



ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH

PERSONAL DUST EXPOSURE AND CHRONIC RESPIRATORY HEALTH SYMPTOMS
AMONG FLOUR MILL FACTORY WORKERS IN AKAKI KALITI SUB-CITY, ADDIS
ABABA; ETHIOPIA, 2019.

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Personal dust exposure and chronic respiratory health symptoms among flour mill factory workers in Akaki kaliti sub city, Addis Ababa, Ethiopia, 2019.

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ABBREVIATIONS' AND ACRONYMS

ACGIH:	American Conference of Governmental Industrial Hygienist
AM:	Arithmetic Mean
AOR:	Adjusted Odds Ratio
ATS:	American Thoracic Society
CI:	Confidence Interval
COPD:	Chronic Obstructive Pulmonary Disease
COR:	Crude Odds Ratio
CVC:	Closed Filter Cassette
Epi Info:	Epidemiological Information package
ETB:	Ethiopian Birr
FF:	Fafa Food share company
GM:	Geometric Mean
GSD:	Geometric Standard Deviation
ILO:	International Labor Organization
KFCx:	Kality Food Complex Share Company
NCDs:	Non-communicable Diseases
OEL:	Occupational Exposure Limit
OR:	Odds Ratio
PNOS:	Particles Not Otherwise Specified
PPEs:	Personal Protective Equipment's
PVC:	Polyvinyl Chloride
RPE:	Respiratory Protective Equipment's
SD:	Standard Deviation
SEGs:	Similar Exposure Groups
SKC:	Scientific Kit Corporation
SPSS:	Statistical Package for Social Sciences
TD:	Total Dust
TLV:	Threshold Limit Value
TWA:	Time-Weighted Average
WHO:	World Health Organization

ABSTRACT

Background: Flour mill workers are at an increased risk of developing respiratory symptoms due to exposure to flour dust in their working environment. Exposure to flour dust linked with the development of chronic respiratory disorders. However, very little evidence has been available on the exposure level of flour dust and the respiratory health status of exposed workers.

Objective: The aim of this study was to assess personal dust exposure level, chronic respiratory health symptoms and associated factors among flour mill workers in Addis Ababa, Ethiopia.

Methods: Cross-sectional study was conducted among a sample of 424 randomly selected workers from Kaliti and Fafa flour mill factories. Respiratory health symptoms were assessed using an American Thoracic Society standard questionnaire customized with local context. For personal dust exposure assessment a total of 50 personal dust samplers were collected from 25 randomly selected workers. A repeated sample was taken from five work sections having similar exposure group following Rappaport sampling recommendation. Epi-Info V. 7.2 and SPSS V.21 statistical software were used for data entry and analysis, respectively. Descriptive statistics was used, and data was presented using tables and figures. Gravimetric analysis of the filters was done using a standard micro-balance with a detection limit 0.01mg in Environmental and Occupational Health accredited Laboratory, School of Public Health, Addis Ababa University. The dust level was described and compared with the threshold limit value of American conference of governmental industrial hygienist recommendation (10 mg/m³) for total dust.

Results: Majority (92%) of workers were exceeded the threshold limit value recommended for total dust (10 mg/m³). The prevalence of chronic respiratory health symptoms among flour mill factory workers was 58.3% (53.7-63.4). Chronic respiratory health symptoms were significantly associated with age group (AOR=1.95, 95%CI;1.17-2.79 and AOR=12.3, 95%CI;4.39-34.6), monthly income (AOR=1.68, 95% CI;1-2.79), work experience (AOR=2.58, 95% CI;1-6.62), past dust exposure (AOR=1.86, 95% CI;1.08-3.2) and utilization of respiratory protective equipment's (AOR=2.29, 95%CI;1.27-4.13).The GM (\pm GSD) of dust exposure level was 62.75(\pm 12.55) mg/m³.

Conclusion and recommendation: Chronic respiratory health symptoms were highly prevalent among flour mill factory workers and workers who exposed to flour dust concentration was above the acceptable recommended limit value. Supportive supervision and solution between Ministry of Labour and Social Affairs, flour mill managers and workers is needed to reduce exposure and improve working environment.

1. INTRODUCTION

1.1. Background

Dust is a small, dry solid particle that range from one to hundred micrometers in diameter size and formed by natural forces or human made processes like (crushing, grinding, milling, drilling, demolition, shoveling, conveying, screening, bagging, and sweeping). Major types of dust are organic and inorganic dusts. Inorganic dust comes from non-living things and includes stones, chemicals, and metals. But, Organic dust comes from living things and include dust from textiles, wood, poultry, leather, grain fungal spores, microbes, and flour (1). Flour dust is a complex organic dust of finely ground particles arising from the milling of cereals or pulses for example wheat, rye, millet, barley, oats or corn cereals, or a combination of these (2).

The respiratory health effects have been documented in workers exposed to a variety of dusts in small and large scale industries, which generate dust during their production process. The diseases of the respiratory system induced by occupational dusts are influenced by the type of dust, dose, duration of exposure and genetic factors. Occupational diseases are caused by a pathologic response of the patients to their working environment. Exposure to flour dust is one of the most common causes of allergic rhinitis, chronic respiratory disorders including asthma and occupational airway diseases. In many industries such as flour mills and bakeries, the dust generated during cleaning, grinding, packaging and transport is released in the atmosphere and can be inhaled (3).

The level of exposure is conditioned by the size of the production enterprise and varied depending on the working area within the factory grounds. In most of flour milling industries, the maximal concentrations of respirable dust at some workplaces in flour mills can even reach 160 mg/m³ and the observed concentrations of total flour dust varied from a few up to more than 400 mg/m³ in the case of peak exposure (4). Illness associated with milling and baking symptoms includes such as cough, shortness of breath, hoarseness, and Asthma and eye problem. Mill and bakery workers' clinical manifestations include conjunctivitis, allergic and baker's asthma, wheezing, febrile reactions, grain fever, lung fibrosis, rhinitis, allergic alveolitis, impairment of lung function, and chronic obstructive pulmonary disease .These respiratory symptoms with continuing occupational exposure can lead to worker disability (5). Flour dust accumulates in the workplace environment because of poor ventilation. Hence workers get exposed excessive amount of flour dust (6).

Flour dust has different characteristic Cereals belonging to the family Poaceae, while particles derived from wheat (*Triticum* sp.), barley (*Hordeum* sp.), rye (*Secale cereale*) and oats (*Avena sativa*) have

high allergenic potency, the flour dust coming from corn (*Zea mays*) is much less reactive. Important flour dust sensitizers, however, derive also from non-cereal grains such as soy (*Glycine hispida*), buckwheat (*Fagopyrum esculentum*) and peas (*Pisum sativum*). The main cereal grain used in the bakery industry is wheat. The wheat seed is composed of endosperm (80–85%), husk and germ. During the milling process, the endosperm is separated from husk and germ and reduced to small ($\leq 6 \mu\text{m}$) particles. Wheat flour contains starch and four groups of proteins: glutelins (glutenins), water-soluble albumins, prolamins (gliadins) and globulins. Glutenins and gliadins form complexes called gluten. Albumins and globulins have shown the strongest allergic potency among wheat proteins, but allergic potency of globulins, prolamins and glutelins should be considered in occupational risk assessment as well. Wheat flour contains 40 allergens at least, which can cause adverse health effects in exposed workers (7).

The flour-milling process are, cleaning (separating wheat from seeds, other grains and foreign materials), conditioning (mixing water with the grain to get the right moisture level), milling (gradual reduction of the wheat kernels to produce particles of endosperm), reduction of semolina to flour and flour dressing (the separation of flour from the other materials) and loading (8). In Ethiopia, around 300 flour mills with a total of 3.7 million tons of milling capacity per year (9) and 55,000 workers are engaged in flour mill factories (10). But most of these studies are conducted to see the effect of flour dust on lung function and respiratory health problem symptoms. Spirometry is one of the most important diagnostic tools in the diagnosis and prognosis of respiratory diseases and describes the effects of flour dust on the pulmonary function reduction (11). In order to know personal exposure it is advisable to assess personal flour dust exposure level and respiratory health symptoms among flour mill workers.

1.2. Statement of the problem

In low and middle income countries, including in Africa, occupational respiratory symptoms and diseases are huge burden due to the expansion of investments, high unemployment rate; workers are probably more likely to continue working even when having poor health status and outdated machine that are producing excessive dust to work environment are still used for production purpose. Work-related respiratory symptoms are broadly abundant in low income regions of Africa, including Ethiopia (12). Flour mill workers are at risk of developing chronic respiratory health effects due to exposure in their working environment (13). Chronic respiratory diseases accounts about 10.7% from the total deaths of all NCD (14). Occupational respiratory illnesses account for up to 30% of all recorded work-

related diseases with up to 50% prevalence among workers in high-risk sectors such as mining, construction, and dust generating works (4). ILO (2011) addresses annual work-related deaths respiratory diseases accounts for about 8% (15).

In Ethiopia, the total death of NCDs was estimated to account for 691,000 individuals (30%), with chronic respiratory diseases 3% (14). Dusty environment and unfavorable climatic conditions are major occupational hazards in flour factory that influence the health of workers (16). Previous studies showed that flour dust exposure cause respiratory symptoms such as chest pain, phlegm, wheezing, cough, shortness of breath in flour mill workers (17, 18).

In Ethiopia, an epidemiological survey was conducted in small grain mill workers in Kola Diba town showed that higher prevalence of respiratory symptoms were found like wheezing (35.7%), cough (42.1%) and chest tightness (35.1%) (19). Recently, study conducted in Addis Ababa in local grain mill workers showed increased respiratory symptoms, such as dry cough(27.7%), productive cough (11.1%), wheeze (14.8%) and breathlessness (16.6%) in grain mill dust exposed workers (20). Those studies investigated only on lung function test and respiratory symptoms. However, there is limited information available on the flour dust exposure level in Ethiopia, where the work setup, production capacity and numbers of workers engaged were different from local grain mill. **Therefore**, in order to fill this gap the aim of this study is to assess personal dust exposure level, chronic respiratory symptoms and its associated factors among flour mill factory workers in Addis Ababa, Ethiopia.

1.3. Rationale of the study

At this time large and medium scale manufacturing industries such as flour mill, textile, food and soft drink processing, and soap manufacturing are growing in Ethiopia to build an industrial sector with the highest manufacturing capability in Africa which is diversified, globally competitive, environmentally-friendly, and capable of significantly improving the living standards of the Ethiopian people. In accordance with its 2nd Growth and Transformation Plan (GTP-II) (2015-2020), Ethiopia is striving to structurally transform the economy from being agriculture dominated to industry dominated in order to increase worker productivity and achieve middle-income status for the country over 50 million workers engaged in different medium and large scale manufacturing industry from this about 55,000 workers are engaged in flour mill factories (21). In most flour milling factories, attention is mainly on negative outcomes. As long as there are no serious accidents, occupational safety and health policies and practices are not carried out fully. As a result, threats to employees' safety are not eliminated in time because accident-prone areas are not recognized and taken care of before accidents occur. Concerning

flour mill occupation a few studies were conducted which deals only prevalence of respiratory symptoms and no study has demonstrated dust exposure level among flour mill workers in the study area. This indicates that no coinciding study has been published that aimed to assess personal flour dust exposure level and respiratory health problems among the flour mill workers.

1.4. Significance of the Study

The findings from this study will benefit flour mill workers and employers to increase their awareness towards the importance of consequently use PPEs and develop good working practice. It guides how to protect themselves from other factors which contribute to a risk of getting chronic respiratory symptoms and diseases. It helps Addis Ababa Bureau of Labour and Social Affairs to develop appropriate workplace intervention measures to protect the health of flour mill workers. Government of Ethiopia, non-governmental organization, industries, authorities, and policy makers may use the recommendation from this study in developing strategies and enforce legislation for further improvement. Findings from this research can contribute as baseline to the body of knowledge and to formulate for other researchers on flour mill workers for the future to protect workers and their families from occupational and other health effects.

2. LITERATURE REVIEW

Occupational related disorders are the main causes of health problems in workforce population. Exposure to dust can cause chronic respiratory health symptoms among flour mill workers. Respiratory disorders in these workers were high due to a number of different factors and great emphasis was not given before to control and prevent the problems due to lack of scientific information. Chronic respiratory symptoms including chronic cough, chronic phlegm, wheezing, shortness of breath, and chest pain are manifestations of respiratory problems which are mainly evolved as a result of occupational exposures (22).

2.1. Prevalence of respiratory health symptoms among flour mill factories

In 2016, the study done in India among 65 flour mill workers, the prevalence of respiratory symptoms 53.8% with the prevalence of cough 92.30%, sneezing 61.53%, runny nose 3.07%, shortness of breath 15.38%, chest tightness 80% and sputum in mouth 27.69% (23). The study done in India among 120 rice mill workers and 50 controls showed that the prevalence of respiratory disorders were phlegm 40.8 %, dyspnea 44.2 %, chest tightness 26.7 %, cough 21.7 %, and nose irritation 27.5 % (24). Other study done in South-South Nigeria revealed that the prevalence of respiratory symptoms in the study group was: cough 46.7%, phlegm expectoration 50.2%, wheeze 5.3%, chest tightness 10.1%, chest pain 5.7% and breathlessness 7.5% (25).

Higher prevalence of respiratory health symptoms were seen in those with cough (33%), cough with phlegm (46.8%) and wheezy (41.6%) among Sunflower Oil Industry workers in Singida Tanzania (26).

Study done in Egypt reported that there was an increase in respiratory symptoms among bakery workers due to exposure to wheat flour (27). Study conducted in Egypt among mill workers suggested that the respiratory symptoms such as cough, expectoration, wheezing, and shortness of breath, were significantly ($p < 0.0001$) higher among exposed workers as compared to unexposed with the prevalence of cough (7.5%), phlegm (87.5%), shortness of breath (60%), wheezing (72.5%) and chest pain (7%) was found from 200 exposed to flour dust and 200 unexposed to flour dust workers and the prevalence respiratory diseases among flour mill workers was chronic bronchitis (30%), asthma (12.5%) and COPD (42.5%) (18).

2.2. Flour dust exposure level and chronic respiratory symptoms among flour mill workers

Flour dust is a complex organic dust of finely ground particles arising from the milling of cereals or pulses for example wheat, rye, millet, barley, oats or corn cereals, or a combination of these. Exposure to flour dust arises principally at the site of milling or subsequently in processing and manufacturing. Workers may be occupationally exposed to flour dust via inhalation during its manufacture or use. Additional exposure arises from dermal contact with any exposed skin. The diseases of the respiratory system induced by occupational dusts are influenced by the type of dust, dose, duration of exposure and genetic factors (18). The level of exposure is conditioned by the size of the production enterprise and varied depending on the working area within the factory grounds (4).

More than 50% of airborne flour dust tends to have an aerodynamic diameter over $15\mu\text{m}$ but up to 20% have a diameter of $\leq 4\mu\text{m}$, a respirable fraction size. Most particle sizes above $5\mu\text{m}$ are trapped in the nasopharyngeal region and removed usually within a few hours by mucociliary action or coughing/sneezing. Particles are also removed by macrophages. The system can become overwhelmed by massive exposure resulting in deeper penetration of larger particles which may then take several dozen to several hundred days to remove. Inhaled particles of $10\mu\text{m}$ or greater can cause eye or nose irritation. Particles of $5 - 10\mu\text{m}$ can cause asthmatic reactions. Below $5\mu\text{m}$ may cause allergic alveolitis reactions (7). Exposure to flour dust at 1.35 to 3.57 mg/m^3 resulted in changes in lung function tests and an increased incidence of respiratory and asthmatic symptoms. Higher incidences of chronic bronchitis and work-related wheezing and nasal symptoms have been reported at exposure above 2 mg/m^3 . Sensitization to wheat flour has been shown at levels as low as 0.5 mg/m^3 inhalable fraction - or 0.2 g/m^3 wheat allergen (2). Respiratory disorders were reported by a high number of flour mill workers, as dust particles easily enter the respiratory tract of an exposed person. These particles attach to the inner wall of the respiratory tract and disturb the process of inhalation and exhalation of air. The inner cell wall of the respiratory tract does not accept the foreign particles (flour dust), causing slight irritation in the respiratory tract which is the primary symptom of respiratory disorder (28).

Different studies conducted among flour mill workers in different countries' on food industries like Egypt, Nigeria, India, Saudi Arabia, Iran, and the UK were found that flour dust exposure cause short and long-term respiratory problems like sensitization, irritating, nasal, asthma, grain

fever, lung fibrosis, rhinitis, impairment of lung function and COPD (5, 12, 17, 18). Respiratory symptoms were significantly higher in flour mill workers than in controls. A significantly higher prevalence of respiratory symptoms in flour mill workers was related to the shortness of breath, wheezes, productive cough ($p < 0.0001$), also there are highly statistically significant differences for wheezes, crackles, hyperinflation and radiological findings ($p < 0.0001$). Furthermore, a significantly and markedly higher percentage of flour milling workers as compared to the control group showed chronic bronchitis, bronchial asthma and chronic obstructive pulmonary disease (COPD) ($p < 0.00001$). None of the symptomatic controls reported work-related changes in the symptoms (18). Another comparative cross-sectional study from North Central Nigeria, in 2015 among flour mill workers found that statistically significantly higher prevalence of respiratory symptoms ($P < 0.05$) (40). A study conducted in India, in 2014 reported respiratory symptoms in rice mill workers were phlegm, chest tightness and cough (24).

2.3. Socio-demographic factors and Socio-economic status with chronic respiratory symptoms

Socio-demographic factor and socio-economic status of workers' age, sex, education, special income and occupation affects the health of the workers in flour mill factories. There was evidence on increase of age and occurrence of chronic respiratory symptoms among flour factory workers. A study from Egypt in 2013 showed significant association between age and chronic respiratory symptoms, ($p < 0.05$) (18). Study done in Tanzania on flour mill workers reported more phlegm 7(63.6%) at age of above 61 years and wheezing 10(50.0%) at the age group of 18 – 35 years with a statistically significant difference, $p < 0.05$. But, more respiratory symptoms including cough 23(65.7%) at the age group of 51 – 60 years, sneezing 15(75.0%) at 18 – 35 years, nose irritating 17(47.2%) at 36 – 50 years, and breathlessness 4(36.4%) at 61 years and above were reported, but not statistically significant, $p > 0.05$ (18).

