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*Full Length Research Paper*

# An appraisal of the prevention of mother-to-child transmission of hepatitis B virus health system in Nigeria

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The study aimed to assess the strengths and weaknesses, opportunities and threats influencing the achievement of prevention of mother-to-child transmission of hepatitis B virus. It also sought to suggest recommendations to improve the current prevention of mother-to-child transmission of hepatitis B virus health system in Nigeria. A critical appraisal of the prevention of mother-to-child transmission of hepatitis B virus health system in Nigeria was conducted. The WHO health system framework was used to assess the prevention of mother-to-child transmission of hepatitis B virus system. Considering the recent call by the World Health Organization to eliminate hepatitis and the existence of a robust prevention of mother-to-child transmission of human immunodeficiency virus health system, the prevention of mother-to-child transmission of hepatitis B virus health system in Nigeria is riddled with numerous challenges. These range from a health worker crisis, poor leadership and governance, inadequate health information, medicines, vaccines and technologies and poor service delivery. Urgent action in the Nigerian prevention of mother-to-child transmission of hepatitis B virus health system is required if Nigeria is to achieve its goal of eliminating hepatitis by 2021.

**Key words:** Mother-to-child-transmission, hepatitis B Virus, health system, Nigeria.

## INTRODUCTION

Hepatitis B Virus (HBV) constitutes a huge public health burden worldwide (WHO, 2012). It is the commonest cause of Chronic Liver Disease (CLD) in Nigeria (Musa et al., 2015). This places an enormous burden on the healthcare system and leads to loss of productivity in the active population (Su et al., 2010). HBV is vaccine-

preventable yet Nigeria is hyper-endemic (14%) for HBV with about 24 million infected people, majority of who are children and young adults (Musa et al., 2015; Forbi et al., 2010). This estimate places Nigeria as one of the most HBV affected countries in Africa (Ott et al., 2012). A recent meta-analysis showed that the pooled prevalence

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of HBV in pregnant women attending Antenatal Care (ANC) in Nigeria was 12% (Musa et al., 2015). This data represents only a fraction of all pregnant women as many women (about 40% or more) still do not attend ANC (NPC and ICF, 2014); hence it could be greater than this. Other studies have shown a similarly high prevalence of HBV in pregnant women: 8 and 11% (Olokoba et al., 2011; Mbaawuaga et al., 2008). Mother-to-child-transmission of HBV (MTCT-HBV) is a main route of HBV transmission in Nigeria (Musa et al., 2015) and contributes significantly to the burden of HBV in the country. Some studies have reported HBV prevalence in infants as high as 12 and 17 % (Donbraye et al., 2014; Sadoh and Sadoh 2013). Studies in Nigeria have reported high HbeAg-positivity rates between 30-63% (Yakasai et al., 2012; Mbaawuaga et al., 2008). Other studies in Nigeria confirmed vertical transmission rates between 40 and 53% (Ogunlaja et al., 2014; Onakewhor et al., 2001). This shows that the risk of vertical-transmission/MTCT is high and cannot be ignored in Nigeria.

The recognition of HBV as a pandemic led to the drafting of the Global Health Sector Strategy (GHSS) on Viral Hepatitis (2016-2021) (WHO, 2015) by the World Health Organisation (WHO) and the recently released Global Hepatitis Report (GHR), 2017 (WHO, 2017). Hence, both the GHSS and GHR recommend PMTCT-HBV as the key to breaking the cycle of ongoing HBV infection globally (Andersson, 2015). Without an accelerated response, the number of people living with HBV globally is estimated to remain at high levels for the next 40-50 years, with about 20 million deaths occurring between 2015 and 2030 (WHO, 2015). Nigeria will experience a fair share of this burden considering its huge population and limited resources. It is therefore crucial that Nigeria adopts PMTCT-HBV as a pathway to reducing the HBV burden in Nigeria. In response to reducing the burden of HBV in Nigeria, the Honorable Minister of Health, reiterated the Federal Government's commitment to eliminating viral hepatitis by 2021 in line with the World Hepatitis Day, 2017 with the theme "Eliminate Hepatitis". A functional PMTCT-HBV health system is fundamental to reducing the HBV burden in the country. A health system, by the WHO is a system "whose primary purpose is to promote, restore, or maintain health". The WHO framework is composed of six building blocks: leadership and governance, human health resources, health financing, service delivery, medical products, vaccines and technology and health information systems (WHO, 2007a).

For the above reasons, an in-depth understanding of the PMTCT-HBV health system in Nigeria is essential to provide information for policy and system development. The aim of this study was to conduct a critical appraisal of the PMTCT-HBV health system in Nigeria with a view to assessing its strengths and weaknesses, opportunities and threats influencing the achievement of PMTCT-HBV.

It also sought to suggest recommendations to improve the current PMTCT-HBV health system in Nigeria.

## METHODOLOGY

This involved literature search via an internet-based search of websites, databases and search-engines. These include: The World Health Organisation (WHO) website, the Nigerian Federal Ministry of Health (FMOH), PubMed database and Google Scholar. Keywords and their synonyms used in the search strategy for the dissertation include: Mother-to-child-transmission (MTCT), vertical transmission, HBV, Nigeria, developing countries, Sub-Saharan Africa, health system, health services, policies. These keywords were chosen because they form the basis of the study topic. Boolean operators "AND" and "OR" were then used to obtain a final set of results containing all aspects of the study topic. Initial article selection was based on article title/abstracts. Snowballing was then used to identify relevant articles by scanning the references of those identified from the database-search. Full-text articles were read for eligibility. Inclusion criteria applied to articles for this study referred to the objectives of the study and the quality of the published material. Only full text articles written in English were used (author reads only English); articles relevant to mother-to-child transmission of HBV; maternal and child health; articles on HBV in low-and-middle-income settings. The WHO Health system framework (WHO, 2007a) (Figure 1) was adopted to assess the PMTCT-HBV health system in Nigeria. The framework is made up of 6 building blocks.

## RESULTS

This section is structured following the components of the WHO health systems framework.

### Service delivery

In Nigeria, health services are delivered through tertiary, secondary and primary health facilities run by the Federal, State, and Local government tiers of government respectively (Okonofua et al., 2011; FMOH, 2016a). The tertiary level of health care is provided by teaching hospitals and specialist hospitals. PMTCT-HBV services are mainly domiciled at this level, situated far away from majority of people, especially those in rural and hard-to-reach areas (Okonofua et al., 2011; FMOH 2016a).

The State Ministries of Health (SMoH) oversee the secondary level of healthcare (General and State hospitals) while the 774 Local Government Areas (LGAs) oversee the Primary Health Care (PHC) level, with support from the SMoH and private organisations (FMOH, 2016a). As at December 2011, there were over 34,000 health facilities across the country: 11,395 (33%) were private health facilities and 23,028 (67%) government health facilities. In total, 30,345 (88%); 3,993 (12%); and 85 (1%) facilities were primary, secondary, and tertiary health facilities, respectively (Makinde et al., 2014). This is a far cry from what is expected.

## The WHO Health System Framework



Everybody's Business. Strengthening Health Systems to Improve Health Outcomes. WHO's Framework for Action. WHO, 2007.

**Figure 1.** The WHO health system framework (WHO, 2007a).

**Table 1.** Types of Health facilities in Nigeria by level of management and expected coverage.

Health facility	Levels of management	Expected numbers
Teaching facilities	Federal Government	1/State: Hence in 36 States + FCT = 37
General hospitals	State Government	1/LGA: Hence a minimum of 774 are expected
Primary health centres	Local Government	1/ward: Hence with an average of 10 wards Per LGA a total of 7740 are expected
Primary health clinics	Local Government and WDC	1/group of villages/neighbourhoods with about 2000-5000 persons
Health Posts	VDC/CDC	1/village or neighbourhood of about 500 persons As many as the number of villages

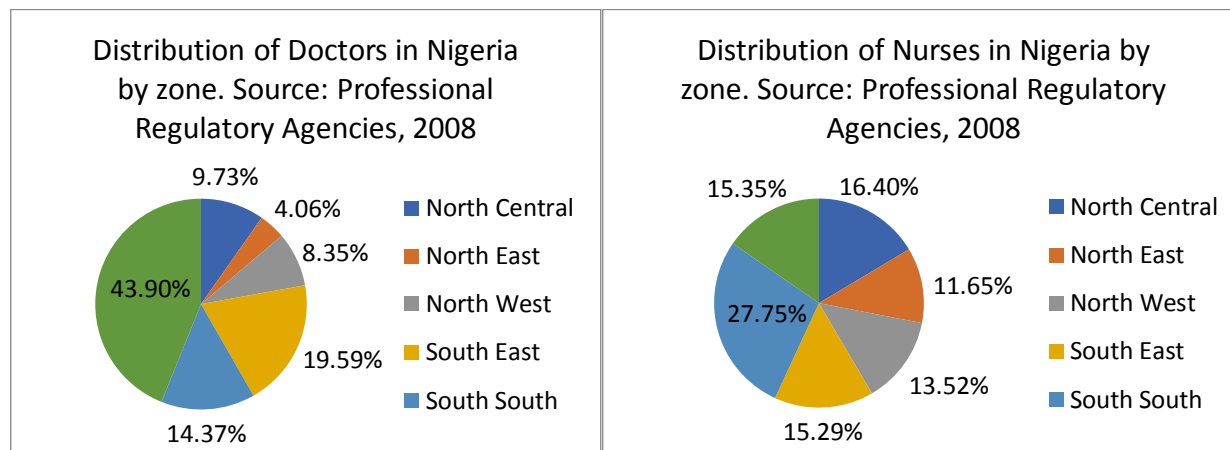
FCT, Federal Capital Territory; LGA, Local Government Area; WDC, Ward Development Committee; VDC, Village Development Committee; CDC, Community Development Committee. Source: Minimum Standards for Primary Health Care in Nigeria (NPHCDA, 2012).

