

Asbestos safety, health and environmental awareness among maintenance workers in Public Universities in Kenya

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Abstract

Background: Asbestos, a common element in insulation and building materials prior to the 1970s, was considered an ideal material for use in the construction industry but is today considered toxic waste. The problem with asbestos arises when the fibers become airborne and are inhaled. Because of the size of the fibers, they cannot be expelled by the lungs. They are also sharp and penetrate tissues. The Universities investigated are characterized with old buildings which were built with asbestos materials during the old colonial period in Kenya. This study aimed at assessing asbestos safety, health and environmental awareness among maintenance workers in Public Universities in Kenya.

Materials and Methods: The study targeted the 22 public Universities in Kenya as per the Universities Act, 2012 and Science, Technology and Innovation Act 2013. This was a descriptive cross sectional study which sampled 400 participants. Purposive sampling methods was used to select Universities containing old buildings characterized by asbestos containing roofing materials. Simple random sampling method was used to choose the participants. Closed ended questionnaires and observation guide were used to collect primary data while secondary data was retrieved through scrutiny of records. Pearson chi square and analysis of variance was determined at 95% confidence interval for all the variables.

Results: Maintenance workers in public Universities were working in environment that is not safe from asbestos fiber/dust exposure since 47.5% confirmed that their work environment was not safe from asbestos dust/fibers.

Conclusion: The study concludes that the employees were working in unsafe environment and were very much aware of the potential health hazards posed by asbestos fibers/dust exposure to their health. Therefore the university management should provide an environment that is safe from asbestos fiber/dust exposure to all the maintenance workers.

Key Word: Universities, hazards, asbestos, fibers/dust, exposure, environment, maintenance workers

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I. Introduction

Asbestos, a common element in insulation and building materials prior to the 1970s, was considered an ideal material for use in the construction industry but is today considered toxic waste. The problem with asbestos arises when the fibers become airborne and are inhaled. Because of the size of the fibers, they cannot be expelled by the lungs¹. They are also sharp and penetrate tissues. Asbestos fibers enter the body by inhalation of airborne particles or by ingestion and can become embedded in the tissues of the respiratory or digestive systems. Years of exposure to asbestos can cause numerous disabling or fatal diseases. Among these diseases are asbestosis, an emphysema like condition; lung cancer; mesothelioma, a cancerous tumor that spreads rapidly in the cells of membranes covering the lungs and body organs; and gastrointestinal cancer². It is a cancer of the mesothelial lining of the lungs and the chest cavity, the peritoneum or the pericardium. Unlike lung cancer, mesothelioma has no association with smoking³ the only established causal factor is exposure to asbestos or similar fibers⁴. The scarring may eventually become so severe that the lungs can no longer function^{4, 5}. The latency period for mesothelioma may be 20–50 years. The prognosis for mesothelioma is grim, with most patients dying within 12 months of diagnosis⁶. Cancer of the lung, gastrointestinal tract, kidney and larynx has been linked to asbestos. The latency period for cancer is often 15–30 years⁷.

This study was conducted in public Universities in Kenya as per the Universities Act, 2012 and Science, Technology and Innovation Act 2013. The study population was derived from maintenance workers in public Universities in Kenya. These Universities are characterized with old buildings which were built with asbestos materials during the old colonial period. Building materials used to construct floors, roofs, walls, boiler insulation and motor vehicle parts like brakes and gaskets were made using asbestos materials. There are few studies that have been done to determine asbestos health and safety management among maintenance workers in

Universities in Kenya. Hence the current study was conducted to assess asbestos safety, health and environmental awareness among maintenance workers in Public Universities in Kenya.

II. Materials and methods

Study sites

The study was conducted in the 22 public Universities in Kenya as per the Universities Act, 2012 and Science, Technology and Innovation Act 2013.

Study design

This was a descriptive cross sectional study carried out in public Universities in Kenya among the maintenance workers.

Study Population

The study population includes both the permanent employees and the casuals working at the estates/maintenance departments of the institutions.

