounding factors. After adjustment, the odds ratios (AOR) with 95% confidence intervals were reported. Frequencies and percentages were used to present the environmental conditions of the workplace.

An ANCOVA was conducted adjusting for potential confounders to compare mean values of FEV_1, FVC, and FEV_1/FVC ratio between exposed and non-exposed groups. Multiple linear regression analyses were conducted to see the effect of occupation, sex, work experience, BMI, and age on lung function measures. The level of significance was set at $p < 0.05$ for all analyses.

Data Quality Assurance

To ensure data quality, several measures were implemented across all study phases. Standardized tools which were adapted from the American Thoracic Society (ATS) were used to assess respiratory symptoms and lung function. The questionnaire was first translated into Amharic and back-translated to ensure accuracy. A pre-test was conducted in Lemi Kura Sub-city, and revisions were made to

improve clarity based on participant feedback. Data collectors got training using a structured manual. That was done so they could have the same understanding of the questionnaire, proper interviewing, communication, and spirometer procedures. The principal investigator supervised the data collection closely, having daily checks for completeness and consistency. Spirometer tests followed ATS guidelines, taking at least three acceptable and repeatable maneuvers, with the best values recorded. Data cleaning was conducted before analysis to check for missing or inconsistent data.

Ethical Considerations

Ethical clearance was obtained from the Institutional Review Board (IRB) of Addis Ababa University. Participation in the study was voluntary and written informed consent was obtained from all participants. The anonymity of our participants as well as the confidentiality of the data was maintained throughout the study. Spirometer tests were performed following established guidelines to ensure accuracy and minimize discomfort. Disposable mouthpieces were used to prevent the transmission of infections. Participants were informed of the potential benefits of identifying respiratory impairments early, and those with lung function impairments were advised to seek medical attention. The necessary information about accessible health services was also provided.

Dissemination of Findings

Reports of the findings will be shared with public health authorities, regulatory bodies, and policymakers like Occupational Health and safety agencies and NGOs to support occupational health regulations. Academic presentations and journal publications will be conducted and done to inform researchers and academicians. Workshops will also be conducted to inform beauty salon workers and owners of the results to educate them about protective measures to undertake and the proper use of PPE. Overall, we will utilize various strategies to ensure that all stakeholders are well-informed to finally create safer working conditions in beauty salons.

5. Results

1. Socio-demographic characteristics of respondents

In this study, a total of 297 participants with a response rate of 96% were included consisting of 150 beauty salon workers and 147 controls. The majority of participants were females 245 (82.4%). Most participants were aged 29 years or younger in both groups (87 (58%) in beauty salon workers, 83 (56.5%) in controls). About 93 (62.4%) of beauty salon workers and 68 (47.2%) of non-exposed had normal BMI, while the remaining participants were overweight. Among the beauty salon workers, secondary education was slightly more common (44%) than primary (42%). Among the non-exposed group, primary education was the most common (51%).

More than half of the beauty salon workers 85 (56.7%) and non-exposed 80 (54.4%) had 4 years or less of work experience. About 94 (62.7%) beauty salon workers and 88 (59.9%) non-exposed worked for more than 8 hours a day. In addition, 107 (71.3%) of the beauty salon workers worked for 6 or more days per week, compared to 89 (60.5%) of the non-exposed group.

Table 1: Socio-demographic and work-related characteristics of beauty salon workers and non-exposed group in Addis Ababa, Ethiopia (n=297)

Variables	Category	Beauty salon workers (n=150)	Non-exposed group (n=147)	Total	P-value
		n (%)	n (%)	n (%)	
Sex	Female	128(85.33)	117(79.6)	245(82.4)	0.19
	Male	22(14.67)	30(20.4)	52(17.6)	
Age	≤ 29	87(58)	83(56.5)	170(57.2)	0.96
	30-40	55(36.7)	56(38.1)	111(37.4)	
	>40	8(5.3)	8(5.4)	16(5.4)	
BMI	Normal	93(62.4)	68(47.2)	161(52.2)	0.006*
	over	56(37.6)	76(52.8)	132(44.4)	
Education	Primary	63(42)	75(51)	138(46.5)	0.28
	Secondary	66(44)	56(38.1)	122(41.1)	
	College and above	21(14)	16(10.9)	37(12.4)	
Experience	≤ 4 years	85(56.7)	80(54.4)	165(55.6)	0.39
	5-9 years	44(29.3)	38(25.9)	82(27.6)	
	>10 years	21(14)	29(19.7)	50(16.8)	
Work hours/day	>8hours	94(62.66)	88(59.86)	182(61.3)	0.62
	≤ 8hours	56(37.33)	59(40.14)	115(38.7)	
Working day/week	< 6days per week	43(28.66)	58(39.5)	101(34)	0.05*
	≥ 6days per week	107(71.33)	89(60.5)	196(66)	

BMI = Body Mass Index, n number of study participants, Pearson chi-square test

2. Behavioral characteristics

About 15 (10%) of the beauty salon workers and 16 (10.9%) of the non-exposed group were passive smokers. The majority of respondents (118 (78.7%) of beauty salon workers and 95

(64.6%) of non-exposed) have a habit of cooking at home. Exercise habits were similar between the groups, with 37 (24.7%) of salon workers and 41 (27.9%) of non-exposed exercising. Regarding the use of RPE, about 74 (49.4%) of beauty salon workers use RPE while only 8 (5.5%) of non-exposed use them. Respondents were allowed to give multiple reasons, and the main reason for not using RP non-exposed who didn't use RPE said it was because no harm was present.

Table 2: Behavioral characteristics of beauty salon workers and non-exposed in Addis Ababa, Ethiopia (n=297)

Variable	Category	Beauty salon workers (n=150)	Non-exposed group (n=147)	Total n (%)	P-value
		n (%)	n (%)		
Passive smoking	Yes	15 (10)	16 (10.9)	31 (10.5)	0.80
	No	135 (90)	131 (89.1)	266 (89.5)	
Cooking habit	Yes	118 (78.7)	95 (64.6)	213 (71.9)	0.007*
	No	32 (21.3)	52 (35.4)	84 (28.1)	
Exercise habit	Yes	37 (24.7)	41 (27.9)	78 (26.3)	0.50
	No	113 (75.3)	106 (72.1)	219 (73.7)	
RPE Use	Yes	74 (49.4)	8 (5.5)	82 (27.6)	<0.01**
	No	76 (50.6)	139 (94.5)	215 (72.4)	
Reason for not using RPE	Unavailable	17 (22.4)	19 (13.7)	36 (16.7)	0.10
	Not comfortable	55 (72.4)	14 (10.1)	69 (32.1)	<0.01**
	Doesn't provide protection	8 (10.5)	4 (2.9)	12 (5.6)	0.02*
	No harm present	16 (21.1)	119 (85.6)	135 (62.8)	<0.01**

RPE = Respiratory Protective Equipment; Pearson chi-square test

3. Environmental factors

About 83 (55.3%) beauty salon workers and 93 (63.3%) non-exposed lived in houses made from concrete and blocks. Compared to the non-exposed 115 (78.2%), a higher number of salon workers 133 (88.7%) reported having windows in their homes and kitchens. Electricity was the most commonly used cooking fuel in both groups, followed by charcoal.

Table 3: Housing and environmental characteristics of beauty salon workers and controls (n=297).