Table 1 shows the expected numbers of facilities at each level of healthcare.

Many of the PHC facilities which several (71%) of Nigerians have access to do not offer PMTCT-HBV services. This is due to lack of essential supplies, equipment and qualified staff. Although 24-h service is available in most tertiary and secondary health facilities, very few PHCs, if any in the country offer 24-h services (NPHCDA, 2012). The administration of Hepatitis B-birth Dose (HB-BD) within 24 h of birth is crucial in preventing MTCT-HBV, yet majority (64%) of births in Nigeria occur

at home in the absence of a skilled provider (doctor, nurse, midwife or trained community health worker) with only 36% in health facilities (NPC and ICF, 2014) leading to a delay in the receipt of the HB-BD and Hepatitis B Immunoglobulin (HBIG) which is critical in PMTCT-HBV (Sadoh and Eregie, 2009). Similarly, many women, especially in the rural areas do not receive Antenatal Care (ANC), (Sadoh and Sadoh, 2014) with an urban: rural ratio of 88 %: 56 % (NBS, 2011). Those who do, book late during the second or third trimester (Oladokun et al., 2010). The ANC attendance rate in 2013 was 61





**Figure 2.** Distribution of Doctors and Nurses by zone in Nigeria.

and 51% for at least one visit and 4 visits respectively (NPC and ICF, 2014). Screening pregnant women for Hepatitis B-surface Antigen (HBsAg) is a prerequisite for vaccination to prevent vertical transmission (Franco et al., 2012). Unfortunately, most health facilities in Nigeria do not routinely screen pregnant women for HBV or offer vaccination services at ANC (Adekanle et al., 2015). Out of the 80% of mothers who received ANC in a study in Nigeria, only 6% of mothers were screened for HBsAg (Sadoh and Eregie, 2014). Some might argue that only those with risk factors should be screened based on cost-effectiveness but some studies showed that majority of HBsAg-positive pregnant women in Nigeria had no identifiable risk factor, making routine screening important (Adeyemi et al., 2014; Okusanya et al., 2013).

### Health workforce

The WHO has estimated that a minimum of 23 health workers for every 10,000 people is required in countries seeking relatively high levels of health system coverage for the basic needs of their populations (WHO, 2016). Nigeria currently has 20 health workers per 10,000 (HRH, 2013). Impressive as the absolute figure might seem, Nigeria suffers from inadequate number of health workers. More worrisome is the inequitable distribution of health workers (Figure 2) with a disproportionately high concentration in urban areas, more in Southern Nigeria compared to the North especially with the current state of insecurity/communal clashes; in tertiary health care facilities and in facilities which mainly provide curative care. Health workers are reluctant to work in rural areas because of difficult working conditions, lack of continuing educational opportunities, shortages of medical supplies and equipment, or a lack of social services for their own families (FMoH, 2014). The frequent industrial strike actions by health workers also affect provision of PMTCT-HBV services (FMoH, 2014) (Figure 2).

In view of the health worker shortage, the Nigerian government increased the number of Community Health Workers (CHWs) by 10,000 in the first-half of 2014 and proposed to have 154,800 additional CHWs by the end of 2015, all being deployed to rural areas (FMoH, 2016a). In a similar manner, the Nigerian Government instituted the Midwives Service Scheme in 2009, as a way of increasing the numbers of midwives in the country though implementation of both schemes has been faulty (Abimbola et al., 2012). It is of utmost importance that PMTCT-HBV services are available 24 h a day/7 days a week in health facilities if Nigeria's high HBV prevalence is to be reduced. Unfortunately, very few doctors, nurses and midwives can be found at the primary level of health care which serves majority of Nigerians. Rather, most PHCs are staffed by CHWs and other lower skilled cadres who have not been trained in PMTCT-HBV, partly because a national policy on PMTCT-HBV has just been put in place (NPHCDA, 2012).

Studies showed that the knowledge of HBV management among health workers in Nigeria is low as only 32% of health workers were aware of the timing of HB-BD administration (Adeyemi et al., 2014; Nwokediuko, 2011). There are also misconceptions held by health workers concerning use of vaccine vials which lead to many infants missing the HB-BD, despite delivery in the hospital (Sadoh and Sadoh, 2014). Health professionals in Nigeria obtain the skills and competencies required to effectively care for people with viral hepatitis through schools for health professionals, on-the-job training and postgraduate training (WHO, 2013).

There are presently 14 professional regulatory bodies for maintaining standards of practice for health professionals. Some of them are the Medical and Dental Council of Nigeria, Pharmacists Council of Nigeria, Nursing and Midwifery Council, Community Health Practitioners Board, Medical Laboratory Science Council etc. but they are limited by weak structures and

institutional capacities to carry out their functions (FMoH, 2016a).

### Health information and research

A National Health Research Policy and Priorities was developed by the Federal Ministry of Health (FMoH) in 2014 (FMoH, 2016a). There are also Research Institutes and training institutions supporting learning and dissemination of research products, yet research is still underfunded in most of these institutions (FMoH, 2016a). Research on advances in HBV is currently carried out by some societies such as the Society for Gastroenterology and Hepatology in Nigeria (SOGHIN) and the Nigerian Society for Paediatric Gastroenterology Hepatology and Nutrition (NISPGHAN) (Eke et al., 2016). A Hepatitis cancer registry is maintained by the National Cancer Control Programme, an arm of the FMoH, yet, routine HBV infection surveillance are not conducted in Nigeria (Howell et al., 2014). While hepatitis outbreaks are required to be reported to the government for further investigation, there is inadequate laboratory capacity nationally to support investigation of viral hepatitis outbreaks and other surveillance activities (WHO, 2015).

### Medical products, vaccines and technologies

Nigeria approved the addition of HB-vaccine to the National Program on Immunisation in 1995 but only became widely available in 2004 (Sadoh and Eregie, 2008). In Nigeria, the HB-vaccine is given at birth as a monovalent vaccine, then at 6, 10 and 14 weeks as a pentavalent vaccine (FMoHN, 2012). The infant vaccination coverage in 2011 for HBV<sub>3</sub> was alarmingly low at 34% and for the birth-dose, 29% (NBS, 2011), while HB-vaccine coverage for adults was estimated at 41% in 2013 (GAVI, 2014). The constant availability of potent vaccines requires a functional cold chain system. This is sadly not the case in Nigeria which has led to the absence of vaccines in some health facilities (FMoHN, 2012). The Cold Chain Assessment (CCA) of the National Programme on Immunisation in Nigeria showed that 43% of cold chain equipment at the local government and health facility levels was non-functional (FMoHN, 2012).

### Financing

The Nigerian Government with support from the Global Alliance for Vaccines and Immunisation (GAVI, 2014) routinely provides HB-vaccines at no cost to infants while couples provide HbIg for their exposed babies (Onakewhor et al., 2013). The cost of 1 vial of HbIg is about ₦360,000 (\$100) (Ezeonu et al., 2014) which is unaffordable for majority of parents. This was

consistent with a study in Nigeria (Ogunlaja et al., 2014) who showed that only 25% of women who were HBsAg-positive could afford HbIg due to the high cost. Majority of the population live below the minimum wage of ₦18,000 (\$50) with an average monthly income of ₦1000 (\$5) (Abdulraheem et al., 2012). The cost of screening is ₦1000 (\$2.7) in some tertiary facilities which is still prohibitive for the population's majority (Onakewhor et al., 2013).

