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Human Health Risk of Exposure to Potentially Toxic Metals (PTMs) in Indoor Settled Dusts from Selected Worship Centres (WCs)

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Abstract
The study aimed to determine the concentration of potentially toxic metals (PTMs) and the health risk of exposure to indoor dust from worship centres in Abeokuta, Nigeria. Twenty-four (24) dust samples were collected from various corners of selected worship centres. One (1) gram of the sieved dust was digested using aqua regia. PTM analyses were done using an Atomic Absorption Spectrometer (AAS). The result revealed the presence of Iron (Fe)> Zinc (Zn)>Manganese (Mn)> Lead (Pb) > Copper (Cu) >Nickel (Ni) > Cadmium (Cd) (1050; 81.6; 72.5; 3.304; 2.43; 0.516; 0.076 mg/kg) respectively. The PTMs were within the permissible limit for PTMs in dust stated by UK and Dutch Intervention.

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Pollution indices revealed Zn as the primary pollutant in the dust. A significant association between Zn, Cu, Ni and Cd while that of Mn and Fe suggest a common origin of anthropogenic and lithogenic sources respectively ($p<0.01$). Health risk assessment revealed inhalation as the major pathway of PTM exposure with the children population being the most susceptible. Hazard index (HI) values were <1, showing a non-significant non-cancer effect on exposure while the cancer risk estimate shows no carcinogenic risk. Conclusively, the selected worship centres have no PTM concentration of health concern at the time of the investigation. However, regular wet cleaning and close monitoring of the worship centres should be considered.

Keywords: Abeokuta, Indoor Dusts, Potentially Toxic Metals, worship centres, health risk

INTRODUCTION

Environmental pollution is an important global health concern, which has attracted a huge amount of research study worldwide. Researchers believe that the quality of indoor air is one of the most important problems for human health (Massey *et al.,* 2013). Indoor pollutants include dust (particulate matter) and gas pollutants (Li *et al.,* 2019). Dusts are solid particles ranging from 1µm – 100 µm in size which may become airborne depending on the physico-chemical characteristics (Fatima and Derrick, 2013). Indoor particulates can be found in a settled state on surfaces or suspended in the atmosphere. Dust particulates originate from various sources such as asbestos, soil, pesticides, shed skin, the activity of moving in and out, burning of incense, vehicular or generator emission, and laden paints from walls among others (Fatima and Derrick, 2013).

Contaminates (organic, physic-chemical, biological and radiological) accompanying this indoor particulate pose a great health challenge to humans on exposure (Van den Eede *et al.,* 2011; Rasmussen *et al.,* 2013; Pelley, 2017). A considerable number of studies have ascertained that human exposure to particulates could be through inhalation since they can be suspendered in air, ingestion through uncovered food or drink and via skin contact (Rasmussen *et al.,* 2013; Devi and Yadav (2018).

Potentially toxic metals (PTMs) which are an example of chemical pollutants in indoor dust are elements with high density and nucleon number (Rehman, *et al.*, 2020). Prolong exposure to PTMs such as Arsenic (As), Lead (Pb), Cobalt (Co), Nickel (Ni), Cadmium (Cd), and Chromium (Cr) tends towards being carcinogenic (Olujimi *et al.,* 2015), while Zinc (Zn), Cd and Cr have also been reported to cause various diseases which include kidney problems, heart and blood diseases, brain injuries, etc. (Mansour *et al.,* 2016).

Literature on PTMs in indoor dust has been largely published across the globe with a considerable amount from developed countries such as Great Britain, Canada, Malaysia, Australia, China, Saudi Arabia, Japan and Turkey among others, with a moderate number from developing countries such as Nigeria.

According to Barrio-Parra *et al.* (2018) it was revealed that adults and children spend most of their time indoors, more so in Nigeria (Abeokuta inclusive) worship centres are one of the most activity occurring centres, and looking at the pica tendency of children (Saeedi *et al.,* 2012; Olujimi *et al.,* 2015). It is pivotal to study indoor dust from worship centres since none of it has been found in the research literature. Therefore, this study aims to evaluate dust from worship centres for (i) The concentration of PTMs compared to the international standard guideline value, (ii) contamination and pollution indexing (iii) apportions of contaminant sources (iv) human health risks associated with multiple exposures.

MATERIALS AND METHODS

Study Area

Abeokuta is located on a crystalline pre-Cambrian basement complex of igneous and metamorphic origin known for its large concentrations of naturally occurring radioactive elements. The coordinates of Abeokuta are Latitude: 7°9'39"N, Longitude: 3°20'54"E. As of 2006, approximately 593,140 people were living in and around Abeokuta (National Population Commission, 2016). The area is home to numerous traditional quarry processors, producing electronics casings, series metalloid materials, abattoir effluents, and industrial and mechanical wastes (Alausa *et al.,* 2019). In the southern part of the area, there are granite mining and quarries, along with local businesses such as canning plants, plastics, breweries, sawmills, and aluminium product factories. A worship centre is a specific location or building where people congregate for spiritual or religious activities. Prayer, meditation, singing, and other acts of devotion are frequently a part of these activities. The terms "house of worship" and "place of worship" are used interchangeably to describe worship centre (Wikipedia, 2024).

