HARAMAYA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

COLLEGE OF HEALTH AND MEDICAL SCIENCES

SCHOOL OF ENVIRONMENTAL HEALTH

Emission level of Particulate Matters (PM_{10} and $PM_{2.5}$) and Factors Associated with Chronic Respiratory symptoms among Cement Factory Workers in Dire Dawa City, Eastern Ethiopia

MSc Thesis

By:

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December, 2025

Haramaya University, Ethiopia

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A Thesis to be submitted to the College of Health and Medical Sciences, School of Graduate Studies, Haramaya University in Partial Fulfillment of the Requirements for a Master's Degree in Occupational Health and Safety

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APPROVAL SHEET

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I hereby certify that I have read and evaluated this thesis prepared under my guidance, by Abdishakur Dida Gelgelo, entitled; "**Emission level of Particulate Matters (PM $_{10}$ and PM $_{2.5}$) and Factors Associated with Chronic Respiratory symptoms among Cement Factory Workers in Dire Dawa City, Eastern Ethiopia**" I recommend that it be submitted as fulfilling the thesis requirement.

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Final approval and acceptance of the thesis is contingent upon the submission of its final copy to the Council of Graduate Studies (CGS) through the candidate's department or school of graduate committee (DGS or SGS).

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By my signature below, I declare that this thesis is my own work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of the thesis. Any scholarly matter that is included in the thesis has been recognized through citation.

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LIST OF ABREVIATIONS AND ACRONYMS

AOR	Adjusted Odds Ratio
BMRC	British Medical Research Council
CI	Confidence Interval
COR	Crude Odds Ratio
COPD	Chronic Obstructive Pulmonary Disease
DALYs	Disability Adjusted Life Years
ETB	Ethiopian Birr
FDRE	Federal Democratic Republic of Ethiopia
IHME	Institute for Health Metrics and Evaluation
PM	Particulate Matter
PPE	Personal Protective Equipment
WHO	World Health Organization

ABSTRACT

Background: Chronic respiratory symptoms—including chronic cough, chronic phlegm, wheezing, shortness of breath, and chest pain—are common outcomes of occupational exposure to particulate matter with diameters of 10 μg/m³ (PM_{10}) and 2.5 μg/m³ ($PM_{2.5}$). However, localized data are scarce, limiting the development of targeted occupational health interventions and leaving workers at continued risk.

Objective: To assess the level of particulate matter ($PM_{2.5}$ and PM_{10}) and its association with chronic respiratory symptoms among cement factory workers in Dire Dawa City, Eastern Ethiopia from February 1 to March 15, 2025.

Methods: An institution-based cross-sectional study was conducted among cement factory workers in Dire Dawa. Out of a total of 938 workers in the study area, 300 participants were randomly selected. Because dust exposure varied across different working units, workers were stratified by department, and samples were proportionally allocated to each stratum. Data were collected through face-to-face interviews using structured questionnaires.The data were analyzed using SPSS version 25.0. Binary logistic regression was used to identify candidate variables ($p < 0.25$ at 95% CI) for inclusion in the multivariable analysis. Subsequently, multivariable logistic regression was performed to identify factors associated with occupational chronic respiratory symptoms among cement factory workers. A p-value < 0.05 was considered statistically significant.

Results: A total of 300 factory workers were approached for the study, achieving an overall response rate of 97%. Out of this, 179 (61.5%) [95% CI: 55.7-67.1] were experienced one or more chronic respiratory symptoms in the last 12 months. The emission levels of $PM_{2.5}$ and PM_{10} varied across working units in the cement factory, ranging from the lowest in the administrative unit (21.5 and 25.2 μg/m³, respectively) to the highest in the raw material receiving unit (4722 and 4998 μg/m³, respectively), exceeding both national (65 and 150 $\mu g/m^3$) and WHO (15 and 45 $\mu g/m^3$) air quality standards, respectively. Chronic respiratory symptoms were significantly associated with working in the raw material receiving unit [AOR: 3.2; 95% CI: 1.27–7.80], cement milling unit [AOR: 4.06; 95% CI: 1.49–11.10], and packing unit; working more than 48 hours per week [AOR: 2.11; 95% CI: 1.03–4.31]; not using PPE [AOR: 2.31; 95% CI: 1.28–4.16]; and cigarette smoking [AOR: 2.30; 95% CI: 1.14–4.64].

Conclusion: The study indicates a high prevalence of chronic respiratory symptoms among cement factory workers, with $PM_{2.5}$ and PM_{10} levels significantly exceeding national and WHO air quality guidelines, highlighting an urgent need for improved occupational health interventions.

Keywords: $PM_{2.5}$ and PM_{10}, Chronic Respiratory Symptoms, Cement Factory Workers. Ethiopia

1. INTRODUCTION

1.1 Background

Cement is one of the most widely used construction materials globally, despite contributing about 5% of global carbon dioxide emissions and being among the most energy-intensive industries (Usón et al., 2013). Driven by social, economic, and geographical factors, global demand for cement is rapidly increasing (Mulatu *et al.*, 2018). In Ethiopia, the cement industry has experienced significant growth since the 1990s, paralleling a construction boom. However, this expansion has also led to serious environmental concerns, as various stages of cement production; such as crushing, milling, and packing are major sources of air pollution (FDRE Addis Ababa, 2013; Mekasha *et al.*, 2018).

Cement production is highly energy-intensive and a major source of particulate matter (PM) emissions, with each stage of the process capable of releasing significant pollutants. These emissions include PM2.5, PM10, nitrogen oxides (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2), and smaller amounts of volatile organic compounds (VOCs), ammonia, chlorine, and hydrogen chloride (Worrell *et al.*, 2001). Clinker-producing cement factories, which consume more energy and materials than non-clinker ones, emit particularly high levels of pollutants. As a result, these factories have been linked to serious health issues such as tuberculosis, chronic bronchitis, cardiovascular diseases, asthma, and various cancers, with emissions contributing to both respiratory and cardiovascular morbidity and mortality (Firdissa *et al.*, 2024).

Particulate matter (PM) refers to a mix of solid and liquid particles suspended in the air, varying in size and composition. It is classified into coarse particles (2.5–10 µm) and fine particles (less than 2.5 µm). The most health-relevant indicators, PM10 and PM2.5, represent particles small enough to penetrate deep into the lungs and even enter the bloodstream. These particles pose serious health risks. Both short-term and long-term exposure can lead to respiratory and cardiovascular issues, including asthma, lung cancer, and increased mortality (WHO, 2013a).PM is a key pollutant in urban and suburban air, with PM2.5 being particularly dangerous due to its ability to be directly inhaled, impairing lung function and contributing to both acute and chronic respiratory problems (Mukherjee and Agrawal, 2017; Zeleke, 2011).

Chronic respiratory symptoms such as chronic cough, chronic phlegm, wheezing, shortness of breath, and chest pain are manifestations of respiratory problems that are mainly developed as the result of occupational exposures to PM and represent a public health challenge in both industrialized and developing countries (Gizaw et al, 2016).

Particulate matter, composed of microscopic particles, has been associated with various health issues, particularly chronic respiratory symptoms. Thus, this study aims to investigate the levels of particulate matter (PM 2.5 and PM 10) in cement factory, to assess the prevalence of chronic respiratory symptoms and also to explore the potential association between particulate matter concentration and chronic respiratory symptoms among cement factory workers in Dire Dawa city.

1.2 Statement of the Problem

Cement production generates substantial dust during processes such as quarrying, crushing, milling, and packaging (Kristin et al, 2017). This dust contributes to airborne particulate matter (PM), a major urban air pollutant known to penetrate deep into the respiratory system. Vulnerable group; including children, the elderly, and those with pre-existing health condition are especially at risk, with health effects depending on the duration of exposure (Liu and Dunea, 2018). Globally, PM exposure has drawn increasing concern due to its association with respiratory and cardiovascular illnesses, as well as higher mortality rates (Nkhama *et al.*, 2017).

According to the Global Burden of Disease Study, particulate matter (PM) was the 9th leading risk factor for respiratory, cardiovascular diseases, and various cancers in 2015 and ranked 5th among all causes of mortality. That year, exposure to fine particulate matter (PM2.5) was responsible for approximately 4.2 million deaths and 103.1 million disability-adjusted life years (DALYs), accounting for 7.6% of global deaths and 4.2% of global DALYs. Notably, PM2.5-related deaths rose from 3.5 million in 1990 to 4.2 million by 2015 (Cohen *et al.*, 2015). Globally approximately 3.2 million premature deaths are attributed to exposure to PM annually (WHO, 2013b).

Particulate matter with aerodynamic diameters less than 2.5 µm (PM2.5) and 10 µm (PM10) can penetrate deep into the respiratory system, leading to a range of health issues. Exposure to PM is associated with both short-term effect like cough, wheezing, phlegm, and breathlessness and long-term impacts like reduced lung function (Nkhama *et al.*, 2017). PM2.5, in particular, can reach the alveoli, contributing to chronic bronchitis, pneumonia, COPD, and progressive lung function decline (Kurniati *et al.*, 2018).

Additionally, it was observed that the risk of ischemic heart disease and COPD increases by 1.3 and 0.6 times, respectively, with every 10 µg/m3 increase in PM2.5 exposure (Arden Pope and Dockery, 2014). While respiratory health is the primary concern, PM10 exposure has also been linked to adverse birth outcomes, DNA damage, congenital heart defects, inflammatory responses, and increased infant mortality (Mukherjee and Agrawal, 2017).

Due to the production of smoke and dust in many industrial sectors by the usage of outdated machines, the global community, particularly those in developing countries, are facing an increased risk of respiratory diseases (Aminian *et al.*, 2014; Kyung and Jeong, 2020).

Chronic respiratory disease is a public health concern both in industrialized and developing countries, which are more common in cement factories in developing nations where occupational health and safety issues are given less attention (Gizaw *et al.*, 2016).

Globally, around 3% and 5% of cardiopulmonary and lung cancer deaths are attributed to PM respectively (WHO, 2013a). In Europe, PM2.5 is responsible for 1% - 3% of cardiopulmonary deaths and 2% - 5% of lung cancer deaths. However, there is no clear evidence on a safe level of exposure to PM or on a threshold below which an adverse health effects occur (WHO, 2011).

In developed countries like Great Britain, occupational respiratory diseases cause approximately 12,000 deaths annually, with nearly two-thirds linked to dust-related illnesses. In China, PM2.5 levels was 166.8 µg/m³ over 24 hours which exceeded the WHO limits of 75 µg/m³ for PM2.5 and 150 µg/m³ for PM10 this leading to increased hospital admissions due to respiratory problems (Ali *et al.*, 2011).

In sub-Saharan Africa, respiratory problems rank as the sixth leading cause of death, with a significant number of these problems attributed to dust exposure, particularly in cement plants (IHME, 2013). In Ethiopia, cement industry is one of the rapidly growing industry and its demands also increased due to the construction of new mega-projects in the country like the Grand Ethiopian Renaissance dam, several industrial parks, sugar factories, highway and rail- way roads, and private sector projects (Mulatu *et al.*, 2018).

However, studies show that there is a high prevalence of occupational chronic respiratory symptoms, particularly among cement production workers who are exposed to dusty environments and also the highest geometric mean dust exposure was found in the crusher section followed by the packing section and the guards. These individuals are also often poorly informed about the negative health effects of their work environment. In these studies, factors that is associated with chronic respiratory symptoms includes age, sex, education level, monthly income, working department, smoking, work experience, and training (Zeleke, 2011; Gizaw *et al.*, 2016; Mekasha *et al.*, 2018). In Ethiopia, occupation-related respiratory symptoms are extensively increasing with the expansion of cement manufacturing industries. However, little information is available on the extent of emissions and its association with chronic respiratory diseases (Mekasha *et al.*, 2018).

Moreover, the cement factory workers are in frequent contact with dust due to the nature of the working environment and this expose them to different health problems especially respiratory symptoms. Thus, it's required to assess the prevalence and associated factors of chronic respiratory symptoms among cement factory workers to reduce their risk of acquisition of disease. Data on chronic respiratory symptoms among cement factory workers and its association with the emission level of PM and other factors remain scarce in most of sub-Saharan Africa including Ethiopia and in study area in particular. knowledge of emission level of PM and predisposing factors for chronic respiratory symptoms among cement factory workers is essential to take appropriate intervention and to check the compliance level with WHO and national guidelines and to take preventive measures to protect the health and safety of workers. Thus, this study aims to investigate the levels of particulate matter (PM 2.5 and PM 10) in cement factory and the prevalence of chronic respiratory symptoms and explore the potential association between particulate matter concentration and chronic respiratory symptoms among cement factory workers in Dire Dawa city.

1.3 Significance of the study

This study provides information on the emission level of particulate matter (PM 2.5 and PM 10), the prevalence of chronic respiratory symptoms among cement factory workers and also determine the association between particulate matter concentration and chronic respiratory symptoms among cement factory workers in Dire Dawa city.

The findings of this study can be used by cement factory's workers and administrators, Dire Dawa city, Health bureaus and regional social and labor affairs to take preventive measures, including design and apply occupational safety programs or hazard prevention programs in order to reduce exposure to particulate matter among cement factory workers and create the healthy working environment. Furthermore, the findings of this study can be used as an input for other researchers who are interested in the area.

1.4 Objectives

1.4.1 General Objective

- To assess the level of particulate matter (PM 2.5 and PM 10), and prevalence of chronic respiratory symptoms among cement factory workers and associated factors among cement factory workers in Dire Dawa city, Eastern Ethiopia from February 1 to March 15, 2025.

1.4.2 Specific Objectives

- To investigate the emission level of particulate matter (PM 2.5 and PM10) in cement factory in Dire Dawa city, Eastern Ethiopia
- To determine the prevalence of chronic respiratory symptoms among cement factory workers in Dire Dawa city, Eastern Ethiopia
- To assess the association between particulate matter concentration and chronic respiratory symptoms among cement factory workers in Dire Dawa city, Eastern Ethiopia

2. LITERATURE REVIEW

2.1 Particulate Matter (PM 2.5 and 10) emission level at different departments of cement factory

Air pollution becomes a risk factor for non-communicable diseases such as ischaemic heart disease, stroke, chronic obstructive pulmonary disease, asthma and cancer, and the economic toll they take. In 2021, in response to increases in the quality and quantity of evidence of air pollution impacts, WHO updated the PM 2.5 daily and annual mean air quality guidelines from 75 to 15 µg/m^3 and from 35 to 5 µg/m3, respectively. And also for PM 10 for daily and annual mean air quality guidelines it's updated from 150 to 45 µg/m^3 and 70 to 15 µg/m^3, respectively (WHO, 2021).

Ambient fine particulate matter ($PM_{2.5}$) is the world's leading environmental health risk factor. Globally, PM2.5 exposure increased from 1998 (28.3 µg/m3) to a peak in 2011 (38.9 µg/m3) and decreased steadily afterwards (34.7 µg/m3 in 2019) (Li *et al.*, 2023).

In Pakistan, the study conducted to assess the emission level of PM (2.5 and 10) reported that the mean concentration for PM (2.5 and 10) in raw mill (312.5 and 125 µg/m³), in cement mill (7867.5 and 590µg/m³), in packing section (502.5 and 514µg/m³) and in main crusher (1796 and 1552µg/m³) respectively. The highest mean concentrations of PM10 &PM 2.5 were found 1552 and 7867.5 (µg/m³) in main crusher and cement mill respectively (Ahmad *et al.*, 2013). Another study conducted in Zambia reported that the mean seasonal concentrations of PM2.5 and PM10 ranged from 2.39–24.93 µg/m3 and 7.03–68.28 µg/m3 respectively in the exposed compared to the control community 1.69–6.03 µg/m3 and 2.26–8.86 µg/m3 (Nkhama *et al.*, 2017).