Subject selection

Inclusion criteria

1. Public University that contain old buildings with asbestos containing roofing materials
2. Employees who have worked for one year and above in the maintenance department and willing to participate in the study

Exclusion criteria

1. Public Universities that does not have old buildings with asbestos containing roofing materials
2. Employees who have worked for less than one year in the maintenance department.
3. Those workers meeting inclusion criteria and were not willing to participate in the study

Sample size determination

A statistical formula recommended for cross sectional studies was used to compute the sample size in this study.

$$n = \frac{Z^2 P (1-P)}{d^2}$$

$$n = \frac{(1.96)^2 (0.50) (1-0.50)}{0.05^2}$$

n = 384.16 approx. 384 to the nearest 100 approximately 400 participants in order to take care of nonresponse.

Sampling method

Purposive sampling methods was used to select Universities containing old buildings characterized by asbestos containing roofing's materials. After selecting the institution, participants were selected from maintenance workers. Simple random sampling method was used to choose the participants. Every worker was assigned roman numbers and those picking odd numbers were selected to participate in this study from each University.

Data collection tools

Closed ended questionnaires were used to collect a wide array of first-hand information to address the respondents' perception of their health and environmental safety awareness among the maintenance workers in the Universities. Observation guide was also used to collect primary data.

Secondary data was collected through scrutiny of documents e.g. General Registers, Health and Safety policies, incidents and accidents occurrence books, various statutory audits and other safety health and environmental literature in the universities.

Study Procedure

The management of the 22 Universities were approached by the researcher and the overall objective of the study were explained to obtain permission. The management notified the workers of the study who were then approached to participate in the study. Participants accepting to participate were requested to sign the consent forms.

Data Management

All research materials; hard copy questionnaires and other scripts were securely kept in lockable lockers and confidentiality maintained before and after analysis. Statistical Package for Social Scientists version 21.0 was used for analysis. Pearson chi square and analysis of variance was determined at 95% confidence interval for all the variables.

Authorization

Authority to carry out the study was sought from; JKUAT board of post graduate studies. Ethical approval to carry out the research study was sought from KNH-UoN ERC who approved all components of the informed consent document and interview questionnaires to the workers.

III. Results

Demographic characteristics of the respondents

Table 1 presents the data on demographic characteristics of the participants. Male participants were 289(72.25%) while the females were 111(27.75%) hence the minority. The study shows that most participants had college education [186 (46.5%)] during the study. Those with primary school education were 17(4.25) while University graduates were 76(19.0%). Most workers in the maintenance department were technicians 216(54.0%), some were engineers 22(5.5%) and 62(15.5%) were cleaners. Those indicated as others in the profession category were secretaries, clerks, tea girls and messengers in the maintenance department. Employees in maintenance department were working as either general workers [243(60.75%)] or managers/supervisors [157(39.25%)]. Regarding marital status, most workers were married [330(82.57%)] while very few were windowed [7(1.75)]. The study participants had an average of 11.89 years of experience in their respective areas of work. Most of them had an experience of 10 years while some had less than one year's experiences in their areas of work. Some of them had work experience of 45 years as shown in Table 1.

Table 1: Demographic information of the participants (n=394)

Variables	Categories	n (frequency)	% (percentage)
Sex	Male	289	72.25
	Female	102	27.75
Educational level	Primary School	17	4.25
	Secondary school	109	27.25
	College	186	46.5
	University	76	19
	Others	12	3.0
	Profession	Cleaner	62
	Technician	216	54
	Engineer	22	5.5
	Laborers	35	8.75
	Others	65	16.25
Work position	General workers	243	60.75
	Managerial/supervisory	157	39.25
Marital Status	Married	330	82.5
	Single	54	13.5
	Divorced	9	2.25
	Windowed	7	1.75
Work experience	0 to 5 years	105	26.25
	6 to 10 years	113	28.25
	11 to 15 years	75	18.75
	16 + years	107	26.75

Asbestos safety and health awareness among maintenance workers

Asbestos health awareness among the participants

The results of asbestos health awareness among the participants is presented in Table 2. Majority of the respondents [190(47.5%)], confirmed that their work environment was not safe from asbestos dust/fibers while few [147(36.8%)] affirmed that their working environment was safe from the fibers/dust. Some [14(14.5%)] workers did not know if their environment was safe or not from asbestos dust/fibers. Most cleaners (45.2%), engineers (45.5%), laborers (40.0%) and Technicians (35.7%) confirmed that their work environment was safe from asbestos dust/fibers. Among those who did not know whether their workplace was environmentally safe from asbestos dust/fibers were; 10(16.1%) cleaners, 20(9.4%) Technicians, 2(9.1%) engineers, 8(22.9%) laborers and 18(28.1%) in the others category.