Evidence shows that payment for PMTCT services mainly out-of-pocket or within the National Health Insurance Scheme (NHIS), which has limited coverage (Adeyemi et al., 2013). Less than 5% of the population is currently covered by any form of health insurance. Only Federal Government workers are currently enrolled in social health insurance and civil servants from most states are yet to be enrolled (FMoH, 2016a). Currently, only women in formal employment are covered by the health scheme which leaves out majority of poor unemployed women who cannot afford such services (Okonofua et al., 2011). WHO suggests that governments should aim at allocating a minimum of 5% of Gross Domestic Product (GDP) for health spending (Savedoff, 2003). Meanwhile, in Nigeria, 4.15% allocated to the health sector in the 2017 budget proposal falls short of the minimum 15% recommended by the Abuja Declaration of 2001 decided by African heads of state at a meeting. There is also no specific line item for tracking financial resources for PMTCT-HBV at all levels (FMoH, 2016b).

### Leadership and governance

In 2013, the Nigerian Government through the FMoH established the Viral Hepatitis Control programme within the National AIDS and STI Control Programme (NASCP). But it was only in July 2015, that the Nigerian Government developed a national policy on viral hepatitis B control and a draft copy of the strategic plan for the control of viral hepatitis B (FMoH, 2015a; FMoH, 2015b). During the World Hepatitis Day, 2017, with the theme "Eliminate Hepatitis", the Minister of Health reiterated the commitment of the Federal Government to eliminate viral hepatitis by 2021 in line with the global commitment. Other policies which operate in Nigeria include the National Policy on screening of blood and blood products and the National Policy on injection safety in health-care settings (FMoH, 2006). It is also not known whether it is mandatory for healthcare workers to be vaccinated against HBV prior to starting work that might put them at risk of exposure to blood and blood products. This will also prevent the transfer of nosocomial infections from workers to their patients (WHO, 2015). Despite the existence of national policies, majority of healthcare providers do not have a management protocol for HBV in pregnancy (Ezeonu et al., 2014). The absence of hospital

**Table 2.** Strengths, Weakness, Opportunities and Threats of the PMTCT-HBV health system in Nigeria.

<b>Strengths</b>	<b>Weaknesses</b>
Availability of PMTCT-HIV services in both the public and private sectors in many states Approximately 20 health workers/10000 persons	Hepatitis control programmes are largely donor dependent and donor support is likely to decrease Low access to care because most people have low awareness of the need for prevention, early detection and treatment and cannot afford the cost of care
Available capacity for training more human resources	Majority cannot afford the cost of care. The cost of Hepatitis B immunoglobulin is high.
The National Health Act aims to improve health care financing through the Basic Health Care Provision Fund	Inequitable distribution of the health care workforce
The Viral Hepatitis Strategic Plan is designed to leverage on the National Health Insurance Scheme (NHIS) Act- this could bring health insurance coverage to more Nigerians and promote disease prevention, data collection and reporting, and quality improvement.	Inequitable distribution of available PMTCT health care facilities. Majority are in tertiary institutions.
The National Viral Hepatitis Policy and National Strategic Plan (2016-2020) focuses on improving universal access to quality and affordable care and rapidly scale up services	
Nigeria has developed a strong health care infrastructure to provide chronic care for people living with HIV. This can be extended to viral hepatitis	
HBV surveillance can be added easily to the already existing routine surveillance for other infections	
Presence of regulatory bodies	
<b>Opportunities</b>	<b>Threats</b>
The commitment of the Federal Government to eliminate viral hepatitis by 2021 in line with the global commitment. National hepatitis health awareness programmes celebrated on World Hepatitis Day sponsored by the FMoH and relevant stakeholders	PMTCT is still give low priority in the health care system
The interest in PMTCT has increased at the global and national level	Facilities for PMTCT are yet to be put in place in PHCs
Primary health care facilities are available in every local government area with potential for developing public PMTCT health services	Inadequate human and financial capacity to provide and manage PMTCT health services
Task shifting leading to training of CHWs translating to an increase in the availability of skilled health care during home deliveries	Poor knowledge of and attitudes towards PMTCT
	Migration of health care workers to other countries for "greener pastures"
	Meagre budgetary allocations to health care at all levels of governance

policies on PMTCT-HBV may hinder effective control of HBV (Adekanle et al., 2015).

Per the WHO health system framework (WHO, 2007a), the PMTCT-HBV health system in Nigeria still has some shortfalls. PMTCT-HBV services are not readily available nor accessible to majority of the Nigerian populace. Most of the services available especially at the tertiary centres

focus on curative rather than preventive care (WHO, 2000). The health workforce is also inadequate to meet the health care needs of the populace. In summary, the Nigerian PMTCT-HBV health system is not sufficient to respond to the needs of the populace. These problems highlight the need for an analysis of the strengths, weaknesses, opportunities and threats (Table 2)

associated with the PMTCT-HBV health system to proffer solutions.

## DISCUSSION

The PMTCT-HBV health system in Nigeria is weak and riddled with challenges, thus underperforming across all building blocks as highlighted in the results above. Nigeria's health system performance by the WHO in 2000 was abysmally low with a rank of 187 out of 191 countries (WHO, 2000). In 2017, the situation is not any different. It is worrisome that the exact numbers of health facilities offering PMTCT-HBV services in Nigeria is unknown (FMOH, 2016a) and that majority of these services are concentrated in the few tertiary centers, and to a lesser extent the secondary facilities (FMOH, 2016a). To tackle this problem, a need assessment of health facilities and implementation of findings needs to be carried out by the FMOH to identify the gaps. PHCs need to be equipped with resources for routine screening to improve access to the majority in rural-settings. Considering that only 36% of deliveries occur in health facilities, (NPC and ICF, 2014) scaling up skilled attendance at birth during home deliveries is of utmost importance. This is feasible due to the ongoing policy of task-shifting using CHWs but will require extensive engagement of both public and private sectors (FMOH, 2014). Studies have shown the effectiveness of home-visits by CHWs in improving other interventions like malaria treatment and breastfeeding practices (Findley et al., 2013). The role of Traditional Birth Attendants (TBAs) should not be overlooked, due to their high demand especially in the Northern part of Nigeria where 22% of deliveries had a TBA in attendance. TBAs can aid in hard-to-reach areas especially in the wake of the lingering Boko Haram crisis in the North-East (NPC and ICF, 2014). The TBAs can be trained and supervised by higher cadre of health professionals. TBAs have been used successfully in Malawi and Cameroon to implement PMTCT services in areas where women had limited access to skilled-staff delivery (Hamela et al., 2014; Findley et al., 2013).

The relatively heat-stable nature of the Hepatitis-B vaccine and its use in a safe single-dose (Uniject®) makes it suitable for use in home visits Outside the Cold Chain (OCC) (Sutanto et al., 1999). The National Primary Health Care Development Agency (NPHCDA, 2012) and National Programme on Immunisation (NPI) should explore ways of improving the cold chain and OCC to reach home-births. In Indonesia, the use of Hepatitis-B vaccine OCC by village midwives to all new-borns led to an increase in vaccine coverage and minimal vaccine wastage (Wang et al., 2015). In a Randomised Controlled Trial conducted in rural China, the two study arms with home-visits by village health workers witnessed a significantly greater increase in birth-dose coverage, from 11 to 68% and from 7 to 77%, respectively, than the

group which relied on vaccination in town-clinics, with a lower coverage increase from 8 % to 58 % (Hamela et al., 2014).

The health work force is the crux of any health system hence the shortage and inequitable distribution of health workers needs to be solved. Task-shifting needs to be scaled up as several studies have shown that lower cadres of health personnel are capable of effectively delivering PMTCT-HBV services when compared to higher cadres. Training, retraining, provision of appropriate technology and supportive supervision are what is required to make this effective (FMOH, 2014). The FMOH and heads of facilities should also develop guidelines on integrating HBV into existing healthcare programmes especially HIV. This is organisationally feasible because both HIV and HBV have shared approaches hence it is easy to make use of the HIV prevention-infrastructure to address the problem of MTCT-HBV (Andersson, 2015). This also leads to better utilisation of scarce human and financial resources (Lemoine et al., 2015). The scale up of PMTCT-HBV services requires reliable and timely information to provide evidence-based information. Emphasis should be placed on a nationwide electronic medical record system (EMRS) and this needs to involve the PHCs and all PMTCT-HBV providers (WHO, 2007b).

Viral load testing should also be incorporated into existing ANC services for HBV infected mothers (FMOH, 2015a). Point-of-care (POC) tests for HBsAg and HBeAg detection are currently available, affordable and need minimal training and can be used in low-resource settings (Arora et al., 2013). Their performance has been validated in both Europe and Sub-Saharan Africa. In the Gambia, and Tanzania, sensitivity and specificity of two HBsAg POC tests have been observed to be precise (Njai et al., 2014; Khuroo et al., 2014).