Sex of study participants has an effect on the occurrence of respiratory health symptoms. A study conducted in Addis Ababa indicated that female were more likely to develop respiratory health symptoms (AOR = 2.188, 95% CI; 1.143 - 4.189) than males (29) But, a study done in India revealed that sex of study participants has no significant difference between the sweepers and the comparison groups (30). A study conducted in America showed that pulmonary diseases affects women with a greater degree of severity than men (31).

Education contributes a great role in social and economic development. It enhances capabilities and is intensely connected with various socio-economic variables such as lifestyle and income for both individuals and societies. Also, level of education influences the type of occupation and income which can determine the home living condition. Education is an important factor influencing an individual's attitudes and awareness related to health and hygiene (32). A study done in South-Ethiopia, Hawassa city reported that workers whose education level (Grade 1-8) were more likely to develop chronic respiratory symptoms than workers whose education level was secondary (Grade 9-12) and above (AOR= 6.2, 95 % CI = 1.6-24.4) (33). Another study from Finland in 2004 found that low education and low household income associated with respiratory health problems. According to the study as educational level low, the risk of asthma and Chronic Obstructive Pulmonary Disease (COPD) increased. Also, low household income increased the risk of asthma and COPD (34).

2.4. Environmental factors and chronic respiratory symptoms

Flour dust accumulates in the workplace environment because of poor ventilation; hence workers get exposed to excessive amounts of flour dust. Long-term continuous exposure of workers to fine dust leads to pulmonary and respiratory diseases. Flour mill workers working in very congested small space though out the day with temperature and humidity of above 30 C° and 70% respectively in standing position very close to the grinding machine are more exposed to high concentration of flour dust, since no exhaust system was observed in the flour mill factory (28).

Poor ventilation is a basic problem of a workplace in flour factory. Workers in developing countries flour mill industries are exposed to occupational hazards due to lack of awareness, neglected, congested workplace, workers are close to grinding machine, lack of both artificial and natural ventilation and lack of any precautionary measures to prevent flour dust exposure during working hours in industries (35). A study conducted in Riyadh, Kingdom of Saudi Arabia found that flour dust accumulated in workplace environment because of poor ventilation; hence, workers get exposed to excessive amounts of flour dust (15). Study from Serbia, showed there was strong association between indoor air pollution and respiratory symptoms (36).

A study conducted in Thailand recommended that one of the major solutions in preventing and solving respiratory tract problems among wood furniture manufacturing factory workers should

be dust reduction by improving air ventilation in the factory (37). A study done in Ethiopia among coffee workers showed, personal total dust exposure among machine room workers was significantly increased when pouring coffee vigorously from a height in factories that had more than one huller machine in the room and when the hopper had open top (38).

2.5. Workplace characteristics and chronic respiratory symptoms

Workers in flour milling industries exposed to hazardous flour dust at all stage of flour processing. A study conducted in Iraq showed that 65.2% of workers exposed in packing unit had allergy symptoms compared to 31.5% in those with a low level of exposure at all other units(39). Another study conducted in Egypt showed that 96.8% of workers exposure to flour dust in the workplace (packing unit) and had high respiratory symptoms (18). In addition, study from Iran, in 2013 found that the maximum exposure to flour dust was seen in the loading-storage section due to direct contact with flour dust and the lowest exposure was in the winnow section probably because the process was confined (40).

Duration of employment is an important epidemiological factor that determines the occurrence of respiratory symptoms in workers. Longer duration of employment was associated with higher the prevalence of allergic Symptoms (41). A study done in Egypt, Workers with a longer duration of employment reported a significantly higher prevalence of symptoms (96.2%) than those with shorter duration (83.3%) ($p < 0.002$) (18). Study conducted in Iraq showed that workers employed in industries longer than 20 years reported higher respiratory symptoms than workers work in industries from 10 to 19 years and less than 10 years and allergic symptoms increase on starting and during work and improve after leaving the workplace, during weekends and on holidays (39). In addition, study conducted in Egypt showed that higher prevalence of respiratory symptoms among workers with longer duration of employment ($p < 0.002$) and who had spent 5 years and above reported a significantly higher prevalence, 98.2%, than those with shorter duration, 97.8% ($p < 0.05$) (17). But, study conducted from Egypt, in 2017 showed that no statistically significant difference between < 10 years working and ≥ 10 years working for groups with regard upper and lower respiratory and work-related symptoms (27) . A study done in Jalgaon Urban Center showed that there was a decline in the lung parameter and increase chronic respiratory symptoms with increasing duration of exposure to flour dust (from 3 years, 3 to 6 years, 6 to 9 years) among flour mill workers (28)

Workers with more than 5 years past dust exposure showed more respiratory health symptoms including wheezing 38.7% and breathlessness 41.9%, even if it is not statistically significant, $p > 0.05$. But, cough 61.2%, phlegm 40.8%, nose irritating 38.7% and sneezing 67.3% are reported more for sweepers who had less than 5 years past dust exposure (42). Additionally, workers with the history of previous dust exposure had the risk of 2.696 times more likely to develop chronic respiratory symptoms (AOR = 2.696, 95 % CI; 1.278-5.685) than those with no previous dust exposure history (43).

Working for 5 – 8 hours per day had more respiratory symptoms such as nose irritating 39.5% and sneezing 68.6% compared to those who are working for ≥ 9 hours with statistically significant difference, $p < 0.05$ (42). Workers who work above 5 hours/day were more likely to develop chronic respiratory symptoms (AOR = 3.925, 95% CI; 2.060 - 7.477) than those who work ≤ 5 hours/day (43). Even if a number of past respiratory illnesses were reported, earlier respiratory diseases such as emphysema (AOR = 2.53 95% CI: 1.072 - 5.97) and TB (AOR = 2.24 95% CI: 1.584 - 3.065) were the contributing factors for respiratory symptoms (29).

2.6. Individual/ behavioral characteristics and chronic respiratory symptoms

Personal protective equipment at workplace is important to protect workers against one or more risks to their health. A study done in Tanzania, the use of respiratory protective equipment was higher among 67.8% of participants while 32.2% reported not using any form of respiratory equipment. Among those responded using respiratory equipment 55.8% of participants use a piece of clothes as their RPE and 14.6% use both a piece of clothes and modern mask to cover their mouth and nose during the 8 hours of working and the equipment were not classified according to the quality of protection (26). A study conducted in India found that PPEs were not available as well as was not used by any flour mill worker while doing their work (44). In addition, study from Nigeria in, 2017 among the rice mill workers showed that PPE (face masks) were not readily available for use (45).

Smoking is a well-known determinant factor causing chronic bronchitis that is the main health problem occurred among street sweepers. A study done on cement production workers presented smoking contributed to increasing the prevalence of respiratory symptom and reduction of lung function indices (46). In addition, a study conducted in Nepalese showed that unprocessed solid biofuels such as cow dung, crop residue, and wood for cooking and heating have higher risk for serious health outcomes compared with those who use cleaner fuels such as kerosene, LPG, and

biogas in the exposed population (47). A study done in Tanzania showed that those smoking cigarette were more likely to have cough, phlegm and wheezing, and previous dusty job are three times more likely to have difficulty breathing and breathlessness as the respiratory health symptoms (26). Cough had the highest percentage of 41.2% in the study group of Prevalence of respiratory symptoms among non-smokers in study and comparison groups (25).

Summary of the review

All the literature showed how exposure to dust can cause chronic respiratory health symptoms among flour mill workers. They also emphasized how the associated factor (age, sex, education, and duration of employment, level of exposure with respect to their task, past dust exposure, working hour, PPE use and smoking habit) highly correlated with workers respiratory symptoms. Some literatures suggested that it is important to understand the individual dust exposure level to link with the respiratory health symptoms of workers. Although the literatures used different method, design and setup they agree with the hypothesis that workers exposed to high flour dust with high duration of working time without using PPE can develop chronic respiratory symptoms. Most of the literatures verify as age increase the occurrence of chronic respiratory symptoms among flour mill workers also increases and males are more exposed than females but there is a discrepancy a study in America among flour mill workers and in Addis Ababa among sweepers shows that females were more likely to develop respiratory health symptoms than males this is due to individual behavior variability. Most of the findings from the literatures show that the maximum exposure to flour dust was seen in the packing and loading-storage section due to direct contact with flour dust and Workers with a longer duration of employment reported a significantly higher prevalence of symptoms than those with shorter duration.

Conceptual frame work

By considering the above reviews respiratory health symptoms and flour dust exposure among flour mill workers are summarized on the conceptual framework presented below. This shows how the particular variables in study connect with each other and identifies the variables required in the research investigation. This conceptual framework is developed by assuming respiratory health symptoms of flour mill workers will also be related to those factors as reviewed from different literature. As indicated in the conceptual framework respiratory health symptoms of flour mill workers can be associated directly and indirectly with socio demographic, behavioral

factors, workplace characteristics, and environmental factors and indirectly associated with exposure to flour dust. This conceptual frame work tells us the boundary of the topic, used for selecting appropriate data collection method, for data analysis, also as referent point for the discussion of the literature, methodology and results. It also seen as an abstract representation of the relationship between the studies variables

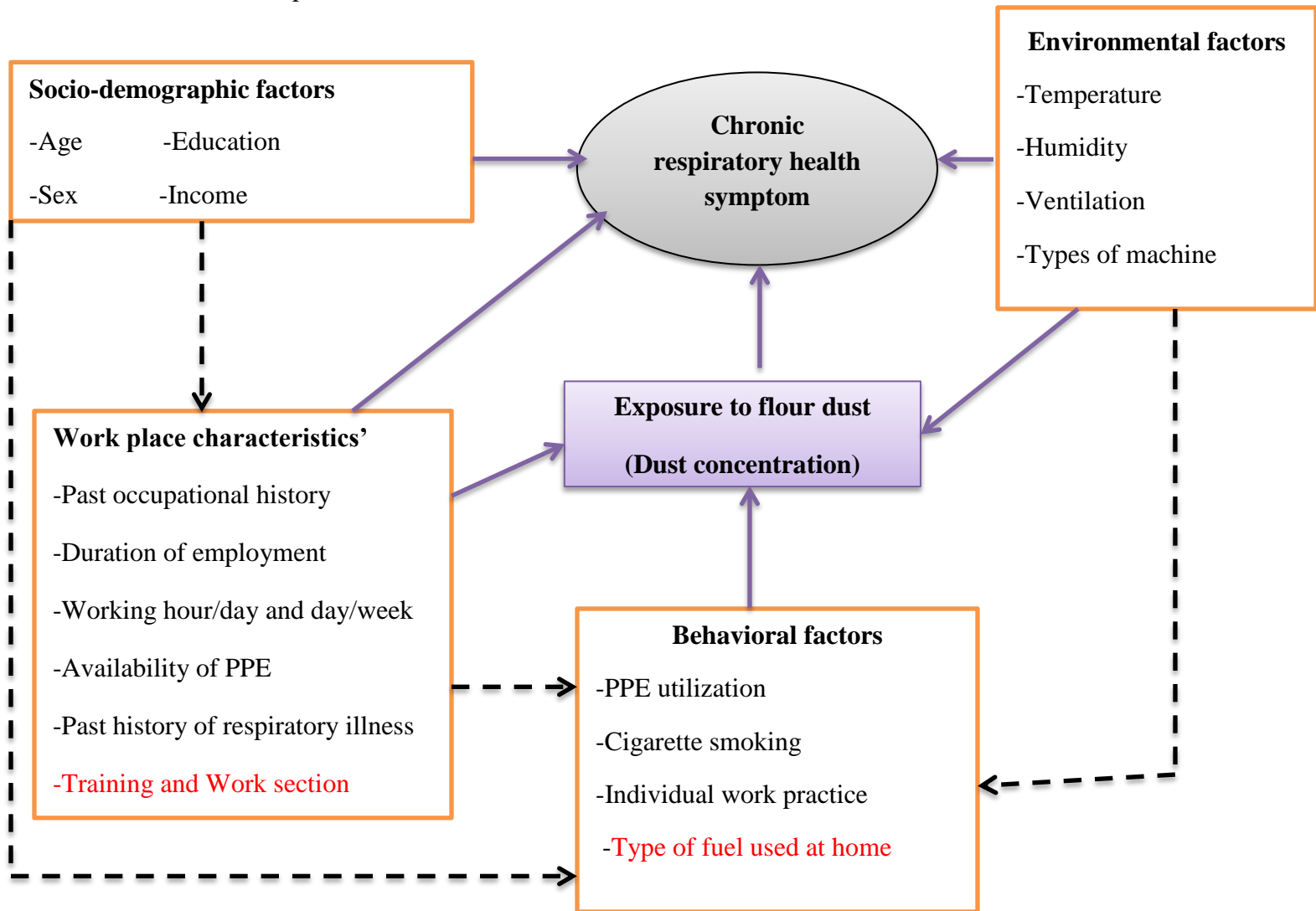


Figure 1: Prepared Conceptual framework for personal flour dust exposure and respiratory health symptoms among flour mill workers in Addis Ababa, Ethiopia, 2019.

3. OBJECTIVES

3.1. General Objective

To assess personal dust exposure level and prevalence of chronic respiratory health symptoms and its associated factors among flour mill workers in Akaki Kaliti sub-city, Addis Ababa, Ethiopia;2019.

3.2. Specific Objective

- ✓ To determine the prevalence of chronic respiratory health symptoms among flour mill workers.
- ✓ To measure personal total dust exposure level among flour mill workers.
- ✓ To identify factors associated with chronic respiratory health symptoms among flour mill factory workers.

4. METHOD AND MATERIALS

4.1. Study area and period

The study was carried out in two factories of Addis Ababa, Akaki kaliti sub city among Kaliti and Fafa food complex share company workers. Addis Ababa is the capital city of Ethiopia that geographically lays $9^{\circ}1'48''N$ latitude and $38^{\circ}44'24''E$ line of longitude. It covers an area of 540 square kilometers (54,000 hectares) with a total population of 3,147,000 (48). The city has ten sub cities and 116 districts. Addis Ababa has about 23 medium and large scale flour mill factories and around 1496 workers are engaged. Akaki Kaliti sub-city has a total of 118.08 square kilometer with a population size of around 195273 with 95558 males and 99715 females. It has also 11 wereda and many medium and large flour mill factories. Kaliti Food S.C. (**Cheralia**) is started in 1930 and it was the only food-processor based in Addis Ababa that is diversified across four concentric and complimentary market concepts ranging from Milling, Biscuit Production, Pasta/Macaroni Production and industrial bakery. The Company currently employs 479 permanent staff and a monthly average of 13 casual (temporary) workers which is the total of 492 workers. From those about 191 workers are females and 301 males, with 439 and 53 production workers and administrative staff respectively. It produces 150 tons/day and it works 10-15 days per month. Fafa Food Share Company, for over 50 years, has been and continues to be a pioneer of the food processing industry in Ethiopia. It is one of the top suppliers of baby foods for Ethiopian children, including fortified foods and breakfast cereals. Although, the company started as an Ethio-Swedish joint venture in 1962, it was privatized in August 2009 and is now owned by Petram Private Limited Company. Its current production capacity is 23,000 Ton/annum. Fafa is home to 346 employees of whom 72 are female and 274 are male and from those 186 are permanent workers while 62 workers are temporary with 74 administrative staff and 272 are production workers. About 50% of the female and 30% of the male employees have worked in Fafa for more than 20 years. Flour mill factory have different working flow which starts from separating wheat from seeds and other grains, eliminates foreign materials such as metal, sticks, stones and straw and it passes many stages to get the final product (flour). This study was conducted from March 10, 2019 – May 25, 2019. The following figure shows flour mill factory work flow.

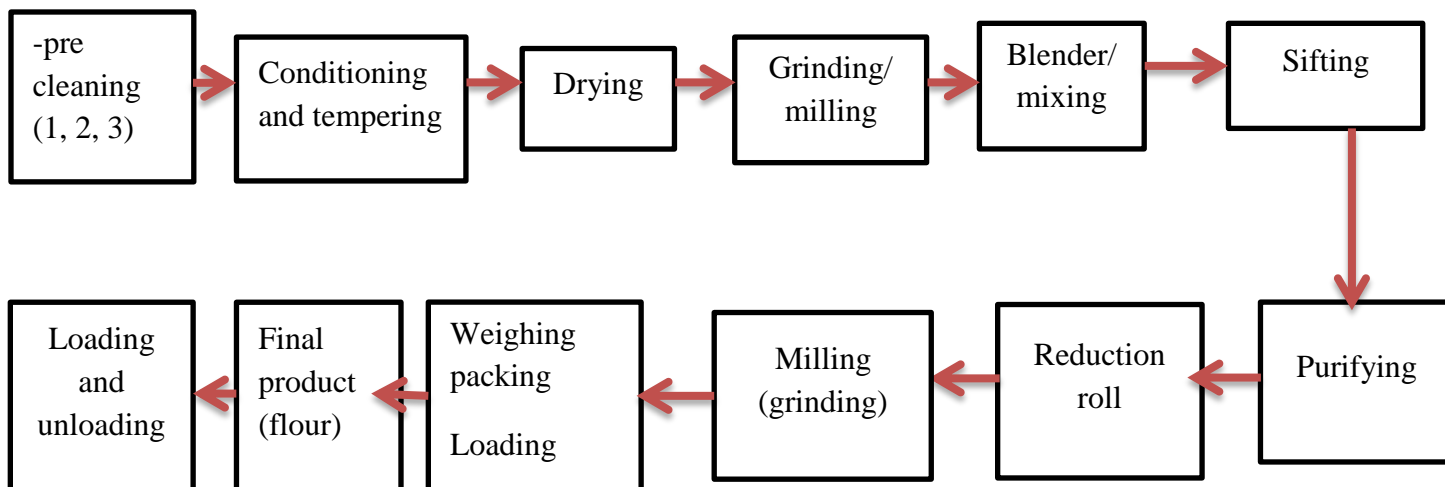


Figure 2: work flow of flour mill factory in Akaki Kaliti sub-city, Addis Ababa, Ethiopia 2019.