Variable	Category	Beauty salon workers (n=150)	Non-exposed group (n=147)	Total (n)	P-value
		n (%)	n (%)		
Residential housing type	Wood and mud	44 (29.3)	20 (13.6)	64 (21.6)	0.003*
	Concrete and blocks	83 (55.3)	93 (63.3)	176 (59.4)	
	Semi-concrete and semi-mud	23 (15.3)	34 (23.1)	57 (19.2)	
Windows	Yes	133 (88.7)	115 (78.2)	248 (83.6)	0.015*
	No	17 (11.3)	32 (21.8)	49 (16.4)	
Energy for cooking	Charcoal	87 (68.5)	60 (63.2)	147 (66.2)	0.40
	Wood/biomass	26 (20.5)	9 (9.5)	35 (15.7)	0.02*
	Kerosene	8 (6.3)	16 (16.8)	24 (10.8)	0.01*
	Electricity	112 (87.5)	90 (94.7)	202 (90.7)	0.67
Kitchen windows	Yes	102 (68)	69 (46.9)	171 (57.6)	<0.01**
	No	48 (32)	78 (53.1)	126 (42.4)	
Pets	Yes	23 (15.3)	44 (29.9)	67 (22.7)	0.03*
	No	127 (84.7)	103 (70.1)	230 (77.3)	
Workplace location	Near main-road	94 (62.7)	82 (55.8)	176 (59.3)	0.20
	Far from main-road	56 (37.3)	65 (44.2)	121 (40.7)	

Pearson chi-square test

4. Respiratory Symptoms

The prevalence of chronic respiratory symptoms was higher 59 (39.3%), among the beauty salon workers than the non-exposed, 20 (13.6%). Cough was the most prevalent symptom among beauty salon workers reported among 45 (30%) workers, while shortness of breath was the most prevalent among non-exposed reported among 11 (7.5%) controls. Phlegm, chest tightness, and wheezing were among the symptoms observed among the participants.

Table 4: Prevalence of chronic respiratory symptoms among beauty salon workers and controls (n=297).

	Beauty salon workers	**Non-exposed**	**Total**	
Symptoms	**n (%)**	**n (%)**	**n (%)**	**PR adj, 95% CI**
Cough	45(30)	7(4.8)	52(17.5)	5.97 (2.51–14.20)**
phlegm	19(12.7)	4(2.7)	23(7.7)	5.08 (1.55–16.66)*
Wheezing	21(14)	2(1.4)	23(7.7)	8.68 (1.85–40.82)*
Shortness of breath	35(23.3)	11(7.5)	46(15.4)	1.93 (0.86–4.29)
Chest tightness	29(19.3)	2(1.4)	31(10.4)	10.39 (2.30–46.98)*
At least one respiratory symptom	59(39.3)	20(13.6)	79(26.6)	2.16 (1.18–3.93)*

PR adj= Adjusted prevalence ratio; n number of study participants; *= p-value <0.05; **= p-value <0.01 after adjusting for housing type, availability of window, energy used for cooking, pet ownership, BMI, RPE use

5. Factors Associated with Respiratory Symptoms

1. Bivariate Analysis

I. Socio-demographic characteristics

In the bivariate analysis, socio-demographic factors were analyzed to observe the association between the developments of at least one respiratory symptom. Overweight workers had significantly higher odds of reporting respiratory symptoms compared to those with normal BMI (COR = 6.285; 95% CI: 3.025–13.058; $p < 0.001$). Workers with more than 5 years of experience were more likely to report respiratory symptoms than those with 5 or fewer years of experience (COR = 3.448; 95% CI: 1.702–6.985; $p = 0.001$). Interestingly, workers with primary

or secondary education had lower odds of respiratory symptoms compared to those with a college education and above (COR = 0.490; 95% CI: 0.251–0.955; p = 0.036). Other variables such as working hours per day and number of working days per week showed no association with respiratory symptoms (p > 0.05)

Table 5: Bivariate analysis of socio-demographic and work characteristics associated with respiratory symptoms among beauty salon workers and controls in Addis Ababa, Ethiopia.

Variables	Symptoms		COR (95%CI)	p-value
	Yes	No		
BMI				
Normal	22	71	1.0	
Overweight	37	20	5.970 (3.025-13.058)	<0.001**
Experience				
≤ 5 years	29	70	1.0	
> 5	30	21	3.448(1.702-6.985)	0.001**
Education				
Primary/Secondary	28	59	0.490(0.251-0.955)	0.036*
College and above	31	32	1.0	
Work hours/ day				
>8hours	33	61	0.671(0.341-1.319)	0.247
≤ 8hours	25	31	1.0	
Working day/week				
<6 days per week	18	25	1.16(0.564-2.382)	0.68
≥6 days per week	41	66	1.0	

COR= Crude Odds Ratio; CI: Confidence Interval; Reference category = 1.0; *= p-value <0.05; **= p-value <0.01

II. Behavioral and Environmental factors

In the bivariate analysis of behavioral and environmental factors associated with respiratory symptoms among beauty salon workers, not using respiratory protective equipment (RPE) was significantly associated with higher odds of respiratory symptoms compared to RPE users (COR = 2.394; 95% CI: 1.217–4.710; p = 0.011). Other factors such as exercise habits (COR = 0.601; 95% CI: 0.284–1.273; p = 0.18), presence of a kitchen window (COR = 1.431; 95% CI: 0.594–3.448; p = 0.425), and having pets at home (COR = 1.860; 95% CI: 0.760–4.540; p = 0.17) were not significantly associated with respiratory symptoms. Working near a main road showed slightly increased odds of respiratory symptoms compared to working far from a main road

(COR = 1.853; 95% CI: 0.920–3.731; p = 0.08), although this was not statistically significant at the 0.05 level.

Table 6: Bivariate analysis of behavioral and environmental factors associated with respiratory symptoms among beauty salon workers and controls in Addis Ababa, Ethiopia.

Variables	Symptoms		COR (95%CI)	p-value
	Yes	No		
RPE use				
Yes	21	53	1.0	
No	37	39	2.394(1.217-4.710)	0.011*
Exercise				
Yes	18	19	1.0	
No	41	72	0.601(0.284-1.273)	0.18
Kitchen window				
Yes	42	62	1.0	
No	12	13	1.431(0.594-3.448)	0.425
Pets				
Yes	12	11	1.86(0.76-4.54)	0.17
No	47	80	1.0	
Workplace location				
Near main road	42	52	1.853(0.920-3.731)	0.08
Far from main-road	17	39	1.0	

COR= Crude Odds Ratio; CI: Confidence Interval; Reference category = 1.0; *= p-value <0.05; **= p-value <0.01

2. Multivariate analysis

In the multivariable logistic regression analysis, factors with significance below 0.2 in the bivariate analysis were assessed for their association with the development of at least one respiratory symptom among beauty salon workers. After adjusting for confounders, a higher BMI was significantly associated with increased odds of reporting respiratory symptoms (AOR = 4.202; 95% CI: 1.822– 9.845; *p* =0.001). Not using RPE was found to be associated with higher odds of reporting respiratory symptoms when compared to the users (AOR = 2.001; 95% CI: 1.010 – 3.960; *p*= 0.046). In addition, workers with more than 5 years of experience had higher odds of developing at least one respiratory symptom (AOR =2.980; 95% CI: 1.400 – 6.340; p=0.005).

Other variables including level of education, exercise habits, pet ownership, and workplace

location didn't show a statistically significant association after adjustment.

Table 7: Multivariate analysis of factors associated with respiratory symptoms among beauty salon workers

Variables	Symptoms		COR (95%CI)	p-value	AOR (95%CI)	p-value
	Yes	No				
BMI						
Normal	22	71	1.0			
Overweight	37	20	5.970 (3.025-13.058)	<0.001	4.202(1.822– 9.845)	0.001**
Experience						
≤ 5 years	29	70	1.0		1.0	
> 5	30	21	3.448(1.702-6.985)	0.001	2.980(1.400 – 6.340)	0.005**
Education						
Primary/Secondary	28	59	0.490(0.251-0.955)	0.036	0.560(0.280–1.120)	0.06
College and above	31	32	1.0		1.0	
RPE use						
Yes	21	53	1.0		1.0	
No	37	39	2.394(1.217-4.710)	0.011	2.001 (1.010 – 3.960)	0.046*
Exercise						
Yes	18	19	1.0		1.0	
No	41	72	0.601(0.284-1.273)	0.18	0.684 (0.260–1.799)	0.441
Pet ownership						
Yes	12	11	1.86(0.76-4.54)	0.17	1.250(0.550–2.805)	0.62
No	47	80	1.0		1.0	
Workplace location						
Near main-road	42	52	1.853(0.920-3.731)	0.08	0.915 (0.358 – 2.337)	0.852
Far from main-road	17	39	1.0		1.0	

COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence; Reference category = 1.0

6. Environmental Assessment

An environmental assessment was conducted in 100 beauty salons to evaluate key environmental conditions. Adequate natural ventilation was present in 59% of the salons, while 41% had operational mechanical ventilation or air conditioning systems. Strong chemical odors were

reported in 9% of salons, and visible dust or particulate matter was observed in 17%. A high proportion (89%) used chemical products such as hair dye, bleach, or nail polish remover, and 69% stored these chemicals in closed, labeled containers. However, only 6% had Material Safety Data Sheets (MSDS) available on site. Although 77% of salons had respiratory personal protective equipment (RPPE) such as masks or gloves available, only 21% of salons had workers observed using PPE during relevant tasks. Workstations were adequately spaced in 77% of salons, and regular cleaning was observed in 93%. Notably, only 4% of salons had proper disposal bins for chemical waste, indicating a gap in hazardous waste management practices.