HBV research should be encouraged and funding made available to carry out such research. Research and operational projects on HBV are very scarce in Sub-Saharan Africa hence increasing knowledge on global HBV prevalence and risk factors for transmission should be a priority through well-defined epidemiological surveys. The PROLIFICA programme in The Gambia and Senegal is one of the few addressing the issue of HBV testing, severity assessment of chronic hepatitis B and screening of liver cancer. It also aims at demonstrating the efficacy of Tenofovir-based antiviral therapy for preventing cirrhosis and hepatocellular carcinoma in West Africa (Lemoine et al., 2015).

The high cost of the HBIG and antiviral medications is another major challenge. The Federal Government needs to improve access to the vaccine and medication by reducing cost. This can be done in collaboration with organizations like GAVI and other donors. Alternative solutions to overcome the barriers of cost do exist. Nigeria can learn from Trade-Related Aspects of Intellectual Property Rights experiences of Egypt and

India in obtaining antiviral drugs at low prices (Lemoine et al., 2015). Social protection schemes like the NHIS should also be scaled up to cater for the majority who are not in the employ of the Federal Government. Viral hepatitis testing can be included as a preventive service in the NHIS scheme (FMOH, 2015a). Community-based health insurance system for the poor has proven to be effective in countries like Mexico, Brazil, Bangladesh and Cambodia, Guinea, Mauritania (Ahmed et al., 2016; Macinko et al., 2015).

## Conclusion

This paper has tried to assess the PMTCT-HBV health system by making use of the WHO building blocks of leadership and governance, service delivery, health manpower, financing, medicines, vaccines and technologies and health information. Suggestions have also been made towards improving this health system before Hepatitis B Virus becomes a pandemic too difficult for the world to handle. The fight against HBV requires a multi-sectoral approach and strong political will on the part of the government for Nigeria to attain its goal of eliminating hepatitis by 2021.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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*Full Length Research Paper*

# Magnitude of occupational injury and associated factors among factory workers in Ethiopia: The case of Muger Cement Factory

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Throughout the world, occupational exposure in cement factories continue to cause serious public health problems and are leading cause of disability and disease among workers. Since there has not been any study on the prevalence and associated factors of occupational injury in cement factory, this study investigates the prevalence and associated factors of occupational injuries among cement factory workers in Muger. An institution based cross-sectional study was conducted using stratified random sampling by job category. The study participants were selected using simple random sampling technique and data collected by trained data collectors using pretested questionnaire. The data was edited, entered into a computer using Epi Info version 3.5.0 then exported to IBM SPSS version 21 and cleaned. Bivariate and multivariate analyses were done. The prevalence of occupational injury in one year was 10.4%. In addition, 1356 working days were lost as a result of 52 work related injuries. Thirty-seven (71.2%) were hospitalized, accounting for 51.4% hospitalization for more than 24 h, 18(34.6%) were absent from work for 15 to 30 days. Job category was the significant contributing factor for occupational injuries with workers in the cement production factory 74.7% less likely to experience occupational injury than workers in clinker production [AOR= 0.25, CI: (0.100-0.639)]. The prevalence of occupational injury was high, hence focus should be on preventive measures like timely provision of adequate and quality safety materials along with workplace supervision.

**Key words:** Occupational injury, cement factory workers, disability, disease and safety materials.

## INTRODUCTION

According to Labor Proclamation No. 377/2003 of Ethiopia, "Occupational injury" means any organic injury or functional disorder sustained by a worker as a result of any cause extraneous to the injured worker or any effort

he makes during or in connection with the performance of his work and includes:

1. Any injury sustained by a worker while carrying out the

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employer's order, even away from the work place or outside his normal hours of work;

2. Any injury sustained by a worker before or after his work or during any interruption of work if he is present in the work place or the premises of the undertaking by reason of his duties in connection with his work;

3. Any injury sustained by a worker while he is proceeding to or from place of work in a transport service vehicle provided by the undertaking which is available for the common use of its workers or in a vehicle hired and expressly destined by the undertaking for the same purpose;

4. Any injury sustained by a worker as a result of an action of the employer or a third party during the performance of his work (Labour Proclamation No.377/2003, 2004).

Occupational injuries are injuries that occur at the location of a person's employment which can include exposure to chemicals or other substances as well as accidents. Occupational accidents, work injury, work-related injury, work accidents, work-related accidents are other names for occupational injuries ([http://www.rightdiagnosis.com/o/occupational\\_injuries/su\\_btypes.htm](http://www.rightdiagnosis.com/o/occupational_injuries/su_btypes.htm)). The primary cause of occupational injuries is the result from exposure to deleterious agents usually toxins, gases, inhalants, etc. while working (Andrina, 1998).

According to International Labor Organization (ILO) projections for the year 2000, based on 1998 statistics there were 2 million work-related deaths annually worldwide of these accidents contribute 19%. The ILO estimated that the total costs of occupational accidents and work-related diseases are 4% of the gross national product. Most of the world's work-related deaths, injuries and illnesses are preventable (International Labour Organization, 2003).

According to results from the Census of Fatal Occupational Injuries conducted by the U.S. Bureau of Labor Statistics, a preliminary total of 4,383 fatal work injuries were recorded in the United States in 2012 (Bureau of Labor Statistics U.S Department of Labor, 2013).

According to Centers for Disease Control and Prevention, 7.9 million nonfatal injuries to younger workers were treated in U.S. hospital emergency departments in 10 years (Centers for Disease Control Prevention, 2010). A global burden of about 10.5 million DALYs is estimated due to both fatal and non-fatal occupational injuries (Marisol et al., 2005).

In Ethiopia, in an accident report by Ministry of Labor and Social Affairs (MOLSA) taken from 66 establishments during 2008/2009, a total of 1968 work accidents were reported of which the 9 were fatal. Among the reported work accidents 56.05% occurred in the manufacturing industries. According to the same report taken from 220 establishments in 2009/2010, 29 fatal and 6127 non-fatal work accidents were reported totally.

Among the total 41.64% occurred in the manufacturing industries. Similarly in an accident report by MOLSA taken from 248 establishments in 2010/2011 showed that there were 16 fatal and 6990 non-fatal work accidents. Among the reported 51.78% taken place in agricultural, hunting, forestry and fishing sector followed by 42.95% in the manufacturing industries (Ethiopian Ministry of Labour and Social Affairs, 2008-2011).

Occupational injuries may occur in the production process of cement factory as a result of unsafe working condition, unsafe acts, personal failure and lack of awareness on the side of both employers and employees. The failure on the part of the management in realizing and applying properly guarded machine, proper illumination and ventilation, non-defective tools etc could be considered as one of the causes of work accidents. Occupational injuries may result in loss of life, physical impairment, material damage and termination of work that might claim very large financial loss (Ethiopian Ministry of Labour and Social Affairs, 2008-2011).

Sex, age (Aderaw et al., 2011; Yiha and Kumie, 2010; Tadesse and Kumie, 2007), educational status (Serkalem et al., 2014; Kifle et al., 2014), marital status (Serkalem et al., 2014), job category, lack of experience, workplace supervision, job satisfaction (Tadesse and Kumie, 2007), working hour per week (Yiha and Kumie, 2010; Tadesse and Kumie, 2007; Serkalem et al., 2014) health and safety training (Aderaw et al., 2011), alcohol use (Yiha and Kumie, 2010; Kifle et al., 2014), sleeping disorder (Yiha and Kumie, 2010; Tadesse and Kumie, 2007; Serkalem et al., 2014), manual handling of very heavy objects (>20 kg), need for visual concentration for the task, and maintenance of machine (Serkalem et al., 2014), job stress (Aderaw et al., 2011; Kifle et al., 2014), non PPE use (Yiha and Kumie, 2010; Kifle et al., 2014) were factors associated with occupational injury in a study done in Ethiopia.

Most of the world's work-related deaths, injuries and illnesses are preventable. Worldwide occupational exposure to cement dust and other hazards is the cause for skin allergies, eye irritation and other work related injuries (Sana et al., 2013). Job category, work experience and use of personal protective equipments are the associated factors (Iqbal et al., 2010).

Different investigations in Africa reported that cement industry is responsible for many type of injuries like burn injury in different part of the body, fracture, falling and responsible for hospitalization, high cost for treatment and loss of productivity due to absence from workplace (Shafik and El-Mohsen, 2012).

Studies done in different parts of Ethiopia reported occupational injury is prevalent in different industries. Occupational injury caused many types of injuries, affect different parts of the body and it is the cause for hospitalization, working days lost (Yiha and Kumie, 2010; Kifle et al., 2014) and death (Tadesse and Kumie, 2007; Serkalem et al., 2014).