In Ethiopia, a study conducted from 1998 to 2019 reported that the average annual mean of total $PM_{2.5}$ concentration in the country was 17 µgm^{-3} and ranged from 13.9 to 20.2 µgm^{-3}. The highest average annual mean $PM_{2.5}$ concentration (from 1998–2019) was in the Afar region, at 27.9 µgm^3, followed by Tigray (21.4 µgm^3), Amhara (21.2 µgm^3), Gambela (20.9 µgm^3), Benishangul-Gumuz (20.4 µgm^3), and Addis Ababa (20.3 µgm^3) (Shiferaw *et al.*, 2023).

In Ethiopia, the study conducted to assess emission level of PM 2.5 in the Mugher cement factory and the emission level was measured at different departments in the cement factory and from each working unit in the factory PM 2.5 widely varies from the highest (35625 µg/m³) in raw material

receiving unit, (27666 µg/m³) cement milling, (27083 µg/m³) packing to the lowest (2292 µg/m³) in administrative unit (Mekasha *et al.*, 2018).

Another study conducted in Dire Dawa, Ethiopia, in 2005 measured the dust exposure and found that the highest geometric mean dust exposure was in the crusher section (38.6 mg/m3) followed by the packing section (18.5 mg/m3) and the guards (0.4 mg/m3) (Zeleke *et al.*, 2010).

2.2 Prevalence of Chronic respiratory symptoms

Globally, hundreds of millions of people are suffering from chronic respiratory illnesses; every year, four million people die prematurely from chronic respiratory diseases (Ferkol and Schraufnagel, 2014). Overall, CRD is on the rise globally, especially among children and the elderly, leading to significant negative impacts on the quality of life and disability among those affected. Experts forecast a significant rise in the worldwide impact of chronic respiratory diseases (CRD) future, despite the fact that many CRDs like asthma, COPD, and respiratory allergies can be managed effectively with proper care in developed and developing nations (World Health Organization, 2010; Chuchalin *et al.*, 2014). A Study conducted in United Kingdom reported the prevalence of work related lower respiratory tract symptoms (38.1%), upper respiratory tract symptoms (45.2%), and chronic bronchitis (15.5%) among organic dust exposed (Simpson *et al.*, 1998).

A cross-sectional study conducted in United Arab Emirates (2012) among Cement factory workers shows that the prevalence of respiratory symptoms was 60.4%. The prevalence of respiratory symptoms was higher among the exposed workers, but the difference from that of unexposed workers was statistically significant only for cough (19.5%; OR=4.5; 95%CI=1.5–13.2), and phlegm (14.8%; OR=13.3; 95%CI=1.8–100.9) (Ahmed and Abdullah, 2012).

A study conducted in Tanzania revealed that the prevalence of chronic cough (25.8% vs. 12.1% ; with 95% CI [1.9-10.4]), chronic sputum production (34.2% vs. 10.3%; with 95% CI [4.4-26.4]), Dyspnea (19.2% vs. 6.5%; with 95% CI [1.9-15.2]), work-related shortness of breath (16.7% vs. 4.7% with 95% CI [1.6-14.2]), wheeze (12.5% vs. 3.7% with 95% CI [0.9-9.9]), and chronic bronchitis (20% vs. 7.5% with 95% CI [2.0-15.3]) among exposed group and control group respectively with significant differences (Mwaiselage *et al.*, 2005). Similar study conducted in

Congo found the prevalence of cough 22.9% vs. 9.6%, wheezing 5.4% vs. 3.3% and phlegm 16.1% vs. 7.6% respectively (Mbelambela *et al.*, 2018).

The finding from Hawassa city indicate that 56.6% and 12.9% of flour mill workers and soft-drinks factory workers experienced chronic respiratory symptoms respectively, with chronic cough (39.3%; 95% CI = 1.53–2.03), chronic cough with sputum (17.86%; 95% CI = 1.02–1.76), chronic wheezing (17.35%; 95% CI = 1.01–1.75), chronic breathlessness (18.9%; 95% CI = 1.08–1.87) (Lagiso *et al.*, 2020). According to the cross-sectional study conducted in Dejen town, west-central Ethiopia (2015), the prevalence of chronic respiratory symptoms among the Dejen cement factory workers was 62.9% (95 % CI : 58.4- 68), with the prevalence of chronic cough at 24.5%, chronic wheezing 36.9%, chronic phlegm 24.5%, chronic shortness of breath 38.6%, and chest pain 21.0% (Gizaw *et al.*, 2016).

Another cross-sectional study conducted in a Mugher cement factory in, Addis Ababa, Ethiopia, (2018), shown that the prevalence of chronic respiratory symptoms among cement factory workers was 50.8%, with the prevalence of chronic cough, chronic phlegm, and chest wheezing were 98.7%, 91.7%, and 30.6%, respectively (Mekasha *et al.*, 2018).

A systematic review conducted in Ethiopia in (2021) revealed that the pooled prevalence of overall occupational respiratory symptom was 54.58% (95% CI: 45.37–63.79), with the dry cough was the most encountered respiratory symptom (34.93, 95% CI: 29.52–40.35), followed by breathlessness (28.67%, 95% CI: 20.13–37.22) (Dagnew *et al.*, 2021). The another systematic review conducted in Ethiopia in (2023) also revealed that the pooled prevalence of respiratory symptoms among Ethiopian factory workers was 54.96% (95% CI: 49.33–60.59%) (Ashuro *et al.*, 2023).

Another study conducted in Dire Dawa cement factory, Ethiopia, in 2005 among 40 exposed production workers from the crusher and packing sections and 20 controls from the guards found that the prevalence of respiratory symptoms for the high exposed workers was; cough (30%), wheezing (35%), stuffy nose (85%), shortness of breath (47%) and "sneezing" (45%). (Zeleke *et al.*, 2010). Another comparative cross-sectional study conducted in North West Ethiopia in (2014) showed that the prevalence of respiratory symptoms was 66.2% in cement factory workers and 31.2% in Civil Servants with a significant difference ($p<0.001$). The prevalence of Cough (32% vs.13.8%), Phlegm (30.5% vs.16.7%), Wheezing (38% vs.10.4), Dyspnea (44% vs.13.4%), Chest

Pain (20.3% vs.1.5%) and Chest Tightness (42.1% vs.2.6%) among cement factory and civil servant workers respectively with significant differences. (Alemu *et al.*, 2014).

A study conducted in Ethiopia showed that the prevalence of chronic respiratory health symptoms among woodworkers was 69.8% with a prevalence of cough (54.6%), phlegm (52.2%), wheezing (44.6%), breathlessness (42.1%), and chest pain (42.9%) (Awoke *et al.*, 2021).

2.3 Factors associated with work-related chronic respiratory symptoms

Different study reported that chronic respiratory symptoms were associated with sex, age, education level, cement mill, burner and clinker, packing and raw material receiving departments, work experience, low monthly income, night shift work, training on occupational safety, smoking, and chronic respiratory diseases (Alemu *et al.*, 2014; Gizaw *et al.*, 2016; Mekasha *et al.*, 2018).

2.3.1. Socio-demographic factors

A study conducted in Ethiopia showed that sex of participants was significantly associated with chronic respiratory symptoms among cement factory workers. In Dejen cement factory, Males were more likely to develop chronic respiratory symptoms (AOR = 2.07, 95 % CI = 1.18, 3.63) than females, and also Workers aged ≥ 45 years were 4 times more likely to develop chronic respiratory symptoms (95 % CI = 1.94, 9.12) than workers in the age category 18–29 years old. (Gizaw *et al.*, 2016) , and also other study revealed that males were more likely to develop respiratory symptoms (AOR= 5.46 95% CI: 2.22-13.44) than females and Cement factories workers aged 25-34years and ≥45years old were more likely to develop respiratory symptoms than <25years old workers with (AOR= 5.95 95% CI: 1.94-18.23), (AOR= 4.6795% CI: 1.16-18.74) respectively and also Higher education status was protective for respiratory symptoms among cement factory workers (AOR= 0.15 95% CI: 0.03-0.78), compared to those had no education (Alemu *et al.*, 2014).

A study conducted in Mugher Cement Industry, Central Ethiopia found that, workers with monthly income of 1000-3000 ETB were 6 times more likely to develop chronic respiratory symptoms compared to the workers whose monthly income was more than 10,000 birr (95% CI: 1.9-17.6) (Mekasha *et al.*, 2018).

2.3.2 Behavioral factors

A study conducted in Ethiopia revealed that odds of experiencing respiratory symptoms among smoker were almost 12 times compared with than that, never smokers (AOR; 11.7 95% CI: 1.6-85.76) and those working in night shift were two times more likely to develop respiratory symptoms (AOR=2.07 95% CI: 1.02-4.18) than do not work the night shift. (Alemu *et al.*, 2014). Study conducted in South Africa also found that workers who reported smoking at the time of data collection were 6.34 times more likely to experience respiratory symptoms (Mkulisi, 2017).

Another study also found the association between smoking and chronic respiratory symptoms. Smokers developed chronic respiratory symptoms 5.38 times more likely (AOR = 5.38, 95 % CI = 1.42, 20.39) than non-smokers (Gizaw *et al.*, 2016).

2.3.3 Environmental/ Occupational related factors

In the study conducted in Dejen cement factory, employees engaged in cement mill were 4 times (95 % CI = 1.92, 7.21) more likely to develop chronic respiratory symptoms than employees engaged in raw mill department. Workers who had work experience greater than five years (AOR = 5.44, 95 % CI = 3.09, 9.59), workers who had no training on occupational safety and health about respiratory problems related to dust (AOR= 2.73,95 % CI = 1.41, 5.29) and workers who had previous chronic respiratory diseases (AOR = 7.79, 95 % CI = 2.02, 30.04) were significantly associated with chronic respiratory symptoms (Gizaw *et al.*, 2016).

Similar study conducted in Ethiopia also revealed that working in Clinker section (AOR= 8.46 95% CI: 2.52-28.39), Burner section (AOR= 4.59 95% CI: 1.33-15.88) and Raw Mill section (AOR= 5.07 95% CI: 1.77-14.48) were more likely to develop respiratory symptoms when compared with workers who work in Cement Mill and Packing section. Training on occupational health and safety related to dust health effect was reduced respiratory symptoms by 82% (AOR=0.18 95% CI: 0.09-0.36) (Alemu *et al.*, 2014). A study conducted in Mugher cement factory also found that among four working units in the factory, employees working in raw material receiving unit (AOR: 7.5, 95% CI: 2.9, 19.4), cement milling unit (AOR: 2.5, 95% CI: 1.2, 4.8), and cement packing unit (AOR: 2.2, 95% CI: 1.2, 4.3) were 8, 3, and 2 times more likely to develop chronic respiratory symptoms, respectively, compared to the workers in administrative unit (Mekasha *et al.*, 2018).

A study conducted in Ethiopia, revealed that woodworkers who had past occupational dust exposure history (AOR = 2.09, 95% CI; 1.09– 4.01), work experience above 5 years (AOR= 9.18, 95% CI; 5.27–16.00), workers who used bio-fuel for cooking (AOR= 2.42, 95% CI; 1.44–4.07) and workers who had no occupational safety and health training (AOR= 3.38, 95% CI; 1.20–9.49) were significantly associated with chronic respiratory symptoms (Awoke *et al.*, 2021).

Another study also showed that workers who had work experience 6–9 years (AOR = 5.1, 95% CI = 2.05–12.48) and work experience ≥10 years (AOR = 2.5, 95% CI = 1.01–6.11) had the odds of developing chronic respiratory symptoms 5.1 and 2.5 times more than workers who had work experiences between 1 and 5 years, respectively. And also workers who stay greater than 8 hr. per day were 2.4 times more likely to develop chronic respiratory symptoms than those who had 8 h or less (AOR = 2.4, 95% CI, (1.16–5.10) (Lagiso *et al.*, 2020).

2.3 Conceptual Framework

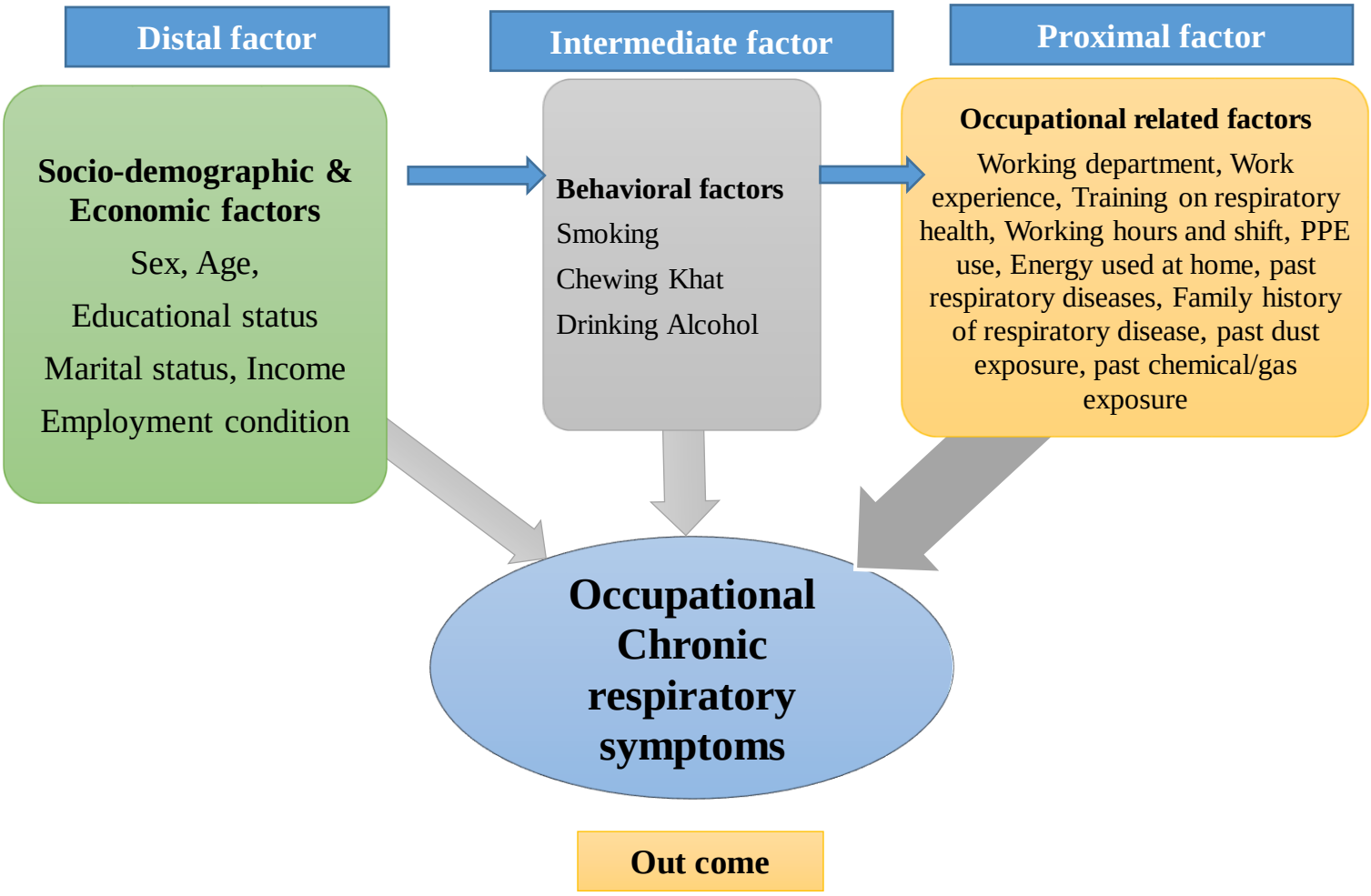


Figure 1: Conceptual framework used to assess factors associated with occupational chronic respiratory symptoms among cement factory workers (Developed by Investigator by reviewing literatures).