Table 8: Environmental and workplace conditions among beauty salon workers (N=100)

Environmental Factor	Percentage (%)
Adequate natural ventilation	59%
Mechanical ventilation or air conditioning is present and operational	41%
The presence of strong odors (chemicals, solvents, perfumes)	9%
Visible dust or particulate matter in the air	17%
Use of chemical products (hair dye, bleach, nail polish/remover)	89%
Chemicals stored in closed, labeled containers	69%
The presence of Material Safety Data Sheets (MSDS) for chemicals	6%
Availability of RPE (masks, gloves, eye protection)	77%
Workers observed using PPE during tasks	21%
Workstations adequately spaced	77%
Proper disposal bins for chemical waste	4%
Regular cleaning of work areas observed	93%

% = proportion of workplaces with each environmental factor observed

7. Lung function reduction

Using ANCOVA, potential confounders like age, sex, height, and BMI were adjusted. The adjusted mean FEV_1 was 2.521 ± 0.059 L in beauty salon workers and 2.838 ± 0.060 L in the non-exposed. The adjusted mean FVC was also significantly lower among beauty salon workers (3.069 ± 0.067 L) when compared to non-exposed (3.357 ± 0.069 L). Similarly, the FEV_1/FVC ratio was also lower in the beauty salon workers ($82.45\% \pm 0.77$) than in controls ($85.46\% \pm 0.79$).

Table 9: Comparison of adjusted mean lung function parameters between beauty salon workers and **non-exposed group**

Lung Function Parameter	Group	Adjusted X ± SE	95% CI	p-value
FVC (L)	Beauty Salon Workers	3.069 ± 0.067	2.936 – 3.203	0.004**
	Non-exposed	3.357 ± 0.069	3.221 – 3.494	
FEV_1 (L)	Beauty Salon Workers	2.521 ± 0.059	2.404 – 2.637	<0.001**
	Non-exposed	2.838 ± 0.060	2.720 – 2.957	
FEV_1/FVC (%)	Beauty Salon Workers	82.451 ± 0.772	80.917 – 83.985	0.009**
	Non-exposed	85.457 ± 0.789	83.891 – 87.024	

Values are adjusted using ANCOVA, controlling for age, sex, height, and BMI. SE = Standard Error; CI = Confidence Interval; FVC = Forced Vital Capacity; FEV_1 = Forced Expiratory Volume in 1 second*= p-value <0.05; **= p-value <0.01

The multiple linear regression models examined the association between predictors and lung function parameters. For both FEV1 and FVC, occupational group, sex (male), and work experience showed significant associations. Non-exposed groups had significantly higher FEV_1 values compared to beauty salon workers (B = 0.287, 95% CI: 0.112 to 0.463, p = 0.002). Being male was also strongly associated with having a higher FEV_1 (B = 0.967, 95% CI: 0.765 to 1.169, $p < 0.001$). Years of work experience showed a significant negative association (B = -0.046, 95% CI: -0.085 to -0.006, p = 0.025). Age and BMI were not significantly associated with FEV_1.

FVC values were also significantly higher among the non-exposed than beauty salon workers (B = 0.264, 95% CI: 0.068 to 0.459, p = 0.009), and males had better lung function (B = 1.157, 95% CI: 0.932 to 1.383, p < 0.001). Years of work experience again showed a significant negative effect (B = -0.052, 95% CI: -0.097 to -0.008, p = 0.021), while age and BMI did not show significant associations.

Table 10: Multivariate linear regression analysis of factors associated with changes in lung function

Variable	B	SE	Beta	p-value	95% CI
Δ FEV1, R^2 adj = 0.609, n = 100					
Constant	1.101	0.359		0.003 **	0.389 – 1.814
Salon workers (1), Non-exposed	0.287	0.088	0.215	0.002 **	0.112 – 0.463
Age, years	0.006	0.013	0.048	0.616	-0.019 – 0.032
Experience, years	-0.046	0.020	-0.219	0.025*	-0.085 – 0.006
Sex Female (1), Male (2)	0.967	0.102	0.637	<0.001 **	0.765 – 1.169
BMI, kg/m ²	2.009E-05	0.072	0.000	1.000	-0.142 – 0.142
Δ FVC, R^2adj = 0.623, n = 100					
Constant	1.371	0.400		0.001*	0.577 – 2.166
Salon workers (1), Non-exposed	0.264	0.099	0.174	0.009*	0.068 – 0.459
Age, years	0.008	0.014	0.054	0.566	-0.020 – 0.037
Experience, years	-0.052	0.022	-0.222	0.021*	-0.097 – 0.008
Female(1), Male(2)	1.157	0.113	0.671	<0.001**	0.932 – 1.383
BMI, kg/m ²	0.020	0.080	0.016	0.806	-0.139 – 0.178

B Unstandardized regression coefficient; SE= Standard error; Beta= Standardized coefficient; CI= Confidence interval; R^2adj= Adjusted R-squared.

The number of people with lung function below the normal limit was similar in both groups. In the exposed group, 14% had low FEV_1 compared to 9% in the non-exposed group. For FVC, 11% of the exposed group and 8% of the control group were below the limit. The FEV_1/FVC ratio below 70% was the same in both groups at 3%. These differences were not statistically significant.

Table 11: Proportion of participants with lung function below the LLN among beauty salon workers and non-exposed groups

Lung Function Parameter	Exposed Group: (% < LLN)	Control Group: (% < LLN)	p-value
FEV1	14%	9%	0.235
FVC	11%	8%	0.444
FEV_1/FVC <70%	3%	3%	1.00

LLN = Lower Limit of Normal; P-values from chi-square tests

6. Discussion

This study found that chronic respiratory symptoms were significantly more common among beauty salon workers than the control group. The observed symptoms among the exposed group were cough, shortness of breath, chest tightness, wheezing, and phlegm. Lung function tests also showed significantly lower FEV_1, FVC, and FEV_1/FVC values in the beauty salon workers, indicating reduced pulmonary function associated with occupational exposure.

In multivariate analysis showed that beauty salon workers with higher BMI were more likely to show respiratory symptoms than those with normal BMI. Workers who used RPE had less odds of developing respiratory symptoms than those who didn't. In addition, workers with more than 5 years of experience showed higher odds of developing respiratory symptoms than those with lower years of experience.

Additionally, being a beauty salon worker, female sex and longer work experience were associated with lower FEV_1 and FVC values. These findings indicate the negative respiratory health impact of occupational exposure in beauty salons and tip off the need for preventive actions and interventions.

The prevalence of overall respiratory symptoms in this study was 39.3%. This result was higher than studies conducted in Gonder City, Ethiopia (33.3%), India (19%), and Kazakhstan (38%) (5,9,10). However, it was lower than studies conducted in Jimma City, Ethiopia (89.6%), South Africa (62%), and Iran (75%) (7,11,20). The differences in the results could be due to differences in study populations, data collection tools, exposure levels, workplace environmental conditions, and the use of respiratory protective equipment.

The highest reported symptoms in our study were cough, shortness of breath, and chest tightness. Other studies on beauty salon workers also reported these symptoms. Cough was the most prevalent one in this study (30%) with AOR=5.97; 95% CI: 2.51–14.20 and the least prevalent symptom was phlegm (12.7%). This result is consistent with other similar studies. A study conducted in Iran reported that hairdressers had a prevalence ratio of 2.18 (1.26–3.77) for cough compared to a reference group and another study in Sweden found that female hairdressers had higher incidence rates of respiratory symptoms, including cough, compared to the general population (20,33). The high prevalence of cough may be due to the effects of volatile

chemicals used in salons, which can affect the upper respiratory tract and result in cough. Phlegm might be the least reported symptom since it often happens after more prolonged or chronic lower respiratory tract inflammation which might not have happened in the workers.

