

Comparative Prevalence of Abnormal Spirometry Results in Female Adults Residing in a Community Without Electric Supply: Impact of Biomass Fuel Exposure - Study Protocol



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ABSTRACT

Background: About one-third of the world's population relies on traditional solid biomass for cooking, heating and lighting. The use of biomass fuels is a practice in the Philippines, especially the use of dry firewood. One community familiar with this practice is Our Lady of Banneux ANCOP Community (OLBAC). Despite this, specific data on these effects in Filipino communities remains limited.

Objective: To determine if there is a difference in the prevalence of abnormal spirometry in female

adult residents of OLBAC who have significant and nonsignificant exposure to biomass fuel smoke.

Methods: A convenience sample of 54 adult female residents of OLBAC in San Mateo, Rizal, will be recruited in this analytical cross-sectional study. After enrollment, they will undergo a single spirometry procedure to determine their lung function status. The primary data to be collected from the experimental groups are FEV₁, FVC and FEV₁/FVC ratio. The data will undergo descriptive and inferential analysis, and the lung function variable will be analyzed with logistic regression to account for confounding variables.

Expected Results: The descriptive data analysis will determine the mean values of lung function parameters (FEV₁ and FVC) where long exposures may lead to an abnormal FVC compared to short or no exposure. The results in the inferential analysis may indicate a negative association between length of biomass fuel exposure and percentage predicted FVC among the sample, suggesting that more prolonged exposure to biomass fuel increases the risk of impaired lung function.

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Academic editor: Leilani B. Mercado-Asis

Submitted date: August 31, 2025

Accepted date: December 15, 2025

Key Words: Biomass fuel, biomass fuel exposure, spirometry, obstructive lung diseases, lung function

INTRODUCTION

Approximately one-third of the global population relies on the use of traditional solid biomass such as wood, agricultural residues and animal waste for cooking, heating and lighting, with Asia being the largest contributor to wood fuel production.[1] Due to customary involvement in cooking, women are disproportionately exposed to biomass compared to men, spending an average of 4-6 hours daily in cooking, consequently inhaling liters of polluted indoor air.[2] Among biofuels, wood smoke is considered the most harmful compared to clean fuel and coal, with prolonged exposure linked to acute infections and respiratory infections with increased risk of mortality from respiratory causes.[3]

A major health outcome of biomass fuel exposure is the development of obstructive lung diseases like chronic obstructive pulmonary diseases (COPD). Globally, WHO reports COPD as the third leading cause of death[4] and ranks seventh in mortality in the Philippines as recognized by the Department of Health.[5] Long-term biomass exposure has been strongly linked to obstructive lung diseases among construction workers. Spirometry, the standard pulmonary function test, is a vital indicator in differentiating between obstructive and restrictive lung diseases. It evaluates parameters like forced expiratory volume in one second (FEV1) and forced vital capacity (FVC). In obstructive lung diseases like COPD, the FEV1/FVC ratio is typically reduced due to airway obstruction.[6]

Despite established risks, further research is warranted to elucidate the extent of biomass fuel exposure among women. The study aims to recruit a representative sample of adult females, assess lung function through spirometry and compare results with a control group with minimal or no biomass exposure. The researchers aim to identify possible associations between biomass fuel exposure and prevalence of obstructive lung diseases. Potential modifying factors such as age, smoking status and lifestyle factors will also be evaluated to better understand the susceptibility to biomass-related respiratory effects.

METHODS

Ethical Considerations

The study will ensure that all participants are fully informed while ensuring their privacy and personal information. They are to be protected under the law with the study conducted in full compliance with the Republic Act No. 10173 or the Data Privacy Act of 2012. Their autonomy and decision-making capacity will be respected including their right to withdraw from the study at any time without facing negative consequences. All participants were free to choose to participate without any pressure or coercion. Measures will be implemented to minimize any potential harm or discomfort to participants during the study. All authors declare no conflict of interest.

This study was reviewed and approved by the University of Santo Tomas Faculty of Medicine and Surgery Institutional Review Board (Approval No. UST: A002-40-LE125; REB Code: 2024-25-MARCELO-SPIROMETRY).

Study Design

By using cross-sectional analytical design, this study will contribute to the growing body of evidence on the health effects of biomass fuel use and may help inform public health interventions to reduce exposure in vulnerable populations. Furthermore, the study will need to generate a sampling frame of the exposed and unexposed participants; A random sampling will be done on both clusters. Confounding variables will be measured via an interviewer administered questionnaire and spirometry will be done.

Study Population and Setting

The study's target population will consist of 27 Filipino female adult residents of Our Lady of Banneux ANCOP Community (OLBAC) with significant exposure to biomass fuel smoke related to daily household activities and 27 Filipino female adult residents with no significant exposure from the same community. Selecting participants among the population will be achieved by using the convenience method of sampling. The data will be collected from participants that fit the inclusion criteria within the OLBAC in San Mateo Rizal, a partner community

Table 1: Inclusion and Exclusion Criteria for the Study Participants.