Regarding asbestos disposal in the Universities, 174(43.5%) workers knew where the asbestos materials was being disposed off in the institutions while 169(42.3%) did not know where the asbestos containing materials were disposed in their work place. A good number of the respondents [50(12.5%)] did not know what

asbestos materials were yet they were working in maintenance department where asbestos containing materials were a common phenomenon. About 7(1.75%) answered in the other category but did not specify their answers meaning that they did not understand the questions and did not sought for clarification. Among those who knew where asbestos fibers containing materials were disposed in their respective universities were; 22(35.5%) cleaners, 113(53.3%) technicians, 14(63.6%) engineers, 12(34.3%) laborers and 15(23.4%) in the category denoted others. Majority of the technicians and engineers seems to be aware of places where asbestos containing materials were disposed off in their respective institutions compared to the other cadre of staff.

According to, the selected Universities had old buildings with asbestos roofing materials. As the norm, regular asbestos environmental assessment is recommended. According to the results of this study, 205(51.25%) of the respondents confirmed that their institutions did not conduct regular asbestos environmental impact assessment test in the old buildings and the surrounding environment while 83(20.75%) affirmed that this assessments were conducted in their work environment. About 26(104%) participants had no idea concerning asbestos environmental impact assessment test. Those who confirmed that their institutions did conduct regular asbestos environmental impact assessment test in the old buildings and their surroundings were; 16(25.8%) cleaners, 48(22.5%) technicians, 8(36.4%) engineers, 4(11.4%) laborers and 7(10.9%) others. Engineers and technicians should be in a better position to know about environmental impact assessments test due to their education level and their position in terms of maintenance and innovations in the departments. The institutions that carry out asbestos environmental impact assessment test according to the respondents, do so in either of the following frequencies:- monthly, quarterly (every three months), after 4 months, after 6 months, annually, rarely, regularly or after 5-6 years. Some participants did not knew if regular asbestos environmental impact assessment test in the old buildings and their surroundings were done in their institutions. These were; 21(33.9%) cleaners, 38(17.8%) technicians, 5(22.7%) engineers, 13(37.1%) laborers and 27(42.2%) others.

Data analysis revealed that there was significant association between asbestos disposal, workplace environmentally safety from asbestos fibers/dust, conducting asbestos environmental impact assessment test especially in the old buildings and the workers profession in this study ($p < 0.05$) as shown in Table 2.

Table 2: Asbestos safety and health awareness among participants (n=394)

Safety Awareness	R	Workers profession						p
		C (n) (%)	T (n) (%)	E (n) (%)	L (n) (%)	O (n) (%)	Total (n) (%)	
Is your work environmentally safe from asbestos dust/fibers	Yes	28(45.2)	76(35.7)	10(45.5)	14(40)	19(29.7)	147(37.1)	0.038
	No	24(38.7)	116(54.5)	10(45.5)	13(37.1)	27(42.2)	190(48)	
	DNK	10(16.1)	20(9.4)	2(9.1)	8(22.9)	18(28.1)	58(14.6)	
	Other	0(0)	1(0.5)	0(0)	0(0)	0(0)	1(0.3)	
	Total	62(100)	213(100)	22(100)	35(100)	64(100)	396(100)	
Do you know where the asbestos is disposed in the institutions	Yes	22(35.5)	113(53.3)	14(63.6)	12(34.3)	15(23.4)	176(44.6)	0.000
	No	30(48.4)	81(38.2)	7(31.8)	13(37.1)	38(59.4)	169(42.8)	
	DNK	10(16.1)	18(8.5)	1(4.5)	10(28.6)	11(17.2)	50(12.7)	
	Total	62(100)	212(100)	22(100)	35(100)	64(100)	395(100)	
Does the university conduct regular asbestos environmental impact assessment test especially in the old buildings	Yes	16(25.8)	48(22.5)	8(36.4)	4(11.4)	7(10.9)	83(21)	0.003
	No	25(40.3)	123(57.7)	9(40.9)	18(51.4)	30(46.9)	205(51.8)	
	DNK	21(33.9)	38(17.8)	5(22.7)	13(37.1)	27(42.2)	104(26.3)	
	Other	0(0)	4(1.9)	0(0)	0(0)	0(0)	4(1)	
	Total	62(100)	213(100)	22(100)	35(100)	64(100)	396(100)	