4.2. Study Design

Cross-sectional study design was conducted to assess chronic respiratory health symptoms, personal flour dust exposure level and its associated factors among production workers of flour mill factory workers.

4.3. Source Population

All flour mill workers who are engaged in large scale flour mill factory in Akaki Kaliti sub-city was the source population

4.4. Study Population

All randomly selected flour mill workers in Kaliti and Fafa food complex share company

4.5. Eligibility Criteria

4.5.1. Inclusion Criteria

Workers who had directly engaged in the production activities in the flour mill factory for one year and above were included.

4.5.2. Exclusion criteria

- Participants who are severely ill at the time of data collection as they may not be able to respond appropriately
- Participants who are working in flour mill factory less than one year work experience.

4.6. Sample Size Determination

4.6.1. Sample Size Determination for Specific Objective One (chronic respiratory symptoms)

The sample size to assess the prevalence of respiratory symptoms among flour mill factory workers was determined using a single population proportion formula with the following assumptions:

- ✓ P: 54.3%, prevalence of chronic respiratory symptoms among flour mill workers (a recently done in Addis Ababa, Ethiopia among flour mill workers.
- ✓ d: Margin of error or level of precision or maximum error to commit = 5 %
- ✓ $Z_{\alpha/2}$: Critical value at 95% confidence interval = 1.96.
- ✓ n: Required sample size

$$n = (Z_{\alpha/2})^2 * p * (1-p) / d^2$$

$$n = (1.96)^2 * 0.543 * (1-0.543) / (0.05)^2 = 381$$

Adding 10% for non-response rate, it becomes 424.

4.6.2. Sample size for second objectives (associated factors)

Study conducted in Egypt showed that the prevalence of work-related respiratory disorders among flour mill workers for longer duration of employment (>10 years) and short duration of employment (≤ 10 years) were 96.2 % and 83.3% respectively (18). The sample size to determine factors associated with respiratory health symptoms among flour mill workers is calculated using Epi-info version 7.2 with the following assumptions

n= sample size to be determined

P1= 96.2 % (proportion of respiratory disorders among workers with longer duration of employment (>10 years))

P2= 83.3 % (proportion of respiratory disorders among workers with shorter duration of employment (≤ 10 years)) (49)

$Z_{\alpha/2}$ = Level of statistical significance 1.96 at confidence level of 95%

Z_{β} = Desired power for 85% power

P1-P2 = Difference between proportions

$$n = (Z_{\alpha/2} + Z_{\beta})^2 * (p_1(1-p_1) + p_2(1-p_2)) / (p_1 - p_2)^2$$

$n = \frac{(1.96 + 1.04)^2 * (0.962(1-0.962) + 0.833(1-0.833))}{(0.962 - 0.833)^2} = 103$, since it is double proportion it becomes 206.

Adding 10% for non-response it becomes total sample size of 227.

4.6.3. Sample Size Determination for Specific Objective Three (personal dust exposure)

The sample size for personal dust exposure assessment is determined based on Rappaport et al 2008 considering that at least 5-10 randomly selected individuals in a similar exposure group (SEG) with repeated measurements are adequate to estimate the group exposure level for dust sampling based on personal exposure measurements (50). SEG is a group of workers working the same type of tasks in a similar work area for the same length of time. With the above assumptions, 5 work groups with 5 study participants from (milling, loading and unloading, packing, pre-cleaning and machine operating) each was selected. This makes to perform a total of 50 dust measurements on 25 randomly selected flour mill workers with a repeated measurement each. This sample size is assumed to be adequate to estimate the dust exposure given limited resources.

Table 1: Sample size determination summary of the study among flour mill factory workers in Akaki Kality sub-city, Addis Ababa; Ethiopia, 2019.

S/no	Variables	Prevalence of chronic respiratory symptoms	Confidence interval	Calculated sample size	Non-response rate (10%)	Total sample size
1	chronic respiratory symptoms	54.3%	95%	381	43	424
2	Factors	Prevalence of respiratory disorders	Power	Calculated sample size	Non-response rate (10%)	Total sample size
	Work experience >10 years	96.2%	85%	103	20.6=21	227
	Work experience ≤10 years	83.3%		103		
3	Parameter	Rappaport recommendation	Number of department	Number of workers	Total number of workers	Total number of dust measurement
	Total dust measurement	5-10 from SEG	5 flour mill department	5 workers from each	25	50

NB: - The sample size for objective one gave maximum sample size, which was 424. Therefore, the minimum requirement sample size for this study was 424. Where, 262 and 162 workers were selected from Kaliti and Fafa food complex share company factories respectively.

4.7. Sampling Procedure

Addis Ababa contains ten (10) sub cities, from which only one sub city is selected, i.e. Akaki Kaliti sub-city is selected because it has large number of medium and large scales manufacturing industry and large number of the population in this sub city is engaged in industrial activities. From the selected sub city two flour mill factories were selected based on their number of workers engaged and production rate capacity. The sample of study participant from both flour mill factories was proportionally allocated. Then for selecting study subject from each department's simple random sampling technique was used. For personal total dust monitoring, sampling was taken purposively from five departments which have comparatively high amount of flour dust (pre-cleaning, production (milling), machine operator, packing and loading and unloading) departments. From the selected five departments five participants from each were selected randomly by using simple random sampling technique. A total of 50 samples were performed on 25 individuals from the selected flour mill factories. This is adequate for representativeness of the study participants due to resource constriction and Rappaport recommendation.

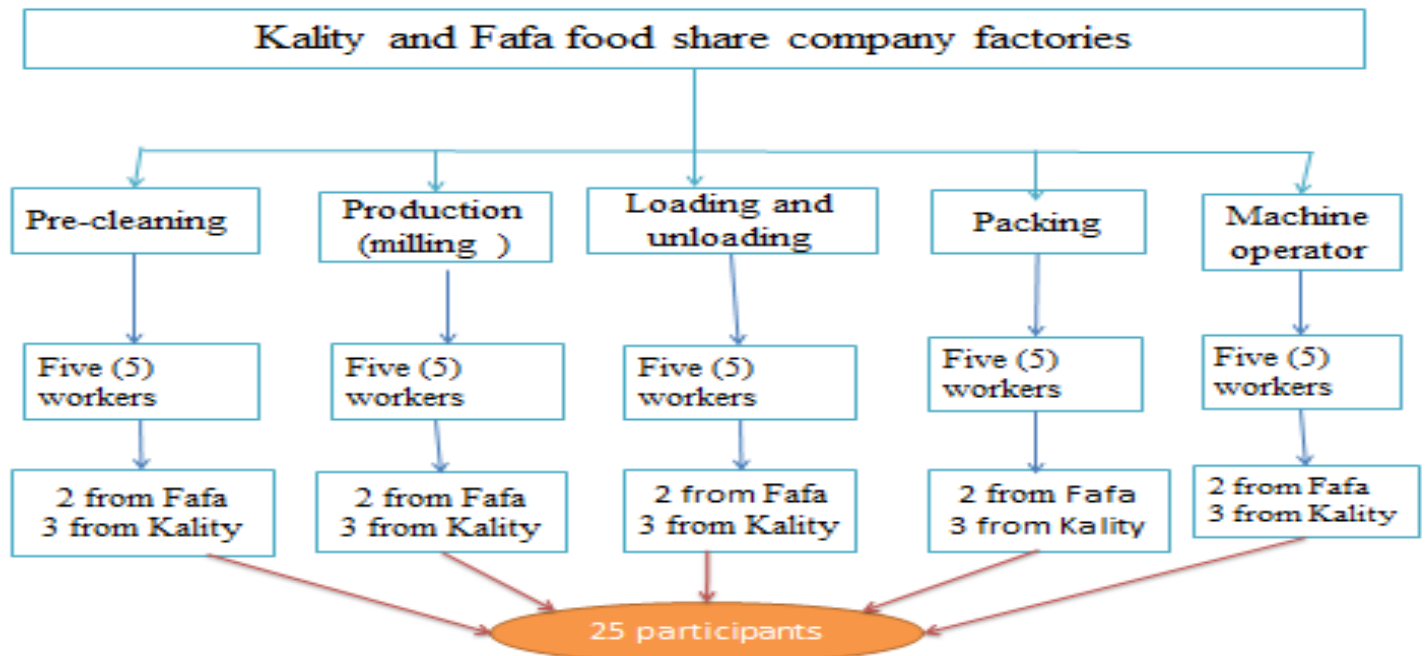


Figure 3: Schematic presentation of sampling procedure for personal total dust sampling in Akaki Kaliti Sub-City, Addis Ababa, Ethiopia; 2019.

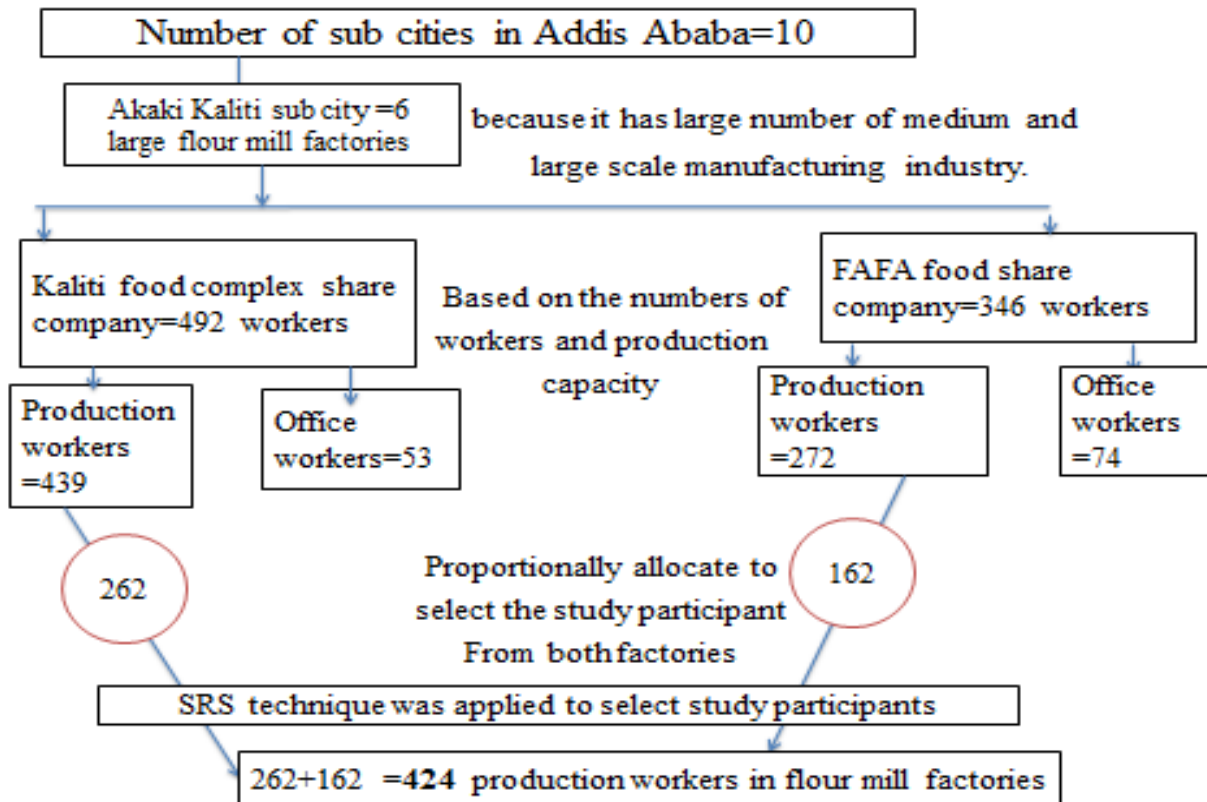


Figure 4: Sampling procedure for assessing respiratory symptoms using questionnaire/ interviews in Akaki Kaliti sub-city, Addis Ababa, Ethiopia, 2019.



Figure 5: Dust sampling equipment's used among flour mill workers in Akaki Kaliti, Addis Ababa, Ethiopia, 2019, i.e., Hand pump, Rota meter , PVC filter and 37 mm Millipore plastic cassette (CFC) respectively.

4.8. Data Collection

Data was collected from March 10, 2019 – May 25, 2019.

4.8.1. Data Collection Tools

Primary data source was used to accomplish this study by using three kinds of data collection tools i.e., structural questionnaire/interview from American Thoracic Society (ATS) to assess chronic respiratory health symptoms, observational checklist for the working condition and environmental factors and personal dust measurement for total flour dust exposure.

Assessment of Respiratory Symptoms/ Questionnaire or Interview

An interviewer-administered questionnaire is important to assess the respiratory health symptoms since their reading skill is uncertain, this is based on the ATS questionnaire on respiratory health symptoms with a few modifications was used in this study. The standardized questionnaire includes socio-demographic information, time of exposure, previous occupational history, smoking habits, past history of respiratory illnesses, and respiratory symptoms like a cough, phlegm, wheezing, shortness of breath, and nose irritating, particularly those associated with the risk of respiratory morbidity. Face to face interview was performed in Amharic by the trained data collectors before the dust sampling was accomplished. Pre-test also performed.

Observational Checklist

Observational checklist was used to assess the working condition(includes housing condition, ventilation, type of machine) and site visit at the work area was made to observe whether the study participants utilizes the appropriate personal protective devices or not, type of operation the study participant covered, and hand direction they use in the activity of working.

Personal dust sampling

To estimate the extent to which workers had been exposed to flour dust, personal dust monitoring was conducted for randomly selected workers at different work groups with SEG. As we observed from a preliminary walk-through visit, five dusty departments were selected from the flour mill industry. (i.e. pre-cleaning, machine operator, milling (production), loading and unloading and packaging. Personal total dust concentration was sampled using pre-weighed polyvinyl chloride (PVC) filter membranes with a pore size of 5 μ m placed on a Millipore plastic closed face 37mm filter cassette (CFC) connected to an SKC sidekick pump through which air was pumped by a rechargeable battery-powered motor at a constant flow rate of 2.0 l/min. The sampling cassettes situated on shoulder straps as close to the breathing zone as possible. Samplers were adjusted in front of either the right or the left shoulder of the participants from their position (hand direction) of working. Sampling was carried out over an entire

working time (without pause) or until the task was finish. The time of the sampling period was recorded using a digital minute timer. During dust sampling, observational checklist and data sheet was used to note pertinent data. In order to eliminate possible weight errors due to small amounts of moisture, both the unexposed and exposed filters was equilibrated for 24 hours in a conditioning environment (the mean relative humidity (RH) and temperature in the microbalance environment and/or the conditioning chamber was held between 30 and 40%, with a variability of not more than $\pm 5\%$ RH and 20 and 23°C, with a variability of not more than $\pm 2^\circ\text{C}$, respectively) over 24 hours before weighing.

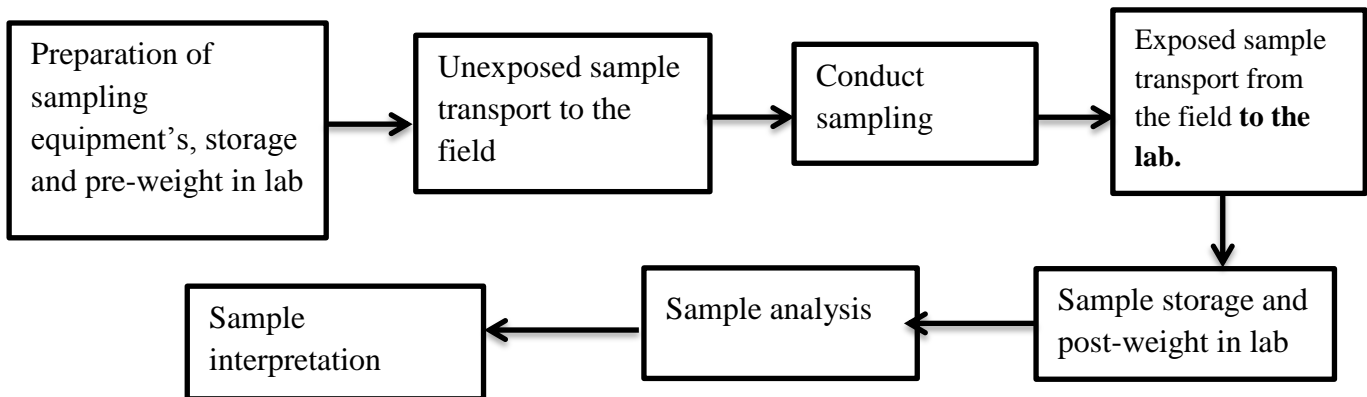
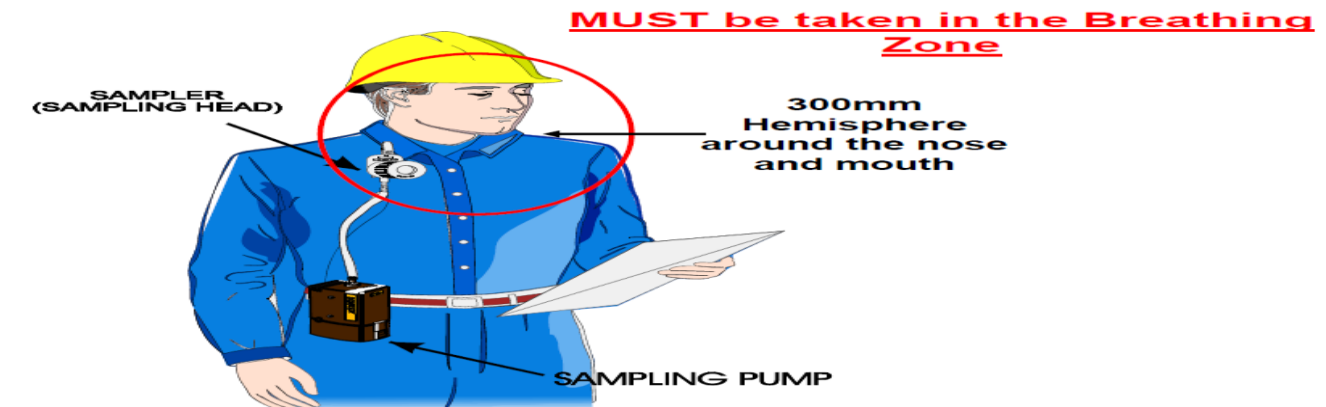


Figure 6: Sequence of dust sampling among flour mill workers in Fafa and Kaliti food complex factory, Addis Ababa, Ethiopia, 2019.