3. METHODOLOGY

3.1 Study Area and Period

The study was conducted on cement factory in Dire Dawa city, Eastern Ethiopia from February 1 to March 15, 2025. The study was conducted on National Cement Share Company which is located in the Eastern part of Ethiopia, right at the entrance of Dire Dawa city at 515 km away from the capital city of Addis Ababa. The establishment of the current National Cement Share Company (NCSC), the former Dire Dawa Cement & Limestone Factory, dates back to 1936 G.C. Established by Italians, during occupation in 1936, and being the pioneering cement producing and selling factory in the country, the factory has played a key role in national development for 8 decades now (NCSC ICT Department, 2022). The Company has 938 total workers out of which 416 are working in administration department and 522 are working in production/technical department (from NCSC HR).

3.2 Study Design

An Institutional-based cross-sectional study design was used to assess the emission level of particulate matter (PM 2.5 and PM 10), and prevalence of chronic respiratory symptoms among cement factory workers and associated factors among cement factory workers in Dire Dawa city, Eastern Ethiopia.

3.3 Source Population

3.3.1 Source Population

All workers who are employed and working in national cement factory in Dire Dawa city was considered as source population.

3.3.2 Study Population

All selected workers who are employed and working in national cement factory in Dire Dawa city was considered as study population.

3.4 Inclusion and Exclusion Criteria

3.4.1 Inclusion Criteria

All workers who are employed and working in national cement factory in Dire Dawa city with more than one-year experience and available during study period were included.

3.4.2 Exclusion Criteria

Workers those on annual leave, seriously ill and unable to communicate and workers with less than one year working experience in the institutions were excluded.

3.5 Sample Size Determination

For the first objective

The size of the sample (n) was determined by using the single population formula; $n = \frac{(z^2) * p(1-p)}{d^2}$

Where n=sample size

d=margin of error which is 5%

p=sample proportion which is 50.8% from the prevalence of chronic respiratory symptoms among cement factory workers in the previous study (Mekasha *et al.*, 2018).

Z=1.96 at 95% confidence interval

$n = \frac{(1.96^2)(0.508)(1-0.508)}{0.05^2}$= **384**. Since the population in the current study is <10,000 correction formula will be used. (N (Total number of cement factory workers) = 938)

$nf = \frac{n}{1+n/N} = \frac{384}{1+384/938}$ =**272** Finally by considering 10% non-response rate the total sample size is **300.**

For the third objective: To determine the sample for the third objective, factors associated with chronic respiratory symptoms particularly, work experience, smoking status and training on respiratory health, the double proportion formula was used by considering a power of 80%, ratio 1:1 and Confidence level of 95% using Epi-info version 7.2.6.0. The sample size calculated by considering outcome among the exposed and among non-exposed and finally 10% non-response rate.

Table 1: Sample size determination for third objective, factors associated with chronic respiratory symptoms among cement factory workers in Dire Dawa city, 2025.

Factors	Prevalence and factors associated with chronic respiratory symptoms among cement factory workers					
	% outcome among Exposed	% outcome among Non-exposed	OR(95% CI)	Initial sample size	Final sample size +10% NRR	References
Work experience	83.5%	45.9%	5.96	60	66	(Gizaw *et al.*, 2016)
Smoking status	91.3%	63.7%	5.98	84	93	(Alemu *et al.*, 2014)
Training on respiratory health	67.6%	42.8%	2.78	140	154	(Gizaw *et al.*, 2016)

Finally, the sample size for the first objective is bigger than the sample size for the third objective, which is **300** cement factory workers.

3.6 Sampling procedure and techniques

Hence, the amount of dust is varied in different working units, workers was stratified based on their working department and sample was proportionally allocated for each stratum (administration and production department).

Finally, the required number of study participants were selected by using simple random sampling method after proportionally allocated to required sample size.

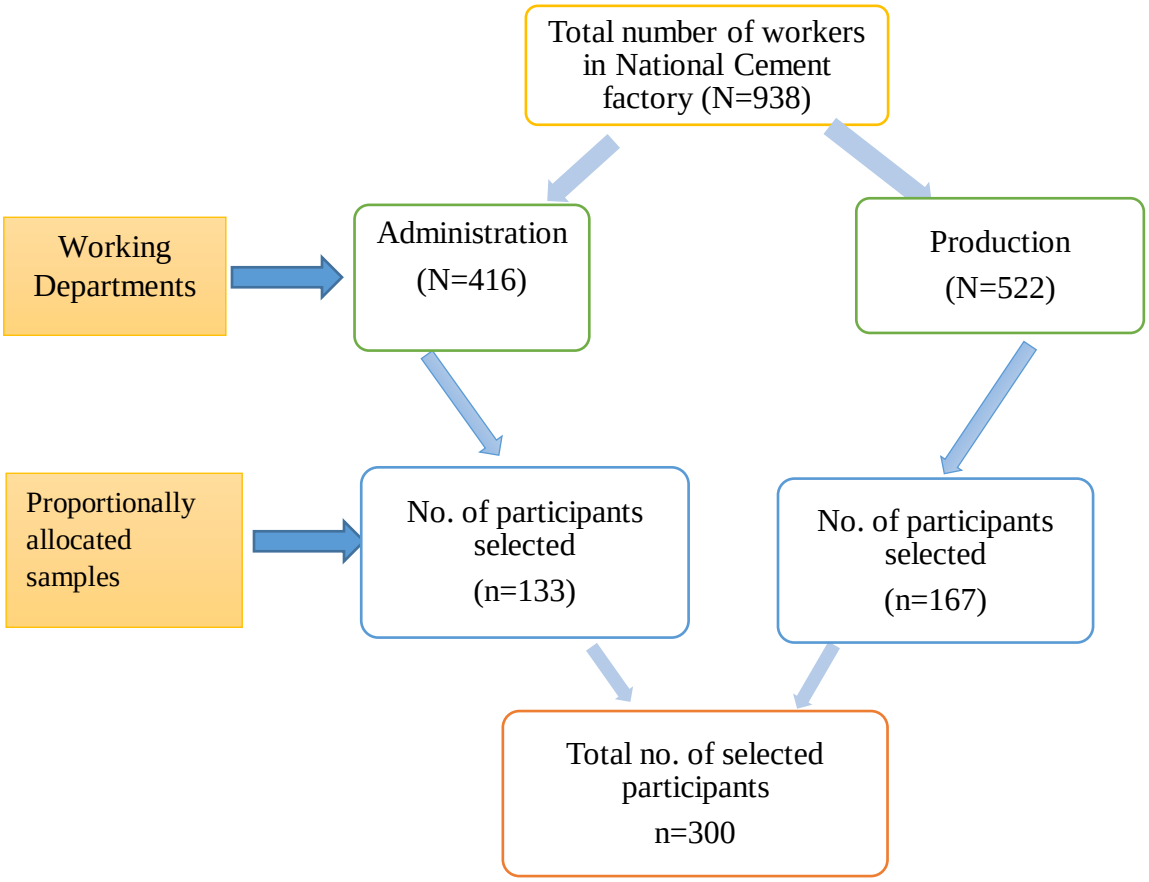


Figure 2: Schematic representation of sampling techniques for the selection of cement factory workers in National Cement Factory, Dire Dawa city, Eastern Ethiopia, 2025

3.7 Data collection method

3.7.1. Data collection instrument

The emission level of PM (2.5 and 10) of the cement factory was measured by using instrument called Low-Cost Sensor (PurpleAir air quality sensor) which is used to measure airborne particulate matter (PM).

Data on respiratory health problems was collected using pre-tested and structured questionnaires adopted from British Medical Research Council (BMRC) adult respiratory assessment questions (BMRC, 1665) and modified to suit for this study purpose. The questionnaire contains issues about socio-demographic and economic factors, behavioral and occupational/environmental factors, and prevalence of chronic respiratory symptoms; mainly chronic cough, phlegm, shortness of breath and wheezing and information on history of chronic respiratory diseases of workers and their families. The questionnaires were translated to Afaan Oromo and Amharic language, the local language of the study participants. Observational checklist was used to assess the practice of dust control mechanism, availability of PPE, use of PPE among workers, waste management conditions of the factory and cleanliness of the rooms in each department.

3.7.2 Data collectors & supervisors

The data was collected by two Nurses, two Environmental health professionals and supervised by one senior Environmental health professional. The data collectors and supervisor were trained for one day on the ethics, principles, and tools to be used for the data collection before data collection.

3.7.3. Data collection procedure

Data on respiratory health was collected by interview using pre-tested and structured questionnaires which is modified to suit the study purpose. The questionnaires were translated to Afaan Oromo and Amharic language, the local language of the study participants and then information on the socio-demographic and economic factors, behavioral and occupational/ Environmental factors, and prevalence of chronic respiratory symptoms were collected.

The emission level of PM (2.5 and 10) was measured by using Low-Cost Sensor PurpleAir samplers by placing the instrument in the selected departments. After sampling completed, the chips were collected, and the data was downloaded in to computers for analysis or determination of the concentration of pollutants.

The emission level was measured from 4 main departments (administration, raw material receiving, cement milling, and packing). The results obtained was compared with the available standards.

3.8 Study variables

3.8.1 Dependent variable

- Chronic respiratory symptoms.

3.8.1 Independent variables

- **Socio demographic factors**: age, sex, education and marital status
- **Behavioral factors**: smoking, Alcohol, Khat chewing,
- **Environmental/Occupational factors**: working department, length of working hours, PPE, work experience (service year), training on respiratory health, past dust exposure history, energy used at home.
- **Occupational history**: dust exposure in work places before employing in the cement factory, chemical/ gas exposure

3.9 Operational Definitions

Chronic respiratory symptoms: The development of one or more of the symptom/s of chronic cough, chronic phlegm, chronic wheezing, and chronic shortness of breath which last/s at least three months in one year.

Chronic Cough: Experience of cough as much as 4– 6 times per day occurring for most days of the week (≥4 days) for at least three months in one year.

Chronic Phlegm: It is sputum expectoration as much as twice a day for most days of the week (≥4 days) for at least three months in one year.

Chronic Wheezing: A condition of causing a wheezy or whistling sound during inspiration/expiration at least three months in a year occasionally apart from that caused by a cold or acute upper respiratory infection.

Chronic Shortness of breath: It is divided into 5 grades with the following definitions:

- **Grade 0**: No breathlessness except with strenuous exercise;
- **Grade 1**: Breathlessness when hurrying on the level ground or walking up a slight hill at least three months in a year.
- **Grade 2**: Walking slower than people of the same age on the level because of breathlessness or need to stop for breath when walking at own pace or level at least three months in a year.
- **Grade 3**: Stopping for breath after walking about a certain distance or a few minutes on the level ground at least three months in a year.
- **Grade 4**: Too breathless to leave the house or breathless when dressing or undressing at least three months in a year.

Smoking habit:

- **Never smokers**: workers who used no cigarette.
- **Current smokers**: workers who smoked at the time of the study or had stopped smoking less than one year before.
- **Ex-smokers**: workers who had quit at least 1 year before the survey.

Occupational (past dust exposure) history: any work experience on dusty environment before the current working position.

Chronic respiratory disease: respiratory disease like TB, chronic bronchitis, lung cancer, and heart disease that could be developed before and identified by physicians (Gizaw *et al.*, 2016).

PM 2.5 was measured as respirable PM with the aerodynamic diameter <2.5 microns.

PM 10 was measured as respirable PM with the aerodynamic diameter <10 microns.

3.10 Data quality control

To assure data quality the calibrated PurpleAir Sensor was used to collect and measure emission level of PM2.5 and 10.

Before conducting data collection, the questionnaires were prepared in English language and translated into Amharic and Afaan Oromo then finally, translated back to English to ensure the consistency of the tools. A pre-test was conducted on 5% of the sample size at Harar city among wood workers, outside the study area to identify potential problems in data collection tools and modification of the questionnaire. The questionnaire was checked for its clarity and logical consistency by the investigators. One day training was given to all data collectors and supervisor about all aspect of data collection tools, questioning techniques, and ethical issue by principal investigator. The collected data was checked daily for completeness and consistency.

3.11 Method of data analysis

The collected data was rechecked, cleaned, coded, organized and entered into Epi Data version 3.1 and then exported to the Statistical Package for Social Sciences (SPSS) Version 25.0. Descriptive statistics was used to determine the profile of the respondents in frequency, percentage distribution and mean at a 95% confidence interval.

Bivariable binary logistic regression analysis was done and crude odds ratio (COR) was computed at a 95% C.I. and thus variables with p-value less than 0.25 are considered as potential candidates in the final multivariable logistic regression analysis. Then, a multivariable logistic regression analysis was run to identify factors associated with chronic respiratory symptoms among cement factory workers. Finally, variables with $p < 0.05$ in the final logistic model was considered statistically significant and the strength and direction of association was measured by adjusted odds ratio (AOR) with corresponding 95% confidence interval. Multicollinearity was also checked for any interaction between independent variables to remove from the final analysis with the cutoff point of variance inflation factor of 10 and tolerance of 0.2. Model fit was tested using Hosmer-Lemshaw goodness-of-fit test ($p>0.713$).

Both descriptive and the analyzed data was presented using tables, bar graphs, frequencies, and percentage.

3.12. Ethical considerations

Ethical clearance of the study was taken from Institutional Health Research Ethics Review Committee (IHRERC) of College of Health and Medical Sciences, Haramaya University (Ref. No. IHRERC/274/2024 and date October 30, 2024). Official letter for cooperation was sent from Haramaya University, College of Health and Medical Science to the cement factory and letter of permission was obtained from the factory.

Informed, voluntary, Written and signed consent was obtained from each head and the study participants after explaining the detail about the objective, purpose, benefits, and risks of the study. Participation in the study was voluntary based. Both participants and head of factory have right to declare whether to participate or not in this study and also right to withdraw from the study at any time. All the information collected from the participants was kept under the custody of the researcher as confidential.

3.13 Information dissemination

The results of this study will be submitted to Haramaya University, Collage of Health and Medical Sciences. The results of this study will be disseminated to Dire Dawa city health bureau, Social and Labor Affairs, cement factory administrators and other sectors responsible to prevent and promote health and safety of workers. Finally, it will be published on a recognized international journal.