Key: DNK- Do not know, R-Response, C- Cleaner, T-Technician, E-Engineer, L-Laborers, O-Others, P-p-value (probability)

Asbestos safety and environmental awareness among participants (n=394)

Table 3 presents results on asbestos safety and environmental awareness among the participants. According to observation, all the Universities studied were in the process of removing asbestos containing roofing materials from old buildings and replacing them with iron sheets. During demolition or replacement of asbestos containing materials, fibers or dust are generated. In this study, 131(32.75%) participants confirmed that safety precautions to safeguard the personnel and environment from asbestos dust/fibers from polluting the environment were adhered. Most [192(48.0%)] said that the management of their institutions did not take any safety precautions to safeguard either the environment or personnel during replacement or demolition of old buildings containing asbestos materials. Among the participants who confirmed that their institutions did not take any safety precaution to safeguard either the environment or personnel during replacement or demolition of old buildings containing asbestos roofing materials were; 39(62.9%) cleaners, 107(50.2%) technicians,

3(13.6%) engineers, 6(17.1%) laborers and 30(46.9%) other professions. Those who did not know if their institutions did take any safety precaution to safeguard either the environment or personnel during replacement or demolition of old buildings containing asbestos materials were; 9(14.5%) cleaners, 18(8.5%) technicians, 20(57.1%) laborers and 21(32.8%) others totaling to 68(17.2%). Replacing of asbestos containing materials with modern materials such as PCV pipes and iron sheets was also a common practice in some of the institutions investigated.

Areas with asbestos containing materials should be restricted from unauthorized personnel's. In this study, 80(20.0%) participants confirmed that there exist restricted areas with asbestos containing materials while 192(48.0%) affirmed that such areas were not restricted in their respective work places. Some [82(20.5%)] participants did not know anything about restricted areas containing asbestos materials while still others had no idea since their response was any other without specification. Observation revealed that areas containing asbestos roofing material waste do exist in the Universities but they were not restricted since there were no warning signs in such areas. Most participants confirmed that areas with asbestos containing materials in their respective institutions were not restricted; there were 29(46.8%) cleaners, 147(68.7%) technicians, 13(59.1%) engineers, 12(34.3%) laborers and 34(53.1%) others.

Regarding environmental pollution, 45(11.5%) participants confirmed that some neighbors have been complaining of asbestos pollution emanating from the University while majority [237(59.25%)] affirmed that nobody from the neighborhood has ever complained on the same. These could be because of the poor awareness level of the dangers or hazards associated with asbestos dust/fibers. Most participants confirmed that nobody from the neighborhood has ever complained of asbestos pollution emanating from the University. These were; 42(67.7%) cleaners, 124(57.7%) technicians, 12(57.1%) engineers, 22(62.9%) laborers and 36(56.3%) others. However, some participants did not know whether anybody from the neighborhood had ever complained on the same issue. These were; 16(25.8%) cleaners, 58(27%) technicians, 1(4.8%) engineers, 11(31.4%) laborers and 28(43.8%) others (Table 3). In these case the category denoted others were secretaries, office messengers, tea girls and office clerks among others. However, analysis revealed that there was a very significant association between safety and environmental awareness among the different professions of the participants/workers (p=0.00).

Table 3: Asbestos safety and environmental awareness among participants (n=394)