4.8.2. Data collection personnel

A total of six (6) data collection personnel were participated for this study. Four of them were data collector and two of them were supervisors with profession of BSc in environmental health were involved in this study. Two days training was given on the purpose of the study, data collection techniques and data quality management by the investigator. Personal flour dust measurement was performed by the trained principal investigator. During personal flour dust sampling, the principal investigator was clearly explained the procedures for dust measurement to the study participants in a group, fix the sampling tools on the study participants and record exposure activities of each study participants.

4.8.3. Data Quality Assurance

Standardized questionnaire modified from ATS was used to assure data quality. Prior to data collection, two days training was given to the data collectors and supervisors in order to fill the questionnaire appropriately and to reduce bias. Additionally, the questionnaire was translated from English to Amharic and back-translated to English using standard procedure to check its validity. Each data collector was checked the questionnaires frequently for completeness and consistency. At the end of the day, the supervisors was checked all the filled questionnaires. The principal investigator was cautiously observed and followed the overall activities of the data collection.

For dust sampling, the air flow rates in the sampling pumps was measured/checked and recorded before and after each sampling event by using Rota-meter (i.e., flow rates more than $\pm 10\%$ different from the target flow rate of 2.0 lit/min was dropped). Each series of sampling was controlled and corrected towards one field blank samples daily. Prior to fieldwork, one-day training was given to the investigator by the senior expert. At the end of sampling, the filter cassettes was separated from the tubing and sampling pumps, then covered, and carefully handled in a labeled container to prevent damage and transported to the lab for analysis. Prior to weighing, the microbalance was waiting until it becomes zero. Standard balance such (100 mg) was used periodically to check the reliability and validity of the microbalance. Pilot study or pre-testing was carried out at Ahfa flour mill factory a week before the actual data collection in order to check the competency of the data collectors, and the reliability and validity of the data collection tools.

4.9. Variables

4.9.1. Dependent Variables

- Chronic respiratory health symptoms

4.9.2. Independent Variables

- flour dust exposure (main independent variable)
- Socio-demographic factors: age, sex, educational status, income,
- Behavioral factors: cigarette smoking, utilization of PPEs, energy source used at home
- Environmental factors :Temperature , Humidity , Ventilation , Type of machine
- Workplace characteristics: duration of employment, length of working hours/day, length of working days/week, past history of dust exposure, availability of PPE, previous history of respiratory illness, training

4.9.3. Operational definitions

Chronic respiratory symptoms: - The development of one or more of the chronic symptoms of a cough, cough with sputum, breathlessness, nose irritation, wheezing, chest illness and sneezing which lasts at least three months in one year (24).

Chronic respiratory disease: - a respiratory disease like TB, chronic bronchitis, lung cancer, asthma, and heart disease that could be developed before and confirmed by physicians.(22)

Chronic Cough:-Experience of a cough for most days of the week (≥ 4 days) for at least three months in one year (24).

Duration of exposure: -defined as the working hours of workers in the factory per day.

Dust: consisting of particles in the environment that originates from several sources such as flour dust.

Duration of employment: defined as current workers experience in the factory.

Previous exposure history: - workers experience in the dusty environment before the current working position.(22)

Cough with sputum production: - It is sputum expectoration on most days of the week (5 days) for at least three consecutive months in one year (24).

Chronic Breathlessness: - Is defined as discomfort or difficult to breathe in different activities like walking up a slight hill, when undressing, walking at own pace (51).

Chronic wheezing:-a condition of causing a wheezy or whistling sound heard during inhalation or exhalation (at least three months in a year) (24)

Chronic chest pain: - In the past one year, chest pain that kept off work.(22)

Current smokers:-Workers who were smoking at the time of the study or a person who smoke cigarettes every day or some days (52).

Ever smoker: -a person smoked at least 100 cigarettes in his entire life

Flour dust: refers to dust coming from finely milled or otherwise processed cereals.

Similar Exposure Group: is a group of workers working the same type of tasks in a similar work area for the same length of time.

Pieces of cloths: Any item of clothing made up of textile/leather which can worn by the workers to cover their nose/mouth to protect the entry of flour dust particles.

Local exhaust ventilation: is the removal of airborne contaminants, close to their source of generation or release, before they can spread and reach the worker's breathing zone (1)

4.9.4. Data Management

At the time of data collection, the principal investigator checked the questionnaire for completeness and consistencies. The coded data were cleaned and entered into epidemiological information package (Epi Info version 7.2) and exported to statistical package for social sciences (SPSS) version 21 for data analysis. But, prior to starting data analysis cross-checking of the questionnaire with the soft copy was performed to ensure consistency. During personal dust sampling the flow rate was checked every one hour of the sampling pump (2.0 lit/min), and the appropriate location of the sampler head on the study participants. Both exposed and unexposed samples were handled carefully in a labeled canned tin during transporting. Dust sampling equipment was handled carefully in a bag, transported and stored in a dust free lab (Environmental and Occupational Health laboratory at the College of Health Sciences, Addis Ababa University) until they weighed. Exposure data was entered into MS-Excel spreadsheet and exported into SPSS version 21 for data analysis.

4.9.5. Data Analysis

Data analysis method for specific objective one (prevalence of respiratory health symptoms)

Descriptive statistics was used to describe the study populations using frequency distribution, measures of central tendency and dispersion that was displayed using tables and figures. Binary logistic regression was used to see the prevalence of chronic respiratory symptoms among flour mill workers.

Analysis method for specific objective two (associated factor for respiratory symptoms)

Descriptive statistics was used to describe the study populations using frequency distribution, measures of central tendency and dispersion that was displayed using tables and figures.

A bivariate analysis was used to identify whether exposure variables are significantly associated with outcome variables or not. Those, variables with $p < 0.2$ were included in the multivariable analysis. The multivariable analysis was used to identify variables associated with both outcome and exposure and to identify the confounding variables and used to determine AOR and 95% CL. Due to the binary nature of the outcome variable, binary logistic regression analysis was used to determine the COR with 95% CI that is used to check the association between dependent and independent variables individually.

Analysis method for specific three (personal flour dust exposure)

The result of the dust concentration was described by using descriptive statistics such as measure of central tendency (GM) and a measure of dispersion (GSD). One-way ANOVA was used to look at within groups and between groups variability based on day to day, subject to subject, place to place and task to task. The concentration of dust was calculated using the following equation;

The exposed filter membrane was weighed quantitatively by gravimetric analysis using a standard Mettler Toledo XPE105 microbalance scale with a detection limit of 0.01 mg at Environmental and Occupational Health (EOH) laboratory of College of Health Sciences, Addis Ababa University. The weighing of the sampling filter before and after sampling was carried out by the trained laboratory technician. Where,

$$\text{Concentration (mg/m}^3\text{)} = \frac{\text{(post weight of filter - pre-weight of filter) (mg) - blank weight (mg)}}{\text{Flow rate (lit per min)} \times \text{sample duration (min)} \times 1/1000 \text{ m}^3/\text{lit}}$$

- Weight of the dust (mg) = (weight of the filter after sampling - weight of the filter before sampling) (mg) - weight of the field blank filter (mg)
- Volume of air sampled (m³) = flow rate of the pump (lit/minutes) multiplied by the time of the sampling (minutes) multiplied by 1000 lit/ m³.
- Concentration of dust (mg/m³) = Weight of the dust (mg) divided by the Volume of air sampled (m³).
- The average dust concentration was compared with the threshold limit values (TLV) for total dust (also denoted as nuisance dust or Particles Not Otherwise Specified (PNOS), recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for 8-hours exposure (10 mg/m³) (35).

4.9.6. Ethical consideration

Ethical clearance was taken from the School of Public Health ethical review committee and was given permission letter. An official letter was wrote to Kaliti and Fafa flour mill factories managing director and Permission letter was obtained for requesting facilitation to conduct a research study and this official letter was approved and distributed to each departments for information and co-operation. The aim and method of the study and importance of their participation was clearly explained to each individual. From the finding the average dust exposure from each department was submitted to the managing director as he was requesting but not for the individual workers. The participant information sheet was given to the study participants for the sake of asking if they have question or anything regarding the study purpose.

The study participants who fulfilled the criteria for the study and agreed to participate were given Amharic written consent and signed before data collection started. Verbal consent was obtained for photo taking to show the dust sampling method and it was signed for witness. Issues of rights, privacy, and confidentiality were ensured during data collection period. Confidentiality was kept by making anonymous and assuring information was not accessible to anyone except the research personnel. Privacy was maintained by arranging a silent and comfortable place to the interviewer and study participants. Participants had the right to participate or not and to withdraw at any time when they feel discomfort. The study participant did not get a direct benefit like money but they become a beneficiary in the future from the study.

4.10. Dissemination of the Results

The result of this study will be presented to Addis Ababa University, school of public health and the copies will be given to Akaki and Fafa food complex share company flour mill factories. The findings will also be disseminated via publication.

5. RESULTS

A total of 424 flour mill workers were selected from two flour mill factories (KFCx and FF factories) to participate in the study, of which 415 were involved, 256(61.7%) from KFCx and 159(38.3%) from FF share company with a response rate of 97.9%. Three individuals were found unwilling to participate and six individuals were partially complete and excluded from the study.

5.1. Socio-demographic characteristics of respondents

Out of 415 respondents, 276(66.5%) were males and 203(48.9%) were found between the age group of 26-45 with the mean (\pm SD) age of 29.67 (\pm 8.52) years. Three hundred (72.3%) of the participants were Orthodox followers and 208(50.1%) of the study participants were single. Regarding educational level, 164(39.5%) of the respondents attended grade 9-12. The mean (\pm SD) monthly income (ETB) of respondents was 2326.03(\pm 1268.17) (Table 2).

Table 2: Socio-demographic characteristics of flour mill factory workers in Akaki Kality sub-city, Addis Ababa, Ethiopia, 2019. (n=415)

Variables	Frequency	Percentage (%)	
Sex	Male	276	66.5
	Female	139	33.5
Age in years	≤ 25	134	32.3
	26-45	203	48.9
	>45	78	18.8
Religion	Orthodox	300	72.3
	Muslim	47	11.3
	Protestant	68	16.4
Marital status	Single	208	50.1
	Married	194	46.7
	Divorced	6	1.5
	Widowed/Widower	7	1.7
Educational status	informal education	71	17.1
	1-8	124	29.9
	9-12	164	39.5
	Above 12	56	13.5
Monthly income in ETB	≤ 1500	175	42.2
	>1500	240	57.8

5.2. Work-related characteristics of flour mill workers

Out of 415 respondents, 331(79.8%) of the respondents had less than ten years (≤ 10 years) work experience in flour milling factory, and the majority (92%) of the study participants worked below eight hours (≤ 8 hours) per a day. Three hundred ninety-four (94.9%) of the respondents worked above five days (> 5) per week and 126 (30.4%) flour mill workers had a past occupational history in dusty areas before they were employed in this flour milling factory. Regarding previous history of respiratory diseases which is confirmed by physician, Sixty-two (14.9%) of the respondents had a past history of respiratory illnesses, out of them, 49(79%) of the respondents were males. Study participants who had: asthma 15(24.2%), chronic bronchitis 19(30.6%), emphysema 21(33.9%), and TB 7(11.3%) were found (Table 3).

Table 3:- Workplace factors of the flour mill factory workers in Akaki Kaliti sub-city, Addis Ababa, Ethiopia, 2019. (n=415)

Variables		Frequency	Percentage (%)
Work experience	≤ 10 years	331	79.8
	> 10 years	84	20.2
Working hours per day	≤ 8 hours	382	92
	> 8 hours	33	8
Working day per week	≤ 5 days	21	5.1
	> 5 days	394	94.9
Past dust exposure	Yes	126	30.4
	No	289	69.6
Energy used for cooking	Yes	364	87.7
	No	51	12.3
Previous respiratory illness	Yes	62	14.9
	No	353	85.1

Regarding the type of fuel used for cooking as primary source, 364(87.7%) of the participants prepared food at home. Of these 364, one hundred eighty-five (50.8%) of participants used biomass (including wood, coal, and gas) and 179(49.2%) participants used electric as a primary

source. Out of 415, one hundred fifty-two (36.6%) of the respondent were worked in the production department (Figure 6).

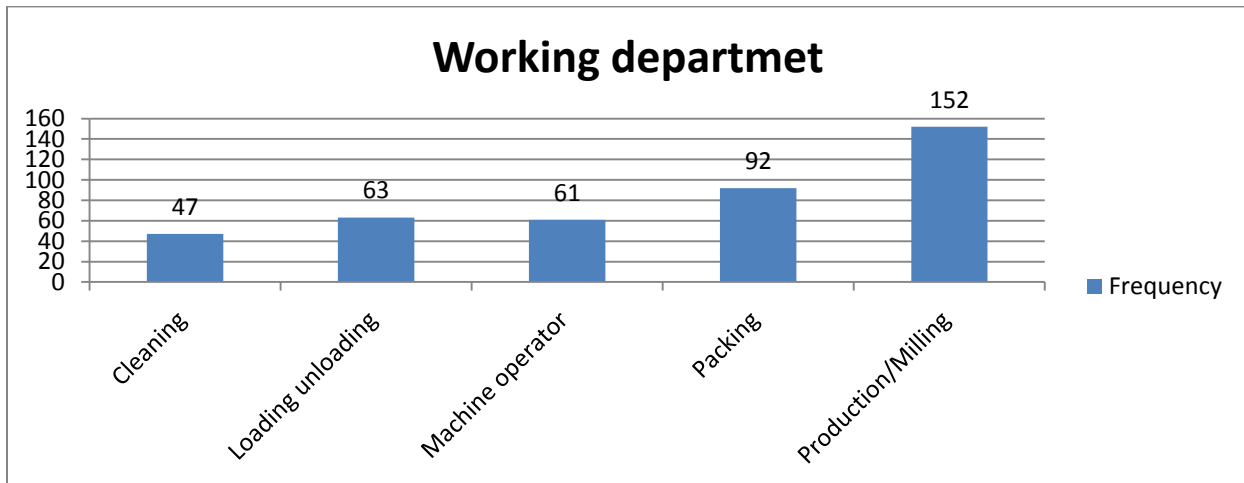


Figure 7: working departments of flour mill factory workers in Akaki Kality sub-city, Addis Ababa, Ethiopia; 2019. (n=415)

5.3. Individual/ behavioral characteristics of flour mill workers

Out of 415 respondents, 93 (22.4%) of respondents were used pieces of cloth as PPE. But none of them reported using proper respiratory protective devices. Regarding the smoking behavior of individuals, only 23(5.5%) study participants had a history of cigarette smoking, of the 23 ever smokers, 7(30.4%) of the respondents were current smokers. Regarding occupational safety training, **123**(29.6%) respondents taken training and 129(31.1%) of the participant were supervised by professionals on occupational health and safety issues. One hundred forty-one (47.2%) of the reasons mentioned by the respondents for none use of PPE was not available in the workplace (Figure 7).

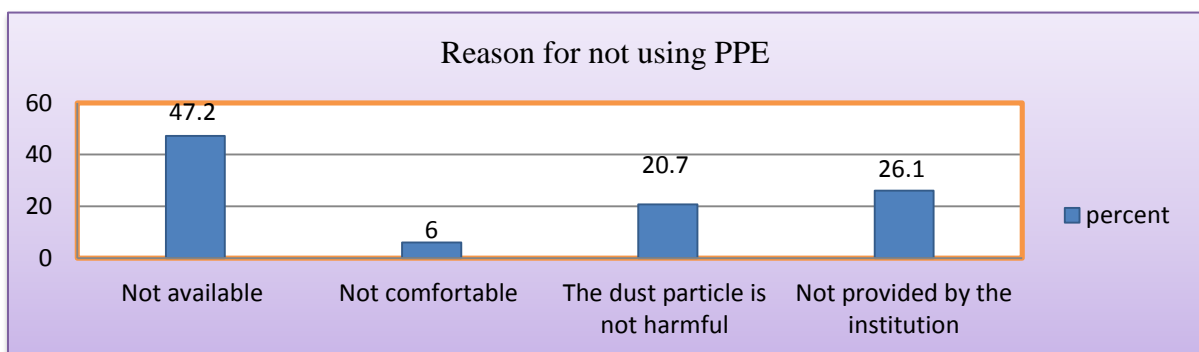


Figure 8: Reason for not using Personal protective devices among flour mill factory workers in Akaki Kality, Addis Ababa;Ethiopia 2019 (n=299).

5.4. Prevalence of chronic respiratory health symptoms among flour mill workers

The overall prevalence of chronic respiratory health symptoms among flour mill workers was 242(58.3%), (95% CI; 53.7-63.4) with prevalence of cough 114(27.5%), phlegm 97(23.4%), wheezing 85(20.5%), nose irritation 109(26.3%), sneezing 141(34%), shortness of breath 116(28%) and chest pain 59(14.2%). The prevalence of chronic respiratory health symptoms among males was 159(65.7%) and the prevalence of chronic respiratory health symptoms among production (milling) workers was 102(42.12%). The prevalence of chronic respiratory health symptoms among the age of 26-45 was 117(48.3%) and the prevalence of chronic respiratory health symptoms among married participants was 132(54.5%). The prevalence of chronic respiratory health symptoms among participants who did not take training and did not use personal protective devices was 71.9% and 81.8 % respectively (Table 4).