4. RESULTS

4.1 Socio demographic characteristics

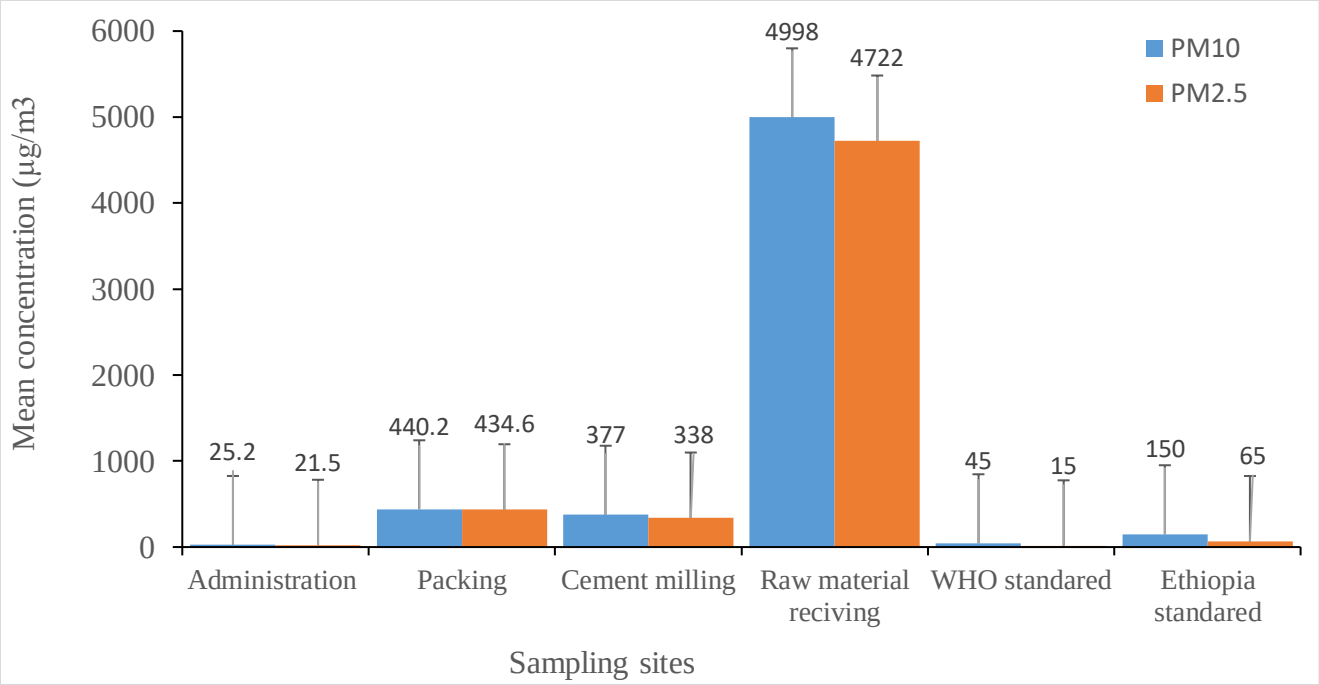
A total of 300 factory workers were appraoched for the study with an overall response rate of 97%. Among 291 cement factory workers, 249 (85.6%) were male while 226 (77.7%) were married. Majority, 133 (45.7%) of the workers were between 25-34 age category and the mean age of the study participants was 36.41 ±7.5 SD. One hundred fifty-four (52.9%) factory workers were attended higher education while 6(2.1%) had no formal education. Majority, 275 (94.5%) workers were permanently employed. Furthermore, 145(49.8%) had income ranged from 10,001-15,000 and the average income of the workers was 13072± 15619 Ethiopian Birr (ETB) (Table 2).

Table 2: Socio-demographic factors of cement factory workers in National cement factory in Dire Dawa city, Ethiopia, 2025

Variables (n=291)	Categories	Frequency	Percentage	Mean ± SD
Sex	Female	42	14.4	
	Male	249	85.6	
Age	18-25	11	3.8	36.41 ±7.5
	25-34	133	45.7	
	35-44	102	35.1	
	>45	45	15.5	
Marital status	Married	226	77.7	
	Single	47	16.2	
	Divorced/ Separated	18	6.2	
Educational level	No Education	6	2.1	
	Primary Education	38	13.1	
	Secondary Education	93	32.0	
	Higher Education	154	52.9	
Employment condition	Temporary	16	5.5	
	Permanent	275	94.5	
Monthly income (In ETB)	<5000	14	4.8	13072± 15619
	5001-10000	95	32.6	
	10001-15000	145	49.8	
	>15000	37	12.7	

4.2 Particulate Matter (PM 2.5 and 10) level at different departments of cement factory

The emission level of PM2.5 and PM 10 from each working unit in the cement factory were varied from the lowest (21.5 and 25.2 µg/m3) in administrative unit to the highest (4722 and 4998 µg/m3) in raw material receiving unit, respectively (Figure 3).



Note:- PM-Particulate Matter **WHO-** World Health Organization

Figure 3: PM2.5 and PM 10 Emission Level by sampling sites of National Cement Factory, Dire Dawa, Ethiopia, 2025

4.3 Prevalence of occupational chronic respiratory symptoms

Out of 291 cement factory workers, 179 (61.5%) [95% CI: 55.7-67.1] were experienced one or more chronic respiratory symptoms in the last 12 months. Two hundred thirty-three (80.1%) [95% CI: 75.0-84.5] were experienced cough however, 141 (48.5%) [95% CI: 42.6-54.4] was chronic cough. One hundred eighty-four (63.2%) [95% CI: 57.4-68.8] had phlegm/sputum on most time in the last 12 months, while 114 (39.2%) [95% CI: 33.5-45.0] were chronic phlegm. The prevalence of chronic wheezing or whistling on chest and breathlessness (shortness of breath) were 29.2% [95% CI: 24.0-34.8] and 22.7% [95% CI: 18.0-27.9] respectively (Table 3).

Table 3: Respiratory symptoms among cement factory workers in National cement factory in Dire Dawa city, Ethiopia, 2025

Variables (n=291)	Categories	Frequency	Percentage
Chronic Respiratory Symptoms	Yes	179	61.5
	No	112	38.5
Cough on most time in the last 12 months	Yes	233	80.1
	No	58	19.9
Chronic Cough	Yes	141	48.5
	No	150	51.5
Phlegm on most time in the last 12 months	Yes	184	63.2
	No	107	36.8
Chronic Phlegm	Yes	114	39.2
	No	177	60.8
wheezing or whistling on chest	Yes	85	29.2
	No	206	70.8
Breathlessness (Shortness of breath)	Yes	66	22.7
	No	225	77.3
Attacks of shortness of breath with wheezing	Yes	26	8.9
	No	265	91.1

4.4 Past Occupational history before employment in the Cement factory

Regarding the history of chronic respiratory diseases before being employed in the cement factory, 36 (12.4%) had attacks of asthma while 47(16.2%) had sinus. But only 10.0% and 11.0% of asthma and sinus were confirmed by doctor respectively. Sixteen (5.5%) of workers had previous occupational dust exposure.

Table 4: History of chronic respiratory diseases before employment in the Cement factory

Variables (n=291)	Categories	Frequency	Percentage
Have you ever had attacks of Bronchitis?	Yes	11	3.8
	No	280	96.2
If yes, was it confirmed by a doctor?	Yes	10	90.9
	No	1	9.1
Have you ever had attacks of emphysema?	Yes	8	2.7
	No	283	97.3
If yes, was it confirmed by a doctor?	Yes	7	87.5
	No	1	12.5
Have you ever had attacks of asthma?	Yes	36	12.4
	No	255	87.6
If yes, was it confirmed by a doctor?	Yes	29	80.6
	No	7	19.4

Have you ever had attacks of sinus trouble?	Yes	47	16.2
	No	244	83.8
If yes, was it confirmed by a doctor?	Yes	32	68.1
	No	15	31.9
Have you ever had attacks of Pulmonary Tuberculosis?	Yes	11	3.8
	No	280	96.2
If yes, was it confirmed by a doctor?	Yes	9	81.8
	No	2	18.2
Have you ever had heart disease?	Yes	8	2.7
	No	283	97.3
If yes, was it confirmed by a doctor?	Yes	1	12.5
	No	7	87.5
Have you ever worked for any other dust?	Yes	16	5.5
	No	275	94.5
Have you ever been exposed to gas or chemical fumes in your work?	Yes	2	0.7
	No	289	99.3

4.5 Occupational characteristics and behavioral factors

Among 291, 124 (42.6%) of workers were working in administration department and the rest 167 (57.4%) were working in production department. Among those working in production department 63 (21.6%), 47 (16.2%) and 57 (19.6%) were working in Raw material receiving, Cement milling and packing unit respectively.

Majority, 186 (63.9) of cement factory workers were working more than forty-eight hours (>48) per week and 158 (54.3) of them worked in the cement factory for more than five years. About 49.5% of workers got training on OHS about respiratory problems however, only 106 (36.4%) of workers use personal respiratory protective materials properly.

Among 291 factory workers, 172 (59.1) and 104 (35.7) of them used electricity and charcoal as kind of energy for cooking in home respectively.

In this study, 87 (29.9%) of cement factory workers ever smoked cigarette. Out of 87 workers ever smoked cigarette 59 (67.8%) were current smokers while, 24 (85.7%) of those not smoking currently were ex-smokers (workers who had quit at least 1 year before the survey).

Table 5: Occupational characteristics and behavioral factors of cement factory workers in Dire Dawa city, Ethiopia, 2025

Variables (n=291)	Categories	Frequency	Percentage
Working department	Administration	124	42.6
	Raw material receiving	63	21.6
	Cement milling	47	16.2
	Packing	57	19.6
Working hours per week	≤48	105	36.1
	>48	186	63.9
Experience	1-5 years	133	45.7
	>5 years	158	54.3
Training on OHS about respiratory problems	Yes	144	49.5
	No	147	50.5
Use Personal respiratory protective materials	Yes	106	36.4
	No	185	63.6
Kind of energy used most for cooking in home	Electricity	172	59.1
	Wood	7	2.4
	Charcoal	104	35.7
	No food cooked in home	8	2.7
Ever smoked	Yes	87	29.9
	No	204	70.1
Current smokers (n=87)	Yes	59	67.8
	No	28	32.2
Ex-smokers (n=28)	Yes	24	85.7
	No	4	14.3
Alcohol drinking	Yes	179	61.5
	No	112	38.5
Frequency of alcohol drinking (n=179)	Every day	2	1.1
	One-three days/wk	26	14.5
	Occasionally	151	84.4
Khat chewing	Yes	188	64.6
	No	103	35.4
Frequency of Khat chewing (n=188)	Every day	86	45.7
	One-three days/wk	54	28.7
	Occasionally	48	25.5

Note:- OHS-Occupational Health and Safety

About 179 (61.5%) and 188 (64.6%) of factory workers had a history of alcohol drinking and Khat chewing respectively. Regarding frequency of drinking alcohol, majority (84.4%) of those drinking alcohol were drink alcohol occasionally and (45.7%) were chew khat every day.

4.6 Predictor variables associated with chronic respiratory symptoms among cement factory workers

In the bivariable logistic regression analysis, variables with p-value less than 2.5 were selected for multivariable logistic regression model during bivariable analysis of factors associated with chronic respiratory symptoms. The candidate explanatory variables selected were; sex, educational status, PPE usage, working department, cigarette smoking, alcohol drinking, working hours per week, experience, Khat chewing and kind of energy used for cooking.

Based on multivariable analysis, there was a significant association between working department and chronic respiratory symptoms. Workers working in raw material receiving [AOR: 3.2, 95% CI: 1.27-7.80], cement milling [AOR: 4.06, 95% CI: 1.49-11.10] and packing unit [AOR: 3.01, 95% CI: (1.02-8.91)] were 3.2, 4.06 and 3.01 times more likely to develop chronic respiratory symptoms.

Furthermore, workers working greater than 48 hours per week [AOR: 2.11, 95% CI: 1.03-4.31], PPE use [AOR: 2.31, 95% CI: 1.28-4.16] and cigarette smoking [AOR: 2.30, 95% CI: 1.14-4.64] were more likely to develop chronic respiratory symptoms when compared with their counterparts (table 6).

Table 6: Factors Associated with Chronic Respiratory Symptoms among Workers in National Cement Factory, Dire Dawa, Ethiopia, 2025

Variables (n=291)	**Categories**	**Chronic respiratory symptoms**		**COR (95% CI)**	**AOR (95% CI)**
		Yes (n, %)	**No (n, %)**		
Sex	Female	20 (47.6%)	22 (52.4%)	1	1
	Male	159 (63.9%)	90 (36.1%)	1.943 (1.01-3.75) *	0.74 (0.27-2.00)
Age	18-25	8 (72.7%)	3 (27.3%)	0.470 (0.12-1.85)	
	25-34	74 (55.6%)	59 (44.4%)	1.042 (0.26-4.22)	
	35-44	75 (73.5%)	27 (26.5%)	0.359 (0.08-1.53)	
	>45	22 (48.9%)	23 (51.1%)	1	
Marital status	Married	145 (64.2%)	81 (35.8)	1.432 (0.54-3.77)	
	Single	23 (48.9%)	24 (51.1%)	0.835 (0.28-2.48)	
	Divorced/ Separated	10 (55.6%)	8 (44.4%)	1	
	No Education	4 (66.7%)	2 (33.3%)	1.850 (0.33-10.40)	0.52 (0.07-4.06)

Educational level	Primary Education	30 (78.9%)	8 (21.1%)	3.47 (1.50-8.05) **	0.77 (0.26-2.24)
	Secondary Education	65 (69.9%)	28 (30.1%)	2.15 (1.25-3.70) **	0.75 (0.36-1.60)
	Higher Education	80 (51.9%)	74 (48.1%)	1	1
Income	<5000	12 (85.7%)	2 (14.3%)	2.13(0.56-8.07)	
	5001-10000	65 (68.4%)	30 (31.6%)	1.67 (0.77-3.63)	
	10001-15000	86 (59.3%)	59 (40.7%)	1.24 (0.60-2.56)	
	>15000	17 (45.9%)	20 (54.1%)	1	
Employment Condition	Temporary	12 (75%)	4 (25%)	1	
	Permanent	167 (60.7%)	108 (39.3%)	0.52 (0.16-1.64)	
Previous dust exposure	Yes	9 (56.2%)	7 (43.8%)	0.79 (0.29-2.20)	
	No	170 (61.8%)	105 (38.2%)	1	
Previous respiratory disease	Yes	41 (67.2%)	20 (32.8%)	1.34 (0.74-2.44)	
	No	139 (60.4)	91 (39.6)	1	
Working department	Administration	51 (41.1%)	73 (58.9%)	1	1
	Raw material receiving	50 (79.4%)	13 (20.6%)	5.50 (2.71-11.17) ***	3.2 (1.27-7.80) *
	Cement milling	34 (72.3%)	13 (27.7%)	3.74 (1.80-7.80) ***	4.06 (1.49-11.10) **
	Packing	44 (77.2%)	13 (22.8%)	4.85 (2.37-9.90) ***	3.01 (1.02-8.91) *
Working hours per week	≤48	45 (42.9%)	60 (57.1%)	1	1
	>48	134 (72%)	52 (28%)	3.44 (2.08-5.68) ***	2.11 (1.03-4.31) *
Experience	1-5 years	67 (50.4%)	66 (49.6%)	1	1
	>5 years	112 (70.9%)	46 (29.1%)	2.40 (1.48-3.90) ***	1.32 (0.68-2.55)
OHS Training	Yes	90 (62.5%)	54 (37.5%)	1	
	No	89 (60.5%)	58 (39.5%)	0.92 (0.57-1.48)	
PPE use	Yes	54 (50.9%)	52 (49.1%)	1	1
	No	125 (67.6%)	60 (32.4%)	2.01 (1.23-3.27) **	2.31 (1.28-4.16) **
Cigarette Smoking	Yes	68 (78.2%)	19 (21.8%)	3.0 (1.68-5.35) ***	2.30 (1.14-4.64) *
	No	111 (54.4%)	93 (45.6%)	1	1
Alcohol drinking	Yes	123 (68.7%)	56 (31.3%)	2.20 (1.35-3.57) **	1.47 (0.76-2.86)
	No	56 (50%)	56 (50%)	1	1
Khat chewing	Yes	125 (66.5%)	63 (33.5%)	1.80 (1.10-2.94) *	0.86 (0.40-1.86)
	No	54 (52.4%)	49 (47.6%)	1	1
Kind of energy used	Electricity	95 (55.2%)	77 (44.8%)	1	1
	Wood	4 (57.1%)	3 (42.9%)	1.081 (0.23-4.97)	1.12 (0.20-6.11)
	Charcoal	80 (76.9%)	24 (23.1%)	2.56 (1.49-4.40) ***	1.98 (0.96-4.09)
	No food cooked in home	1 (12.5%)	7(87.5%)	0.12 (0.01-0.96)	0.27 (0.03-2.74)

Note: **P< 0.05, **P<0.01, ***P<0.001,* **COR**=Crude Odds Ratio, **AOR**=Adjusted Odds Ratio **PPE**=personal protective equipment, **OHS**=Occupational Health and Safety

5. DISCUSSION

This study investigates particulate matter (PM2.5 and PM10) emissions and explores the prevalence and determinants of chronic respiratory symptoms among cement factory workers in Dire Dawa City, Eastern Ethiopia.