Procedure for Sampling and processing of dust Sample

Collected dusts were randomly sampled from worship centres in Abeokuta, Southwestern Nigeria in the month of September 2022, Samples were collected from window sills, chairs, altars, benches and tables in worship centres using a dust brush. To make a composite sample, three to five sub-samples were mixed and then passed through a sieve of 0.55 mm diameter mesh size to obtain a fine particle. Dirt was removed while larger grits were grinded with a mortar and pestle. Collected samples were kept in sealed sample bags to avoid contamination and transported to the soil laboratory for acid digestion (Famuyiwa *et al.,* 2022).

Acid-Digestion of samples

Acid digestions of samples were carried out at the College of Environmental Resource Management, Federal University of Agriculture using analytical reagent-grade chemicals. One gram of the sample was weighed using an analytical weighing balance. Then poured into a 250 mL sterile Erlenmeyer flask then treated with 20 mL *Aqua regia* (Conc. 5 mL HNO_3 and 15 mL HCl). The mixture was heated with a hot plate at 90 ^{0}C in a fume cupboard until a clear solution was observed. On cooling, the sample was diluted with 80 mL of deionized distilled water then filtered using Whatman No. 42 filter paper and transferred into a 100 mL measuring cylinder for volume measurement. Filtrates were stored in a well-labelled 120 mL sterile specimen bottle for PTM estimation.

Heavy metal assessment and determination

Assessments of PTMs in dust were done at the laboratory of the Lagos State Environmental Protection Agency (LASEPA). Potentially toxic metals such as Iron (Fe), Lead (Pb), Nickel (Ni), Cadmium (Cd), Copper (Cu), Manganese (Mn) and Zinc (Zn) in samples were determined using an Atomic Absorption Spectrometer (AAS) Analyzer (iCE 3000 Series).

Pollution Indexing and Contamination

Researchers has employed various methods in determining the level of pollution in dusts. However, in the investigation, Pollution indexing and Contamination of dust were determined using the Contamination factor (CF), Geo-accumulation index (I_{geo}) and Enrichment factor (EF) as described in equations 1-3.

Contamination factor (CF)

The contamination level in the dust by PTMs was estimated using the contamination factor according to (Fang *et al.,* 2019; Umoren *et al.,* 2024b). CF was calculated using Equation 1.

$$Contamination\ Factor\ (CF) = \frac{PTM\ Conc._{Sample}}{PTM\ Conc._{\ Crustal\ region}} \qquad (1)$$

Where the PTM Conc. sample is the PTM concentration of dust in worship centres and PTM Conc. Crust region is the PTM concentration in the reference or crust sample. Level of contamination is classified as follows; CF<1=Low, 1≤CF<3=moderate, 3≤CF<6 considerable, CF>6=Very high.

Geo-accumulation Index (I_{geo})

Geo-accumulation index (I_{geo}) shows the degree of contamination in dust and soil due to the comparison of the concentration of PTMs with those of non-anthropogenically induced dust and soil (Famuyiwa *et al.,* 2018). Therefore, Igeo is used to determine the degree of contamination in dust using Eqn. 2.

$$Igeo = \text{Log}\,2\ x\left({Cn}/{1.5\ x\ BV}\right) \qquad (2)$$

Where ***Cn*** is the concentration of PTMs in the sample, ***BV*** is the background value in the average shale of PTM according to Famuyiwa *et al.* (2022) while 1.5 is the background matrix correction factor due to lithogenic effects. The contamination of PTMs will be categorized using the following index: <0 = Uncontaminated, 0–1 = Uncontaminated to moderately contaminated, 1–2 = moderately contaminated, 2–3 = moderately to strongly contaminated, 3–4 = strongly contaminated, 4–5 = strongly to extremely contaminated, and >5 = extremely contaminated.

Enrichment Factor (EF)

Enrichment Factor (EF) has been employed to determine the level of contamination in soil, sediment and dust by researchers (Famuyiwa *et al.,* 2018). It is, however, also used in the present investigation using the formula in eqn. 3

$$Enrichment\ factror\ (EF) = \frac{Cn\ /Cref\ (sample)}{Bn\ /Bref(crust\ )} \qquad (3)$$

Where: C_n = Content of the Heavy metal in the examined environment, *Cref* = Content of the Heavy metal in the reference environment, *Bn* = Content of the reference Heavy metal in the examined environment, B_{ref} = Content of the reference Heavy metal in the reference environment. Heavy metal is regarded as a reference heavy metal if it is of low occurrence variability and is present in the element in trace amounts. In the study, Fe is deployed as the reference for Heavy metal (Famuyiwa *et al.,* 2018; 2022). According to Famuyiwa *et al.* (2018) and Umoren *et al.* (2024a), there are five categories of level of pollution based on enrichment factor: EF < 2 No or minimal enrichment, EF = 2 - 5 Moderate enrichment, EF = 5 – 20 Significant enrichment, EF = 20 – 40 Very high enrichment, EF > 40 Extremely high enrichments.