Table 4: Prevalence of respiratory health symptoms among flour mill factory workers in Akaki Kaliti sub-city, Addis Ababa, Ethiopia, 2019 (n=415)

Variables		Frequency	Percentage (%)
Cough	Yes	114	27.5
	No	301	72.5
Cough with sputum	Yes	97	23.4
	No	318	76.6
Wheezing	Yes	85	20.5
	No	330	79.5
Nose irritation	Yes	109	26.3
	No	306	73.7
Sneezing	Yes	141	34
	No	274	66
Shortness of Breath	Yes	116	28
	No	299	72
Chest pain	Yes	59	14.2
	No	356	85.8
Chronic respiratory health symptoms	Yes	242	58.3
	No	173	41.7

5.5. Factors associated with chronic respiratory symptoms among flour mill workers

5.5.1. Bivariate analysis

The bivariate analysis summarized in the (Table, 5, 6 and 7) showed that from socio-demographic factors (age, marital status, educational level, average monthly income), work-related factors (working hour per day, working experience, past dust exposure, past history of chronic respiratory symptoms) and behavioral factors (smoking habit and using of personal protective devices) were significantly associated with chronic respiratory health symptoms in bivariate analysis ($p < 0.2$); However, sex, working day per week, types of fuel used for cooking and occupational health and safety training were not significantly associated with chronic respiratory health symptoms in bivariate analysis ($P > 0.2$). Then variables with p-value < 0.2 at bivariate analysis entered in to the multivariate analysis.

Table 5: Respiratory health symptoms and socio-demographic factors among flour mill factory workers, Akaki Kality sub-city, Addis Ababa, 2019. (n=415)

Variable	At least one chronic respiratory symptoms		COR(95%CL)	p-value
	Yes	No		
Sex				
Male	159	117	0.92(0.6-1.39)	0.682
Female	83	56	1.00	
Age in year				
<=25	53	81	1.00	
26-45	117	86	2.08(1.33-3.24)	<0.001*
>45	72	6	18.34(7.44-45.19)	<0.001*
Marital status				
single	101	107	1.00	
married	132	62	2.26(1.5-3.39)	<0.001*
divorced/separated	4	2	2.12(0.38-11.82)	0.392
widowed/widower	5	2	2.65(0.5-13.96)	0.251
Educational level				
Informal education	58	13	3.35(1.5-7.46)	0.003*
1-8	66	58	0.85(0.45-1.61)	0.625
9-12	86	78	0.83(0.45-1.52)	0.542
>12	32	24	1.00	
Monthly income (ETB)				
<= 1500	114	61	1.64(1.1-2.44)	0.016*
> 1500	128	112	1.00	

Table 6: Respiratory health symptoms and work-related factors among flour mill factory workers, Akaki Kaliti sub-city, Addis Ababa, 2019. (n=415)

Variable	At least one chronic respiratory symptoms		COR(95%CL)	p-value
	Yes	No		
Work experience (years)				
<= 10	186	164	1.00	
> 10	56	9	8.18(3.97-16.88)	< 0.001*
Working hour per day				
<=8	232	168	1.00	
>8	10	5	4.4(1.66-11.63)	0.003
Working day per week				
<= 5	14	7	1.00	
>5	228	166	1.5(0.58-3.69)	0.428
Past dust exposure				
Yes	94	32	2.8(1.76-4.45)	< 0.001*
No	148	141	1.00	
Types of fuel used at home				
Biomass	106	79	1.3(0.75-2.31)	0.407
Electric	109	70	1.00	
Past history of respiratory disease				
Yes	53	9	5.1(2.45-10.68)	< 0.001*
No	189	164	1.00	

Table 7: Respiratory health symptoms and behavioral factors among flour mill factory workers, Akaki Kaliti sub-city, Addis Ababa, 2019. (n=415)

Variable	At least one chronic respiratory symptoms		COR(95%CL)	p-value
	Yes	No		
smoking behavior				
Yes	21	2	8.1(1.879-35.126)	0.005*
No	221	171	1.00	
Using of respiratory devices				
Yes	44	49	1.00	
No	198	124	1.78(1.117-2.831)	0.015*
Occupational health and safety training				
Yes	68	55	1.00	
No	174	118	1.19(0.78-1.83)	0.417

Note : 1.00= reference, * $p \leq 0.2$ for COR

CL-Confidence interval, COR- crude odds ratio, * Variables which were included in the multivariable analysis, biogas (coal, wood, and gas), $p < 0.05$.

5.5.2. Multivariable analysis

The multivariate analysis summarized in (Table 8) showed that after controlling the possible confounders age, average monthly income, past dust exposure, work experience and using of personal protective devices were statistically significant with development of chronic respiratory health symptoms in the final model ($P < 0.05$).

Age was significantly associated with chronic respiratory health symptoms among flour mill factory workers. The odds of developing chronic respiratory health symptoms among workers with the age of 26-45 (AOR=1.95, 95%CL; 1.17-3.24) and >45 (AOR=12.33, 95%CL; 4.39-34.64) years were 1.95 and 12.33 times significantly higher than workers with the age of ≤ 25 years respectively.

Average monthly income was significantly associated with chronic respiratory health symptoms among flour mill workers. The odds of developing chronic respiratory health symptoms among workers with monthly income of ≤ 1500 ETB (AOR=1.68, 95%CL; 1-2.79) were 1.68 times significantly higher than workers with monthly income of > 1500 ETB.

Past history of dust exposure was significantly associated with chronic respiratory health symptoms among flour mill factory workers. The odds of developing chronic respiratory health symptoms were 1.86 times significantly higher among workers who had worked in a dusty job before engaging in these factories than workers not worked in dusty work environment before (AOR=1.86, 95% CL; 1.08-3.21).

Employees used pieces of cloths instead of respirator /dust mask as PPE was significantly associated with chronic respiratory health symptoms among flour mill factory workers. Flour mill workers who used pieces of cloths had 56% less likely to develop chronic respiratory symptoms (AOR = 0.44, 95 % CI; 0.26 - 0.84) than workers who did not use pieces of cloths.

Work experience of flour mill workers were significantly associated with the development of chronic respiratory health symptoms. The odds of developing chronic respiratory symptom(s) were 2.58 times significantly higher among workers who had work experience of > 10 years (AOR=2.58, 95%CL; 1.-6.62) than workers who had work experience of ≤ 10 years.

Table 8: Multivariable analysis of associated factors and chronic respiratory health symptoms among flour mill factory workers in Akaki Kality sub-city, Addis Ababa, Ethiopia, 2019 (n=415).

Variables	At least one chronic respiratory symptoms		COR(95%CL)	AOR(95%CL)
	Yes	No		
Age in year				
<=25	53	81	1.00	1.00
26-45	117	86	2.08(1.33-3.24)	1.95(1.17-3.24)
>45	72	6	18.34(7.44-45.19)	12.3(4.39-34.64)
Marital status				
single	101	107	1.00	1.00
married	132	62	2.26(1.5-3.39)	1.54(0.94-2.51)
divorced/separated	4	2	2.12(0.38-11.82)	2.16(0.37-12.49)
widowed/widower	5	2	2.65(0.5-13.96)	1.76(0.27-11.51)
Educational level				
Informal education	58	13	3.35(1.5-7.46)	1.6(0.67-3.96)
1-8	66	58	0.85(0.45-1.61)	0.67(0.32-1.37)
9-12	86	78	0.83(0.45-1.52)	0.85(0.43-1.69)
>12	32	24	1.00	1.00
Monthly income (ETB)				
<= 1500	114	61	1.64(1.1-2.44)	1.68(1.01-2.79)
> 1500	128	112	1.00	1.00
Working experience				
<= 10	186	164	1.00	1.00
> 10	56	9	8.18(3.97-16.88)	2.58(1.-6.62)
Past dust exposure				
Yes	94	32	2.8(1.76-4.45)	1.86(1.08-3.19)
No	148	141	1.00	1.00
Past history of respiratory disease				
Yes	53	9	5.1(2.45-10.68)	2.35(0.94-5.895)
No	189	164	1.00	1.00
Smoking behavior				
Yes	21	2	8.1(1.88-35.13)	4.21(0.84-21.04)
No	221	171	1.00	1.00

Using of respiratory

devices	Yes	44	49	1.00	1.00
	No	198	124	1.78(1.17-2.83)	2.29(1.27-4.13)

Note: 1.00= reference, ** $p \leq 0.05$ for AOR

AOR- adjusted odds ratio, CI- confidence interval, COR- crude odds ratio, ETB- Ethiopian birr, Biomass (coal, wood, and gas), ** variables which were statistically significant in the final model ($p < 0.05$).

5.6. level of dust exposure among flour mill factory workers

A total of 25 flour mill workers with repeated measurements each were included in this study and majority (80%) of the study participants was male workers. Workers from these sections were highly exposed to flour dust due to the nature of the factories which had high production rate per day and repeated duration of exposure.

5.6.1. Personal flour dust exposure (n=50)

The current study showed that, majority (92%) of the workers were exposed to dust above the acceptable recommended limit value of 10 mg/m³ of total dust of American Conference of Governmental Industrial Hygienist (ACGIH recommendation). The geometric mean (\pm GSD) of the overall personal flour dust concentration was 62.75(\pm 12.55) with a range varying from 8.65-21727.78 mg/m³. The time of measurement ranges from 72-251 minutes with mean (\pm SD) of 204.42(\pm 49.89) minutes.

Personal total dust exposure within the five departments varied considerably between flour mill factories. The GM personal total dust exposure among the five department ranges from 13.76-690.05 mg/m³. Flour mill workers who were working in the production (milling) section were highly exposed to flour dust [GM (\pm GSD) of 690.05(\pm 36.05)] mg/m³. On the other hand, flour mill workers who engaged in machine operating were less exposed to flour dust comparing to the other departments [GM (\pm GSD) of 13.76(\pm 1.34)] mg/m³.

Table 9: personal total dust exposure levels by work section among flour mill factory workers, in Akaki Kality, Addis Ababa, Ethiopia, 2019.

Task (work section)	KFCx		FF		Average GM(\pm GSD)	Above OEL 10 mg/m ³
	Range (mg/m ³)	Mean \pm (SD)	Range	Mean \pm (SD)		

			(mg/m ³))		
Pre-cleaning	9.78-22.97	14.69(±4.65)	9.1-22.24	15.65(±6.4)	14.3(±1.4)	80%
Milling	3821.6-21727.78	12288(±6043.8)	8.6-13.75	11.2(±2.2)	690.1(±36.1)	90%
Machine operator	11.79-24.06	24.06(±16.48)	9.23-14.09	11.1(±2.1)	13.8(±1.34)	90%
Packing	706.5-2869.1	1708.98(±939.83)	13.59-19.4	16.3(±2.5)	244.2(±10.8)	100%
Loading & unloading	10.94- 426.6	143.63(±187.05)	11.1-14.18	12.1(±1.4)	29.39±4.19)	100%
Total					62.8(±12.6)	92%

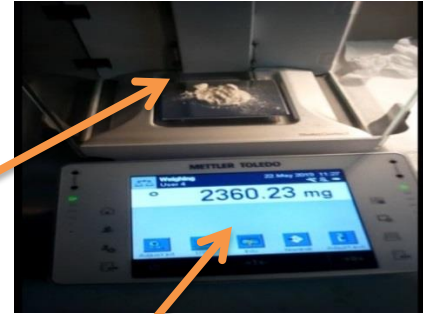
Regarding dust exposure concentration there was no significant difference between the sampling days (df =9, F = 1.37, p = 0.234). The *post hoc test* (Bonferroni) revealed that there was no significant difference in mean exposure levels between sampling days (first round is not different from second round). Comparing dust exposure concentration with the factories there was a significant difference between the two factories (df = 1, F = 7.24, p = 0.010).

Regarding the working sections, total dust exposure concentration was highly significant difference between the working departments (df =4, F= 10.09, p<0.001). The *post hoc test* (Bonferroni) revealed that there was a significant difference among pre-cleaning (m=15.07, SD= 5.10) and production (milling) but pre-cleaning is not different with machine operator (m= 14.30, SD= 4.41), packing (m= 1031.89, SD= 1120.18) and loading unloading (m=91.02, SD= 155.08) sections. It also showed that production department was significant difference with all departments, which means that milling department was highly significant with pre-cleaning, packing, machine operator and loading and unloading departments. But there was no difference among pre-cleaning, packing, machine operator and loading unloading section.



Packing department

Flour dust during measurement



post weight of the dust (mg)



**Measured sample transport
breathing zone)**

position of the sampling head on the worker (30 cm from

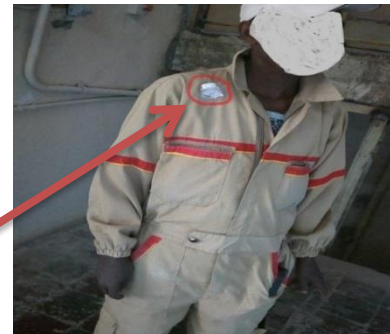


Figure 9: personal dust sampling procedures (transportation, proper position of sampling head and sampling pump, post-weight of the dust) and work section Addis Ababa, 2019(by Embay A.)

5.7. Environmental factors on flour mill workers

Observational findings of the study indicated that flour dust was accumulated on the walls, ceiling, floors and machines of different working areas, especially very high dust accumulated in the flour mill and packing department of flour mills as fine organic flour dust gets airborne in the indoor environment of the flour mills. Due to this workers easily inhaled heavy dose of flour dust. The reason for high dust was due to lack of dust absorber or local exhaust ventilation. The workplaces of flour mills was very congested and above six machines were found in one room and perform different activities each. There was no employee using proper personal protective mask/respirator. The organizations were provided pieces of cloths which were tied on the neck of workers to protect the entry of flour dust particles. But most of them did not use even those pieces of cloths due to lack of supply. Some of them did not use the provided piece cloths since they believed that it reduces performance, was not comfortable, and inefficient for protecting the dust particles. Most females used the provided piece of cloth in the work place. Even though the

organization did not provide PPE, females also used their own cloths for protecting themselves from flour dust.

The nature of the house was very old and the floors were made up of woods and it easily accumulates the dust. The state of natural and mechanical ventilation, design of machine and high production rate had an impact on dust exposure. Individual behaviour was observed carefully, the standing position of some workers were very close to the machines and works different working activities. The type of sack (bag) used for packing also had an impact (the dust was higher when they used old sack (bag) than new sack) which produces heavy amount of dust concentration. As a result they are continuously exposed to heavy concentration of flour dust. Flour mill workers were performed their duty by rotation (shifts) and they have similar exposure level in each departments, some of the workers were performed their duty in standing position which is very close to the machines, some of the workers perform additional activities. Flour dust were found in any corners of the working place even out side the rooms which perform different activities. The workplace area is very congested, have poor ventilation and used very old machine which increase dust concentration.



Figure 10: Flour dust accumulated in in different corners of the factories (floor, wall, ceiling and machines of any working sections of the factories, 2019 (By Embay A.)

6. DISSCUSSION

The finding of this study showed that the overall prevalence of chronic respiratory health symptoms among flour mill factory workers was 58.3%, (95% CL; 53.7-63.4) and high personal total flour dust exposure in the flour mill factories was found. This study was in-line with study done in Ethiopia, Hawassa city among flour mill factory workers with the prevalence of (56.6%) (33) . But comparatively higher than previous study conducted in UK, prevalence of respiratory symptoms among flour millers was 22%. (5) This difference could be due to the variation in the definition of the outcome variable, T.A. Smith (2000) used only the development of upper respiratory tract, allergy, cough and nose irritation while this study used the development of cough, cough with sputum, sneezing, nose irritation, wheezing, shortness of breath and chest pain. Other reason could be no one was used any respiratory protective devices and only (22.4%) workers used pieces of cloths in this study. The observed difference could be explained by study setting in which the study was done and the sample size of this study was large.

The finding of this study revealed that the prevalence of chronic respiratory symptoms such as cough (27.5%), cough with sputum (23.4%), wheezing (20.5%), nose irritaion (26.3%), sneezing (34%), shortness of breath (28%) and chest pain (14.2%) was in line with the study done in Hawassa among flour mill workers (33) but comparatively lower than the study done in North West Ethiopia, in Kola Diba town with cough (42.1%), wheezing (35.7%), sneezing (64.9%), and chest pain (17.5%) (19). The difference is might be due to the type of factory, since the study done in Kola Diba was conducted in local flour mill workers but this study was done in large scale industry which uses advanced machine than that of the local flour mill, so the local flour mill have more dust than current study and in local flour milling manual working is common but in this study most of the activities were covered machanically . In addition the difference could be due to the local/place where Kola Diba is located in the rural side compared to this study area and the workers may lack awareness. The present study suggested that the prevalence of cough (27.5%) was consistent with previous study conducted in Addis Ababa among local flour milling workers (27.7%), but the prevalence of this study was higher than the previous study where cough with sputum (11.1%), wheezing (14.3%), shortness of breath (14.8%) and no chest tightness was observed (20). The observed difference might be due to small sample size in the previous study and conducted only on male workers. High production rate in the current study also the other reason for the high prevalence of chronic respiratory symptoms.

This study suggested that age of flour mill workers was significantly associated with chronic respiratory symptoms, (age group, 26-45 years)(AOR=1.95, 95% CL; 1.17-3.24) and >45 years (AOR=12.33, 95% CL; 4.39-34.64) which was consistent with the previous study conducted in Egypt among flour mill workers in 2013, ($p < 0.05$)(18). The difference between the age group might be due to the variation in the appropriate utilization of nose/mouth mask, i.e., the young people may wear it properly while the old people may have a misconception on the nose/mouth mask utilization. Other reason could be as age increase individual immunity decrease. But age is not significantly associated in the previous study conducted in Ethiopia, Hawassa city among flour mill factory workers (33).