In the current study, the emission levels of particulate matter (PM2.5 and PM10) were measured across four main departments of the cement factory using a PurpleAir sensor. The results showed that PM2.5 and PM10 concentrations ranged from 21.5 and 25.2 μg/m³ in the administrative unit to 4722 and 4998 μg/m³ in the raw material receiving unit, respectively. These levels far exceed the daily limits set by WHO (15 and 45 μg/m³) (WHO, 2021) and Ethiopian National Air Quality Guidelines (65 and 150 μg/m³) (EPA, 2003), indicating a serious occupational health risk, particularly for workers in dust-generating processes. The findings highlight the urgent need for improved dust control, use of personal protective equipment, and stricter enforcement of occupational safety standards to protect workers' respiratory health.

The current study revealed that out of 291 cement factory workers included in the study, 61.5% [95% CI: 55.7-67.1] were experienced chronic respiratory symptoms in the last 12 months. The finding of the current study is consistent with the study conducted in United Arab Emirates (60.4%) (Ahmed and Abdullah, 2012), Dejen town, Ethiopia (62.9%) (Gizaw *et al.*, 2016), and in Hawassa, Ethiopia (56.6%) (Lagiso *et al.*, 2020) but higher than the study conducted in Addis Ababa (50.8%) (Mekasha *et al.*, 2018), and lower when compared with the study conducted in North West Ethiopia (66.2%) (Alemu *et al.*, 2014), Addis Ababa, Ethiopia (69.8%) (Awoke *et al.*, 2021). This finding was further supported by the factory's clinic records, where respiratory diseases ranked first among the top ten diseases, accounting for 23.4% of all reported cases. These variations might be due to differences in the study population, nature of working environment, availability and utilization of PPE and implementation of OHS guidelines.

In the current study the prevalence of chronic cough was 48.5%, chronic phlegm 39.2%, chronic wheezing or whistling on chest 29.2% and breathlessness (Shortness of breath) 22.7%. This finding is comparable with the study conducted in Hawassa city, Ethiopia; chronic cough (39.3%) and chronic breathlessness (18.9%) (Lagiso *et al.*, 2020).

However, the findings of this study is higher than the study conducted in Tanzania; chronic cough (25.8%), chronic sputum production (34.2%), work-related shortness of breath (16.7%), wheeze (12.5%) (Mwaiselage *et al.*, 2005), in Congo; cough (22.9%) , wheezing (5.4%) and phlegm (16.1%) (Mbelambela *et al.*, 2018), in Dejen town, west-central Ethiopia; chronic wheezing 36.9%, chronic phlegm 24.5%, chronic shortness of breath 38.6% (Gizaw *et al.*, 2016), in Hawassa city, Ethiopia; chronic cough with sputum (17.86%) and chronic wheezing (17.35%) (Lagiso *et al.*, 2020) and in North West Ethiopia; Cough (32%), Phlegm (30.5%) (Alemu *et al.*, 2014), and lower when compared with the study conducted in, Addis Ababa, Ethiopia; chronic cough (98.7%), chronic phlegm (91.7%), and chest wheezing (30.6%) (Mekasha *et al.*, 2018) and cough (54.6%), phlegm (52.2%), wheezing (44.6%) and breathlessness (42.1%) (Awoke *et al.*, 2021). The likely explanation for this finding might be due to differences in study population, exposure level, study design and measurement and adherence safety practices.

In the current study, the working department was significantly associated with chronic respiratory symptoms. Workers in the raw material receiving, cement milling, and packing units were more than three, four, and three times more likely, respectively, to develop chronic respiratory symptoms compared with their counterparts. This finding is inline with study conducted in Dejen, Ethiopia, which reported employees engaged in cement mill were 4 times (95 % CI = 1.92, 7.21) more likely, respectively, to develop chronic respiratory symptoms (Gizaw et al., 2016). Similarly, (Mekasha *et al.*, 2018) found that workers in the raw material receiving unit had 7.5 times higher odds (AOR = 7.5, 95% CI: 2.9–19.4), those in the cement milling unit had 2.5 times higher odds (AOR = 2.5, 95% CI: 1.2–4.8), and those in the packing unit had 2.2 times higher odds (AOR = 2.2, 95% CI: 1.2–4.3) of developing chronic respiratory symptoms compared with those working in administration department. The variation in risk across departments aligns with the known exposure profile in cement factories, where administrative units have lower dust exposure. The significantly increased odds in production departments, raw material receiving, packing, and cement milling strongly suggest a dose-response relationship between dust exposure and adverse respiratory health outcomes.

Cement milling department consistently has among the highest levels of airborne particulate matter, which also shows the strongest association. This finding is supported by study conducted by (Gizaw *et al.*, 2016) who also found milling workers to be at highest risk (AOR:3.72).

Workers working in raw material receiving and packing unit were more exposed to raw mix dust and finished cement dust during loading/unloading and bagging operations, respectively. This is also supported by study conducted in Mugher cement factory which revealed, raw material receiving unit were 7.5 times and packing unit were 2.2 times more likely to develop chronic respiratory symptoms (Mekasha *et al.*, 2018).

Furthermore, the current study found that working hours were significantly associated with chronic respiratory symptoms. Workers working greater than 48 hours per week were two times more likely to develop chronic respiratory symptoms when compared with those work less than 48 hours per week. This result was supported by the studies AOR: 2.4 (Lagiso *et al.*, 2020) and AOR: 5.44 (Gizaw *et al.*, 2016) and this difference is most likely due to increased cumulative exposure time, inadequate recovery, fatigue and higher dust inhalation rates among those working longer hours.

This study revealed that cement factory workers who did not use personal protective equipment (PPE) regularly were more than twice as likely to develop chronic respiratory symptoms compared with those who used PPE. This finding is supported by a study conducted in South Africa (Mkulisi, 2017). The higher risk among non-users is likely due to PPE serving as a protective barrier, reducing dust inhalation and cumulative exposure, thereby lowering the likelihood of developing chronic respiratory symptoms.

Smoking was another significant predictor of chronic respiratory symptoms. Smokers were more than twice as likely to develop chronic respiratory symptoms compared with non-smokers. This finding is supported by studies conducted in Ethiopia, (AOR: 5.38) (Gizaw *et al.*, 2016), (AOR: 11.7) (Alemu *et al.*, 2014) and South Africa (AOR: 6.34) (Mkulisi, 2017).The increased risk among smokers may be due to the synergistic effect of smoking and dust exposure, which can impair lung defense mechanisms and cause airway inflammation and irritation, thereby exacerbating respiratory symptoms.

Strengths and Limitations of the study

This study has several strengths. The use of a structured questionnaire administered through face-to-face interviews, combined with instrument-based data collection, ensured comprehensive data capture. Proportional allocation of the sample across different working departments enhanced representativeness, increasing the generalizability of the findings to all cement factory workers. Additionally, employing trained data collectors minimized the risk of misinterpretation of questions by participants and improved the reliability of the collected data.

However, the study has some limitations. One key limitation is the potential healthy worker effect, as workers who developed chronic respiratory symptoms may have left their jobs, potentially leading to an underestimation of the true prevalence and introducing selection bias. Additionally, use of questionnaire-based method of data collection may have introduced biases such as recall bias, social desirability bias, and interviewer bias, which could affect the accuracy of self-reported information.

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The study concludes that the prevalence of chronic respiratory symptoms among cement factory workers and the emission levels of particulate matter (PM2.5 and PM10) were high, exceeding both national and WHO guidelines. The findings also indicate that specific occupational departments and certain work practices are significant independent predictors of chronic respiratory symptoms. The current study also showed that workers in the raw material receiving, cement milling, and packing units had significantly higher odds of developing chronic respiratory symptoms compared with administrative staff. Additionally, prolonged work hours (>48 hours/week), failure to use personal protective equipment (PPE), and cigarette smoking were each associated with approximately a two-fold increase in risk.

6.2 Recommendation

- **To Dire Dawa Regional Health Bureau**

  - Enforce occupational health and safety standards in cement factories.
  - Support regular health screening (e.g., spirometry, respiratory check-ups) for workers.
  - Promote smoking cessation and health education programs targeting industrial workers.

- **Social and Labor Affairs**

  - Ensure compliance with labor standards on maximum working hours (<48 hours/week).
  - Monitor and enforce workplace safety practices, including PPE provision and use.
  - Strengthen worker protection policies and reporting mechanisms for occupational hazards.

- **Cement Factory Administration / Safety Officers**

  - Reduce dust exposure through engineering controls (ventilation, dust suppression, machinery maintenance).
  - Ensure consistent PPE availability, proper use, and worker training.
  - Conduct routine occupational health surveillance of employees.
  - Provide workplace health education on dust hazards and smoking risks.
  - Regulate working schedules to avoid excessively long hours.

- **To researchers**

Future researchers are recommended to use longitudinal study designs to minimize the influence of the healthy worker effect and better assess long-term outcomes. In addition, researchers are also encouraged to complement questionnaire-based assessments with objective clinical measurements, such as spirometry and chest radiography would help reduce reporting bias and improve the accuracy of findings.

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8. ANNEXES

8.1. Information sheet and informed voluntary consent form for head of cement factory.

Introduction

My name is Abdishakur Dida. I am the principal investigator of the study to be conducted on the cement factory in Dire Dawa city. I am studying for my Master's degree at Haramaya University, the College of Health and Medical Sciences. I kindly request you to lend me your attention to explain to you about the study and your institution being selected as the study setting.

The title of the study

Assessment of Particulate Matter (Pm 10 & Pm 2.5) and Its Association with Chronic Respiratory Symptoms among Cement Factory Workers in Dire Dawa City, Eastern Ethiopia, 2024

Purpose/aim of the study:

The findings of this study can be of paramount importance for the cement factory to plan intervention programs to prevent work-related chronic respiratory problems among cement factory workers. Moreover, this study aims to write a thesis as a partial requirement for the fulfillment of a Master's Program in Occupational Health and Safety for the principal investigator.

Procedure and duration:

I will be interviewing the study participants (workers) using a questionnaire to provide me with pertinent data and I will measure the emission level of particulate matter (PM2.5 and 10) from selected working departments that is helpful for the study. There are 63 questions to answer and I will fill the questionnaire by interviewing the study participants. The interview of each study participant will take about 20 minutes.

Risks and benefits:

The risk of participating in this study is very minimal, but only taking a few minutes from workers' time. There would not be any direct payment for participating in this study. However, the findings from this research may reveal important information for the local health planners.

Confidentiality:

The information that we will be provided will be kept confidential. There will be no information that will identify the participants in particular as well as the factory name. The findings of the study

will be general for the study community and will not reflect anything particular about individual persons. The questionnaire will be coded to exclude showing names. No reference will be made in oral or written reports that could link participants and factory name to the research.

Rights:

Participation in this study is fully voluntary. The participants have the right to declare whether to participate or not in this study. If they decide to participate, they have the right to withdraw from the study at any time and this will not label them for any loss of benefits to which they otherwise are entitled. They do not have to answer any question that they do not want to answer. The factory has also the right to stop this study from being conducted if any misdeeds and unethical procedures are observed during the data collection process in the factory's premises

Contact address

If there are any questions or enquires any time about the study or the procedures, please contact: principal investigator: Abdishakur Dida, Mobile phone: 0977715651

E-mail: abdishakurdida2010@gmail.com

Contact address of the responsible Institutional Ethics Review Committee (IRERC) at office, Haramaya University Health Science College Tel: 0254662011 or P.O.Box 235, Harar, Ethiopia)

Declaration of informed voluntary consent

I have read the participant information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the right to participate, and the contact address for any queries. I have been given the opportunity to ask the questions for things that may have been unclear. I was informed that participants have the right to withdraw from the study at any time or not to answer any question that they do not want. I am also informed that the cement factory has the right to stop this study from being conducted if any misdeeds and unethical procedures are observed during the data collection process in the bank's premises. Therefore, I declare my voluntary consent on behave of _____to allow this study to be conducted in our cement factory with my initials

Name and signature of head of the cement factory _____ _____ Date_____
Name and signature of the PI: _____ _____ Date_____

8.2. Participant information sheet and informed voluntary consent form for study participants (age ≥18) (English version)

Introduction

My name is …….. . I am working as a data collector for the study being conducted in Dire Dawa city among cement factory workers by Abdishakur Dida, who is studying for his master's degree at Haramaya University, College of Health and Medical Science. I kindly request you to lend me your attention to explain to you about the study and being selected as the study participant.

The title of the study

Assessment of Particulate Matter (Pm 10 & Pm 2.5) and Its Association with Chronic Respiratory Symptoms among Cement Factory Workers in Dire Dawa City, Eastern Ethiopia, 2025

Purpose/aim of the study:

The findings of this study can be of paramount importance for the cement factory to plan intervention programs to prevent work-related chronic respiratory problems among cement factory workers. Moreover, this study aims to write a thesis as a partial requirement for the fulfillment of a Master's Program in Occupational Health and Safety for the principal investigator.

Procedure and duration:

I will be interviewing the study participants (workers) using a questionnaire to provide me with pertinent data that is helpful for the study. There are 63 questions to answer and I will fill the questionnaire by interviewing the study participants. The interview of each study participant will take about 20 minutes.

Risks and benefits:

The risk of being participating in this study is very minimal, but only taking a few minutes from your time. There would not be any direct payment for participating in this study. However, the findings from this research may reveal important information for the local health planners.

Confidentiality:

The information you will provide us will be confidential. There will be no information that will identify you in particular. The findings of the study will be general for the study community and will not reflect anything particular about individual persons or housing. The questionnaire will be coded to exclude showing names. No reference will be made in oral or written reports that could link participants to the research.

Rights:

Participation in this study is fully voluntary. You have the right to declare whether to participate or not in this study. If you decide to participate, you have the right to withdraw from the study at any time and this will not label you for any loss of benefits to which you otherwise are entitled. You do not have to answer any question that you do not want to answer.

Contact address

If there are any questions or enquires any time about the study or the procedures, please contact: Name and address of the principal investigator: Abdishakur Dida, Mobile phone: 0977715651

E-mail: abdishakurdida2010@gmail.com

Contact address of the responsible Institutional Ethics Review Committee (IRERC) at office, Haramaya University Health Science College Tel: 0254662011 or P.O.Box 235, Harar, Ethiopia)

Declaration of Informed Voluntary Consent

I have read/was read to me and have a clear understanding of the research's purpose, procedures, potential risks and benefits, confidentiality measures, participant rights, and the contact information for any inquiries. I have been given the opportunity to seek clarification by asking questions regarding any unclear aspects. I acknowledge that I have the right to withdraw from the study at any time and decline to answer any questions I do not wish to answer. Therefore, I confirm my voluntary agreement to participate in the study and provide the required information by signing below.