Environment safety	R	Profession of the participants						P
		C (n) (%)	T (n) (%)	E (n) (%)	L (n) (%)	O (n) (%)	Total (n) (%)	
Taking precaution to safeguard the environment from asbestos dust/fibers during renovation/demolition	Yes	14(22.6)	86(40.4)	19(86.4)	9(25.7)	8(12.5)	136(34.3)	0.000
	No	39(62.9)	107(50.2)	3(13.6)	6(17.1)	30(46.9)	185(46.7)	
	DNK	9(14.5)	18(8.5)	0(0)	20(57.1)	21(32.8)	68(17.2)	
	Other	0(0)	2(0.9)	0(0)	0(0)	5(7.8)	7(1.8)	
	Total	62(100)	213(100)	22(100)	35(100)	64(100)	396(100)	
Restricted areas containing asbestos from unauthorized personnel's	Yes	19(30.6)	38(17.8)	8(36.4)	9(25.7)	6(9.4)	80(20.2)	0.000
	No	29(46.8)	147(68.7)	13(59.1)	12(34.3)	34(53.1)	235(59.2)	
	DNK	14(22.6)	29(13.6)	1(4.5)	14(40)	24(37.5)	82(20.7)	
	Total	62(100)	214(100)	22(100)	35(100)	64(100)	397(100)	
Has anybody in the neighborhood complained of asbestos pollution emanating from the university	Yes	3(4.8)	33(15.3)	8(38.1)	2(5.7)	0(0)	46(11.6)	0.000
	No	42(67.7)	124(57.7)	12(57.1)	22(62.9)	36(56.3)	236(59.4)	
	DNK	16(25.8)	58(27)	1(4.8)	11(31.4)	28(43.8)	114(28.7)	
	O	1(1.6)	0(0)	0(0)	0(0)	0(0)	1(0.3)	
	Total	62(100)	215(100)	21(100)	35(100)	64(100)	397(100)	

Key: DNK- Do not know, R-Response, C- Cleaner, T-Technician, E-Engineer, L-Laborers, O-Others, P-p-value (probability)

IV. Discussions

Male participants were the majority (72.25%) compared to their females (27.75%) counterparts in this study. Bisexual gender was not represented in this study since it was done before 2019 census when the third gender in Kenya were enumerated and recognized. Most often than not, work in maintenance department require strength and masculinity that's why it attracts more males than females as seen in this study. Hard work with high occupational risk is usually done by men according to ILO⁹ and WHO¹⁰. Men are known to take high risk in order to provide for their families especially during economic hard times (ILO, 2007) hence the high number of men working in the maintenance department of the Universities as observed by this study. Kimeto¹¹ in his study had similar observation regarding risk taking nature of men. In nature, males tend to select themselves

into more hazardous jobs and females tend to do less physically demanding jobs¹² as observed in the current study. The results on gender concur with a similar study by Acharya¹³ among Industrial Workers of Nepal, majority of the respondents were male (68.4%).

Most participants (65.5%) had either college or University education during the study. A good number had either primary or secondary school education. The category referred to as others were those individuals who after completing primary school went to do artisan course, others were trained by professionals such as welders and mechanics. Those with college and university level of education usually take managerial positions such as, supervision, managerial and others as technical experts. Maintenance work require technical skills hence majority (54.0%) of workers in this study worked as technicians, some were engineers (5.5%) and a good number (15.5%) worked as cleaners. Those indicated as others in the profession category were secretaries, clerks, tea girls and messengers in the maintenance department. Education is very important for one to acquire relevant technical skills to do a certain job. We also need people with less education to work as cleaners, tea girls and messengers hence all categories were well represented in the maintenance departments in the Universities studied. Literacy could facilitate understanding and appreciation of basic safety measures among the workers. Similarly Sambo *et al.*,¹⁴ in Nigeria observed that, more than half (53.5%) of the respondents had secondary education while 3.5% had informal and no form of education hence does not concurs with the results of the current study since all participants had formal education.

Regarding marital status, most workers were married (82.57%) while others were single, windowed or divorced. In this study most participants were married despite the fact that most of them worked in maintenance department. The work in maintenance department involves constructions, demolition and renovation of buildings which is considered risky as a result of high incidence of injury through falls, abrasion, collapsing of building and accidents according to ILO⁹. Muemaet *et al.*,¹² in a similar study revealed that majority (69.0%) of the employees were either married or divorced. It is evident by the results of the current study that all people, despite their marital status are able to work in the maintenance departments of the University.

Health awareness among employees working in hazardous environment is very important. The Universities investigated were characterized with old buildings with asbestos containing materials which is a potential hazards. When asbestos materials are disturbed, they produce asbestos fibers inform of dust. This dust/fibers can find themselves in the lungs when inhaled or in the digestion system when ingested. In this study, most (63.25%) workers either said that their work environment was not safe from asbestos dust or did not know whether it was safe or not. This shows that working in estate/maintenance department in the University is not safe from asbestos fibers/dust exposure. More than 35% of cleaners, engineers, laborers and Technicians confirmed that their work environment was safe from asbestos dust/fibers. Some workers were not sure of their safety in terms of asbestos dust exposure. This reveals that some workers are not aware of the dangers post by asbestos dust/fibers in their work environment. Some could not differentiate between different roofing and building materials.