This study suggested that monthly income of the participants were significantly associated with the development of chronic respiratory health symptoms among flour mill workers with monthly income of ≤ 1500 (ETB) (AOR =1.68, 95% CL; 1.01-2.79). This finding indicated that workers with monthly income of ≤ 1500 were 1.68 times more likely than workers with monthly income of >1500 ETB to develop chronic respiratory health symptom. This study was consistent with the study conducted in Finland among low socio economic status population which indicated that population with low income develops chronic respiratory symptoms than with high income population (34). This finding may be due to those workers with monthly income of less than 1500 ETB works an extra time to get bonus or additional fee. This could be due to the fact that exposures to flour dust for a long time (hours) enhanced dust accumulation in the respiratory system as a result workers can develop chronic respiratory symptoms.

The current study found that workers with previous dust exposure were significantly associated with development of chronic respiratory health symptoms than workers with no past dust exposure (AOR=1.86, 95% CL; 1.08-3.21). This study is similar with the study done in Tanzania among sunflower oil industry which stated that previous dusty job are three times more likely to have difficulty breathing and breathlessness as the respiratory health symptoms than free from previous dusty job (26). This can be explained by the fact that workers with previous exposure ignore to use personal protective equipments because they think they adapt the dust. This statistical significance could be because the workers might have previously worked in dusty jobs identified to cause respiratory problem so this may lead to the aforementioned respiratory tissue physiologic change in a later life and exacerbate the occurrence of respiratory symptoms.

Our study found that there was a statistically significant association between chronic respiratory symptoms and duration of employment. Workers with work experience >10 years were significantly associated with the development of chronic respiratory symptoms (AOR=2.58, 95% CL; 1.00-6.62). This finding was in line with the study done in Ethiopia and Egypt (Duration of employment was found to be an important factor that influenced the prevalence of respiratory symptoms among flour mill workers ($p=0.0027$) (18, 33). This could be due to increased dust accumulation in respiratory system with long-term exposure leading to air way limitation and workers with high work experience may not use PPE due to ignorance.

This study revealed that respiratory protective devices utilization was significantly associated with the development of chronic respiratory health symptoms. Workers who did used pieces of cloths to cover their nose and mouth while at work was 56% less likely to develop chronic respiratory health symptoms than workers who did not use pieces of cloths (AOR = 2.29 95 % CI; 1.27-4.13). Respiratory protective equipment utilization behavior of the flour mill factory workers was very low. Even majority of workers agreed on the importance of RPE using for preventing themselves from flour dust particles, but the factories did not supply RPE for workers and which is similar with the result of study done in Hawassa, India and Nigeria flour milling factory workers (24, 33, 53). This may be due to lack of standardized respiratory protective devices used in those factories because no one was used any respiratory protective device rather than pieces of cloth and the equipment were not classified according to the quality of protection. Yet the usage of pieces of cloths in this study was (22.4%) which is lower than the study done in Tanzania (55.8%) (26). This difference may be due to lack of awareness on utilization of personal protective equipment while at work and lack of occupational health and safety training in the present study.

Statistically significant association was detected between the presence of respiratory symptom and work section. Workers who were working in milling (AOR=3.24, 95% CL; 1.54-6.82) and packing (AOR=2.42 95% CL; 1.06-5.49) sections were more likely to develop chronic respiratory symptoms than workers in machine operating sections. This finding was inconsistent with previous study conducted in Ethiopia, Hawassa city, which reported that mixing workers had high prevalence of chronic respiratory symptom than milling section (33) but in line with the study done in Iraq and Egypt, which reported that packing and milling departments had high chronic respiratory symptoms than other departments (18, 39). This could be due to difference in working condition such as ventilation type, machine type, number of machine present in one room and use of personal protective device. Other

reason could be participants who were working in packing and milling had direct contact with the fine products of flour which can be easily inhaled.

From this finding we observed that the overall personal total dust concentration was much higher than that of the previous study conducted in Tanzania with GM (5.25 ± 0.51) mg/m³, in Iran among flour factory workers (8.06) mg/m³ and UK among flour millers where only 43% were above the acceptable recommended limit value (3, 5, 26). This difference might be due to the type of the machine which is very old in this study and multiple exposure, which is more than 6 machines were found in one room performing different activities. Individual practice (behavior) could increase the dust concentration. Other reason for high flour dust concentration also poorly ventilated workplace and unhygienic working environments. In addition, no local exhaust system or dust absorbers (sucker) were observed in any flour mill factories of this study.

The maximum exposure to flour dust in this study was seen in the production (milling) with GM (690.05) and packing (244.19) mg/m³ section and the lowest exposure was in the machine operators (13.76) and pre-cleaning (14.32) mg/m³ section. This might be due to workplace ventilation since machine operator and loading workers work outside the factories which is well ventilated than the inside factory. This is consistent with the study conducted in Iraq where milling and packing workers were highly exposed to flour dust (39). But inconsistent with the study done in Hawassa where packing and milling workers were less exposed (33). This is may be due to the variation in working condition and types of ventilation of the workplace as well as the type of machine used. Other reason could be due to variation in utilization of personal protective equipment's.

This study revealed that there was a statistical difference in dust exposure concentration between the two factories. This variation may be due to the difference in the types of machine and the number of machine present per room which perform different activities which can increase the exposure for dust concentration and the production rate per day where Kality food complex share company produces 600 quintal. It investigated also there was a significant difference between the five departments. This variation could be due to the quantity of dust produced among (milling) and packing departments was very high and due to direct contact with flour dust.

7. STRENGTH AND LIMITATION OF THE STUDY

7.1. Strength

Personal total dust monitoring was performed for the measurements of dust exposure level and Standard balance (Mettler Toledo) was used periodically to check the reliability and validity of the microbalance in accredited laboratory with data quality assurance. Unlike previous studies this study used large sample size and strong power used to assess chronic respiratory symptoms. Three types of data collection tools were used to assess chronic respiratory symptoms and personal total flour dust exposure.

7.2. Limitation

Respondents recall bias and interviewers bias was possibly introduced during interviewing the study participants. This study tries to know personal dust exposure level only on flour mill worker but did not use comparison group. In nature total dust sampler has inherent characteristics in underestimating the coarse particles in the inhalable dust fraction. Since the sampling head used in the present study was 37mm Millipore plastic sampling head (CFC) it is known to significantly underestimate these coarse particles found in the flour dust above 30 μm . It was difficult completely to apply Rappaport recommendation due to dust concentration variation between the factories. During personal dust measurements the participants may expose intentionally. Since this study used cross-sectional study design, no conclusive remarks can be drawn on causal-outcome associations between flour dust exposure and adverse respiratory health effects in such studies.

8. CONCLUSION AND RECOMMENDATION

8.1. Conclusion

The overall prevalence of chronic respiratory health symptoms among flour mill factory workers was high. Respiratory symptoms were found to be more common among older age, low monthly income, with past dust exposure, milling and packing work section, long work experience (>10 years) and not using of respiratory protective devices workers. The geometric mean of the dust concentration was $62.75(\pm 12.55)$ mg/m³. Majority (92%) of flour mill workers were exposed to flour dust concentration exceeded the occupational exposure limit recommended by the ACGIH TLV guideline of total dust (10 mg/m³). Most flour mill workers were unaware of the effect of exposure to flour dust. Unhealthy condition at work place environment was observed and none of the workers used respiratory protective devices.

8.2. Recommendation

The following important measures are recommended to protect flour mill workers from development of chronic respiratory health symptoms while at work.

For Ministry of Labour and Social Affairs (MoLSA)

It could be better if workplace risk assessment is done by Ministry of Labour and Social Affairs to identifying the level of flour dust exposure and set occupational exposure limits value in Ethiopia, because flour dust was observed as the most predictor for respiratory symptoms. Regular supervision of flour mill factory also needed. They should issue detailed regulations that can be legally binding and should monitor to ensure the implementation of these regulations.

For Flour mill factories owners and managers

In the long run it is recommended to apply engineering control to reduce dust concentration at work place i.e. local exhaust ventilation or dust absorber, modification of the old machine or better to change by new machine and the workplace should be designed with easy to clean floor. It is advisable to apply administrative control method i.e. policy and producers should posted and practice accordingly, job rotation of workers, occupational health and safety training should give regularly, giving Incentives or any reward is better for those who have good work practices which minimize exposure. Managers should ensure continue and effective inspection and maintenance program. It is recommended to provide standard and adequate respiratory protective devices and better to encourage the workers to utilize it.

For Flour mill workers

Workers should keep workplace hygiene and should properly wear respiratory protective equipment 'which supplied by the institution. They should apply policy and producers which are posted in the work place and better to develop good working practice.

For Researchers

Further study is advised to use longitudinal study for investigating personal dust exposure level, chronic respiratory symptoms and lung function changes among flour mill workers.

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ANNEXES

ANNEX I: QUESTIONNAIRES (ENGLISH VERSION)

Addis Ababa University, College of Health Sciences, school of Public Health, Department of Preventive Medicine (Environmental and Occupational Health unit)

Participant information sheet

I. Participant Information Sheet for the Interview

Greetings:

How are you? I am **Embay Amare Alemseged**. I came from Addis Ababa University, College of Health Science, and School of Public Health to conduct research. The aim of the study is to assess personal flour dust exposure and chronic respiratory health symptoms among flour mill workers in Kaliti food share company, Addis Ababa, Ethiopia. Therefore, this study will have a great role in the control and prevention of chronic respiratory symptoms among flour mill workers. Further, I believe that this study will help governmental and stakeholders to focus in this area to solve the problems faced among these workers. During the study period standard questionnaire from ATS with few modifications and observational checklist will be used. The study has ethical approval from School of Public Health. You will be requested for the willingness after I provide you the required information about the study. This interview will take about 30 minutes.

This study will not provide any direct benefit to the study participants. However, the information obtained from this study will help to generate data in order to design an appropriate intervention. This study will not have any harm to the study participants except spending time for the interview. Your participation is voluntary and you have the right to be involved or not after being fully informed. Nothing will happen if you say “No”. If you feel discomfort with the interview, please be free to withdraw or discontinue at any time you want. Any personal information given by you will be kept anonymously.

Whom to contact: If you have any question about the research you may contact Embay Amare (PI) Addis Ababa University, College of Health Sciences, School of Public Health (Tel +251-9-14-79-63-08) or Dr. Abera Kumie (Tel +251-9-11-88-29-12) or Mr. Yifokire Tefera (Tel +251-

9-13-75-40-82) (supervisors) Addis Ababa University, College of Health Sciences, School of Public Health or School of Public Health ethical review committee (Tel +251-115157701). At this time, do you want to ask me anything about the purpose or content of this interview? Are you willing to participate in the study?

II. Participant Information Sheet for the Dust Monitoring

Greetings:

How are you? I am Embay Amare Alemseged. I came from Addis Ababa University, College of Health Science, and School of Public Health to conduct research. During the study period standard dust measurement will be conducted. The study has ethical approval from School of Public Health. This study will not provide any direct benefit to the study participants. However, the information obtained from this study will help to generate data in order to design an appropriate intervention. In addition to that, we will inform you exposure level you will have during the exposure assessment. This study will not have any harm to the study participants except spending time for the exposure measurement over the whole working hours.

The aim of the study is to assess personal flour dust exposure and chronic respiratory health symptoms among flour mill workers in Kaliti and FAFA food complex share company, Addis Ababa, Ethiopia. Therefore, this study will have a great role in the control and prevention of chronic respiratory symptoms among flour mill workers. Further, I believe that this study will help governmental and stakeholders to focus in this area to solve the problems faced among these workers. You will be requested for the willingness after I provide you the required information about the study.

The procedure how to perform: you will be requested to fix the tools of dust samplers on your body for quantifying the flour dust which is probably to be inhaled by you. A small sampling head will be attached to your breathing zone that is used to trap the flour dust. A 0.5 kg hand pump will be mounted on your waist. The pump draws air through a connecting tube passing the sampling head. The tool has no any interference with your health as well as your work except a bit of sound since it works with a battery. The sampling duration is to cover the whole working hours. The principal investigator will help you in fixing the tool, start and stop the hand pump. Your participation is voluntary and you have the right to be involved or not after being fully informed. Nothing will happen if you say “No”. If you feel discomfort with the measurement,

please be free to withdraw or discontinue at any time you want. The exposure data will not be accessible to anybody other than the study members. All information forwarded will be kept confidential and names will not be written.

Whom to contact: If you have any question about the research you may contact Embay Amare (PI) Addis Ababa University, College of Health Sciences, School of Public Health (Tel +251-9-14-79-63-08) or Dr. Abera Kumie (Tel +251-9-11-88-29-12) or Mr. Yifokire Tefera (Tel +251-9-13-75-40-82) (supervisors) Addis Ababa University, College of Health Sciences, School of Public Health or School of Public Health ethical review committee (Tel +251-115-15-77-01). At this time, do you want to ask me anything about the purpose or content of this interview? Are you willing to participate in the study?

INFORMED CONSENT FORM

Having the above information, I kindly ask you to take part in the study.

I undersigned will like to approve that, as I give my consent to participate in this study after detailed objective of the study have been explained to me in the language I understand. I have also understood that I can withdraw my consent any time without loss of any personal benefits.

1. If yes, continue to the following questions
2. If no, provide compliment, and skip to the next participant

Participant signature: _____ Date: _____

Name of data collector _____ Signature: _____ Date: _____

IDENTIFICATION

Questionnaire code: _____ working department _____

Name of flour mill factory: **1. FAFA food complex** **2. Kaliti food complex**

Please encircle the correct answer and write a correct number in the space provided, example age in years using pen (Blue).

Table 1: Questionnaire (English Version)

PART I. SOCIO-DEMOGRAPHIC CHARACTERISTICS

S/N	Question	Response	Skip
100	Sex	1. Male 2. Female	
101	Age (in year)	_____years	
102	Marital status	1. Single 2. Married 3. Separated /Divorced 4. Widowed/Widower	
103	Religion	1. Orthodox 2. Muslim 3. Protestant 4. Catholic 5. Others (specify)	
104	Educational level	1. can't read and write 2. not attending formal education (can read & write) 2. 1 – 8 3. 9 - 12 4. Above 12	
105	What is your income per a month?	_____ Ethiopian birr	
Current occupation of the respondents			
106	How long do you working in this job?	_____ Year	
107	How many working hours per a day?	_____ hours	
108	How many working days per a week?	_____ days	
109		Working department	Service year

	Which section are you working now and for how long?	Cleaning		
		Milling		
		Machine operating		
		Packaging		
		Loading		
110	Have you ever worked in other sections in the past in the flour factory?	1. Yes 2. No		
111	If Q 110 answer is "Yes" indicate which section and for how long? (in years & months) (Multiple answer is possible)	Working department	Service year	
		Cleaning		
		Milling		
		Machine operating		
		Packaging		
		Loading		
PART II. PAST OCCUPATIONAL HISTORY				
200	Have you ever worked for any other dusty job?	1. Yes 2. No		If "NO", skip to No. 202
201	If "Yes" for Q. No 200 For how long did you work in the areas listed below (more than one answer is possible)	1. Welding _____ 2. Crusher _____ 3. Mining _____ 4. Flour mill _____ 5. Sweeping 6. Other (specify) ____		
202	Does food prepared in your home by you or other person?	1. Yes 2. No		If "NO" skip to 204

203	If “Yes” for Q. No 202 What kind of energy source mostly do you use for food preparation? (your primary fuel type)	1. Coal 2. Wood 3. Gas 4. Electric 5.LPG 6. Others (specify)_____	
PART III. PAST HISTORY OF RESPIRATORY ILLNESSES			
204	Did you have previous chronic lung conditions told by a doctor?	1. Yes 2. No	If “NO” go to Q.No 300
205	If “Yes” for Q. No 204 What type of health problem did you experienced earlier? (more than one answer possible)	1. Chronic bronchitis 2. Emphysema 3. Asthma 4. Lung cancer 5. Tuberculosis (TB) 6. Other (specify) ____	
PART IV. CIGARETTE SMOKING BEHAVIOUR			
Ever smoker: - a person smoked at least 100 cigarettes in his entire life.			
Currently smoker: - a person who smoke cigarettes every day or some days.			
300	Have you ever smoked cigarettes?	1. Yes 2. No	If “NO” go to Q. No. 304
301	Do you now smoke cigarettes (as of 1 month ago)?	1. Yes 2. No	

302	How many cigarettes do you smoke per day now?	_____ cigarettes/day	
303	For how long did you smoke cigarette?	_____ years	
304	Is there any person who smoke cigarette in your home?	1. Yes 2. No	
PART V. Respiratory Symptoms			
A. Cough:			
<p>Cough: Experience of a cough as much as 4– 6 times per day occurring for most days of the week (≥ 4 days), or cough at all on getting up in the morning or during the rest of the day/night for at least three months in one year)</p>			
400	Do you usually have a cough?	1. Yes 2. No	If ‘‘NO’’ go to No. 403
401	Do you usually cough as much as 4 to 6 times a day, 4 or more days out of the week?	1. Yes 2. No	
402	Do you usually cough at all on getting up in the morning?	1. Yes 2. No	
403	Do you usually cough at all during the rest of the day or at night?	1. Yes 2. No	
404	If ‘‘Yes’’ to any of the above (400, 401, 402, or 403), Answer the following 2 questions: Do you usually cough like this on most days for 3 consecutive months or more during the year?	1. Yes 2. No	If No to all skip to Q.No. 406
405	For how many years have you had this cough?	_____ years	

A Cough with sputum production related questions

A Cough with sputum :- is sputum expectoration on most days of the week (5 days) for at least three 3 consecutive months in one year

406	Do you usually cough with sputum first thing in morning	1. Yes 2. No	
407	Do you usually cough with sputum during the day or at night?	1. Yes 2. No	
408	Do you usually cough with sputum for 4 or more days in a week?	1. Yes 2. No	
409	Do you cough with sputum on most of days for as much as 3 consecutive months or more in a year?	1. Yes 2. No	

Phlegm

Phlegm: Sputum expectoration as much as twice a day for most days of the week (≥ 4 days), or bring up phlegm at all on getting up in the morning, or during the rest of the day/night for at least three months in one year.