Name and signature of the study participant_____ _____ Date_____

Name and signature of the data collector _____ _____ Date_____

Thank you for your cooperation!

8.3. Participant information sheet and informed voluntary assent form for study participants (Age < 18 years) (English version)

Introduction

My name is _____. I am working as a data collector for the study being conducted in cement factory by Abdishakur Dida, who is studying for his Master's degree at Haramaya University, the College of Health and Medical Sciences. Your child is randomly selected to be a participant in this study. I kindly request you to lend me your attention to explain to you about the study and the child's participation.

The title of the study

Assessment of Particulate Matter (Pm 10 & Pm 2.5) and Its Association with Chronic Respiratory Symptoms among Cement Factory Workers in Dire Dawa City, Eastern Ethiopia, 2025

Purpose/aim of the study:

The findings of this study can be of paramount importance for the cement factory to plan intervention programs to prevent work-related chronic respiratory problems among cement factory workers. Moreover, this study aims to write a thesis as a partial requirement for the fulfillment of a Master's Program in Occupational Health and Safety for the principal investigator.

Procedure and duration:

I will ask you 63 questions about your child that will help us to know the chronic respiratory problems' status of the child. This procedure will take approximately 20 minutes of your time. Therefore, I kindly request you to spare this time and allow me to perform the procedure on your child.

Risks and benefits:

There is no any risk of being participating for your child in this study, but only taking a few minutes from your time. There would not be any direct payment for participating in this study. However, the findings from this research may reveal important information for the local health planners.

Confidentiality:

The information that we will collect from this study will be confidential. There will be no information that will identify your child or yourself in particular. The findings of the study will be general for the study community and will not reflect anything particular about individual persons or housing. The data that we gather from the measurements will exclude showing names. No reference will be made in oral or written reports that could link participants to the research.

Rights:

Participation in this study is fully voluntary. You have the right to declare whether to allow your child to be involved in this study or not. If you would allow your child for this study, you have the right to withdraw him/her from the study at any time and this will not label you/your child for any loss of benefits to which you/your child otherwise are entitled. You do not have to answer any question that you do not as well.

Contact address

If there are any questions or enquires any time about the study or the procedures, please contact: Name and address of the principal investigator: Abdishakur Dida, Mobile phone: 0977715651

E-mail: abdishakurdida2010@gmail.com

Contact address of the responsible Institutional Ethics Review Committee (IRERC) at office, Haramaya University Health Science College Tel: 0254662011 or P.O.Box 235, Harar, Ethiopia)

Declaration of informed voluntary consent:

I have read/ was read to me the participant information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the rights of participating, and the contact address for any queries. I have been given the opportunity to ask questions for things that may have been unclear. I was informed that I have the right to withdraw my child from the study at any time or not to answer any question that I do not want. Therefore, I declare my voluntary consent to allow my child to participate (be involved) in this study with my initials.

Name of the participant: _____ (Assent affirmed if a minor aged 12-17 years

Name and signature of parent/legal guardian: _____ Date: _____

Name and signature of Data Collector: _____ Date: _____

8.4. Participant information sheet and informed voluntary consent form for study participants (age ≥18) (Amharic version)

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Assessment of Particulate Matter (Pm 10 & Pm 2.5) and Its Association with Chronic Respiratory Symptoms among Cement Factory Workers in Dire Dawa City, Eastern Ethiopia, 2025

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8.5. Participant information sheet and informed voluntary assent form for study participants (Age < 18 years) (Amharic version)

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Assessment of Particulate Matter (Pm 10 & Pm 2.5) and Its Association with Chronic Respiratory Symptoms among Cement Factory Workers in Dire Dawa City, Eastern Ethiopia, 2025

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ኢሜል፡- abdishakurdida2010@gmail.com

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8.6. Participant information sheet and informed voluntary consent form for study participants (age ≥18) (Afaan Oromoo version)

Seensa

Maqaan koo_____Qo'annoo magaalaa Dirree Dhawaatti hojjettoota warshaa simintoo irratti gaggeeffamaa jiruuf, Yunivarsiitii Haramayaatti, Kolleejjii wal'aansaa fi Saayinsii Fayyaa Hararitti digirii lammaffaa barachaa kan jiru Abdishakur Diidaan gaggeeffamaa jiruuf ragaa walitti qabaa ta'ee hojjechaan jira. Waa'ee qorannichaa fi dhaabbanni keessan hirmaataa qorannichaa ta'ee filatamuu akkan isiniif ibsuuf xiyyeeffannoo keessan akka naaf kennitan kabajaan isin gaafadha.

Mata duree qorannichaa

Assessment of Particulate Matter (Pm 10 & Pm 2.5) and Its Association with Chronic Respiratory Symptoms among Cement Factory Workers in Dire Dawa City, Eastern Ethiopia, 2025

Kaayyoo qorannichaa:

Argannoon qorannoo kanaa warshaan simintoo hojjettoota warshaa simintoo biratti akkaataa rakkoo sirna hargansuu yeroo dheeraa hojiin walqabatee dhufu ittisuuf karoorfachuuf gargaara. Kana malees, qorannoon kun qorataadhaaf Sagantaa Maastarsii Fayyaa fi Nageenya Hojii (Occupational Health & Safety) guutuuf isa gargaara.

Hojimaataa fi turtii qorannichaa

Hirmaattota qorannichaa (hojjattoota) gaaffii fayyadamee daataa barbaachisaa qorannichaaf gargaaru naaf kennuuf af-gaaffii nan taasisa. Gaaffiiwwan filannoo qaban 63 yoo ta'u, hirmaattota qorannichaa af-gaaffii gochuun gaaffilee nan guuta. Af-gaaffiin qo'annichaa gara daqiiqaa 20 fudhata.

Miidhaa fi faayidaa:

Miidhaan qorannoo kana irratti hirmaachuu baayyee xiqqaadha, innis yeroo keessan irraa daqiiqaa muraasa qofa fudhachuudha. Qorannoon kana irratti hirmaachuuf kaffaltiin kallattiin hin jiraatu. Haa ta'uu malee, argannoon qorannoo kanarraa argamu karoorsitoota fayyaa naannoo sanaaf odeeffannoo barbaachisaa ta'e kennuuf oola.

Iccitii:

Odeeffannoon isin nuuf kennitan iccitiin isaa eeggamaadha. Odeeffannoon addatti si adda baasu hin jiraatu. Argannoon qorannichaa hawaasa qorannichaaf waliigalaa kan ta'u yoo ta'u, waa'ee namoota dhuunfaa ykn mana jireenyaa isaanii kan hin calaqqisiifne ta'a. Gaaffiin akka maqaa hin agarsiifneef koodiin ni kennama. Gabaasa afaaniin ykn barreeffamaan hirmaattoota qorannicha waliin walqabsiisuu danda'u keessatti eeruun hin kennamu.

Mirgoota:

Hirmaannaan qorannoo kanaa guutummaatti fedhii irratti kan hundaa'eedha. Qo'annoo kana irratti hirmaachuu fi dhiisuu kee labsuuf mirga qabda. Yoo hirmaachuuf murteessite yeroo barbaaddetti qorannicha keessaa ba'uuf mirga qabda kunis faayidaa silaa argattu tokkoyyuu sin dhorgu. Gaaffii deebii kennuu hin barbaanne kamiyyuu deebisuun si hin barbaachisu.

Teessoo quunnamtii

Waa'ee qorannichaa ykn hojimaata yeroo kamiyyuu gaaffiin ykn yaadni yoo jiraate: Maqaa fi teessoo qorataa ijoo: **Abdishakur Dida**, Bilbila harkaa: **0977715651** qunnamaa

Imeelii: abdishakurdida2010@gmail.com irratti ergaa

Teessoo quunnamtii itti gaafatamaa koree gamaaggama naamusa qorannoo dhaabbilee (IRERC) waajjira, Kolleejjii Saayinsii Fayyaa Yuunivarsiitii Haramayaa Bilbila: 0254662011 ykn P.O.Box 235, Harar, Ethiopia)

Labsii hayyama ibsa odeeffannoo irratti hundaa'e

Waraqaa odeeffannoo hirmaattotaa dubbiseera/ naaf dubbifameera. Odeeffannoo waa'ee kaayyoo qorannichaa, hojimaata, miidhaa fi faayidaa dhufuu danda'u, tarkaanfiiwwan iccitii, mirga hirmaattotaa, fi odeeffannoo quunnamtii gaaffii kamiifuu hubannoo ifa ta'e qaba. Waan ifa hin taane kamiyyuu gaaffii gaafachuudhaan ibsa akkan argadhu carraan naaf kennameera. Yeroo barbaadetti qo'annoo keessaa ba'uuf mirga akkan qabuu fi gaaffii deebii kennuu hin barbaanne kamiyyuu deebisuuf akkan dirqamne nan beeka. Kanaaf, qorannicha irratti hirmaachuuf waliigaltee fedhii kootiin mirkaneessuu fi odeeffannoo barbaachisu armaan gaditti mallatteessuudhaan nan mirkaneessa.

Maqaa fi mallattoo hirmaataa qorannichaa_____ _____ Guyyaa_____ .

Maqaa fi mallattoo nama odeeffannoo walitti qabuu _____ _____ Guyyaa_____ .

8.7. Participant information sheet and informed voluntary assent form for study participants (Age < 18 years) (Afaan Oromoo version)

Seensa

Maqaan koo_____Qo'annoo magaalaa Dirree Dhawaatti hojjettoota warshaa simintoo irratti gaggeeffamaa jiruuf, Yunivarsiitii Haramayaatti, Kolleejjii wal'aansaa fi Saayinsii Fayyaa Hararitti digirii lammaffaa barachaa kan jiru Abdishakur Diidaan gaggeeffamaa jiruuf ragaa walitti qabaa ta'ee hojjechaan jira. Mucaan keessan qorannoo kana irratti hirmaataa akka ta'uuf akka tasaa filatame. Waa'ee qo'annoo fi hirmaannaa daa'imaa keessanii irratti akka isiniif ibsuuf xiyyeeffannoo keessan akka naaf kennitan kabajaan isin gaafadha.

Mata duree qorannichaa

Assessment of Particulate Matter (Pm 10 & Pm 2.5) and Its Association with Chronic Respiratory Symptoms among Cement Factory Workers in Dire Dawa City, Eastern Ethiopia, 2025

Kaayyoo qorannichaa:

Argannoon qorannoo kanaa warshaan simintoo hojjettoota warshaa simintoo biratti akkaataa rakkoo sirna hargansuu yeroo dheeraa hojiin walqabatee dhufu ittisuuf karoorfachuuf gargaara. Kana malees, qorannoon kun qorataadhaaf Sagantaa Maastarsii Fayyaa fi Nageenya Hojii (Occupational Health & Safety) guutuuf isa gargaara.

Hojimaataa fi turtii qorannichaa

Waa'ee daa'ima keessanii gaaffilee 63 kanneen rakkoo sirna hargansuu yeroo dheeraa' haala daa'ima kanaa beekuuf nu gargaaran isin gaafadha. Hojimaanni kun yeroo keessan keessaa tilmaamaan daqiiqaa 20 fudhata. Kanaaf yeroo kana fudhadhee, qorannoo kana daa'ima keessan irratti akkan raawwadhu akka naaf hayyamtan kabajaan isin gaafadha.

Miidhaa fi faayidaa:

Qorannoon kana irratti hirmaachuun daa'ima keessaniif miidhaa tokkollee hin qabu, garuu yeroo keessan irraa daqiiqaa muraasa qofa fudhachuudha. Qorannoon kanaratti hirmaachuuf kaffaltiin kallattiin hin jiraatu. Haa ta'u malee, argannoon qorannoo kanarraa argamu karoorsitoota fayyaa naannoo sanaaf odeeffannoo barbaachisaa ta'e mul'isuu gargaara.

Iccitii:

Odeeffannoon isin nuuf kennitan iccitiin isaa eeggamaadha. Odeeffannoon addatti si ykn daa'ima kee adda baasu hin jiraatu. Argannoon qorannichaa hawaasa qorannichaaf waliigalaa kan ta'u yoo ta'u, waa'ee namoota dhuunfaa ykn mana jireenyaa isaanii kan hin calaqqisiifne ta'a. Gaaffiin akka maqaa hin agarsiifneef koodiin ni kennama. Gabaasa afaaniin ykn barreeffamaan hirmaattoota qorannicha waliin walqabsiisuu danda'u keessatti eeruun hin kennamu.

Mirgoota:

Qorannoon kun hirmaannaan guutummaatti fedhii ofiitiin kan raawwatamudha. Mucaan keessan qorannoo kana irratti akka hirmaatu hayyamuu fi dhiisuu isaa ibsuuf mirga qabdu. Yoo daa'ima kee qorannoo kanaaf hayyamte, yeroo barbaaddetti qo'annoo keessaa baasuuf mirga qabda kunis faayidaa ati/daa'imni kee karaa biraatiin argachuuf mirga qabdu kamiyyuu hin dhorgu. Gaaffii deebii kennuu hin barbaanne kamiyyuu deebisuun si hin barbaachisu.

Teessoo quunnamtii

Waa'ee qorannichaa ykn hojimaata yeroo kamiyyuu gaaffiin ykn yaadni yoo jiraate: Maqaa fi teessoo qorataa ijoo: **Abdishakur Dida**, Bilbila harkaa: **0977715651** qunnamaa

Imeelii: abdishakurdida2010@gmail.com irratti ergaa

Teessoo quunnamtii itti gaafatamaa koree gamaaggama naamusa qorannoo dhaabbilee (IRERC) waajjira, Kolleejjii Saayinsii Fayyaa Yuunivarsiitii Haramayaa Bilbila: 0254662011 ykn P.O.Box 235, Harar, Ethiopia)

Labsii hayyama ibsa odeeffannoo irratti hundaa'e

Waraqaa odeeffannoo hirmaattotaa dubbiseera/ naaf dubbifameera. Kaayyoo qorannichaa, hojimaata, miidhaa fi faayidaa, dhimmoota iccitii, mirga hirmaachuu, fi teessoo quunnamtii gaaffii kamiyyuu sirriitti hubadheera. Wantoota ifa hin taaneef gaaffii akkan gaafadhu carraan naaf kennameera. Yeroo barbaadetti mucaa koo qo'annoo keessaa baasuu ykn gaaffii deebisuu hin barbaanne kamiyyuu deebisuu dhabuu mirga akkan qabu naaf himameera. Kanaafuu, daa'imni koo qorannoo kana irratti akka hirmaatu (hirmaattu) armaan gaditti mallatteessuudhaan nan mirkaneessa.

Maqaa hirmaataa: _____ (Eeyyamni kan mirkanaa'u yoo daa'imni umuriin isaa waggaa 12-17 ta'e

Maqaa fi mallattoo warraa/guddistuu seeraa: _____Guyyaa: _____ .

Maqaa fi mallattoo Walitti qabaa Odeeffannoo: _____Guyyaa: _____ .

8.8. Data collection instruments

8.8.1. PM emission level measurement

Emission level was measured by Purple Air PA-II which is an outdoor air-quality monitor designed for residential, commercial, and industrial uses. It uses dual laser particle detectors to provide real-time measurements of PM1.0, PM2.5, and PM10 particulates. The Purple Air PA-II is powered by a small, waterproof, plug-in, power supply so it must be mounted near an outdoor environment. A 120 VAC outlet or a hole needs to be drilled in an exterior wall of the home to route the wire from the power supply to the Purple Air PA-II as shown in Fig 4. The measured data will be logged into a *.csv fle on a microSD card, after which Excel, software will be used to process the data. Daily averages of PM will be measured to compare with WHO daily standards.