On the lung function tests, FEV_1 was 2.521 ± 0.059 L in the exposed group and 2.838 ± 0.060 L in the non-exposed group; FVC 3.069 ± 0.067 L was and 3.357 ± 0.069 L, respectively; and the FEV_1/FVC ratio was 82.45 ± 0.77 % and 85.46 ± 0.79 %, respectively. The observed reduction in lung function is consistent with other studies conducted among beauty salon workers. Studies conducted in Slovakia, India, Iran, and Palestine reported the same reduction in lung function (8,10,20,24).

Being overweight was found to be associated with increased odds of developing respiratory symptoms (AOR = 4.202; 95% CI: 1.822– 9.845). This result is consistent with a study conducted in Ethiopia as well as other international studies (4,9). This could likely be due to reduced lung expansion, increased airway resistance, and systemic inflammation caused by excess body fat. Work experience above five years was also significantly associated with respiratory symptoms (AOR = 2.980; 95% CI: 1.400–6.340). It shows the impact of long-term exposure to chemicals used in beauty salons and poor indoor air quality. This finding aligns with previous research, which observed that hairdressers with 3–5 years of experience were nearly three times more likely to develop symptoms than those with less than two years of experience (26). Not using RPE was associated with increased odds of symptoms (AOR = 2.980; 95% CI: 1.400 – 6.340). Similar studies conducted are consistent with these findings (7,14,20). This could be because RPEs help reduce inhalation of harmful airborne chemicals commonly found in beauty salons.

Although an increase in BMI was associated with higher odds of respiratory symptoms, it was not significantly associated with lung function measurements. This might be due to our small sample size, which could limit the statistical power to detect the effect of BMI on lung function.

This study revealed that beauty salon workers had significantly reduced lung function compared to controls. Salon workers had lower FEV_1 (B = 0.287, 95% CI: 0.112–0.463) and FVC (B = 0.264, 95% CI: 0.068–0.459) compared to the controls. These findings are consistent with multiple studies. A study among Palestinian hairdressers showed significantly reduced FEV_1 and FVC values as a result of long exposure to chemicals in beauty salons (24). Similarly, research from India and Slovakia observed reduced PEF and other lung function parameters among salon

workers (8,10).

Work experience was also significantly associated with decreasing lung function, where each year of experience was associated with a reduction in FEV_1 (B = -0.046, p = 0.025) and FVC (B = -0.052, p = 0.021). This is consistent with other studies showing that longer work duration in salons is associated with increased inhalation of pollutants and then pulmonary decline (24). Prolonged exposure to hair sprays, dyes, and nail products likely contributes to this decline, especially in poorly ventilated environments. In addition, males had significantly higher FEV_1 (B = 0.967, $p < 0.001$) and FVC (B = 1.157, $p < 0.001$) than females. This may be due to biological differences in lung capacity between sexes.

The environmental assessment showed a potential reason for the high prevalence of respiratory symptoms and reduced pulmonary function. About 59% of salons had adequate natural ventilation and 41% had functioning mechanical ventilation/ air conditioning. Still, a very high number of beauty salons have no proper air conditioning systems. The use of chemical products such as hair dye, bleach, and nail products was high (89%). While most salons (77%) had RPE available, only a few workers were seen using PPE during tasks. These environmental conditions likely contributed to increased chemical exposure leading to reduced pulmonary function among beauty salon workers.

6.1 Strengths and Limitations of the Study

6.1.1 Strengths

This study conducted a comparative cross-sectional design through both subjective and objective data. This helps in providing an inclusive assessment of respiratory health among beauty salon workers. Including a non-exposed group with similar socio-demographic characteristics contributed to having a clearer understanding of the occupational impact on respiratory outcomes. In addition, this study contributes to new evidence in Ethiopia, where data on occupational respiratory health in beauty salons is limited. The use of standardized lung function tests and validated questionnaires improves the reliability and comparability of results with other international studies.

6.1.2 Limitations

This study also had limitations that should be considered. The cross-sectional design limits the establishment of a cause-effect relationship between occupational exposure and respiratory outcomes. The relatively small sample size due to resources and time may have reduced statistical power to detect small associations like BMI and lung function parameters. Personal exposure measurements to airborne pollutants were not conducted. That limits the ability to directly correlate exposure levels with health outcomes. Self-reported symptom data may be subject to recall bias. Different tasks in beauty salons are associated with different levels of chemical exposure. However, workers were not stratified based on this which might have introduced some limitations.

7. Conclusion and Recommendation

7.1 Conclusion

This study found that beauty salon workers are at an increased risk of developing chronic respiratory symptoms and having reduced pulmonary function. Reported respiratory symptoms were cough, shortness of breath, chest tightness, wheezing, and phlegm. Lung function test results also showed reduced FEV_1, FVC, and FEV_1/FVC ratio in the beauty salon workers. Factors such as being overweight, longer work experience, and lack of RPE use were associated with the development of at least one respiratory symptom among beauty salon workers. In addition, being a beauty salon worker, a female, and having longer work experience of more than 5 years are associated with reduced pulmonary function.

The environmental assessment supports these findings. Lack of adequate ventilation in many beauty salons, wide use of chemical products, and low PPE use were observed. These conditions are contributing factors for more hazards present in beauty salons and likely contribute to increased chemical exposure and respiratory issues.

In conclusion, these study findings show the occupational hazard that is posed to beauty salon workers. It's a reminder that control measures like proper ventilation, use of personal protective equipment, and regular health check-ups are needed. Addressing these will help in creating a better respiratory health outcome and quality of life for beauty salon workers.

7.2. Recommendations

- National occupational exposure limits (OELs) for chemicals that are used in beauty salons should be established followed by monitoring.
- Regulatory bodies should provide training and inspection guidelines for beauty salons, to address current gaps in oversight.
- Salon owners and managers should improve indoor ventilation, reduce overcrowding, and use safer products.
- Salons should provide appropriate respiratory protective equipment (RPE), ensure its availability at all times, and train workers on proper use.
- Health and safety training programs should be provided to beauty salon workers.
- Further research is needed to quantify chemical exposure levels in salons.

- Investigations on the long-term effects of exposure should be conducted through cohort or longitudinal studies.

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Annex

Annex 1: Participant information sheet

Information sheet English version

Title: "**Assessment of Respiratory Symptoms, Pulmonary Function and Associated Factors among Beauty Salon Workers in Addis Ababa, Ethiopia.**"

I would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask questions if anything you read is not clear or if you would like more information.

Purpose of the study:

I am a Masters student at Addis Ababa University. I am conducting this study for an MPH program to understand the respiratory health of beauty salon workers in Addis Ababa. The aim of the study is to assess the prevalence of respiratory symptoms, measure pulmonary function, and identify factors that may affect respiratory health among beauty salon workers. We will collect data using questionnaires, spirometer, and workplace assessment. The results will provide information about respiratory health risks in beauty salons and help future workplace health improvements.

What participation involves

Participation in this study will involve completing a structured questionnaire, which will include questions about your respiratory health, work history, workplace conditions, and any symptoms you may have experienced. We will also conduct a pulmonary function test using a spirometer for some participants to measure lung function through non-reusable mouth pieces and observe the work environment to assess factors like ventilation and use of protective equipment.

Why you were selected

You have been invited to take part in this study because you are a beauty salon worker in Addis Ababa, and your work may involve exposure to chemicals and conditions that could affect respiratory health. We are specifically focusing on beauty salon workers to better understand the unique health challenges faced in this occupation. Participants have been selected based on their experience working in salons, as this will provide valuable insights into the study's objectives.

Harm/Benefit

Taking part in this study carries minimal risk. The pulmonary function test is non-invasive and safe, but

you might feel brief discomfort while performing the breathing maneuvers. There is no psychological or physical harm anticipated from answering the questionnaire or participating in workplace observations. If you experience any discomfort during the study, we will stop immediately and provide appropriate support. While there may be no direct benefits to you, your participation will help provide important insights into the respiratory health of beauty salon workers, which could inform future workplace health improvements.

Confidentiality

All information obtained from you will be kept confidentially in a computer using the identification number. The information will only be used for the purpose of this research.