410	Do you usually bring up phlegm from your chest as much as twice a day, 4 or more days out of the week?	1. Yes 2. No	
411	Do you usually bring up phlegm at all on getting up in the morning?	1. Yes 2. No	
412	Do you usually bring up phlegm at all during the rest of the day or at night?	1. Yes 2. No	

413	If “Yes” to any of the above (410, 411, 412), Answer the following 2 questions: Do you bring up phlegm like this on most days for 3 consecutive months or more during the year?	1. Yes 2. No	If No to all skip to No. 415
414	For how many years have you had trouble with phlegm?	_____ years	
<p>Wheezing, Nose Irritating, and Sneezing</p> <p>Wheezing: - is a condition of causing a wheezy or whistling sound heard during inhalation or exhalation (at least for three months in a year).</p>			
415	Do you have wheeze/whistling/ sound in your chest?	1. Yes 2. No	If “No” go to 418
416	When you have wheeze/whistling/ sound in your chest?	1. In the morning 2. In the daytime 3. At night	
417	For how long has this wheezy sound persisted?	_____ (Years)	
418	Are you troubled by nose irritation?	1. Yes 2. No	If ‘NO’ go to Q. No. 420
419	For how many years has this been present?	_____ years	
420	Are you troubled by sneezing once you start flour mill?	1. Yes 2. No	If ‘NO’ go to Q. No. 422
421	For how many years has this been present?	_____ years	

Breathlessness Related Questions

Breathlessness :- is a discomfort or difficult to breathe in different activities or a condition occurring when hurrying on the level ground or walking up a slight hill for at least 3 months in a year)

422	Are you troubled with shortness of breath when hurrying or walking uphill?	1. Yes 2. No	If “No” go to 428
423	If Yes Q. 422 , Do you have to walk slower than people of your age on the level because of breathlessness?	1. Yes 2. No	
424	Do you ever have to stop for breath when walking at your own pace on the level?	1. Yes 2. No	
425	Do you ever have to stop for breath after walking about 100 yards or 96 m (after a few minutes) on the level?	1. Yes 2. No	
426	Are you too breathless to leave the house or breathless on dressing or undressing?	1. Yes 2. No	
427	For how long have you been this short of breath?	_____ (In years)	

Chest pain Related Questions

428	In the past three years, have you experienced any chest illness that kept you off duty, or in bed?	1. Yes 2. No	If “No” go to 500
429	If you get a cold, does it usually go to your chest?	1. Yes 2. No	

ANNEX II: QUESTIONNAIRES (AMHARIC VERSION)

አዲስ አበባ ዩኒቨርሲቲ፣ ጤና ሳይንስ ኮሌጅ፣ የሕብረተሰብ ጤና ትምህርት ክፍል ለጥናቱ ተሳታፊዎች የመረጃ መስጫ

I. ለቃለ መጠይቅ የሚሰጥ የመረጃ መስጫ

ጤና ይስጥልኝ!

እንደምን አሉ? ስሜ _____ ይባላል። እዚህ የተገኘሁት የአዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ የህብረተሰብ ጤና ሳይንስ ትምህርት ቤት የድህረ-ምረቃ ተማሪ የሆኑት እምባይ አማረ ወክሎ ነው። እሳቸውም በዱቄት ፋብሪካ ውስጥ በሚሰሩ ሰራተኞች የዱቄት አባራ/ብናኝ መለካትና የመተንፈሻ አካላት ችግርና መንስኤዎቻቸው ዙርያ ላይ ጥናት በመስራት ላይ ይገኛሉ። ይህንን ጥናት ለማካሄድ ተሳታፊ የሚሆኑትን በሎቶሪ የናሙና አወጣጥ ምልመላ ሲካሄድ እርሶ በዚህ ጥናት እንዲሳተፉ የተመረጡ ስምን ጥናቱ በሚካሄድበት ወቅት የመተንፈሻ አካላት ችግርና መንስኤዎቻቸውን ዳሳሳ ለማድረግ ደረጃውን የጠበቀ መጠይቅ እጠቀማለሁ። መጠይቁንም ለመሙላት ከ30 እስከ 45 ደቂቃዎች የሚወስድ በመሆኑና የእርስዎንም ሙሉ ትብብር የሚጠይቅ በመሆኑ ይህንኑ እንዲያደርጉ በታላቅ ትህትና እጠይቅዎታለሁ።

በጥናቱ ላይ በመሳተፍዎ በእርሶ ላይ የሚደርስ ምንም አይነት የጎንዮሽ ጉዳት የሌለ ሲሆን ከጥናቱም የሚያገኙት ምንም አይነት ቀጥተኛ ጥቅም የለም። ነገር ግን በተዘዋዋሪም ጥናቱ በዱቄት ፋብሪካ በሚሰሩ ሰራተኞች ላይ የሚታዩ የመተንፈሻ አካላት ችግሮች ለመከላከልና ለመቆጣጠር ትልቅ አስተዋፅኦ ይኖረዋል። በተጨማሪም ለቀጣይ ምርምር መሰረት በመሆን ከማገልገሉም ባሻገር ይህንን ጥናት መሰረት በማድረግ መንግስትና የተለያዩ ባለድርሻ አካላት ትኩረት በመስጠት ችግር ላይ የራሳቸው አስተዋፅኦ እንዲያደርጉ ይረዳል ብዬ አስባለሁ።

የሚሰጡን መረጃ ሁሉም ምስጢራዊነቱ የተጠበቀና ቅፅ ላይ ስም አይሰፍርም። ስለዚህ በጥናቱ መሳተፍም ሆነ አለመሳተፍ የእርሶ መብት ነው። በጥናቱ ላይ መሳተፍ በሙሉ ፈቃደኝነት የተመሰረተ ነው፤ ስለሆነም በጥናቱ ላይ ለመሳተፍም ሆነ ባልተመቻቸው ግዜ ጥናቱ አቋርጦ ለመውጣት መብትዎ የተጠበቀ ነው። እርስዎ የሰጡን መረጃ ከግል ማንነትዎ ጋር ምንም ዓይነት ግንኙነት የለውም።

ለበለጠ መረጃ: ጥናቱ በተመለከተ ማንኛውም ጥያቄ ካለዎት እምባይ አማረ (የጥናቱ ተመራማሪ) በአዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ የሕብረተሰብ ጤና ትምህርት ክፍል ስልክ ቁጥር +251-9-14-79-63-08 ወይም ዶ/ር አበራ ቁሜ ስልክ ቁጥር +251-9-11-88-29-12 ወይም አቶ ይፎክር ተፈራ ስልክ ቁጥር +251-9-13-75-40-82 (የጥናቱ አማካሪዎች) በአዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ የሕብረተሰብ ጤና ትምህርት ክፍል ወይም የሕብረተሰብ ጤና ትምህርት ክፍል የስነ-ምግባር ግምገማ ተቋም ስልክ ቁጥር +251115157701 ደውለው ማነጋገር ይችላሉ። እባክዎ ጥናቱ በተመለከተ ማንኛውም ግልፅ ያልሆነ ጥያቄ ካለዎት? በጥናቱ ለመሳተፍ ፈቃደኛ ነዎት?

II. ለአባራ መለካት የሚሰጥ የመረጃ መስጫ

ጤና ይስጥልኝ!

እንደምን አሉ፣ እኔ _____ እባላለሁ። ከአዲስ አበባ ዩኒቨርሲቲ፣ ጤና ሳይንስ ኮሌጅ ሕብረተሰብ ጤና ትምህርት ክፍል መረጃ ለመስጠት ስሜን የመጣሁት። የዚህ ጥናት ዋና ዓላማ በአዲስ አበባ ከተማ አስተዳደር ከሚገኙት የዱቄት ፋብሪካ ሰራተኞች በሰውነት ውስጥ ሊገባ የሚችል የዱቄት አባራ/ብናኝ መለካትና የመተንፈሻ አካላት ችግር ምልክቶች ዳሰሳ ማድረግ ነው። በዚህ መሰረት ይህ ጥናት በዱቄት ፋብሪካ ሰራተኞች ላይ የሚታዩ የመተንፈሻ አካላት ችግሮች በመከላከልና መቆጣጠር ትልቅ አስተዋፅኦ ይኖረዋል። ስለሆነም ይህንን ጥናት መንግስትና የተለያዩ ባለ ድርሻ አካላት በችግሩ ላይ ትኩረት በመስጠት በነኚህ ሰራተኞች ላይ ሊያጋጥም የሚችል ችግር መፍትሄ እንድያስቀምጡ ይረዳል ብዬ አስባለው። ጥናቱ በሚካሄድበት ወቅት የዱቄት አባራ/ብናኝ መለኪያ መሳርያ እጠቀማለሁ። ጥናቱ ከሕብረተሰብ ጤና ትምህርት ክፍል የስነ-ምግባር ፈቃድ የተሰጠው ነው። እርስዎ በጥናቱ ስለተመረጡ ስለጥናቱ አስፈላጊውን መረጃ እንዲሰጡኝ በትህተና እጠይቃለሁ።

የዱቄት አባራ/ብናኝ መለኪያ አካላት: የዱቄት አባራ/ብናኝ መለኪያ መሳርያ በሰውነት ላይ እንድያደርጉ በትህተና ይጠየቃሉ። መሳርያው በመተንፈሻ አካላት ዙሪያ የሚደረግ አባራ መለኪያ የያዘ ሆኖ ወገብ ላይ የሚደረግ ፓምፕ አለው። ፓምፑ በአባራ መለኪያ በኩል መተንፈሻ አካላት አካባቢ ላይ ያለውን አየር ለመሳብ የሚያገለግል ነው። የዱቄት አባራ/ብናኝ መለኪያ መሳርያ ከትንሽ ድምፅ በስተቀር በጤና ይሁን በስራ ላይ የሚያመጣው ተፅዕኖ የለም። የዱቄት አባራ/ብናኝ የምንለካው ሙሉ የሰራ ሰዓት የሚሸፍን ነው። የጥናቱ ተመራማሪ መሳርያው በሰውነት ላይ በማድረግ፣ ፓምፑ በማስጀምርና በማስቆም ይረድዎታል።

ጥናቱ ለተሳታፊዎች በቀጥታ የሚሰጥ ነገር የለውም። ነገር ግን ከጥናቱ የሚገኝ መረጃ መሰረት በማድረግ የመስተካከል እርምጃ እንዲወሰድ ይረዳል። ከዚህ በተጨማሪ በዳሰሳ ግዜ የተገኘውን የብናኝ ደረጃ እናሳውቅዎታሉን። ጥናቱ አባራ/ብናኝ ለመለካት ከሚፈጀው ግዜ ውጭ በተሳታፊዎች የሚያስከትለው አንዳች ጉዳት የለም። በጥናቱ ላይ መሳተፍ በሙሉ ቃደኝነት የተመሰረተ ነው፤ ስለሆነም በጥናቱ ላይ ለመሳተፍም ሆነ ባልተመችዎት ግዜ ጥናቱ አቋርጦ ለመውጣት ሙብትዎ የተጠበቀ ነው። በተሳታፊዎች ላይ የሚገኝ የአባራ መጠን ከጥናቱ አባላት ውጭ ለሌላ ማንም ተላልፎ አይሰጥም። እርስዎ የሰጡን መረጃ ከግል ማንነትዎ ጋር ምንም ዓይነት ግኑኝነት የለውም። የሰጡንን መረጃ ምስጢራዊነቱ የተጠበቀ ነው።

ለበለጠ መረጃ: ጥናቱ በተመለከተ ማንኛውም ጥያቄ ካለዎት እምባይ አማረ (የጥናቱ ተመራማሪ) በአዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ የሕብረተሰብ ጤና ትምህርት ክፍል ስልክ ቁጥር +251-9-14-79-63-08 ወይም ዶ/ር አበራ ቁጭ ስልክ ቁጥር +251-9-11-88-29-12 ወይም አቶ ይፎክር ተፈራ ስልክ ቁጥር +251-9-13-75-40-82 (የጥናቱ አማካሪዎች) በአዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ የሕብረተሰብ ጤና ትምህርት ክፍል ወይም የሕብረተሰብ ጤና ትምህርት ክፍል የስነ-ምግባር ግምገማ ተቋም ስልክ ቁጥር +251115157701 ደውለው ማነጋገር ይችላሉ። እባክዎ ጥናቱ በተመለከተ ማንኛውም ግልፅ ያልሆነ ጥያቄ ካለዎት?

በጥናቱ ለመሳተፍ ፈቃደኛ ነዎት?

ANNEX VIII. የስምምነት መዋዋያ ቅጽ

ጥናቱን በሚካሄደው አካል ስለጥናት በቂ መረጃ ተሰጥቶኛል። የጥናቱ ዋና ዓላማ በአዲስ አበባ ከተማ አስተዳደር ከሚገኙት የዱቄት ፋብሪካ ሰራተኞች በሰውነት ውስጥ ሊገባ የሚችል የዱቄት አቧራ/ብናኝ መለካትና የመተንፈሻ አካላት ችግር ምልክቶች ዳሰሳ ማድረግ መሆኑን ተረድቻለሁ። ከዚህም በተጨማሪ ከኔ የሚወሰደው መረጃ በእኔ ላይ ምንም ዓይነት ጉዳት የማያስከትልና መረጃውን ለጥናት ዓላማ ብቻ እንደሚውል ተረድቻለሁ።

ማንኛውም እኔን የተመለከተ መረጃ ሚስጥራዊነቱ የተጠበቀ ነው። እንደዚሁም በጥናቱ ለመሳተፍ ፍቃደኛ ካልሆንኩ በጥናቱም ለመሳተፍ እንደማልገደድ ነገር ግን በዚህ ጥናት መሳተፌ ለሳይንሳዊ ዕውቀት ጠቃሚ መረጃ የማበርከትና ወደ ፊት በዚህ ዙሪያ ለሚሰሩ ስራዎች መሰረት የሚሆኑ ግብዓት መስጠት እንደምችል ተረድቻለሁ። በመሆኑም በዚህ ጥናት ላይ ለመሳተፍ የተስማማሁ መሆኔን በፊርማዬ አረጋግጣለሁ።

የተሳታፊው ፊርማ _____ ቀን _____

የመረጃ ሰብሳቢው ስምና ፊርማ _____ ቀን _____

Annex I. Amharic Version Questionnaire

አዲስ አበባ ዩኒቨርሲቲ፣ ጤና ሳይንስ ኮሌጅ፣ የሕብረተሰብ ጤና ትምህርት ክፍል ለጥናቱ ተሳታፊዎች የመረጃ መስጫ

በ 2011 ዓ/ም በአዲስ አበባ ከተማ አስተዳደር ስር በሚገኙ የድቄት ፋብሪካዎች ውስጥ በሚገኙ ሰራተኞች ላይ የሚታየውን የአቧራ/ብናኝ መጠንና የመተንፈሻ አካል በሽታዎችን ለመወሰን የተዘጋጀ መጠይቅ።

ቃለ-መጠይቅ የተደረገበት ቀን _____

የመጠየቁ ኮድ _____ የሚሰሩበት የስራ ክፍል _____

- የፋብሪካው ስም 1. ፋፋ የምግብ ፋብሪካ 2. ቃሊቲ የምግብ ፋብሪካ

እባክዎ መልስዎ ከትክክለኛው አማራጭ ላይ ሙሉ በሙሉ በሰማያዊ እስክርቢቶ በማክበብ ይመልሱ። መልስዎ በቁጥር ከሆነ እባክዎ ትክክለኛ ቁጥር በተሰጠው ክፍት ቦታ ያስቀምጡ፣ ለምሳሌ ዕድሜ በዓመት።

ክፍል አንድ፡ ማህበራዊና ዲሞክራሲያዊ መስፈርት			
ተ/ቁ	መጠይቅ	መልስ	ማሳለፊያ
100	የታ፡	1. ወንድ 2. ሴት	
101	ዕድሜ	_____ ዓመት	
102	የጋብቻ ሁኔታ	1. ያላገባ/ች 2. ያገባ/ች 3. ተለያይተው የሚኖሩ 4. የፈታ/ች 5. የሞተችበት/ባት	
103	ሐይማኖትዎ ምንድን ነው?	1. ኦርቶዶክስ 2. ሙስሊም 3. ፕሮቴስታንት 4. ካቶሊክ 5. ሌላ ካለ ይግለፅ _____	
104	የትምህርት ደረጃ	1. መደበኛ ትምህርት ያልወሰደ/ች 2. 1 – 8 3. 9 – 12 4. ከ 12 በላይ	
105	የወር ገቢዎት ምን ያህል ነው?	_____ ብር	
106	በዚህ ስራ ላይ ምን ያህል ጊዜ ሰሩ?	_____ ዓመት -----ወር	
107	በአማካይ በቀን ለምን ያህል ሰዓት ይሰራሉ?	_____ ሰዓት	
108	በአማካይ በሳምንት ለምን ያህል ቀን ይሰራሉ?	_____ ቀን	
109	አሁን የሚሰሩበት በየተኛው የሥራ ክፍል ለምን ያክል ጊዜ ሰሩ?	የሥራክፍል	ለምን ያክል ጊዜ
		1. ጽዳት	
		2. አህል መፍጨት	