#		
1		
2		
3		
4		
5	AGE	157
6	Diabetic Mellitus	153
7	Osteoarthritis	141
8	AFI	140
9	Hypertension	123
10	Urinary tract infection	120
	TOTAL	**2199**

Figure 4: Purple Air PA-II

8.8.2. Top 10 Diseases of National cement factory clinic from January to December, 2024

Table 7: Top 10 Diseases of National cement factory clinic from January to December, 2024

8.8.3. Questionnaire (English version)

HrU, College of Health and Medical Science, School of Environmental Health

Questionnaires designed to assess prevalence of chronic respiratory symptoms and associated factors among cement factory workers in Dire Dawa city, Eastern Ethiopia

PART I- Socio demographic information

S/N	Question	Code for response	Response
Q101	Sex	0=female 1=male	
Q102	Age	_____years	
Q103	Religion	0=orthodox 1=Muslim 2=catholic 3=protestant 4=other specify	
Q104	Marital status	0=married 1=single 2=widowed 3=divorced 4=separated	
Q105	Educational level	0-No education 1-. Primary education 2-Secondary 3-Higher education	
Q106	Employment condition	0=Temporary 1=permanent	
Q107	What is your monthly income?	_____Birr.	

PART II Information on Respiratory symptoms within the last one year

Q201 COUGH

S/N	Question	Code for response	Response
Q201A	Have you had cough on most time in the last 12 months? If Q201A is no, skip to Q201C)	0=No 1=yes	
Q201B	Have you had cough on most time as much as 4 to 6 times a day, 4 or more days out of the week in the last 12 months?	0=No 1=yes	
Q201C	Have you had cough at all on most time on getting up, or first thing in the morning in the last 12 months?	0=No 1=yes	
Q201D	Have you had cough at all on most time during the rest of the day or at night in the last 12 months?	0=No 1=yes	
Q201E	If yes to Q201A or Q201B or Q201C or Q201D, Have you had cough on most time like this on most day for 3 consecutive months or more during the year?	0=No 1=yes	

Q202 Phlegm (sputum production)

S/N	Question	Code for response	Response
Q202A	Have you brought up phlegm from your chest on most time in the last 12 months? If Q202A is no, skip to Q202C)	0=No 1=yes	
Q202B	Have you brought up phlegm like this on most time as much as twice a day, 4 or more days out of the week in the last 12 months?	0=No 1=yes	
Q202C	Have you brought up phlegm at all on most time on getting up or first thing in the morning in the last 12 months?	0=No 1=yes	
Q202D	Have you brought up phlegm at all on most time during the rest of the day or at night in the last 12 months?	0=No 1=yes	
Q202E	If yes to any of the above (Q202A, Q202B, Q202C or Q202D) Have you brought up phlegm like this on most days for 3 consecutive months or more during the year?	0=No 1=yes	

Q203 WHEEZING

S/N	Question	Code for response	Response
Q203A	Have you had attacks of wheezing or whistling in your chest at any time in the last 12 months?	0=No 1=yes	
Q203B	Have you ever had attacks of shortness of breath with wheezing?	0=No 1=yes	

Q204 Breathlessness

S/N	Question	Code for response	Response
Q204A	Have you troubled by shortness of breath when you were hurrying on the level or walking up a slight hill at any time in the last 12 months? If yes, answer the questions Q104B, C, D and E.	0=No 1=yes	
Q204B	Have you walked slower than people of your age on the level because of breathlessness at any time in the last 12 months?	0=No 1=yes	
Q204C	Have you ever had to stop for breath when you were walking at your own pace on the level in the last 12 months?	0=No 1=yes	
Q204D	Have you ever had to stop for breath after walking about a certain distance or a few minutes on the level ground in the last 12 months?	0=No 1=yes	
Q204E	Have you been too breathless to leave the house or breathless on dressing or undressing?	0=No 1=yes	

PART III Information on history of chronic respiratory diseases before employment in the Cement factory

S/N	Question	Code for response	Response
Q305A	Have you ever had attacks of Bronchitis?	0=No 1=yes	
Q305B	If yes to Q305A, was it confirmed by a doctor?	0=No 1=yes	
Q305C	Have you ever had attacks of emphysema?	0=No 1=yes	
Q305D	If yes to Q305C, was it confirmed by a doctor?	0=No 1=yes	
Q305E	Have you ever had attacks of asthma?	0=No 1=yes	
Q305F	If yes to Q305E, was it confirmed by a doctor?	0=No 1=yes	
Q305G	Have you ever had attacks of sinus trouble?	0=No 1=yes	
Q305H	If yes to Q305G, was it confirmed by a doctor?	0=No 1=yes	
Q305I	Have you ever had attacks of Pulmonary Tuberculosis?	0=No 1=yes	
Q305J	If yes to Q305I, was it confirmed by a doctor?	0=No 1=yes	
Q305K	Have you ever had heart disease?	0=No 1=yes	
Q305L	If yes to Q305K, was it confirmed by a doctor?	0=No 1=yes	

Part IV Family history of chronic respiratory diseases

S/N	Question	Code and response		
	Were either of your natural parents (Mother or Father) ever told by a doctor that they had a chronic lung condition as mentioned below:	0=No	1=yes	2=I don't know
Q401	Chronic bronchitis?			
Q402	Asthma?			
Q403	Lung cancer?			
Q404	Chronic sinus?			

Q405	Other chest condition?			

Part V Information on Occupational history before employment in the Cement factory

S/N	Question	Code and response
Q501	Have you ever worked for any other dust? If no, skip to Q505	0=Non 1=yes
Q502	Specify the job?	
Q503	Total years worked?	
Q504	What perceived level of dust has been exposed in that job?	0=mild 1=moderate 2=severe
Q505	Have you ever been exposed to gas or chemical fumes in your work? If no, skip	0=no 1=yes
Q506	Specify the job?	
Q507	Total years worked?	
Q508	What perceived level of fume has been exposed in that job?	0=mild 1=moderate 2=severe

Part VI Behavioral factors

S/N	Question	Code and response	
Q601	Have you ever smoked cigarettes? If No, skip to Q605	0=No 1=yes	
Q602	If Q601is Yes, Do you now smoke cigarettes?	0=No 1=yes	
Q603	If Q602 is No, Have you stopped smoking?	0=No 1=yes	
Q604	If Q603 is Yes, How long ago did you stop?	_____years ago	
Q605	Have you ever taken a drink that contains alcohol? If no, skip to Q607	0=No 1=yes	
Q606	If Q605 is Yes, how often?	0=every day 1=one-three days/wk 2=occasionally	
Q607	Have you ever chewed khat? If No, skip to Q609	0=No 1=yes	
Q608	If Q607 is yes; how often?	0=every day 1=one-three days/wk 2=occasionally	
Q609	Did you use Personal respiratory protective material?	0=No 1=yes	

Part VII Occupational and Environmental factors

S/N	Question	Code and response	
Q701	Working department		
Q702	How many Working hours per week	0= ≤48 1= >48	

Q703	Length of time worked in the cement factory	0= 1-5 years 1= >5 years	
Q704	Do you have training on occupational safety and health about respiratory problems related to your work?	0=No 1=yes	
Q705	What kind of energy do you use most for cooking in your home?	0=Electricity 1= kerosene 2=Wood 3=Charcoal 4=Biogas 5=No food cooked in home 6= Other specify----------	

This is the end of the questionnaire. Thank you very much for your cooperation!

8.8.4. Observational checklist

Sr. No.	Questions	Response
1.	Practice of dust control mechanism	
2.	Availability of PPE	
3.	Use of PPE among workers	
4.	Waste management conditions of the factory	
5.	Cleanliness of the rooms in each department	

8.8.5. Questionnaire (Amharic version)

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□□□ **I-** □□□□ □□-□□□ □□□

S/N	□□□□ (Question)	□□□□ □□	□□□
Q101	□□	0=□□ 1=□□□	
Q102	□□□	_____□□□□	
Q103	□□□□□	0=□□□□□□ 1=□□□□ 2=□□□□ 3=□□□□□□□ 4=□□ □□□□	
Q104	□□□□ □□□	0=□□□ 1= □□□□ 2=□□□□□ 3=□□□□	

		4=□□□□□□	
Q105	□□□□□□ □□□	0-□□□ □□□□□ 1-. □□□□□□ □□□ □□□□□ 2-□□□□ □□□ 3-□□□□ □□□□□	
Q106	□□□□ □□□	0=□□□□ 1=□□	
Q107	□□□□ □□□ □□□ □□?	_____□□	

□□□ **II** □□□□ □□□ □□□ □□□ □□ □□□□□□ □□□□ □□□□□ □□□

Q201 □□

S/N	□□□□ (Question)	□□□□ □□	□□□
Q201A	□□□□ 12 □□□ □□ □□ □□ □□□□□□□□? Q201A □□□ □□□□ □□ Q201C □□□□)	0=□□ 1=□□	
Q201B	□□□□□□ □□ □□□ □4 □□□ 6 □□□ □□□□□ 4 □□□ □□□ □□□ □□□ □□□□ 12 □□□ □□□ □□ □□□□□□□□?	0=□□ 1=□□	
Q201C	□□□□ □□□□□□ □□□ □□□□□□ □□ □□□□□□□ □□□ □□□□ 12 □□□ □□□ □□□□□ □□□?	0=□□ 1=□□	
Q201D	□□□□□ 12 □□□ □□□ □□□□ □□ □□□ □□□ □□ □□ □□ □□□□□□□□?	0=□□ 1=□□	
Q201E	□Q201A □□□ Q201B □□□ Q201C □□□ Q201D □□□□ □□□□ □□□□ □□ □□□□□□□ □□□ □3 □□□□□ □□□ □□□ □□□ □□□ □□□ □□ □□□□□□□□?	0=□□ 1=□□	

Q202 □□□ **(**□□□□ □□□□□ □□□□**)**

S/N	□□□□ (Question)	□□□□ □□	□□□
Q202A	□□□□ 12 □□□ □□□ □□ □□ □□□□□ □□ □□□ □□□□□□□? Q202A □□□ □□□□ □□ Q202C □□□□)	0=□□ 1=□□	
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Q202C	□□□□□ 12 □□□ □□□ □□□ □□□□□□ □□□ □□ □□ □□□□□□□?	0=□□ 1=□□	

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Q202E	□□□ □□□□□□□□ □□□ □□□ (Q202A□ Q202B□ Q202C □□□ Q202D) □□□□□□□□ □□□ □3 □□□□□□ □□□ □□□ □□□ □□□ □□□□ □□□ □□□□□ □□□□ □□□□□□?	0=□□ 1=□□	

Q203 □□□

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Q203B	□□□□ □□□□□ □□□ □□□□ □□□□□□□ □□□□?	0=□□ 1=□□	

Q204 □□□□□□ □□□

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Q204C	□□□□ 12 □□□ □□□ □□□□□ □□□□ □□□ □□□□□ □□□□□□□ □□ □□□□□□ □□ □□□ □□□□?	0=□□ 1=□□	
Q204D	□□□□ 12 □□□ □□□ □□□□□ □□□ □□□ □□□ □□□□□ □□□□ □□□□□ □□□ □□□□□□ □□ □□□ □□□□□?	0=□□ 1=□□	
Q204E	□□□ □□□□□□□ □□□□□□□ □□□□□□□□ □□□ □□□□□□□□ □□ □□□ □□□□ □□□ □□□□□?	0=□□ 1=□□	

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S/N	□□□□ (Question)	□□□□ □□	□□□
Q305A	□□□□□□□□ □□□□ □□□□□□□ □□□□?	0=□□ 1=□□	
Q305B	□Q305A □□ □□□ □□□□□ □□□□□□?	0=□□ 1=□□	

Q305C	□□□□□□ □□□□ □□□□□□□ □□□□?	0=□□ 1=□□	
Q305D	□ Q305C □□ □□□□ □□□□□ □□□□□□?	0=□□ 1=□□	
Q305E	□□□□ □□□□ □□□□□□□ □□□□?	0=□□ 1=□□	
Q305F	□Q305E □□ □□□□ □□□□□ □□□□□□?	0=□□ 1=□□	
Q305G	□□□□□ □□□ □□□□□ □□□□?	0=□□ 1=□□	
Q305H	□ Q305G □□ □□□ □□□□□ □□□□□□?	0=□□ 1=□□	
Q305I	□□□□ □□□□ □□□□ □□□□□□□ □□□□?	0=□□ 1=□□	
Q305J	□Q305I □□ □□□ □□□□□ □□□□□□?	0=□□ 1=□□	
Q305K	□□□ □□□ □□□□□ □□□□?	0=□□ 1=□□	
Q305L	□ Q305K □□ □□□ □□□□□ □□□□□□?	0=□□ 1=□□	

□□□ **IV** □□ □□□□ □□□□□□ □□□□ □□□ □□□□□ □□□

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Q401	□□ □□□□ □□□□□□□?			
Q402	□□□?			
Q403	□□□□ □□□□?			
Q404	□□ □□□□ □ sinus?			
Q405	□□ □□□□ □□□?			

□□□ **V** □□□□□ □□□□ □□□ □□□□□ □□□ □□ □□ □□□ □□□

S/N	□□□□ (Question)	□□□□ □□ and □□□

Q501	□□□ □□ □□ □□ □□□□ □□ □□□ □□□ □□ □□□□ □□□□□? □□□□□ □□□□ □□ Q505 □□□□	0=□□□□□ 1=□□
Q502	□□□□ □□□□?	
Q503	□□ □□□ □□□□ □□□□□?	
Q504	□□□ □□ □□□ □□ □□□□ □□□□ □□□ □□□□□?	0=□□□ 1=□□□□ 2=□□□
Q505	□□□□ □□□ □□□ □□□ □□□□□ □□ □□□□□ □□□□? □□□□□ □□□□ □□□□	0=□□□□□ 1=□□
Q506	□□□□ □□□□?	
Q507	□□□□ □□□□ □□□□□?	
Q508	□□□□ □□□ □□□ □□□□ □□□ □□□□ □□□□ □□□ □□□□ □□□□?	0=□□□□□ 1=□□□□ 2=□□□

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S/N	Question	□□□□ □□ □□ □□□
Q601	□□□ □□□□ □□□□□? □□ □□□□ □□ Q605 □□□□	0=□□ 1=□□
Q602	Q601 □□ □□□□ □□□ □□□ □□□□?	0=□□ 1=□□
Q603	Q602 □□ □□□□ □□□ □□□□□?	0=□□ 1=□□
Q604	Q603 □□ □□□□ □□□ □□ □□□ □□ □□□□ ?	_____ □□□□ □□□
Q605	□□□□□ □□□ □□□ □□□□□? □□□□□ □□□ □□ Q607 □□□□	0=□□□□□ 1=□□
Q606	Q605 □□ □□□ □□□□□ □□□ □□□□□ ?	0=□□□□ 1=□□□-□□□ □□/□□□□ 2=□□□ □□□
Q607	□□ □□□ □□□□□? □□ □□□□ □□ Q609 □□□□	0=□□ 1=□□
Q608	Q607 □□ □□□; □□□□□ □□ □□□□□?	0=□□□□

		1=□□□-□□□ □□/□□□□ 2=□□□ □□□
Q609	□□□ □□□□□□ □□□□□ □□□□□□ □□□□□□?	0=□□ 1=□□

□□□ **VII** □□□ □□ □□□□□ □□□□□

S/N	Question	□□□□ □□ □□ □□□
Q701	□□□ □□□	
Q702	□□□□□ □□□ □□□ □□□ 0=≤48 1=>48	
Q703	□□□□□ □□□□ □□□ □□□□ □□□ □□□□	0=1-5 □□□ 1=>5 □□□
Q704	□□□□ □□ □□□□□ □□□□□□ □□□□ □□ □□ □□□ □□□□□ □□ □□ □□□□ □□□□□ ?	0=□□ 1=□□
Q705	□□□□ □□□ □□□□□ □□ □□□□□□ □□ □□□□ □□□ □□?	0=□□□□□□ 1= □□□□ 2=□□□□ 3=□□□ 4=□□□□ 5=□□□ □□□ □□□ □□□□□□ 6= □□ □□□□ ----------

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8.8.6. Questionnaire (Afaan Oromoo version)

Yuunivarsiitii Haramayaa, Kolleejjii Fayyaa fi Saayinsii Meedikaalaa, Mana Barumsaa Fayyaa Naannoo

Gaaffilee babal'ina mallattoolee sirna hargansuu yeroo dheeraa fi wantoota kanaan walqabatan hojjettoota warshaa simintoo Baha Itoophiyaa magaalaa Dirre Dhawaa ji'a September hanga October, 2025tti madaaluuf qophaa'e.