Result Dissemination

The results of this study will be used to fulfill the requirements of my Master of Public Health (MPH) program at Addis Ababa University and will be submitted as part of my dissertation. The findings may also be shared in academic settings, such as conferences or seminars, and could be considered for publication in relevant public health journals to contribute to broader knowledge on occupational health. Additionally, the results may be used to inform future workplace health practices and policies, benefiting beauty salon workers.

Person to Contact

If you need any clarification on the study you can contact the following people:

Principal Investigator: Elsabet Girma

Phone: 0924306647

E-mail:elsabethgirma9@gmail.com

Primary advisor: Prof. Abera Kumie: 0911882912; aberakume2@yahoo.com

አባሪ 1፡ የተሳታፊ መረጃ ወረቀት

የመረጃ ሉህ የእንግሊዝኛ ቅጂ

ርዕስ፡ "የመተንፈሻ ምልክቶች፣ የሳንባ ተግባር እና ተያያዥ ምክንያቶች በአዲስ አበባ፣ ኢትዮጵያ ውስጥ የውበት ሳሎን ሠራተኞች ግምገማ።"

በምርምር ጥናት ላይ እንድትሳተፉ ልጋብዛችሁ እወዳለሁ። ከመወሰንዎ በፊት ጥናቱ ለምን እንደሚደረግ እና ለእርስዎ ምን እንደሚያካትት መረዳት ያስፈልግዎታል። እባክዎ የሚከተለውን መረጃ በጥንቃቄ ለማንበብ ጊዜ ይውሰዱ። ያነበቡት ነገር ግልጽ ካልሆነ ወይም ተጨማሪ መረጃ ከፈለጉ ጥያቄዎችን ይጠይቁ።

የጥናቱ ዓላማ፡-

በአዲስ አበባ ዩንቨርስቲ የማስተርስ ተማሪ ነኝ ይህንን ጥናት በአዲስ አበባ የሚገኙ የውበት ሳሎን ሰራተኞችን የመተንፈሻ ጤና የበለጠ ለመረዳት የ ኤም.ፒ.ኤች ፕሮግራም አካል ነኝ። የጥናቱ ዓላማ የመተንፈሻ አካላትን ምልክቶች መስፋፋት መገምገም፣ የሳንባ ተግባራትን መለካት እና በዚህ ሥራ ውስጥ የመተንፈሻ አካልን ጤንነት ሊጎዱ የሚችሉ ነገሮችን መለየት ነው። መረጃን በመጠይቅ፣ በስፒሮሜትር ፈተናዎች እና በስራ ቦታ ምልከታዎች እንሰበስባለን። ውጤቶቹ በውበት ሳሎኖች ውስጥ ስላለው የመተንፈሻ አካላት ጤና ስጋቶች ግንዛቤን ይሰጣሉ እና የወደፊት የስራ ቦታ የጤና ማሻሻያዎችን ለማሳወቅ ይረዳሉ።

ተሳትፎ ምንን ያካትታል

በዚህ ጥናት ውስጥ መሳተፍ የተዋቀረ መጠይቅን መሙላትን ያካትታል ይህም ስለ እርስዎ የመተንፈሻ አካላት ጤና፣ የስራ ታሪክ፣ የስራ ቦታ ሁኔታ እና ያጋጠሙዎት ምልክቶችን ይጨምራል። እንዲሁም ለአንዳንድ ተሳታፊዎች የሳንባ ተግባርን እንደገና ጥቅም ላይ በማይውሉ የአፍ ክፍሎች ለመለካት እና እንደ አየር ማናፈሻ እና የመከላከያ መሳሪያዎችን አጠቃቀም ያሉ ሁኔታዎችን ለመገምገም የሳንባ ተግባርን ለመለካት በስፒሮሜትር በመጠቀም የሳንባ ተግባር ደረጃ መለኪያ እንሰራለን።

ለምን ተመረጡ

በአዲስ አበባ የውበት ሳሎን ሰራተኛ ስለሆንክ በዚህ ጥናት እንድትሳተፍ ተጋብዘሃል፣ ስራህ ለኬሚካሎች እና የመተንፈሻ አካልን ጤንነት ሊጎዱ የሚችሉ ሁኔታዎችን ሊያካትት ይችላል። በዚህ ሙያ ውስጥ የሚያጋጥሙትን ልዩ የጤና ችግሮች የበለጠ ለመረዳት በተለይ በውበት ሳሎን ሰራተኞች ላይ እያተኮርን ነው። ተሳታፊዎች በሳሎኖች ውስጥ በመስራት ባላቸው ልምድ ተመርጠዋል ፣ይህም በጥናቱ ዓላማ ላይ ጠቃሚ ግንዛቤዎችን ይሰጣል ።

ጉዳት/ጥቅም

በዚህ ጥናት ውስጥ መሳተፍ አነስተኛ አደጋን ያመጣል. የሳንባ ተግባር ደረጃ መለኪያ ጎጂ ያልሆነ እና ደህንነቱ የተጠበቀ ነው፣ ነገር ግን የአተነፋፈስ እንቅስቃሴዎችን በሚያደርጉበት ጊዜ አጭር ምቾት ሊሰማዎት ይችላል። መጠይቁን ከመመለስ ወይም በስራ ቦታ ምልከታዎች ላይ ከመሳተፍ የሚጠበቅ የስነ-ልቦና ወይም የአካል ጉዳት የለም። በጥናቱ ወቅት ምንም አይነት ምቾት ካጋጠመዎት ወዲያውኑ ቆም ብለን ተገቢውን ድጋፍ እንሰጣለን። ምንም እንኳን ለእርስዎ ምንም አይነት ቀጥተኛ ጥቅም ላይኖር ይችላል, የእርስዎ ተሳትፎ ስለ የውበት ሳሎን ሰራተኞች የመተንፈሻ ጤና ላይ ጠቃሚ ግንዛቤዎችን ለማቅረብ ይረዳል, ይህም ለወደፊቱ የስራ ቦታ የጤና ማሻሻያዎችን ሊያሳውቅ ይችላል.

ሚስጥራዊነት

ከእርስዎ የተገኘ መረጃ ሁሉ መለያ ቁጥሩን በመጠቀም በኮምፒተር ውስጥ በሚስጥር ይቀመጣል። መረጃው ለዚህ ምርምር ዓላማ ብቻ ጥቅም ላይ ይውላል.

የውጤት ስርጭት

የዚህ ጥናት ውጤት በአዲስ አበባ ዩኒቨርሲቲ የማስተር ኦፍ ፐብሊክ ሄልዝ መርሃ ግብሬን ለማሟላት ይጠቅማል እና የመመረቂያ ፅሑፌ አካል ሆኖ ይቀርባል።ግኝቶቹ እንደ ኮንፈረንስ ወይም ሴሚናሮች ባሉ የአካዳሚክ መቼቶች ውስጥ ሊካፈሉ ይችላሉ እና በሚመለከታቸው የህዝብ ጤና ጆርናሎች ላይ ለሙያ ጤና ሰፋ ያለ እውቀት ለማበርከት ሊታተሙ ይችላሉ። በተጨማሪም ውጤቶቹ ለወደፊቱ የስራ ቦታ የጤና አሠራሮችን እና ፖሊሲዎችን ለማሳወቅ ጥቅም ላይ ሊውሉ ይችላሉ፣ ይህም የውበት ሳሎን ሰራተኞችን ይጠቅማል።

የሚገናኘው ሰው

በጥናቱ ላይ ማንኛውንም ማብራሪያ ከፈለጉ የሚከተሉትን ሰዎች ማነጋገር ይችላሉ፡-

ዋና መርማሪ፡ ኤልሳቤት ግርማ

ስልክ፡ 0924306647

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ዋና አማካሪ፡ ፕሮፌሰር አበራ ቁሜ፡ 0911882912; aberakume2@yahoo.com

Annex 2: Consent Form
Consent Form

Title: "**Assessment of Respiratory Symptoms, Pulmonary Function and Associated Factors among Beauty Salon Workers in Addis Ababa, Ethiopia.**"

Hello, My name is Elsabet Girma. I am a Masters student at Addis Ababa University, College of Health Sciences, department of Environmental and Occupational Health. I am doing my research on the topic "Assessment of Respiratory Symptoms, Pulmonary Function and Associated Factors among Beauty Salon Workers in Addis Ababa, Ethiopia" and I would like you to participate in the study. Your participation is highly appreciated and useful. Full confidentiality of your privacy will be maintained and the information you give will not be shared. The Questionnaire interview might take about 15 minutes and you will encounter no harm during the participation in the study and It's all voluntary.