		3. ጥላል		
		4. ዱቄት ማሸግ		
		5. ዱቄት መጫን		
110	ከአሁን በፊት እዚህ ፋብሪካ ላይ በሌላ የሥራ ክፍል ስርተው ያውቃሉ	1. አዎ 2. አይደለም		
111	ለጥያቄ ቁጥር 110 አዎ ከሆነ መልስዎ በየተኛው የሥራ ክፍል ለምን ያክል ጊዜ ሰሩ?	የሥራ-ክፍል	ለምን ያክል ጊዜ	
		1. ጽዳት		
		1. እህል መፍጨት		
		2. ጥላል		
		4. ዱቄት ማሸግ		
		5. ዱቄት መጫን		
ክፍል ሁለት፡ ከስራው ጋር የተያያዘ የቀድሞ ታሪክ				
200	እዚህ በፊት ከወፍጮ ቤት ወጪ አባራማ በሆነ ቦታ ላይ ስርተዋል?	1. አዎ 2. አይደለም		መልስዎ አይደለም ከሆነ ወደ ጥያቄ . 202
201	ለጥያቄ ቁጥር 200 መልስዎ አዎ ከሆነ፣ ለምን ያህል ጊዜ ከዚህ ቦታች በተጠቀሱት ቦታ ስርተዋል(በዓመት) (ከአንድ በላይ መልስ ይቻላል)	1. ብረታ ብረት 2. ድንጋይ መፍጫ 3. ህንፃ ግንባታ 4. ዱቄት ፋብሪካ 5. መንገድ ጥርጊያ/ፅዳት 6. ሌላ ካለ ይጥቀሱ		
202	ከመኖሪያ ቤትዎ ውስጥ ምግብ በራስዎት ወይም በሌላ ሰው ያበስላሉ?	1. አዎ 2. አይደለም		
203	ለጥያቄ ቁጥር 202 መልስዎ አዎ ከሆነ፣ በአብዛኛው ምግብ ለማብሰል ምን ዓይነት ሀይል ይጠቀማሉ? (ከአንድ በላይ መልስ ይቻላል)	1. ከሰል 2. እንጨት 3. ጋዝ 4. ኤሌክትሪክ 5. LPG (ስሊንደር 6. ሌላ ካለ ይጥቀሱ		

ክፍል ሦስት፡ የቀድሞ ታሪክ የመተንፈሻ አካላት ህመም በተመለከተ

204	በቀድሞ ሂደትም በሃኪም የተነገረት የቆየ የሳንባ ችግር ታመው ያውቃሉ?	1. አዎ 2. አይደለም	መልስዎ አይደለም ከሆነ ወደ ጥያቄ 300 ይለፉ
205	መልስዎ አዎ ከሆነ፣ የትኛው ዓይነት የጤና ችግር ከዚህ በፊት ገጥመዎት ነበረ (ከአንድ በላይ መልስ ይቻላል)	1. የቆየ የጉሮሮ ቁስለት (የቆየ ብሮንካይትስ) 2. መተንፈስ የሚያውክ የሳንባ በሽታ 3. አስም 4. የሳንባ ካንሰር 5. የሳንባ ነቀርሳ/ቲቢ 6. ሌላ አይነት ይጠቀስ--	

ክፍል አራት፡ ሲጋራ የማጨስ ባህሪ

300	ሲጋራ አጭሰው ያውቃሉ? (የለም ማለት እስካሁን ድረስ ከ 20 ፓኮ በታች ማጨስ ወይም በቀን ከአንድ ሲጋራ በታች ለአንድ አመት ማጨስ)	1. አዎ 2. አይደለም	አይደለም ከሆነ ወደ ቁ.304 ይለፉ
301	መልስዎ አዎ ከሆነ፣ አሁን ሲጋራ ያጨሳሉ (ባለፈው አንድ ወር ውስጥ)?	1. አዎ 2. አይደለም	
302	አሁን በአማካይ በቀን ምን ያህል ሲጋራ ያጨሳሉ?	_____ ሲጋራ በቀን	
303	ምን ያህል አመታት ሲጋራ አጨሱ (በአመት)?	_____ አመት	
304	በቤትዎ ውስጥ ሲጋራ የሚያጨስ ሰው አለ ወይ?	1. አዎ 2. አይደለም	

ክፍል አምስት፡ የመተንፈሻ አካላት ችግር

ሀ. ሳል
ሳል፡ በአንድ አመት ውስጥ ለሶስት ወር ያህል በቀን ከ4-6 ጊዜ፣ በሳምንት 4 ቀንና ከዛ በላይ ወይም አብዛኛውን ጊዜ ጧት ከእንቅልፍ ሲነሱ ወይም በተቀሩት የቀን ወይም የሌሊት ሰዓት ሳል ካለዎት

400	አብዛኛውን ጊዜ በጠዋት ያስልዎታል?	1. አዎ 2. አይደለም	ወደ ጥ.ቁ. 403
401	አብዛኛውን ጊዜ ከ 4 እስከ 6 ጊዜ በቀን ፤ 4 ወይም	1. አዎ 2. አይደለም	

	ከዛ በላይ በሳምንት ሳል ያስለዎታል?		
402	አብዛኛውን ጊዜ ጧት ከእንቅልፍ ሲነሱ ያስለዎታል?	1. አዎ 2. አይደለም	
403	በተቀሩት የቀን ወይም የሌሊት ሰዓት ያስለዎታል?	1. አዎ 2. አይደለም	
404	ላንዳቸው ጥ.ቁ. (400, 401, 402 ወይም 403) መልስዎ አዎ ከሆነ, የሚከተሉት ሁለት ጥያቄዎች ይመልሱ:: በ 1 ዓመት ውስጥ እንደዚህ ዓይነት ሳል በአብዛኛው ቀናት ለተከታታይ 3 ወርና ከዛ በላይ አስለዎት ያቃል?	1. አዎ 2. አይደለም	አይደለም ከሆነ ወደ ቁጥር 406 ይለፉ
405	ሳሉ ለምን ያህል ጊዜ ቆይቷል?	_____ ዓመት	

ለ. አክታ

አክታ: በአንድ አመት ውስጥ ለሶስት ወር ያህል በቀን ሁለቴ፣ በሳምንት 4 ቀንና ከዛ በላይ ወይም አብዛኛውን ጊዜ ጧት ከእንቅልፍ ሲነሱ ወይም አብዛኛውን ጊዜ በቀን ወይም በሌሊት አክታ የመውጣት ችግር ካለዎት

406	አብዛኛውን ጊዜ ከደረትዎ አክታ ይወጣል?	1. አዎ 2. አይደለም	
407	አብዛኛውን ጊዜ በቀን ወይም በሌሊት አክታ አለዎት?	1. አዎ 2. አይደለም	
408	አብዛኛውን ጊዜ እንደዚህ ዓይነት አክታ በቀን 2 ጊዜ ወይም በሳምንት 4 ወይም ከዛ በላይ ይወጣል?	1. አዎ 2. አይደለም	
409	በአመት እንደዚህ ዓይነት አክታ ያለበት ሳል በአብዛኛው ቀናት ለተከታታይ ሶስት ወር ነበረብዎት?	1. አዎ 2. አይደለም	
410	በአብዛኛው በቀን 2 ጊዜ፣ 4 ወይም ከዛ በላይ በሳምንት ከደረትዎ አክታ ይወጣል?	1. አዎ 2. አይደለም	
411	በአብዛኛው ጊዜ ጥዋት ከእንቅልፍ ሲነሱ አክታ ያወጣሉ?	1. አዎ 2. አይደለም	
412	በአብዛኛው ጊዜ በእረፍት ቀን ወይም ለሊት አክታ ያወጣሉ?	1. አዎ 2. አይደለም	
413	ላንዳቸው ጥ.ቁ. (410, 411, or 412) መልስዎ አዎ ከሆነ, በ 1 ዓመት ውስጥ እንደዚህ ዓይነት አክታ በአብዛኛው ቀናት ለተከታታይ 3 ወርና ከዛ በላይ ነበረብዎት?	1. አዎ 2. አይደለም	መልስዎ አይደለም ከሆነ ወደ ቁጥር 415

			ይህዱ
414	እንደዚህ አይነት አክታ የመውጣት ችግር ከጀመረዎት ስንት ዓመት ሆነዎት?	_____ ዓመት	
ሐ. የማንከራፈት ድምፅ በተመለከተ			
<p>የማቃተት ድምፅ: በአንድ አመት ውስጥ ለሶስት ወር ያህል ወደ ውስጥ ወይም ወደ ውጭ ስያስተነፍሱ ወይም ሲቀዘቅዘዎት ወይም አልፎ አልፎ ከቅዝቃዜ ሲወጡ ወይም አብዛኛው ቀን ወይም ሌሊት ደረትዎ የማንከራፈት ወይም የማፋጨት ድምፅ ደረትዎ ላይ የማንከራፈት ወይም የማፋጨት ድምፅ ካለዎት</p>			
415	ከደረትዎ የማንከራፈት ወይም የማፋጨት ድምፅ ያሰማል?	1. አዎ 2. አይደለም	መልስዎ አይደለም ከሆነ ወደ ቁጥር 418 ይህዱ
416	መቸ ነው ከደረትዎ የማንከራፈት ወይም የማፋጨት ድምፅ የሚሰማው?	1. ትዋት 2. ቀን 3. ማታ	
417	ይህን የማንከራፈት ድምፅ ማሰማት ከጀመረዎት ምን ያህል ጊዜ ሆነዎት?	_____ ዓመት	
418	የአፍንጫ መቆጣት ችግር አለዎት?	1. አዎ 2. አይደለም	አይደለም ከሆነ ወደ ቁ. 420
419	መልስዎ አዎ ከሆነ, ይህን የአፍንጫ መቆጣት ከጀመረዎት ምን ያህል ጊዜ ሆነዎት?	_____ ዓመት	
420	ይህን ስራ ከጀመሩ የማስነጠስ ችግር ይታያልዎታል?	1. አዎ 2. አይደለም	ጥ.ቁ. 422
421	መልስዎ አዎ ከሆነ, ይህን አይነት ማስነጠስ ከጀመረዎት ምን ያህል ጊዜ ሆነዎት?	_____ ዓመት	
የትንፋሽ ማጠር ወይም መቆራረጥ			
<p>መ. የትንፋሽ ማጠር: በአንድ አመት ውስጥ ለሶስት ወር ያህል በፍጥነት ሲራመዱ ወይም ኮረብታ ሲወጡ የትንፋሽ መቆራረጥ ችግር ካለዎት</p>			
422	በፍጥነት ሲራመዱ ወይም ኮረብታ ሲወጡ የትንፋሽ ማጠር ችግር አጋጥመዎት ያውቃል?	1. አዎ 2. አይደለም	ጥ.ቁ. 428
423	ከትንፋሽ ማጠር ምክንያት ከእኩዮችዎ ባነሰ ፍጥነት የመራመድ ችግር አጋጥመዎት ያውቃል?	1. አዎ 2. አይደለም	

424	በራስዎ ፍጥነት ሜዳ ላይ ሲራመዱ የትንፋስ መቋረጥ ችግር አጋጥመዎት ያውቃል?	1. አዎ 2. አይደለም	
425	ለ100 ያርድ ወይም 96 ሜ ያህል ሜዳ ላይ ከተራመዱ በኋላ የትንፋስ መቋረጥ ችግር አጋጥመዎት ያውቃል?	1. አዎ 2. አይደለም	
426	ከቤት ሲወጡ ፣ ልብስ ሲለብሱ ወይም ስያወልቁ ከፍተኛ የትንፋስ መቋረጥ ችግር አጋጥመዎት ያውቃል?	1. አዎ 2. አይደለም	
427	እንደዚህ አይነት የትንፋስ መቋረጥ ችግር ከጀመረዎት ስንት ዓመት ሆነዎት?	_____ ዓመት	
ሠ. የደረት ህመም			
428	ባለፉት ሦስት አመታት በደረት ህመም ምክንያት ስራ ቀርተዉ (ተኝተዉ) ያዉቃሉ?	1. አዎ 2. አይደለም	መልስዎ አይደለም ከሆነ ወደ ጥያቄ 500 ይለፉ
429	በአብዛኛዉ ለቅዝቀዜ በሚጋለጡበት ጊዜ የደረት ህመም ይሰማዎታል?	1. አዎ 2. አይደለም	
430	የደረት ህመሙ አከታ ኑሮት ያዉቃል?	1. አዎ 2. አይደለም	

ክፍል ስድስት: የሰራተኞች ባህሪ በተመለከተ (ለመተንፈሻ አካል መከላከያ መሳሪያ አጠቃቀም በተመለከተ)

500	በስራ ላይ በሚሆኑበት ወቅት የብናኝ መከላከያ ይጠቀማሉ?	1. አዎ 2. አይደለም	መልስዎ አይደለም ከሆነ ወደ ጥያቄ 502 ይለፉ
501	አዎ ከሆነ ከሚከተሉት ዉስጥ የትኛዉን መከላከያ ይጠቀማሉ? (ከአንድ በላይ መልስ ይችላል)	1. የአፍ/አፍንጫ መሽፈኛ 2. ጭምብል (የፊት መሽፈኛ) 3. የአየር ማጣሪ ያመሳሪያ 4. ሌላ ካለ ይጥቀሱ _____	
502	ለጥያቄ ቁጥር 500 መልስዎ አይደለም ከሆነ፤ የብናኝ መከላከያ ልብስ የማይለብሱበት ምክንያቱ ምንድን ነዉ?	1. ጭራሽ ስለሌለ 2. ለመልበስ ስለማይመች 3. በማስሪያ ቤት ስለማይቀረብ 4. ጎጅ ብናኝ ስለሌለ	

		5. ሌላ ካለ ይጥቀሱ_____	
503	የስራ ደህንነትና ጤና ስልጠና ወስደው ያውቃሉ?	1. አዎ 2. አይደለም	
504	በስራ ደህንነት ጤና ጉዳዮች ላይ ክትትልና ድጋፍ ተደርጎለት ያውቃል?	1. አዎ 2. አይደለም	

መረጃ ስብሰቢዉ ባለሙያ ስም _____

ANNEX III: OBSERVATIONAL CHECKLIST (ENGLISH VERSION)

A. Observational checklist for PPE usage and workplace ventilation

S/no	PPE Usage	Response		Comments
		YES	NO	
1	Is required equipment provided, and used? Respirator or Nose/mouth masks ----- Other protective equipmen			
2	Is there a written procedure for the selection, use and maintenance of PPE?			
3	Is personal protection utilized only when it is not reasonably practicable to eliminate or control the hazardous substance or process?			
4	Are the areas requiring PPE usage properly identified by warning signs?			
5	Individual behavior during personal measurement (all activities and additional works).			
Workplace ventilation				
1	Is the work place well ventilated /free fresh air movements?			
	Is there any artificial ventilation in the work place?			
2	Is the ventilation system appropriate for the work performed? Natural ventilation [adequate ventilation with the windows and openings area greater than or equal to 10% of the floor area of the machine room or			

	inadequate ventilation with the windows and openings area less than 10% of the floor area of the machine room ?			
3	Is exhaust ventilation required before confined space entry?			
4	Is there any Dust absorber?			
5	Is the surrounding free of dust? The nature of the road near to the factory?			
6	What was the Weather during the data collection and observation? (Surrounding) or internal and external condition of the study area?			
Nature of the machine				
2	the production rate per day	<50 tonnes per day	>50 tonnes per day	
3	type of used in the factories	Old machine	New machine	
4	Number of machines present in one room? (crowdedness)			

Annex I: Curriculum vitae of principal investigator

❖ Personal information

Full name	Embay Amare Alemseged
Date of birth	September 24, 1988 G.C.
Age	29
Sex	Male
Place of birth	Adigudom, South-East Tigray, Northern Ethiopia
Marital status	Single
Nationality	Ethiopian
Address	embayamare2@gmail.com
Phone No	+251914796308

❖ Educational Background

Educational level	Institution attended	Year
Elementary (1-8)	Mainebri, Adigudom, South-East Tigray	2001-2006
High school (9-10)	Adigudom, South-East Tigray	2007-2008
Preparatory (11-12)	Adigudom, South-East Tigray	2009-2010
Higher Education	University of Gondar, North-East, Ethiopia	2010-2014

❖ Qualifications

1. Attending master/postgraduate education in Environmental and Occupational specialty track

At School of Public Health, College of Health Sciences, Addis Ababa University (since September, 2017)

2. BSc. in Environmental and occupational health and safety (2010-2014)

College of Medicine and Health Science, University of Gondar, Ethiopia.

Undergraduate thesis: Assessment of personal dust exposure level, prevalence of chronic respiratory symptoms and associated factors among flour mill factory workers in Akaki Kality, Addis Ababa, Ethiopia, 2019.

3. Academic and performance awards

I have graduated with great distinction. I have been awarded by achieving different activities of health institutions in my profession.

❖ Employment history

- I have served as an environmental professional (sanitation co-coordinator), member of hospital management committee, team leader and chairman for infection prevention in Dansha hospital Western Tigray Ethiopia from September, 2015 to September, 2016.
- I was serving as an Assistant lecturer in Department of Public Health, College of Health Sciences and Medicine, Adigrat University, Northern Ethiopia.

❖ Research interest: exposure assessment and respiratory symptoms

I am preparing a thesis proposal on: “ Assessment of personal dust exposure level, prevalence of chronic respiratory symptoms and associated factors among flour mill factory workers in Akaki Kality, Addis Ababa, Ethiopia, 2019.”

❖ Skills

- Proficient ability of to conduct both quantitative and qualitative researches
- Creative, innovative, highly self-motivated and strong solving health problems
- Ability of statistical and other qualitative analysis software (SPSS, Epi-info, Epidata, Stata and Open code)
- Good computer skill like MS word, excel, MS Power point
- Expertise in designing and preparing attractive presentation and other demonstrations
- Good communication skill both verbally and written.

❖ Hobbies

- Highly motivated in data collection and reading researches
- To master my profession in order to have good performance in many contexts
- To serve community very well

- To conduct researches
-

❖ **Language**

Language	Writing	Speaking
Tigrigna (native)	Excellent	Fluent
Amharic (national)	Excellent	Fluent
English	Excellent	Very good

Reference

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3. Getachew Gebremedhin (RN, BSC, MSC, ASSt. PROFESSOR, PHD FELLOW) lecturer at adigrat university, CHS, department of nursing). 0963520515 e-mail getachew345@gmail.com
4. Kbrom Gemechu (BSC, MSC In Adult Health Nursing lecturer an adigrat university, CHS, department of nursing Address:-phone0963520515
5. Abadi Hailay (BSc, MPH student in Addis Ababa University). Address:- phone...0919010908 ...email...abadih1901@gmail.com