Studies done in different industry sector (even though



they are different sectors they use similar machineries) of Ethiopia reported that age, working hour in a week, health and safety training, alcohol consumption and sleep disorder (Tadesse and Kumie, 2007), educational status, marital status, manual handling of heavy objects, maintenance of machine (Kifle et al., 2014), work stress (Aderaw et al., 2011; Kifle et al., 2014), work experience, job category, work place supervision (Tadesse and Kumie, 2007), use of personal protective equipment (PPE) (Kifle et al., 2014) were associated factors of occupational injury. While some of them reported that sex, educational level, monthly salary, job category, work experience, job satisfaction and use of PPE (Yiha and Kumie, 2010; Tadesse and Kumie, 2007), age, sex, employment pattern, work place supervision, health and safety training and sleep disorder (Kifle et al., 2014) were not associated with occupational injury.

Work, when it is well-adjusted and productive can be an important factor in health promotion, e.g. partially disabled workers may be rehabilitated by undertaking tasks suited to their physical and mental limitations and in this way, may substantially increase their working capacity (Occupational Health, 2001).

There is a great discrepancy in the studies explained above in relation to the associated factors of occupational injuries in different industry sectors. In addition there is no study carried out on the prevalence and associated factors of occupational injury in cement factory. Occupational health and safety affect not only the worker but also his/her family and significant others and his community.

There is rapid industrialization due to favorable investment policy, which may result in an increased number of industries and employment in Ethiopia, placing a greater number of people at risk from cement dust exposure and other hazards. Therefore, it is important to know the prevalence and determinants of occupational injuries among cement factory workers.

## METHODS

### Study area

According to Ministry of Industry there are around 10 cement factories in Ethiopia. Mughher Cement Enterprise is a state owned plant constructed in 1984. Mughher Cement Enterprise's first production line was commissioned and officially inaugurated in 1984 with a capacity of 300,000 tons of clinker per annum, near Mughher River, located 90 km west of Addis Ababa. The enterprise doubled its capacity to 600,000 tons per annum of clinker production in 1990 with the construction of a second plant. The 3rd line cement expansion project was commissioned in 2011. It is the largest cement producer in Ethiopia with a production capacity of 900,000 tones and a 35% market share and has a total workforce of 1,488. The head office is based just outside the capital and its quarrying sites are spread across the country. Mughher Enterprise produces two main products OPC (Ordinary Portland cement) and PPC (Poslana Portland Cement). Sulphate resistance cement is sometimes produced on demand.

The firm produces about 60 million packaging sacs for its own

consumption in Addis Ababa branch. Mughher also extracts and sells natural resource minerals such as gypsum, limestone and silica to other manufacturing companies and farms. Mughher uses an outdated production technology from Germany which has high energy consumption and dust emission (Yessuf et al., 2013). There were around 1488 workers in Mughher cement Enterprise in all branches (Mughher, Addis Ababa, Derba, Tatak and Nazreth). Out of the 1488 workers, 955 were working on the cement production process which includes raw material, clinker production, cement production and engineering processes. There were around 690 workers with greater than one year work experience in the production process of Mughher which was selected as a study area.

### Study design

An industry based cross sectional study complemented with observation checklist and record review was conducted.

### Source population

All workers in the production process of the cement factory. The production process consists of four main sections clinker production, cement production, raw material production and preparation and engineering team because they are considered as exposed to occupational health and safety hazards that leads to occupational injury.

### Study population

All workers are randomly selected from the production process of the cement factory.

### Inclusion criteria

All employees who were directly engaged in the production process within the study period and who have been working at least for one year in the selected factory irrespective of sex were included in the study.

### Exclusion criteria

Workers less than 18 years old were excluded. Workers who were absent from work for more than 3 times of visit at the time of data collection were not included.

### Sample size determination

The total sample size was calculated for each specific objective by using Epi Info version 7 and considering different parameters, and the largest sample size was taken. Considering 95% confidence level, 90% Power ( $1-\beta$ ), odds ratio of 1.9 (Shafik and El-Mohsen, 2012) and adding 5% non-response rate, a sample size of 500 was calculated.

### Sampling procedures

Stratified random sampling was applied to get the desired sampling unit. It was stratified by job category. The calculated sample size was allocated to each stratum using probability proportional to size (PPS). The sampling frame was obtained from Mughher Cement Factory, Human Resource Management Office. A total of 500 study

participants were selected using simple random sampling technique from the sampling frame using lottery method.

### Data collection procedures

Data was collected using pretested and structured Amharic version questionnaire via face to face interview of the study participants after getting ethical clearance from responsible bodies and informed verbal consent from study participants. Before the actual data collection the questionnaire was pretested in 5% (25 workers) outside the study area; in Addis Ababa (Ethiopian Iron and steel factory).

Based on the pretest necessary modification was done on the questions and participants who were involved in the pretest were excluded in the actual data analysis. The questionnaire was prepared in English and translated to Amharic and later translated back to English. The questionnaire was adopted from previous researches (Tadesse and Kumie, 2007). The questionnaire focused on socio demographic, behavioral, and environmental variables and occupational injury characteristics. Work place observation checklist, record reviews were done and sick leaves were checked to supplement the quantitative data.

Data collection was administered by four persons, one who have bachelor degree and the rest 10 complete and two supervisors with B.Sc degree in occupational health and MPH degree, respectively after two-day training. In case the selected respondents were absent, the data collectors tried to visit three times.

### Study variable

#### *Dependent variable*

This includes occupational injury.

#### *Independent variables*

This includes the following:

1. Socio demographic factors: Sex, age, educational level, monthly salary, service duration, job category.
2. Work environment factors: Hours worked per week, workplace supervision, health and safety training.
3. Behavioral factors: Alcohol use, chat chewing, sleep disorder, job satisfaction, and use of personal protective equipment.

### Operational definition

Occupational Injury-an injury sustained on worker in connection with the performance of his or her work in cement factory within one year that causes hospitalization, working days lost or disabilities and death as reported by the worker, confirming clinical records and sick leave.

### Data management

After the completion of data collection, the raw data was edited, entered in to a computer using Epi Info version 3.5.0 then exported to IBM SPSS version 21. Data was cleaned in Epi Info version 3.5 as well as IBM SPSS version 21 by running frequencies and cross tabulations. Preliminary frequencies were run to identify missing variables. Data was backed up by saving it in different folders in the computer, removable flash disk and email. Continuous variables were coded and some coded variables were recoded.

### Data analysis procedures

Data was analyzed using IBM SPSS version 21 and used to display percentages, graphs and tables. Descriptive statistics of the collected data was done for all variables in the study using standard statistical parameters: Percentages, means and standard deviations. Bivariate analysis (Cross tabulation and chi square, Crude OR with 95% confidence interval) were done for the independent variables with the outcome variable to select candidate variables for the multivariate analysis (Adjusted OR). Variables which showed significant association with the outcome variable on the bivariate analysis were entered in to multivariate logistic regression analysis to identify their independent effects on the outcome variable. 95% confidence interval and p-value <0.05 was used. To avoid an excessive numbers of variables and unstable estimates in the multivariate analysis variables reached a p-value less than 0.2, variables which become significant and those variables that were considered as determinants were kept. The variables which showed significant association in the bivariate and continue in the multivariate were the determinants of occupational injury. The overall effect of socio demographic variables on the occurrence of occupational injury was assessed in the first step. In the second step of the analysis, the work environment variables were added, and their effect was assessed. Behavioral factors were entered in the third step. In the fourth step selected socio demographic factors, work environment and behavioral factors together was assessed to see the overall effect on the occurrence of occupational injury.

### Data quality assurance

Training of the data collection team with pretesting in 5% of the sample size before the actual survey was conducted for two days to ensure the possible quality of the data. Based on the pretest results, the questionnaire was additionally adjusted quantitatively, contextually and terminologically, and administered on the study population.

Every day the completed questionnaires were handled to the supervisor on each day of data collection. The data collected in the cement factory was checked daily for completeness, clarity and logical consistency by the investigator and supervisor. Incorrectly filled or missed ones were sent back to data collectors for correction. Anything, which was unclear and ambiguous were corrected on the next day. Five percent of the samples were rechecked by the supervisors whether the interviewers have done their job correctly or not. Five percent of the collected data was entered twice by the investigators to verify whether the data was properly entered or not.

### Ethical consideration

The study was approved by Addis Ababa University, School of Public Health Ethical Clearance Committee. A letter obtained from Addis Ababa University, School of Public Health Ethical Clearance Committee was submitted to the relevant and concerned bodies in the cement factory before starting the study. The information sheet and consent was provided for respondents to read for those who can read and the interviewer read the consent form for those respondents who cannot read. Finally the respondents were asked the agreement to participate in the study.

The respondents were informed about the objective of the study. Confidentiality was maintained by omitting their names and personal identification, never be used in connection with any information and it was not revealed to anyone except the principal investigator and assistants and was kept locked with key in the entire study period. Privacy was maintained by arranging quite

place for interviewer and study participant to protect them exposing other parties according to the choice of the respondent ensuring visual and auditory privacy throughout the data collection.