Do you agree to participate in the study: Yes ☐ No ☐

If you agree with Participating in the study, please fill the form below:-

I understood the information regarding the study and I agree to participate in the study. Therefore, I will confirm my agreement by signing this form.

Signature of a participant_____

Date:_____.

Interviewer name: .

Signature: .

አባሪ 2፡ የስምምነት ቅጽ

የስምምነት ቅጽ

ርዕስ፡ "የመተንፈሻ ምልክቶች፣ የሳንባ ተግባር እና ተያያዥ ምክንያቶች በአዲስ አበባ፣ ኢትዮጵያ ውስጥ የውበት ሳሎን ሠራተኞች ግምገማ።"

ሰላም ኤልሳቤት ግርማ እባላለሁ። በአዲስ አበባ ዩኒቨርሲቲ፣ ጤና ሳይንስ ኮሌጅ፣ የአካባቢና የሥራ ላይ ጤና ትምህርት ክፍል የማስተርስ ተማሪ ነኝ። “በአዲስ አበባ ኢትዮጵያ የውበት ሳሎን ሠራተኞች የመተንፈሻ አካላት፣ የሳንባ ተግባር እና ተያያዥ ምክንያቶች ግምገማ” በሚል ርዕስ ጥናቴን እያደረግሁ ነው እና በጥናቱ እንድትሳተፉ እጋብዛችኋለሁ። የእርስዎ ተሳትፎ በጣም የተከበረ እና ጠቃሚ ነው። የግላዊነትዎ ሙሉ ሚስጥራዊነት ይጠበቃል እና የሰጡት መረጃ አይጋራም። የመጠይቁ ቃለ መጠይቁ 15 ደቂቃ ያህል ሊወስድ ይችላል እና በጥናቱ ውስጥ ምንም አይነት ጉዳት አያጋጥምዎትም እና ሁሉም በፈቃደኝነት ላይ የተመሰረተ ነው.

በጥናቱ ለመሳተፍ ተስማምተሃል?

አዎ _____ አይሆንም _____.

በጥናቱ ውስጥ ለመሳተፍ ከተስማሙ እባክዎን ከዚህ በታች ያለውን ቅጽ ይሙሉ፡-

በጥናቱ ላይ ያለውን መረጃ ተረድቻለሁ እና በጥናቱ ለመሳተፍ ተስማምቻለሁ። ስለዚህ ይህን ቅጽ በመፈረም ስምምነቴን አረጋግጣለሁ።

የአንድ ተሳታፊ ፊርማ

የጠያቂው ስም፡.

ፊርማ፡.

Annex 3: Interview Guide

This an interview guide while assessing issues regarding respiratory health of beauty salon workers. This guide ensures consistency across interviews while allowing flexibility to explore participants' experiences.

1. **Preparation**

- ✓ Ensure you have all materials ready
- ✓ Familiarize yourself with the questions to maintain a smooth flow.

2. **Introduction and Greeting**

- ✓ Greet Warmly
- ✓ Introduce yourself
- ✓ Explain the purpose of the interview
- ✓ Inform the interviewee that their responses will remain confidential

3. **Consent:** Ask for permission to record the interview.
4. **Clarify:** Explain how to respond to questions
5. **Interview Administration:** Conduct interview
6. **Conclusion:** Thank the participant
7. **Post interview:** Verify that all questions are answered

Annex 4 : Questionnaire

Part I: Demographic data			
No	**Variable**	**Response**	**Skip**
1.	Date of birth (day/month/year) in EC		
2.	Age in years		
3.	Sex	Male Female	
4.	Education level	Read and write 1-4 5-8 9-10 11-12 College and above	
5.	Marital status	Single Married Divorced Widowed Other specify	
Part II: personal factors			
6.	Do animals live in your home?	Yes No	
7.	Do you do any physical activity?	Yes No	Q13
8.	If yes, how often do you exercise?		
9.	Do you usually cook food at home?	Yes No	Q12
10.	If Yes, what type of energy do you use for cooking?	Charcoal Fire wood/biomass Kerosene Electricity	
Part III: Occupational factors			
11.	For how long have you been working in Beauty salons (years)		
12.	How many hours do work per day?		
13.	How many hours do you work per week?		
Part IV: Respiratory symptoms			

Cough			
13.	Do you experience frequent cough?	Yes No	Q28
14.	Do you usually cough first thing in the morning?	Yes No	
15.	Do you usually cough during the day or at night?	Yes No	
16.	Do you usually cough as much as 4-6 times a day for 4 or more days in a week?	Yes No	Q18
17.	For how long have you had this cough? (years)		
18.	Do you cough most on any particular day of the week	Yes No	Q20
19.	If Yes, which day(s)		
20.	Do you have any seasonality to your cough?	Yes No	Q22
21.	If you say Yes, when do you usually cough?	Winter (October-January) Spring (February-May) Summer (June-September)	
22.	Do you usually cough with sputum first thing in the morning?	Yes No	
23.	Do you usually cough with sputum during the day or at night?	Yes No	
24.	Do you usually cough with sputum as much as twice a day, or 4 or more days in a week?	Yes No	
25.	Do you cough with sputum on most of days for as much as 3 consecutive months or more in a year?	Yes No	
26.	Do you have any seasonality to your sputum?	Yes No	Q28
27.	If you say Yes, when do you usually cough with sputum?	Winter Spring Summer	

Tightness in chest			
28.	Does your chest ever feel tight or your breathing becomes difficult?	Yes No	Q33
29.	Is your chest tight or your breathing difficult on any particular days?	Yes No	Q31
30.	If Yes, Specify	Most of the first days back at work only Other days also Only other days	
31.	Is there any seasonality for your chest tightness?	Yes No	Q33
32.	If you say Yes, when do you usually feel the chest tightness?	Winter Spring Summer	
Breathlessness			
33.	Are you troubled by shortness of breath when hurrying on level ground or walking up slight hill?	Yes No	Q41
34.	If Yes, do you have to walk slower than people of your age on level ground because of breathlessness?	Yes No	
35.	Do you ever have to stop for breath walking at your own pace on level ground?	Yes No	
36.	Is your breathlessness worse on any particular day?	Yes No	Q39
37.	If Yes, specify the day(s)		
38.	For how long did you experience breathlessness?		
39.	Do you have any seasonality for your breathlessness?	Yes No	Q41

40.	If you say Yes, when do you usually feel the breathlessness?	Winter (October-January) Spring (February-May) Summer (June-September)	
Wheezing			
41.	Does your chest ever sound wheezy or whistling	When you have a cold Occasionally Most days or nights No	Q46
42.	If your answer for the above question is 1, 2 or 3, for how many years this been present? In years		
43.	Have you ever had an attack of wheezing in the last 12 months?	Yes No	
44.	Do you have any seasonality for your wheezing?	Yes No	Q46
45.	If you say Yes, when do you usually wheez?	Winter (October-January) Spring (February-May) Summer (June-September)	
Chronic bronchitis			
46.	During the past 3 years have you had a period of increased cough with increased sputum production for as long as three weeks or more?	Yes No	
Respiratory symptoms while at work			
47.	Do you have any of the following noticeable feeling differently at work.	Cough Phlegm Tightness Wheezing Breathlessness Sneezing No	
Past illness			
48.	Did you have any lung trouble before the age of 16?	Yes No	Q50

49.	If your answer is Yes, what was illness	An injury/operation affecting your chest Heart trouble Bronchitis Pneumonia Pleurisy Asthma Pulmonary tuberculosis High blood pressure Emphysema Other	
Part IV: Tobacco Smoking			
50.	Have you ever smoked cigarettes?	Yes No	Q54
51.	If Yes, do you smoke cigarettes now?	Yes No	
52.	How many cigarettes do you smoke per day?		
53.	For how many years did you smoke?		
54.	Is there a smoker living in your house?	Yes No	
Part V: Family History			
55.	Did either of your parents have any chronic lung conditions	Yes No	Q57
56.	If Yes, what was the condition?	Chronic bronchitis Asthma Lung cancer Other	
Part VI: Respiratory protective devices			
57.	Do you usually wear respiratory protective devices while at work?	Yes No	
58.	If yes, which of the respiratory protective device do you use?	Half mask Full face mask	