Inclusion Criteria
Participants must be:
Female
Resident of OLBAC - San Mateo, Rizal
Use biomass fuel in daily activities
Exclusion Criteria
Participants with pre-existing respiratory conditions affecting FEV1

of the Center for Respiratory Medicine of the UST Hospital and sponsored by the Couples for Christ organization.

Instrument

The spirometry is the instrument of choice that will be used to determine the participants' FEV1 and FVC. The instrument will be borrowed from the University of Santo Tomas Hospital - Center for Respiratory Medicine.

Data Collection

The study will conduct two sets of screening procedures. The first screening of the participants will be performed to gather general information and data regarding participants' exposure to biomass fuel. Then, a second screening will be performed to assess whether the participant will be qualified to further participate in the study based on the inclusion and exclusion criteria set by researchers. Participants will be then provided an informed consent prior to their inclusion to the testing procedure of the study.

Prior to testing, the researchers will schedule a testing session at a convenient time for participants. The venue should consist of a well-ventilated area with proper lighting and comfortable seating arrangements. The researchers should ensure that participants refrain from smoking and performing any rigorous activity at least one hour before their testing proper as this could alter their spirometry results.

Demographic measurements such as age, height, weight and relevant history will be obtained from each participant. Then, a physical examination will be conducted to assess the overall health status of participants prior to spirometry testing.

Respiratory function parameters, such as FEV1 and FVC are measured using spirometry. The researchers should first explain the procedure to the participants in a reassuring manner and confirm that they understand the said procedure. Then, the researchers would demonstrate the proper technique for performing spirometry, including deep inhalation followed by maximal forced expiration into the spirometer mouthpiece. The test should be repeated three times to ensure that results are acceptable based on ERS/ATS technical standards. The highest FEV1 and FVC are recorded from the acceptable test trial for each participant. Following each testing session, all spirometry equipment will be cleaned and disinfected according to manufacturer guidelines to prevent cross-contamination between participants. Furthermore, all equipment will be inspected for any signs of damage or malfunction to be repaired or maintained or calibrated as recommended by the manufacturer.

The researchers will provide participants opportunities to ask questions or address any concerns related to the testing procedure. Then, the participants will be interviewed regarding the status of their environment, current health and nutrition through a numbered survey that is interpreted using a range table that depicts whether the participant has poor, moderate, or good status in a particular parameter to identify confounding variables that may contribute to results of the study.

Data Analysis

The study utilized interviews as the primary tool for data collection to screen potential participants of the study. This approach allowed primary data collection as the researchers were able to directly obtain information from the participants.

The two parameters (FEV1 and FVC) of the measurements of lung function will be recorded in a tabulated format for each of the participants in an organized manner. To evaluate confounding variables, a scoring system was developed and its range was computed to standardize interpretation of results.

The study utilized descriptive and inferential statistics to analyze lung function parameters. The respondents from the group were categorized into

clusters wherein the obtained FEV1 and FVC results will be used to calculate the arithmetic average. The values from this calculation were used in performing inferential statistics, particularly in determining and assessing the relationship between length of biomass fuel smoke exposure and percentage predicted FVC among Filipino female residents of OLBAC community. This was done through logistic regression, providing odds ratios and p-values.

EXPECTED RESULTS

It is expected that the descriptive analysis will determine the mean values of lung function parameters (FEV1 and FVC) of the clustered OLBAC community respondents. Based on existing knowledge, it is anticipated that individuals with longer exposure to biomass fuel smoke may have abnormal FVC, FEV1 and/or FEV1/FVC parameters.

For inferential analysis, the results may indicate a negative association between length of biomass fuel smoke exposure and percentage predicted FVC, FEV1 and/or FEV1/FVC among Filipino female residents of the OLBAC community. In general, longer exposure of an individual to biomass fuel smoke might increase an individual's risk of having impaired lung function.

Overall, the expected results of the study would highlight the impact of biomass fuel exposure on respiratory function of the OLBAC community residents.

Individual author's contributions

NM oversaw the group, and MM served as the liaison officer. DTT and DIT co-authored the spirometry protocol and communicated it with the community. All authors drafted, revised and participated in the study.

Disclosure statement

This paper did not receive any funding.

Conflicts of interest

The authors declare no known conflicts of interest.

Acknowledgment

We are grateful to Dr. Trinidad, Dr. Tiburcio and Dr. Llauderres for their guidance and support throughout the entire process of this paper. We also like to thank United American Pharmaceuticals, Inc (UAP), UniLab for providing us with the mouthpieces and the OLBAC community for their cooperation in our study.

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