Study participants had the right to participate on the study or not and they can withdraw at any time of the study they wish. There was no benefit the study participants can get in terms of money or other item but they can get benefit in the future if there is a change of policy and strategies by considering this study, the benefit is to improve occupational safety, health and working environment services provided based on their answers to the questions. There was no risk to the study participants because of this study.

## RESULTS

A total of 498(99.6%) respondents were included in the study and interviewed if they had experienced work related injury in the last 12 months.

### Socio demographic characteristics of the respondents

The 498 respondents included 484 males. The mean age (SD)  $37.36 \pm 10.32$  was years. About 89(17.9%) of the respondents were in the age group 26 to 30 years. The majority 422 (84.7%) of study participants were orthodox Christian religion followers. About 189(38%) of the respondents have attended secondary school. Regarding marital status of the respondents, the majority 406 (81.5%) was married. Out of 498 study participants, 354 (71.1%) were permanent and 144 (28.9%) were from micro and small enterprise. One hundred seventy six (35.3%) of the respondents were from clinker production. 165(33.1%) of the respondents had 1727 to 3684 monthly salary in birr. Most, [261 (52.4%)] of the respondents had working experience of five years or below (Table 1).

### Occupational injury characteristics

A total of 63(12.7%) respondents reported occupational injuries during the last 12 months. Due to the definition of occupational injury in this study and after reviewing records the overall prevalence during the last 12 months was 52(10.4%) and 48 92.3%) of the injured respondents reported they had sustained occupational injury once. The two week prevalence was 3(0.6%). Of this case all reported that they had sustained occupational injury once (Table 2).

Hands were the body part with the highest frequency of occupational injuries 11(21.2%), lower leg 10(19.2%), finger 9(17.3%) and eye 7(13.5%) were other sites frequently affected. The main types of injuries reported were cuts, 10(19.2%), burn, 10(19.2%), abrasions, 7(13.5%) and eye injury, 7(13.5%) (Table 3).

In this study the most common agent stated as cause was machinery 25 (48.1%), splintering objects 10

(19.2%) and falls 10 (19.2%) followed by hot substances 9(17.3%). Thirteen (25%) of the occupational injuries occurred on Tuesday and Wednesday 13(25%) followed by Monday [9(17.3%)]. The most 17(32.7%) common time of injury was in the afternoon followed by morning [16(30.8%)] (Table 4).

### Severity of occupational injuries

Of the total 52 injured respondents, 37(71.2%) were hospitalized, accounting for 51.4% hospitalization more than 24 h. 18(34.6%) were absent from work for 15 to 30 days There was one report with disability (total disability was 10% from the whole man) resulted in lumbar contusion and mild difficulty of walking which is decided by medical board of St. Paul hospital. In addition, 1356 working days were lost as result of 52 occupational injuries (Table 5).

### Work environment characteristics

Four hundred eighty three (97%) respondents worked more than 48 h per week. Two hundred and fifteen (43.2%) of the respondents reported that their workplaces were not supervised regularly. Majority (60.6%) of the respondents were not taken any health and safety training (Table 6).

### Behavioral characteristics

310 (62.2%) and 25(5%) of the respondents consumed alcohol and chewed chat, respectively. Tela was consumed by majority of them [231(46.4%)]. 298(59.8%) consumed occasionally. About 57 (11.4%) of the respondents reported that they had sleep disorder. The majority 442 (88.8%) of the respondents were satisfied by their current job. 488 (98.0%) of the respondents used personal protective equipment at their workplace, while 10 (2.0%) did not used any type of personal of protective equipment. Glove was used by majority of the respondents [464(93.2%)]. All of the study participants were interviewed for non-use of protective equipment and reported the most frequent reasons were lack personal protective equipment [359 (72.1%)], and not comfortable to use [53 (10.6%)] (Table 7).

### Workers health information on illness symptoms

Eighty-four (16.9%) of the respondents reported that they are exposed to eye irritation 15 days prior to the data collection followed by skin allergy [51(10.2%)]. General weakness [34(6.8)], wheezing [18(3.6)], cough longer than 3 weeks [6(1.2)] and cough with sputum 1(0.2) were also reported.

**Table 1.** Socio demographic characteristics of the respondents in Mugher Cement Factory, Mugher, March, 2014 (n=498).

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Sex</b>		
Female	14	2.8
Male	484	97.2
<b>Age</b>		
<21	13	2.6
21-25	64	12.9
26-30	89	17.9
31-35	67	13.5
36-40	75	15.1
41-45	67	13.5
46-50	67	13.5
51-55	36	7.2
>55	20	4.0
<b>Religion</b>		
Orthodox	422	84.7
Protestant	64	12.9
Others	12	2.4
<b>Educational status</b>		
Primary school and below	199	40
Secondary school(9-12)	189	38
12 <sup>+</sup>	110	22
<b>Marital status</b>		
Married	406	81.5
Single	85	17.1
Others	7	1.4
<b>Employment pattern</b>		
Permanent	354	71.1
Micro and small enterprise	144	28.9
<b>Job category</b>		
Clinker	176	35.3
Cement production	114	22.9
Raw material	127	25.5
Engineering	81	16.3
<b>Service duration</b>		
<5	261	52.4
5-9	57	11.4
10-14	28	5.6
>=15	152	30.5
<b>Monthly salary in birr</b>		
<1050	155	31.1
1050-1726	94	18.9
1727-3684	165	33.1
>3684	84	16.9

### Work environment observation

According to the observation workers around the kiln were exposed to heat, noise and splintering objects that

pass through the conveyer belt without cover. Workers in cement packing were exposed to excessive dust, radiation and there was no adequate light. Some of the control rooms and cement packing room were not

**Table 2.** Distribution of occupational injury in the last 12 months among respondents in Mughher Cement Factory, March, 2014 (n=498).

Variable	Frequency	Percentage
Injury in the last 2 weeks	3	0.6
<b><i>Injury in the last 12 Months</i></b>		
Yes	52	10.4
No	446	89.6
<b><i>No. of occurrence(n=52)</i></b>		
Once	48	92.3
More than once	4	7.7

**Table 3.** Distribution of occupational injury by part of the body affected and type of injury in Mughher Cement Factory, March, 2014 (n=52).

Variable	Frequency	Percentage
<b><i>Part of the body affected</i></b>		
Hand	11	21.2
Lower Leg	10	19.2
Finger	9	17.3
Eye	7	13.5
Back	6	11.5
Upper Leg	5	9.6
Others*	13	25
<b><i>Type of injury</i></b>		
Burn	10	19.2
Cut	10	19.2
Abrasion	7	13.5
Puncture	7	13.5
Eye injury	7	13.5
Fracture	6	11.5
Others **	8	15.3

Others\*: Tooth = 2, Ear = 2, Knee = 2, Toe = 2, Head = 1, Lower arm = 2, Chest = 2; Others\*\*: Dislocation = 4, Ear injury = 2, Amputation = 2.

properly ventilated; some of the ventilators were not functional at the time of data collection. There was dust in the raw mill when the electro filter (conditioning tower) was not functioning. It pollutes the environment by changing its direction to different areas, sometimes it goes also to residential area of the workers that can cause many health problems and it is the cause for wastage of the raw material up to 9 tons per hour so that we can see that there is economical loss. No enough safety precautions were observed.

There were some directives and fire extinguishers in most of the work areas but the instructions are written in English that all workers may not read it. Some of the permanent workers use necessary PPE but they complained that they lack quality and were not provided timely. For example safety shoes provided cannot prevent foot where there is the risk of foot injuries from

hot substances. Workers from the micro and small enterprises were not provided PPE by the organization, they bought by themselves. There was occupational health and safety officer but there was no adequate supervision from our observation. Training was given for some of the workers. There were two cafeterias near the plant which was patronized by many people and this may cause many health hazards. First Aid facilities were available but not functional in their workplace, but there was a health center in the compound.

### Socio demographic factors

Educational level, job category, and monthly salary were identified as the major socio demographic determinant of occupational injury. When comparing workers who

**Table 4.** Distribution of occupational injuries in the last 12 months by cause of injury, day of injury and time of injury among 52 injured respondents in Mughher Cement Factory, March, 2014 (n=52).

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Cause of injury</b>		
Machinery	25	48.1
Splintering objects	10	19.2
Falls	10	19.2
Hot substances	9	17.3
Hit by falling objects	9	17.3
<b>Day of injury</b>		
Monday	9	17.3
Tuesday	13	25
Wednesday	13	25
Thursday	7	13.5
Friday	3	5.8
Saturday	3	5.8
Sunday	6	11.5
<b>Time of injury</b>		
Morning	16	30.8
Afternoon	17	32.7
Evening	14	26.9
Mid night	5	9.6
<b>Others</b>		
Lifting heavy objects	4	
Fire	2	
Electricity	1	
Hand tools	1,	
Collision with objects	1	

**Table 5.** Severity of occupational injuries as reported by the respondents and confirmed by the investigator in Mughher Cement Factory, March, 2014 (n=52).