KUTAA I- Odeeffannoo hawaas-dimoogiraafii

T/L	Gaaffii	Koodii Deebii	Deebii
G101	Saala	0=dubartii 1=dhiira	
G102	Umrii	_____waggaa	
G103	Amantii	0=ortodoksii 1=Muslima 2=kaatolikii 3=pirootestaantii	

		4=kanneen biroo (ibsi)	
G104	Haala gaa'elaa	0=fuudhe/te 1=kan hin fuudhin/heerumin 2=kan abbaan manaa irraa du'e 3=hiikte 4=addaan bahe	
G105	Sadarkaa barnootaa	0-Barnoota hin qabu 1-. Barnoota sadarkaa tokkoffaa 2-Sadarkaa Lammaffaa 3-Barnoota olaanaa	
G106	Haala Qaxarrii hojii	0=Yeroodhaaf 1=dhaabbiidhaan	
G107	Galiin ji'a ji'aan argattu meeqa?	_____Birr.	

KUTAA II Odeeffannoo mallattoolee sirna hargansuu waggaa tokko darbe keessatti mul'atan

G201 QUFAA

T/L	Gaaffii	Koodii Deebii	Deebii
G201A	Ji'oota 12 darban keessatti yeroo baay'ee Qufaan isan qunnamee ni beeka? Yoo G201A lakki ta'e gara G201C darbi.	0=Lakki 1=eeyyee	
G201B	Ji'oota 12 darban keessatti yeroo baay'ee guyyaatti si'a 4 hanga 6, torban keessaa guyyaa 4 fi isaa ol qufa'aa turtee?	0=Lakki 1=eeyyee	
G201C	Ji'oota 12 darban keessatti yeroo baay'ee ka'uu irratti, ykn ganama waan jalqabaa irratti tasumaa qufaa si mudateettaa?	0=Lakki 1=eeyyee	
G201D	Ji'oota 12 darban keessatti yeroo baay'ee guyyaa hafe ykn halkan tasumaa qufa'aa turtee?	0=Lakki 1=eeyyee	
G201E	Yoo eeyyee ta'e G201A ykn G201B ykn G201C ykn G201D, Waggaa keessatti ji'oota 3 walitti aansuun fi isaa ol yeroo baay'ee guyyaa baay'ee akka kanaa qufaa qabaatteettaa?	0=Lakki 1=eeyyee	

G202 Akkitaa (Phlegm)

T/L	Gaaffii	Koodii Deebii	Deebii

G202A	Ji'oota 12 darban keessatti yeroo baay'ee laphee kee irraa dhangala'aa/akkitaa fiddee ni beekta? Yoo G202A lakki ta'e gara G202C darbi	0=Lakki 1=eeyyeetti	
G202B	Ji'oota 12 darban keessatti yeroo baay'ee guyyaatti al lamaa, torban keessaa guyyaa 4 fi isaa ol akkasitti dhangala'aa/akkitaa fiddee ni beekta?	0=Lakki 1=eeyyee	
G202C	Ji'oota 12 darban keessatti yeroo baay'ee ka'uu irratti, ykn ganama waan jalqabaa irratti tasumaa akkitaan si mudateettaa?	0=Lakki 1=eeyyee	
G202D	Ji'oota 12 darban keessatti yeroo baay'ee guyyaa hafe ykn halkan tasumaa akkitaan si mudateettaa?	0=Lakki 1=eeyyee	
G202E	Kanneen armaan olii keessaa tokkoof eeyyee yoo ta'e (G202A, G202B, G202C ykn G202D) Waggaa keessatti ji'oota 3 walitti aansuun fi isaa ol guyyoota baay'ee akkasitti akkitaan si mudatee?	0=Lakki 1=eeyyee	

G203 Sagalee iyyanna/ Wheezing

T/L	Gaaffii	Koodii Deebii	Deebii
G203A	Ji'oota 12 darban keessatti yeroo kamiyyuu laphee keessan irratti sagalee iyyanna ('wheezing' ykn 'whistling') isin mudateeraa?	0=Lakki 1=eeyyee	
G203B	Hafuura baafachuu dadhabuu fi sagalee iyyansaanwajjin si mudatee beektaa?	0=Lakki 1=eeyyee	

G204 Hafuura baafachuu dadhabuu

T/L	Gaaffii	Koodii Deebii	Deebii
G204A	Ji'oota 12 darban keessatti yeroo kamiyyuu yoo ariifattan ykn tulluu xiqqoo ol ba'aa turtan hafuura kutuun isin mudateeraa? Yoo eeyyee ta'e gaaffilee G104B, C, D fi E. deebisi	0=Lakki 1=eeyyee	
G204B	Ji'oota 12 darban keessatti yeroo kamiyyuu sababa hafuura baafannaa dhabuutiin namoota umurii kee keessa jiran caalaa suuta deemtee ni beektaa?	0=Lakki 1=eeyyee	
G204C	Ji'oota 12 darban keessatti sadarkaa irratti saffisa mataa keetiin yeroo deemtu hafuura baafachuuf dhaabbatee ni beektaa?	0=Lakki 1=eeyyee	

G204D	Ji'oota 12 darban keessatti lafa walqixaa irratti gara fageenya murtaa'e ykn daqiiqaa muraasa erga deemtee booda hafuura baafachuuf dhaabbatee ni beektaa?	0=Lakki 1=eeyyee	
G204E	Manarraa ba'uuf ykn Uffata uffachuuf ykn baafachuuf yeroo jettu yeroo baay'ee hafuura baafachuu dadhabdee ni beektaa?	0=Lakki 1=eeyyee	

KUTAA III Odeeffannoo seenaa dhukkuba sirna hargansuu yeroo dheeraa warshaa Simintoo keessatti qacaramuun duratti.

T/L	Gaaffii	Koodii Deebii	Deebii
G305A	Dhukkubni Biroonkaayitii si mudatee beektaa?	0=Lakki 1=eeyyee	
G305B	G305Af eeyyee yoo ta'e, Doktoraan mirkanaa'ee turee?	0=Lakki 1=eeyyee	
G305C	Dhukkubni emphysema si mudatee beektaa?	0=Lakki 1=eeyyee	
G305D	G305Cf eeyyee yoo ta'e, Doktoraan mirkanaa'ee turee?	0=Lakki 1=eeyyee	
G305E	Dhukkubni asmii si mudatee beektaa?	0=Lakki 1=eeyyee	
G305F	G305E irratti eeyyee yoo ta'e, Doktoraan mirkanaa'ee turee?	0=Lakki 1=eeyyee	
G305G	Rakkinni saayinasii si mudatee beektaa?	0=Lakki 1=eeyyee	
G305H	G305Gf eeyyee yoo ta'e, Doktoraan mirkanaa'ee turee?	0=Lakki 1=eeyyee	
G305I	Dhukkubni Sombaa (Pulmonary Tuberculosis) si mudatee beektaa?	0=Lakki 1=eeyyee	
G305J	Q305If eeyyee yoo ta'e, Doktoraan mirkanaa'ee turee?	0=Lakki 1=eeyyee	
G305K	Dhukkubni onnee si mudatee beektaa?	0=Lakki 1=eeyyee	
Q305L	Q305K irratti eeyyee yoo ta'e, Doktoraan mirkanaa'ee turee?	0=Lakki 1=eeyyee	

Kutaa IV Seenaa maatiin dhukkuba sirna hargansuu yeroo dheeraa irratti qaban

T/L	Gaaffii	Koodii fi Deebii

	Maatii kee keessaa tokko (Haadha ykn Abbaa) akka armaan gadiitti ibsametti dhukkuba sombaa yeroo dheeraa akka qaban doktoraan itti himamee beekaa:	0=Lakki	1=eeyyee	2=Hin beeku
G401	Dhukkuba biroonkaayitii yeroo dheeraa?			
G402	Dhukkuba Asmii?			
G403	Kaansarii sombaa?			
G404	Saayinasii yeroo dheeraa?			
G405	Dhukkuba sombaa kan biraa?			

Kutaa V Odeeffannoo seenaa hojii warshaa Simintoo keessatti qacaramuu dura

T/L	Gaaffii	Koodii fi Deebii
G501	Bakka hoii dhukkee/dust qabu kan biroo hojjattee ni beektaa? Yoo lakki ta'e gara G505 darbi	0=lakki 1=eeyyee
G502	Hojichi maali?	
G503	Waggoota waliigalaa hojjatte?	
G504	Hojii sana keessatti dhukkee/dust hammamiif saaxilame jetttee yaadda?	0=salphaa dha 1=giddu galeessa 2=cimaa dha
G505	Hojii keessan keessatti aara gaazii ykn keemikaalaaf saaxilamtanii beektuu? Yoo lakki ta'e darbi	0=lakki 1=eeyyee
G506	Hojichi maali?	
G507	Waggoota waliigalaa hojjetame?	
G508	Hojii sana keessatti aara/fumes hammamiif saaxilame jetttee yaadda?	0=salphaa dha 1=giddu galeessa 2=cimaa dha

Kutaa VI Gaaffilee waa'ee amalaa

T/L	Gaaffii	Koodii fi Deebii
G601	Tamboo/sigaaraa xuuxxee beektaa? Yoo Lakki ta'e gara G605tti darbi	0=Lakki 1=eeyyee
G602	Yoo G601Eeyyee ta'e, Amma sigaaraa ni xuuxuu?	0=Lakki 1=eeyyee
G603	G602 Lakki yoo ta'e, Tamboo xuuxuu dhiisteettaa?	0=Lakki 1=eeyyee
G604	Q603 Eeyyee yoo ta'e, Yeroo meeqa dura dhaabde?	waggoota _____ dura

G605	Dhugaatii alkoolii of keessaa qabu fudhattee beektaa? Yoo lakki ta'e gara G607tti darbi	0=Lakki 1=eeyyee
G606	G605 Eeyyee yoo ta’e, yeroo meeqatti?	0=guyyaa hunda 1=guyyaa tokko-sadii/torbanitti 2=darbee darbee
G607	Jimaa qamaatee ni beektaa? Yoo Lakki ta'e gara G609tti darbi.	0=Lakki 1=eeyyee
G608	Yoo G607 eeyyee ta’e; yeroo hammam hammamiitti?	0=guyyaa hunda 1=guyyaa tokko-sadii/torbanitti 2=darbee darbee
G609	Meeshaa eegumsa sirna hargansuu dhuunfaa fayyadamtee beektaa?	0=Lakki 1=eeyyee

Kutaa VII Gaafilee Hojii fi Naannoon walqabatan

T/L	**Gaaffii**	**Koodii fi Deebii**
G701	Kutaa hojii/Department	
G702	Torbanitti Sa’aatiin Hojii meeqa?	0= ≤48 1= >48
G703	Warshaa simintoo keessatti yeroo hangamiif hojjattan?	0= waggaa 1-5 1= >waggaa 5
G704	Waa’ee rakkoolee sirna hargansuu hojii keessaniin walqabatan irratti nageenya hojii fi fayyaa irratti leenjii fudhattanii ni beektuu?	0=Lakki 1=eeyyee
G705	Mana keessan keessatti nyaata bilcheessuuf anniisaa akkamii yeroo baay’ee fayyadamtu?	0=Elektirikii 1= keeroosinii/gaasii 2=Muka 3=Chaarkoolii 4=Baayoogaazii 5=Nyaata manatti hin qopheeffadhu 6= Kan biroo ibsu----------

Kun xumura gaaffilee kooti. Deeggarsanuuf gootaniif baay'ee galatoomaa!

8.9. Curriculum Vitae

❖ PERSONAL PROFILE

- Name Abdishakur Dida Gelgelo
- Date of birth July 24, 1999 G.C
- Place of birth Nagelle Borena
- Sex Male
- Marital status Single
- Nationality Ethiopian
- Telephone +251 977715651
- E-Mail: – abdishakurdida2010@gmail.com

❖ EDUCATIONAL BACKGROUND

S/N	Institution	Program	Area of Study	year
1.	Elementary school	1-5	Laga Gula primary school	1998-2002 E.C
		6-8	Mekane Iyasus Primary School	2003-2005 E.C
2.	Secondary school	9-10	Nagelle Borena High School	2006-2007 E.C
3.	Preparatory school	11-12	Nagelle Borena preparatory school	2008-2009 E.C
4.	University	✓ B.Sc. in Environmental Health Science ✓ **CGPA: 3.85**	Haramaya university	2010-2014 E.C

❖ QUALIFICATION

- BSc. Degree in Environmental Health Science from Haramaya University, on Dec. 30, 2021, G.C with CGPA of 3.85, hardworking, creative, committed to work, excellent communication skills and taking immediate corrective action and position where my determination can make a different.

- Level of degree; Bachelor of Art in Economics with CGPA 3.81 from Rift Valley University on August 8 2021.G.C (quick learner, enthusiastic, committed, ready for responsibility, punctual and strongly honest)

Skills

Strong analytical and research skills.

Proficient in data collection, analysis, and interpretation.

Excellent written and verbal communication abilities.

Solid understanding of statistical analysis methods and software.

- ***Other Skills***
  I have basic computer skill like MS word, MS Excel, MS power points, internet explorer, SPSS and QGIS software.

Experience

- Teaching and helping students in my free time.
- Active participation in the university.

Hobbies/Interest

Learning new things, reading books and playing football, Willingness to help others, and due care for responsibilities.

Reference

1. Dr. Abraham Geremew (PhD) Head School of Environmental Health, collage of Health and Medical Sciences, Haramaya University, office phone +251-256661866, mobile phone +251-913483242, Email address abrahamgeremew2010@gmail.com
2. Dr. Roba Argaw (MSc, MPhil/Epid, PhD, Assistant Professor) Haramaya University College of Health and Medical Sciences, School of Environmental Health, Email: robaargaw@gmail.com
3. Dr. Sina Temesgen (PhD) Haramaya University College of Health and Medical Sciences Hiwot Fana specialized hospital Env/Occ/H/S/ Head, Email: sina.temesgen@haramaya.edu.et

8.10. Approval sheet

HARAMAYA UNIVERSITY POSTGRADUATE PROGRAM DIRECTORATE

Submitted by Signature Date

_____ _____ _____ _____

Name of student

Approved by

1, _____ _____ _____ _____

Major Advisor

2, _____ _____ _____ _____

Co-advisor

3, _____ _____ _____ _____

Research Thematic Area Leader

4, _____ _____ _____ _____

Chairman, DGC/SGS

5, _____ _____ _____ _____

PGPD