Asbestos is the collective name for several naturally occurring fibrous silicate minerals that can be separated into thin, durable threads. It was once widely used because of its properties: it is heat resistant, withstands acids and other chemicals, is a good insulator, has a high strength and can be woven. Asbestos can be found in a wide range of construction and electrical equipment, including floor tiles, insulation, plaster, cement, caulk, adhesives, roofing materials, siding, boilers, furnaces, generators, heating ducts, valves, pumps, wires and cables, and wiring insulation¹⁵. The OSHA¹⁶ regulations require asbestos training for any employee exposed to or potentially exposed to asbestos fiber levels of 0.1 f/cc for an 8-hour time-weighted average or for 1.0 f/cc as a 30-minute time-weighted average. Asbestos training comes in three levels: asbestos awareness training, special operations, and maintenance training, and abatement training.

In this study, employees who could not differentiate different roofing materials had difficult time answering some question like if they knew where asbestos containing materials were disposed in their work environment. This is evidenced by the fact that 42.3% of the respondent did not know where asbestos containing materials were disposed while 12.5% had no idea of asbestos containing materials and how they should be disposed yet they were working in maintenance departments. Those who did not know where asbestos containing materials were disposed in their environment were; 48.4% cleaners, 38.2% technicians, 31.8% engineers, 37.1% laborers and 59.4% from other professions. The group named others did not know about asbestos disposal because their work did not involve handling asbestos containing materials directly. Since these group comprise of office messengers, secretaries, clerks and tea girls. Generally, asbestos safety and health awareness was very poor among the maintenance workers in public Universities investigated. In this study, asbestos were disposed in the institutions in the following areas; Collection and disposal points for the contractors, estate asbestos containing materials disposal yard, no designated area for disposal (next to the toilet, workshops, estate departments, walk-ways, near buildings, work places, along the roads, in the dust bins), old buildings roofs (lab, staffs houses, animal sheds, classrooms, tailoring units, hostels, offices, estate areas, residential houses), waste disposal pit and dumping site (burying underground completely and covering them with polythene papers).

Asbestos containing materials disposal were done by the following according to the participants; laboratory technicians/ staffs, maintenance teams at estate departments, NEMA approved contractor, anybody (no specific department, person or company), nobody (they are just kept outside), registered company contracted for the disposal, relevant departmental technicians, they have not been disposed yet due to high cost and workers (casuals, cleaning attendant, carpenters, health workers and tractor drivers) who collect them and bury under supervision.

According to OSHA¹⁶, employees should be trained periodically on occupational health and safety in their work environment. They should also be inducted upon employment and be made aware of all hazardous materials in their work place. The results of the current study reveals that some maintenance workers had no knowledge on asbestos safety and health awareness in their work place. Observation checklist revealed that the selected Universities were characteristic by old buildings with asbestos containing roofing materials. Brake pads and caskets containing asbestos materials were among the waste materials in the vehicle workshops. There were also boilers insulated with asbestos fibers. This shows that all participants are exposed to asbestos fibers/dust on a day to day basis. The OSHA¹⁶ stipulates that environmental assessment should be carried out to determine the amount of inhalable dust that is exposed to the environment. In this study most workers (51.25%), confirmed that their institutions did not conduct regular asbestos environmental impact assessment test in the old buildings and their surroundings. These were 25.8% cleaners, 22.5% technicians, 36.4% engineers, 11.4% laborers and 10.9% other categories of staff. These imply that the management of the institutions were not keen on asbestos safety of their workers.

Others (28%) had no idea concerning asbestos environmental impact assessment test. The management of the Universities investigated were very aware of the asbestos hazards since they were in the process of replacing asbestos roofing materials with iron sheets. However, they were not training the workers on the hazards associated with asbestos dust/fibers. Asbestos environmental impact assessment test should include periodic measurement of inhalable dust in the air. None of the Universities investigated measured the amount of inhalable asbestos dust in the air periodically even during demolition of old building with asbestos containing materials. According to the laws, the employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter of (1 f/cc) as averaged over an 8-hour TWA (*Time-Weighted Average –TWA*) day. The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air (0.1 f/cc) as averaged over a sampling period of 30 minutes (*Excursion Limit -ELT*). The OSHA has adopted the term "excursion limit" to refer to the short-term permissible exposure limit to be consistent with the terminology used by the American Conference of Governmental Industrial Hygienists – ACGIH¹⁷.