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Hospitalization</b>		
Yes	37	71.2
No	15	28.8
<b>How long(n=37)</b>		
Less than 24 h	18	48.6
More than 24 h	19	51.4
<b>Working days lost</b>		
<2	3	5.8
2-6	12	23.1
7-14	12	23.1
15-30	18	34.6
>30	7	13.5

attended primary school and those below with workers who attended higher education, the difference was statistically significant. Workers who attended primary school had 2.44 times more odds of occupational injuries

than workers who attended high school and colleges [OR=2.44, 95% CI: 1.084-5.508].

Occupational injury was statistically associated with job category. Workers who were working in cement

**Table 6.** Work environment characteristics of respondents in Mugher Cement Factory, March, 2014 (n=498).

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Working hour in a week</b>		
≤48	15	3.0
>48	483	97.0
<b>Supervision</b>		
Yes	283	56.8
No	215	43.2
<b>Safety training</b>		
Yes	196	39.4
No	302	60.6

**Table 7.** Behavioral characteristics of respondents in Mugher Cement Factory, March, 2014 (n=498).

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Alcohol</b>		
Yes	310	62.2
No	188	37.8
<b>How often</b>		
1-3 days in a week	12	2.4
Occasionally	298	59.8
<b>Chat</b>		
Yes	25	5.0
No	473	95.0
<b>How often</b>		
Every day	2	0.4
1-3 days in a week	5	1.0
Occasionally	18	3.6
<b>Sleeping disorder</b>		
Yes	57	11.4
No	441	88.6
<b>Job satisfaction</b>		
Yes	442	88.8
No	56	11.2
<b>Use of PPE</b>		
Yes	488	98.0
No	10	2.0
<b>Type of PPE</b>		
Glove	464	93.2
Ear plug	253	50.8
Respirators	270	54.2
Helmet	352	70.7
Overalls	397	79.7
Goggles	150	30.1
Face shield	69	13.9
Boots	304	61.0
<b>Reasons for not using</b>		
Lack of PPE	359	72.1
Lack of safety and health education	4	0.8
Not comfortable to use	53	10.6

Table 7. Contd.

Decrease work performance	5	1.0
<b>Others</b>		
It lacks Quality	5	1.0
Not needed	15	3.0
Not timely	4	0.8

Table 8. Crude statistics of socio demographic factors of occupational injuries in Muger Cement Factory, Muger, March, 2014.

Variable	Injury		P-value	COR(95%CI)
	Yes (%)	No (%)		
<b>Sex</b>				
Female	2(14.3)	12 (85.7)	0.635	1.45(0.315-6.65)
Male	50(10.3)	434 (89.7)		1.00
<b>Age</b>				
≤30	18(10.8)	148 (89.2)	0.836	1.06(0.582-1.951)
>30	34(10.2)	298 (89.8)		1.00
<b>Religion</b>				
Orthodox	46(89.1)	376 (10.9)	0.432	1.43(0.587-3.469)
Others	6(92.1)	70 (7.9)		1.00
<b>Educational level</b>				
Primary and below	32(16.1)	167 (83.9)	<b>0.031</b>	<b>2.44(1.084-5.508)</b>
Secondary	12(6.3)	177 (93.7)	0.758	0.86 (0.342-2.185)
12+	8(7.3)	102(92.7)		1.00
<b>Marital status</b>				
Married	46(11.3)	360 (88.7)	0.179	1.83(0.758-4.427)
Others	6(6.5)	86 (93.5)		1.00
<b>Employment pattern</b>				
Permanent	32(9.0)	322 (91.0)	0.111	0.62(0.340-1.118)
Micro and small enterprise	20(13.9)	124 (86.1)		1.00
<b>Job category</b>				
Clinker	31(17.6)	145 (82.4)	0.000	1.00
Cement production	7(6.1)	107 (93.9)	<b>0.007</b>	<b>0.30(0.130-0.721)</b>
Raw material	7(5.5)	120 (94.5)	<b>0.003</b>	<b>0.27(0.116-0.642)</b>
Engineering	7(8.6)	74 (91.4)	0.065	0.44(0.186-1.053)
<b>Service duration</b>				
≤5	26(10.0)	235 (90.0)	0.713	0.90(0.505-1.595)
≥6	26(11.0)	211 (89.0)	0.000	1.00
<b>Monthly salary in Birr</b>				
<1400	25(15.0)	142 (85.0)	<b>0.034</b>	<b>2.24(1.062-4.727)</b>
1400-3045	16(8.9)	164 (91.1)	0.596	1.24(0.558-2.764)
>3045	11(7.3)	140 (92.7)	0.000	1.00

production, raw materials preparation and production respectively were 69 and 73% less likely to report occupational injury than clinker production. Monthly salary was also another variable that showed association with prevalence of occupational injury. Workers who were paid less during the interview were more likely to report occupational injury [OR=2.24, 95 CI: 1.062-4.727] compared to those who were paid relatively higher.

However, in this study occupational injury was not associated with sex, age, religion, marital status and service duration of the respondents (Table 8).

#### Work environment factors

Hours worked per week, workplace supervision, health



**Table 9.** Crude statistics work environment factors of occupational injuries in Mugher Cement Factory, Mugher, March, 2014.

Variable	Injury		P-value	COR(95%CI)
	Yes (%)	No (%)		
<b>Working hour in a week</b>				
<=48	1 (6.7)	14 (93.3)	0.631	0.60 (0.078-4.697)
>48	51(10.6)	432 (89.4)		
<b>Supervision</b>				
Yes	34(12.0)	249 (88.0)	0.190	1.49 (0.819- 2.726)
No	18 (8.4)	197 (91.6)		
<b>Safety training</b>				
Yes	17(8.7)	179 (91.3)	0.300	0.73(0.394-1.333)
No	35(11.6)	267 (88.4)		

**Table 10.** Crude statistics of behavioral factors of occupational injuries in Mugher Cement Factory, Mugher, 2014.

Factors	Injury		P-value	COR(95%CI)
	Yes (%)	No (%)		
<b>Alcohol use</b>				
Yes	33 (10.6)	277 (89.4)	0.849	1.06 (0.584-1.923)
No	19 (10.1)	169 (89.9)		
<b>Chat</b>				
Yes	1 (4.0)	24 (96.0)	0.302	0.35 (0.046-2.603)
No	51 (10.8)	422 (89.2)		
<b>Sleeping disorder</b>				
Yes	8 (14.0)	49 (86.0)	0.348	1.47 (0.656-3.310)
No	44 (10.0)	397 (90.0)		
<b>Job satisfaction</b>				
Yes	47 (10.6)	395 (89.4)	0.695	1.21 (0.461-3.192)
No	5 (8.9)	51 (91.1)		
<b>Use of PPE</b>				
Yes	49 (10.0)	439 (90.0)	0.057	0.26 (0.065-1.040)
No	3 (30.0)	7 (70.0)		

and safety training showed no association with the prevalence of occupational injuries (Table 9).

### Behavioral factors

Alcohol use, chat chewing, sleeping disorder, job satisfaction and use of personal protective equipments did not show significant association (Table 10).

### Multivariate logistic regression analysis

The overall effect of socio demographic variables on the occurrence of occupational injury was assessed in the first step. In the second step of the analysis, the work environment variables were added, and their effect was

assessed. Behavioral factors were entered in the third step. In the fourth step selected socio demographic factors, work environment and behavioral factors together was assessed to see the overall effect on the occurrence of occupational injury.

Among the mentioned socio demographic variables computed in the first step, job categories in cement production and raw material remained significant. Workers in the cement production were 74.3% less likely to experience occupational injury than workers in clinker production [OR=0.26, 95% CI: 0.105-0.628], workers in the raw material production had 75.2% less than lower odds of having occupational injury than workers in the clinker production [OR=0.25, CI 95%:0.102-0.607].

From work environment variables analyzed hours worked per week, supervision of workplace and health and safety training were not statistically significant.

From the behavioral factors, the use of PPE was found to be significant. Workers who used PPE were 0.24 less likely to experience occupational injury than who did not use PPE [OR=0.24, 95% CI: (0.058-0.973)].

From the variables computed in the fourth step only job category was found to be significant. Workers in the cement production were 74.7% less likely to experience occupational injury than workers in clinker production [OR= 0.25, CI: (0.100-0.639)]; workers in the raw material production had 73.6% less likely to experience occupational injury than workers in the clinker production [OR = 0.26, CI: (0.107-0.653)] (Table 11).