		Other specify	
59.	If No, Select the reasons for not using respiratory protective device?	Not available Not comfortable to wear Do not offer protection The dust is not harmful Other	
Part VII: Physical Measurement			
60.	Weight (Kg)		
61.	Standing height (cm)		

መጠይቅ

ክፍል አንድ ስነ-ሕዝብ በተመለከተ

ተ.ቁ	ጥያቄ	መልስ	ማሳለፊያ
1.	የትውልድ ቀን (ቀን / ወር / ዓ.ም)	/_____/_____/_____/	
2.	ዕድሜ በዓመት		
3.	ፆታ	ወንድ ሴት	
4.	የትምህርት ደረጃ	አልተማረም 1-4 5-8 9-10 11-12 ኮሌጅና ከዚያ በላይ	
5.	የጋብቻ ሁኔታ	ያላገባ/ች የገባ/ች የፈታ/ች የሞተበት/ባት ሌላ ካለ ይጠቀስ	
ክፍል ሁለት የስራ ሁኔታ			
7.	ለምን ያህል ጊዜ በፀጉር ቤቶች ሰርተዋል? (በአመት)		
8.	በአማካይ ለምን ያህል ሰዓት በቀን ይሰራሉ? (በሰዓት)		
9.	በአማካይ ለምን ያህል ሰዓት በሳምንት? (በሰዓት)		
10.	እራስዎ ምግብ ያበስላሉ ወይ	አዎ አይ	ጥ**12**
11.	ለጥያቄ ቁጥር 10 መልስዎ አዎ ከሆነ በአብዛኛው ምግብ ለማብሰል ምን ዓይነት ሀይል ይጠቀማሉ	ከሰል እንጨት ጋዝ ኤሌክትሪክ	
12.	የመኖሪያ ቤትዎ ውስጥ እንስሳት አብረው ያድራሉ ወይ	አዎ የለም	
ክፍል ሶስት የመተንፈሻ ችግር ምልክቶች			
ሳል			
13.	ብዙ ጊዜ ሳል አለዎት	አዎ አይ	ጥ**27**
14.	በቀን ወይንም በማታ ሳል አለዎት ወይ	አዎ አይ	
15.	ከ4-6 ጊዜ በአንድ ቀን ለአራት ቀን ወይንም ከዛ በላይ በሳምንት ውስጥ ሳል አለዎት ወይ	አዎ አይ	

16.	በተከታታይ ለሶስት ወራት ወይንም ከዛ በላይ አብዛኛውን ቀን ሳል ነበረዎት ወይ	አዎ አይ	
17.	ለምን ያህል ጊዜ ነው ሳሉ የቆየዉ (በአመት)		
18.	ከሳምንቱ ቀናት ውስጥ በተለይ ሳል የሚበዛብዎ ቀን ወይም ቀናት አሉ	አዎ አይ	
19.	መልስዎ አዎ ከሆነ በየትኛው ቀን/ናት		
20.	ሳልዎ በተለይ የሚበረታበት ወቅት/ወራት አለ ወይ	አዎ አይ	ጥ22
21.	መልስዎ አዎ ከሆነ በየትኛው ወቅት/ወራት (ከአንድ በላይ መልስ ይቻላል)	በበጋ (ጥቅምት - ጥር) በበልግ (የካቲት - ግንቦት) በክረምት (ሰኔ - መስከረም)	
22.	ብዙ ጊዜ ጡዋት ላይ ሳል ከሃክታ ጋር ነበረዎት ወይ	አዎ አይ	
23.	ብዙ ጊዜ በቀንና በማታ ሲያስሎት ሳሉ ሀክታ አለው ወይ	አዎ አይ	
24.	በቀን ውስጥ ከ4 - 6 ጊዜ ወይንም ለ4 ቀንና ከዛ በላይ በአንድ ሳምንት ሳል ከሃክታ ጋር ነበረዎት ወይ	አዎ አይ	
25.	በአመት ለ3 ሳምንትና ከዚያ በላይ በተከታታይ የሚቆይ ሀክታ የተቀላቀለበት ሳል አጋጥሞዎት ያውቃል	አዎ አይ	ጥ27
26.	መልስዎ አዎ ከሆነ ይህ አይነት ክስተት ለምን ያህል አመታት ገጥሞዎት ያውቃል (በአመት)		
ደረት ላይ ክብድ/እፍን/ደረት የመወጠር ስሜት			
27.	ደረትዎ ላይ ክብድ/እፍን/ውጥር የሚያደርግና መተንፈስ የማስቸገር ስሜት ገጥሞዎት ያውቃል	አዎ አይ	**ጥ32**
28.	ደረትዎ ላይ ክብድ/እፍን/ውጥር የሚያደርግና መተንፈስ የማስቸገር ስሜት በሰምንቱ የተለዩ ቀን/ናት ያጋጥምዎታል	አዎ አይ	**ጥ30**
29.	መልስዎ አዎ ከሆነ መቼ መቼ ነበር	አብዛኛውን ጊዜ ከእረፍት መልስ የመጀመሪያውን የስራ ቀን በሌሎች ቀናትም ጭምር በሌሎች ቀናት ብቻ	
30.	ደረትዎ ላይ ክብድ/እፍን/ውጥር የሚያደርግ ስሜት በተለይ የሚበረታብዎ ወቅት/ወራት አለ ወይ	አዎ አይ	ጥ32
31.	መልስዎ አዎ ከሆነ በየትኛው ወቅት/ወራት (ከአንድ በላይ መልስ ይቻላል)	በበጋ (ጥቅምት - ጥር) በበልግ (የካቲት - ግንቦት) በክረምት (ሰኔ - መስከረም)	
ትንፋሽ ማጠር/ቃታዬን የመሳብ			
32.	ስትቸኩሎ ወይንም ትንሽ ዳገት ስትወጡ ትንፋሽ የማጠር ችግር አለበዎት ወይ (ከአካል ጉዳት ውጪ በሆነ ምክንያት)	አዎ አይ	**ጥ40**
33.	መልስዎ አዎ ከሆነ ከእድሜ እኩያዎ ጋር ሲነጻጸር ለጥ ባለ መንገድ ላይ ሲሄዱ የትንፋሽ ማጠር ይገጥሞታል ወይ?	አዎ አይ	**ጥ40**