Observation of activities in the Universities under investigation revealed that the managements were in the process of removing asbestos containing materials in the roofs of old buildings. This observation implies that the University management are aware of hazards associated with asbestos materials. Safety precaution is thus required during renovation, demolition and removal of asbestos roofing materials. In this study, only 32.75% of participants confirmed that safety precautions were put in place during demolition, renovation or removing asbestos materials in old buildings. Majority (67.3) of the participants confirmed that there were no safety precautions put in place during these exercise. Among the participants, 62.9% cleaners, 50.2% technicians, 13.6% engineers, 17.1% laborers and 46.9% other professions confirmed that their institutions did not put safety precautions in place during demolition and renovation of asbestos containing buildings. Cleaners, technicians and engineers are in a better position in answering question related to asbestos safety since they handle these materials on a regular basis. Data analysis revealed that there was a very significant association between the profession of workers and putting in place safety precautions during demolition and renovation of asbestos containing buildings ($p=0.00$).

The following are some of the precautions workers took to safeguard the asbestos fibers from polluting the environment during renovation or demolition of old buildings or when handling any item containing asbestos:- burying the asbestos containing materials in deep pits when wrapped and covered by soil, creating safety awareness, following safety procedures and precautions when handling (e.g. clean hands regularly with a lot of water, enclosing the area under renovation, hooding the buildings before demolitions, ensuring proper removal and disposal), informing management and preparing cost estimates, packaging asbestos fibers containing materials in bags for disposal, replacing asbestos containing roofing materials with modern iron sheets, seeking NEEMA guidelines on asbestos fibers containing materials disposal, replacing pipes containing asbestos materials with the right pipes and wearing protective gear (e.g. gloves, helmet, apron, mask, muffs, overall).

The University management knew about occupational hazards of asbestos fiber/dust exposure yet they hardly put in place safety precautions to safeguard the environment or personnel during demolition, renovation or replacement of asbestos roofing materials. It is evidenced by 11.5% of the participants who confirmed that some neighbors have been complaining of asbestos fibers pollution emanating from the University. Those participants confirming that there were complaints from neighborhood concerning asbestos fiber pollutions

were; 4.8% cleaners, 15.3 technicians, 38.1% engineers and 5.7% laborers. Asbestos fibers/dust when blown by wind will not only affects the workers but everyone in the surrounding including the neighborhood. The following are the measures undertaken by the safety officers to stop asbestos fibers pollution emanating from the universities: - awareness creation, undertaking disposal measures, reporting to the management and disposal companies and replacing with non-asbestos containing materials such as; PVC pipes, iron sheets among others.

According to observation checklist, there were areas designated for waste materials such as timbers, metals, building stones as well as pieces of asbestos containing roofing materials. These waste materials were not segregated and the areas were not restricted. According to the questionnaires, a good number (20.5%) of the participants had no idea of restricted areas with asbestos containing materials in their environment while 48.0% affirmed that areas with asbestos containing materials were not restricted in their work place. The participants who confirmed that areas with asbestos containing waste materials were not restricted were; 46.8% cleaners, 68.7% technicians, 59.1% engineers, 34.3% laborers and 53.1% from others professions within the estate departments.

When asbestos containing materials are disturbed, they produce dust/fibers which when inhaled or ingested are capable of causing cancers. This shows that the University management did not take care of the safety of its workers. Since according to the OSHA¹⁶, it is the responsibility of the occupier to provide a safe working environment to its workers.

V. Conclusions

The Universities investigated were characterized with old buildings with asbestos containing materials which is a potential hazards. Maintenance workers in public Universities were working in environment that is not safe from asbestos fiber/dust exposure since 47.5% confirmed that their work environment was not safe from asbestos dust/fibers. It is true that these employees were working in unsafe environment and were very much aware of the potential health hazards posed by asbestos fibers/dust exposure.

Therefore the university management should provide an environment that is safe from asbestos fiber/dust exposure to all the maintenance workers.

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Conflict of interest

We declare that there is no conflict of interest whatsoever regarding publication of this manuscript.

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