## DISCUSSION

The 12 months prevalence was 52(10.4%) and 48 (92.3%) of the injured respondents reported they had sustained occupational injury once. The two week prevalence was 3(0.6%). Of this case all reported that they had sustained occupational injury once. The overall prevalence was relatively low compared with other studies (Yiha and Kumie, 2010; Tadesse and Kumie, 2007; Kifle et al., 2014; Yessuf et al., 2013). Of the total 52 injured respondents, 37(71.2%) were hospitalized, accounting for 51.4% hospitalization more than 24 h. 18(34.6%) were absent from work for 15 to 30 days. There was one report with disability (total disability was 10% from the whole man) resulted in lumbar contusion and mild difficulty of walking which is decided by medical board of St. Paul hospital. In addition, 1356 working days were lost as result of 52 occupational injuries. Hospitalization and working days lost can result to increase in medical cost, compensation cost, absenteeism and loss of working capacity which adversely affects productivity of the employees as well as the employer so we can see it economically. Work that resulted in production loss and disregard the safety and health of workers cannot be the basis of sustainable development. In a study done in Afar, 70 (11.0%) were hospitalized. Regarding the length of hospitalization, 7 (10.0%) were for 1 day, 25 (35.7%) were between 24 h and 4 days, 25(35.7%) were 5 to 10 days, and 13(18.6%) were admitted for more than 10 days. One death was also reported due to severe head injury while working in the ginning section in the past 12 months. A total of 6153 work days were lost among 634 injured respondents (Yiha and Kumie, 2010). A study done in Kombolcha textile factory revealed that 73(43.45%) were hospitalized where 67% of the hospitalization were for more than 24 h. 137 working days were lost as result of work related injuries in the last 12 months (Yessuf et al., 2013).

Fifty five (17.1%) were hospitalized, accounting for 40% hospitalization more than 24 h. One hundred and three (53.9%) were absent from work for more than 4 days. In addition, 191 working days were lost as result of 322 work related injuries. There were 2 reported deaths as

result of work related injuries in a study done in North Gondar (Tadesse and Kumie, 2007).

Hands were the body part with the highest frequency of occupational injuries 11 (21.2%), lower leg 10 (19.2%), finger 9 (17.3%) and eye 7(13.5%) were other sites frequently affected. The possible explanation is due to more involvement in work which has direct exposure to machines, hot materials and can be affected more by injuries. Non-use of PPE can also be the reason. This is consistent with a study done in Kombolcha (Yessuf et al., 2013) and North Gondar (Tadesse and Kumie, 2007) and inconsistent with a study done in Bangladesh (Iqbal et al., 2010), Afar (Yiha and Kumie, 2010) and Addis Ababa (Kifle et al., 2014) this might be due to use of adequate PPE in this studies.

The main types of injuries reported were cuts 10(19.2%), burn 10(19.2%), abrasions 7(13.5%) and eye injury 7(13.5%). This is inconsistent with findings in Ethiopia (Yiha and Kumie, 2010; Tadesse and Kumie, 2007; Kifle et al., 2014; Yessuf et al., 2013); this could be due to the difference in the nature of the work, the type of machineries used in this different industries are not similar.

In this study the most common agent stated as cause was machinery 25 (48.1%), splintering objects 10 (19.2%) and falls 10 (19.2%) followed by hot substances 9(17.3%). This could be due to presence of unguarded machine parts and nonuse of PPE. This is in agreement with (Tadesse and Kumie, 2007; Yessuf et al., 2013) and inconsistent with Yiha and Kumie (2010) and can be explained by the difference in materials they used for work. Thirteen (25%) of the occupational injuries occurred on Tuesday and Wednesday 13(25%) followed by Monday 9(17.3%).The most 17(32.7%) common time of injury was in the afternoon followed by morning 16(30.8%). This is inconsistent with Tadesse and Kumie (2007); the reason could be the difference of work shifts. There are three working shifts with 8 working hour interval in the cement factory. The possible explanation for the high frequency of injury in the afternoon could be due to speeding up of the production by the second round shift workers to meet the target before it becomes dark.

In this study, eighty four (16.9%) of the respondents reported that they are exposed to eye irritation 15 days prior to the data collection followed by skin allergy 51(10.2%). Findings from India (Sana et al., 2013) and Cairo (Shafik and El-Mohsen, 2012) reported similarly.

The use of personal protective equipment (PPE) is found to be significant when the effect of behavioral factors on occupational injury detected alone. Workers who used PPE were 0.238 less likely to experience occupational injury than those who did not use PPE [AOR=0.24, CI: (0.058-0.973)], but did not show significant association when socio demographic and work environment factors were added. Even though use of PPE did not show in the bivariate and multivariate

**Table 11.** Multivariate logistic regression analysis of the relative effect of socio demographic, work environment and behavioral factors on the prevalence of occupational injuries in Mughher Cement Factory, Mughher, March, 2014.

Variable	Injury		COR(95%CI)	AOR(95%CI)
	Yes	No		
<b>Educational level</b>				
Primary and below	32	167	<b>2.44</b>	<b>(1.084-5.508)</b>
Secondary	12	177		0.86(0.342-2.185)
12+	8	102	1.00	1.00
<b>Marital status</b>				
Married	46	360	1.83	(0.758-4.427)
Others	6	86	1.00	1.00
<b>Employment pattern</b>				
Permanent	32	322	0.62	(0.340-1.118)
Micro and small enterprise	20	124	1.00	1.00
<b>Job category</b>				
Clinker	31	145	1.00	1.00
Cement production	7	107	<b>0.30</b>	<b>(0.130-0.721)</b>
Raw material	7	120	<b>0.27</b>	<b>(0.116-0.642)</b>
Engineering	7	74	0.44	(0.186-1.053)
<b>Service duration</b>				
<=5	26	235	0.90	(0.505-1.595)
>=6	26	211	1.00	1.00
<b>Monthly salary in Birr</b>				
<1400	25	142	<b>2.24</b>	<b>(1.062-4.727)</b>
1400-3045	16	164		1.24(0.558-2.764)
>3045	11	140	1.00	1.00
<b>Working hour in a week</b>				
<=48	1	14	0.60	(0.078-4.697)
>48	51	432	1.00	1.00
<b>Supervision</b>				
Yes	34	249	1.49	(0.819- 2.726)
No	18	197	1.00	1.00
<b>Safety training</b>				
Yes	17	179	0.73	(0.394-1.333)
No	35	267	1.00	1.00
<b>Alcohol use</b>				
Yes	33	277	1.06	(0.584-1.923)
No	19	169	1.00	1.00
<b>Chat</b>				
Yes	1	24	0.35	(0.046-2.603)
No	51	422	1.00	1.00
<b>Sleeping disorder</b>				
Yes	8	49	1.47	(0.656-3.310)
No	44	397	1.00	1.00
<b>Job satisfaction</b>				
Yes	47	395	1.21 (0.461-3.192)	0.76 (0.262-2.223)
No	5	51	1.00	1.00
<b>Use of PPE</b>				
Yes	49	439	0.26 (0.065-1.040)	0.44 (0.092-2.086)
No	3	7	1.00	1.00

analysis when added with the other factors in this study 72.1% of the workers reported there was lack of PPE and

it was not provided timely and did not have quality. From the variables computed in the multivariate

analysis job category was found to be significant which is consistent with a study done in North Gondar (Tadesse and Kumie, 2007). This can be explained by the work environment in clinker production is very hazardous, most of the workers in clinker production are from micro and small enterprises from which they are not provided adequate and quality PPE, lack of safety and health training and lack of regular workplace supervision.

Some studies revealed that increasing educational levels have been associated with decreasing work related injuries. This may be explained that education is likely to enhance workers health and safety practice that prevent them from work-related injuries. However, in our study educational level was not associated with occurrence of work-related injuries. This could be explained education only cannot eliminate injury when the level of hazards is high and when the use of adequate PPE and safe work organization are limited.

However, in this study occupational injury was not associated with marital status, employment pattern, service duration, monthly salary, hours worked per week, workplace supervision, health and safety training, alcohol use, chat chewing, sleeping disorder, job satisfaction and use of PPE of the respondents.

This study was not free of limitations. Since the study was a one year cross sectional study, the possibility of recall bias may result in under reporting and misreporting of events. Moreover, lack of studies with similar methodology and similar topic particularly in Ethiopia context made it difficult to compare results.

## CONCLUSIONS AND RECOMMENDATIONS

The prevalence of occupational injury was 10.4%. Job category increased the risk of work related injuries. Taking modifiable and preventable factors that affect occupational injury occurrence into consideration, the following recommendations are forwarded to Muger Cement Factory based on the findings of the study. Provision and supervision of adequate and quality safety materials timely and their appropriate use should be done. Besides, regular work place supervision should be focused upon.

## CONFLICTS OF INTERESTS

The authors have not declared any conflict of interests.

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