34.	ለጥያቄ ቁጥር 33 መልስዎ አዎ ከሆነ ለጥ ባለ መንገድ ላይ ሲጓዙ አየር ለመውሰድ ይቆማሉ ወይ	አዎ አይ	
35.	የትንፋሽ ማጠሩ ከሳምንቱ ቀናት በተለየ የሚብስብዎ ቀን/ቀናት አሉ ወይ	አዎ አይ	**ጥ40**
36.	መልስዎ አዎ ከሆነ በየትኛው ቀን/ቀናት ነው		
37.	ለምን ያህል ጊዜ ነው የትንፋሽ ማጠር የቆየብዎ (በዓመት)		
38.	የትንፋሽ ማጠር ስሜት በተለይ የሚበረታብዎ ወቅት/ወራት አለ ወይ	አዎ አይ	**ጥ40**
39.	መልስዎ አዎ ከሆነ በየትኛው ወቅት/ወራት **(**ከአንድ በላይ መልስ ይቻላል**)**	በበጋ (ጥቅምት-ጥር) በበልግ (የካቲት-ግንቦት) በክረምት (ሰኔ-መስከረም)	
ኩር ኩር**/**ሲር ሲር የሚል ድምፅ			
40.	ሲተነፍሱ ደረትዎ ላይ ኩርኩር ወይንም ሲር ሲር የሚል ድምፅ ይሰማዎታል	በጉንፋን በሽታ ስያዝ አብዛኛውን ጊዜ ከጉንፋን በሽታ ውጪ አብዛኛውን ጊዜ በቀንና በማታ የለም	**ጥ47**
41.	ለጥያቄ ቁጥር 40 መልስዎ 1፤2፤3 ከሆነ ለምን ያህል ጊዜ ኩርኩር ወይንም ሲር ሲር የሚል ድምጽ ተሰምቶዎታል (በአመት)		
42.	ባለፈው አንድ አመት ውስጥ ኩርኩር ወይንም ሲጥ ሲጥ የሚል ድምፅ ተከስቶበዎት ያውቃል	አዎ አይ	
43.	ኩርኩር ወይንም ሲጥ ሲጥ የሚል ድምፅ ስሜት በተለይ የሚበረታብዎ ወቅት/ወራት አለ ወይ	አዎ አይ	**ጥ47**
44.	መልስዎ አዎ ከሆነ በየትኛው ወቅት/ወራት **(**ከአንድ በላይ መልስ ይቻላል**)**	በበጋ (ጥቅምት-ጥር) በበልግ (የካቲት-ግንቦት) በክረምት (ሰኔ-መስከረም)	
<u>ክፍል አራት - የቀድሞ በሽታ</u>			
47.	ከ16 አመት እድሜዎ በፊት የሳንባ ህመም ችግር ነበረብዎት	አዎ አይ	ጥ49
48.	መልስዎ አዎ ከሆነ የትኛው አይነት የጤና ችግር ከዚህ በፊት ገጥሞዎት ነበረ (ከአንድ በላይ መልስ ይቻላል)	በደረት ላይ የደረሰ ጉዳት ወይንም ቀዶ ጥገና የልብ ችግር የአየር ቧንቧ መቆጣት የሳንባ ምች የሳንባ ማቀፊያ መቆጣት/የሳንባ ዉሀ መቐጠር አስም የሳንባ ነቀርሳ/ቲቢ የደም ግፊት ኢምፊዜሚያ ሌላ አይነት የጠቀስ	

ክፍል አምስት ሲጋራ ማጨስ			
49.	ሲጋራ አጭሰው ያዉቃሉ (የለም ማለት በቀን ከአንድ ሲጋራ በታች ለአመት ማጨስ ወይም እስካሁን ድረስ ከ20 ፓኮ በታች ማጨስ)	አዎ አይ	ጥ54
50.	መልስዎ አዎ ከሆነ አሁን ሲጋራ ያጨሳሉ (ባለፈው አንድ ወር ውስጥ)	አዎ አይ	
51.	ምን ያህል ሲጋራ በቀን በአማካይ ያጨሳሉ		
52.	ምን ያህል አመታት ሲጋራ አጨሱ (በአመት)		
53.	በቤትዎ ውስጥ ሲጋራ የሚያጨስ ሰው አለ ወይ	አዎ አይ	
የቤተሰብ የጤና ሁኔታ			
54.	ወላጅ እናትዎ ወይም አባትዎ በሀኪም የተረጋገጠ የቆየ የሳንባ/የደረት ላይ ህመም ነበረባቸው	አዎ አይ	ጥ**56**
55.	መልስዎ አዎን ከሆነ በየትኛው በሽታ ታመው ነበር **(**ከአንድ በላይ መልስ ይቻላል**)**	የቆየ አየር ቧንቧ መቆጣት አስም የሳንባ ካንሰር ሌላ ይጠቀስ	
ክፍል ስድስት መከላኪያ መሳርያ በተመለከተ			
56.	በአብዛኛው በስራ ወቅት የመተንፈሻ መከላኪያ መሳርያ ይጠቀማሉ?	አዎ አይ	ጥ59
57.	መልስዎ አዎ ከሆነ የትኛዉን መከላከያ መሳርያ ነዉ የሚጠቀሙት	የአፍና አፍንጫ መከላኪያ ማስክ የሙሉ ፊት መከለያ መተንፈሻ ሌላ ከሆነ ይጠቀስ	
58.	ለጥያቄ ቁጥር 57 መልስዎ የለም ከሆነ ዋነኛው ምክንያቱ ምንድን ነው	ስለሌለ ስለማይመቹ ብናኝ ስለማይከላከል ብናኝ አደጋ ስለማያመጣ ሌላ ምክንያት ካለ ጥቀሱ	
ክፍል ስባት፡ቁመት ና ክብደት			
59.	ክብደት (ኪግ)		
60.	ቁመት (ሰ.ሚ)		

Annex 5: Spirometer test procedure

A. Preparation

3. Setting equipment

- ✓ Ensure the spirometer is properly calibrated according to the manufacturer's guidelines before the testing session.
- ✓ Attach a clean, disposable mouthpiece to the spirometer.

4. Participant preparation

- ✓ Explain the test purpose and procedure clearly to the participant.
- ✓ Confirm that the participant:
  - o Avoids smoking for at least 1 hour before the test.
  - o Does not consume heavy meals 2 hours before the test
  - o Avoids vigorous physical activity 30 minutes before the test.
- ✓ Record the participant's demographic information (age, sex, height, weight).

8. **Posture and Positioning**

- ✓ Have the participant sit upright with their feet flat on the floor, or stand if they prefer.
- ✓ Instruct them to keep their head slightly elevated during the test.
- ✓ Use a nose clip to ensure breathing occurs only through the mouth.

B. Testing procedure

- ✓ Ask the participant to breathe normally a few times to relax.
- ✓ Instruct them to inhale as deeply as possible to completely fill their lungs
- ✓ Ask them to seal their lips tightly around the mouthpiece.
- ✓ Instruct them to blow out as hard and fast as they can into the spirometer, expelling all the air in their lungs.
- ✓ Emphasize that the exhalation should be sustained for at least **6 seconds** or until no more air can be expelled.
- ✓ Perform at least **three acceptable trials**:

C. Post-test procedure

- ✓ Discard the used mouthpiece.
- ✓ Sanitize the spirometer components as per manufacturer guidelines.

Annex 6: Checklist

Environmental Observation Checklist for Beauty Salons

1. General Salon Information

Salon Name: _____
Location: _____
Date of observation: _____
Number of workers present: _____
Types of Services provided:

- ☐ Hair styling
- ☐ Hair dyeing
- ☐ Manicures/Pedicures
- ☐ Makeup

Others: _____

2. Indoor Air Quality

Ventilation

- ☐ Adequate natural ventilation
- ☐ Mechanical ventilation systems
- ☐ Air conditioning or air purifiers present and operational
- ☐ Presence of strong odors (e.g., chemicals, solvents, perfumes)
- ☐ Visible dust or particulate matter in the air

3. Chemical Exposure

Chemicals/products used:

- ☐ Hair dye or bleach
- ☐ Nail polish/remover

Other chemical products: _____

- ☐ Proper labeling of chemical containers
- ☐ Chemicals stored in closed, labeled containers.
- ☐ Presence of Material Safety Data Sheets (MSDS) for chemicals

Frequency of chemical application observed: _____

4. Personal Protective Equipment

Availability of PPE for workers:

- ☐ Masks
- ☐ Gloves
- ☐ Eye protection
- ☐ Usage of PPE by workers during tasks involving exposure
  - ☐ Training provided for proper use of PPE

5. Workstation Arrangement

- ☐ Workstations spaced adequately to reduce overcrowding
- ☐ Chemical handling areas separate from other activities
- ☐ Proper disposal bins for chemical waste
- ☐ Regular cleaning of work areas observed

6. Health and Safety Practices

- ☐ Workers aware of the hazards of chemicals used
- ☐ Presence of first aid kits

- [ ] Emergency exits clearly marked and accessible.
- [ ] Fire safety measures in place (e.g., extinguishers, alarms).
- [ ] Regular breaks taken by workers to minimize prolonged exposure

7. Observed Issues and Concerns

- [ ] Overexposure to dust
- [ ] Lack of ventilation or airflow
- [ ] Workers not using PPE consistently
- [ ] Overcrowded workstations
- [ ] Improper storage or handling of chemicals
- [ ] Any other observations: _____

Annex 7: Declaration

I, the undersigned declare that this my original work, has not been presented for a degree in this or other university and that all sources of materials used for this thesis have been fully acknowledged.

Name: Elsabet Girma

Signature _____

Place: Addis Ababa University

Date of submission: _____

This thesis has been submitted for examination with my approval as university advisor,

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Signature: _____