Human Health Risk Assessment

Human health risk due to exposure to PTMs from dust via inhalation, dermal contact and ingestion route was estimated according to Umoren *et al.* (2024a). Estimation was achieved using the eqns. 4-6.

$$D_{ing} = Conc.\ \times \left(\frac{IngR \times EF \times ED}{BW \times AT}\right) \times\ 10^{-6} \qquad (4)$$

$$D_{inh} = Conc.\ \times \left(\frac{InhR \times EF \times ED}{PET \times BW \times AT}\right) \qquad (5)$$

$$D_{dermal} = Conc.\ \times \left(\frac{SA\ \times\ DAF\ \times\ SAF\ \times\ EF\ \times\ ED}{BW\ \times\ AT}\right) \times\ 10^{-6} \qquad (6)$$

Where D (mg kg^{-1} day^{-1}) is the dose contacted through ingestion (D_{ing}), inhalation (D_{inh}) and dermal contact (D_{dermal}). C is the measure of heavy metal in dust (mg/kg), $IngR$ (ingestion rate) is 200mg/day for children and 100 mg/day for adults and $InhR$ (inhalation rate) is 7.6mg/day for children and 20 mg/day for adult of heavy metal in dust, respectively, ED is the exposure duration (6 years for children and 24 years for Adults), and EF is the exposure frequency 180days/year for children and adult. BW and AT represent the body weight (70 kg for adults and 15 kg for children) and averaging time for non-carcinogens (ED x 365 days); for carcinogens (70 x 365 = 25,550 days) respectively (Olujimi *et al.*, 2015). CF is the conversion factor (1×10^{-6} kg/ mg), SA is the exposed skin surface area (2800 cm^2 for children and 3300 cm^2 for adults), SAF is the skin adherence factor (0.2mg/cm^2/d^1 for children and 0.7mg/cm^2/d^1 for adult), DAF is the dermal absorption factor used in this study is 0.001 for both children and adult, and PEF is the particle emission factor (1.36×10^9 m^3/kg for both children and adult). The reference dose is used as a measure of non-carcinogenic chronic hazards. Toxic effects are likely to ensue when the exposure dose of the target contaminant exceeds the reference dose, which is generally represented as HQ and HI. The hazard quotient (HQ) is employed to estimate the non-carcinogenic risks of heavy metal in dust in different exposures. It is the ratio of the D and the specific reference dose (RfD) and can be estimated using the eqn. 7

$$Hazard\ Quotient_i = {}^{D_i}/_{RfD_i} \qquad (7)$$

RfD (mg/kg/day) is the daily maximum allowable dose of PTE without posing a non-carcinogenic risk to humans during their lifespan. Three different types of RfDs are used for three different exposure pathways: reference dose RfD_{ing} (mg/kg/day) for ingestion, RfD_{dermal}, (mg/kg/day) for dermal contact and RfD_{inh} (mg/m^3) for inhalation. The summation of specific chemical risks via various exposure routes is expressed as the hazard index (HI). The total risks of PTMs in dust through multiple exposures can be calculated using Equation 8.

$$Hazard\ Index\ (HI) = \sum HQi \qquad (8)$$

Where i = different exposure pathways. The value of HI <1 shows that there is no significant risk of non-carcinogenic effects. However, when an HI value is >1, non-carcinogenic effects are probable (USEPA, 2013). Human carcinogenic risks were estimated using the dose contacted (D) multiplied by the respective slope factor (SF, 1mg/kg) as in eqn. 9. A slope factor is an upper-bound probability of an individual developing cancer as a result of lifetime exposure to an agent by ingestion, inhalation and dermal contact.

$$TCRs = RfD_I \times CSF_I \qquad (9)$$

Carcinogenic risk is the probability of an individual developing any type of cancer from lifetime exposure to carcinogenic hazards. CR value less than 1×10^{-6} specifies negligible carcinogenic risk, while CR greater than 1×10^{-4} recommends high carcinogenic risk to humans (Wu *et al.*, 2015; Olujimi *et al.*, 2015).

RESULTS AND DISCUSSION

Concentration of Heavy metal in dusts

The concentration of PTMs in dust from worship centres presented in Table 1, Shows that all PTMs were within the permissible limit stated by the UK, Environment Agency (2013) and Dutch intervention value for PTMs in soil. The value for Iron takes president over others followed by Zinc and Manganese, the value for Iron (1050 mg/kg) was lower than the value recorded from Jeddah, Saudi Arabia (8751 mg/kg) by Mansour *et al.* (2019) and Shah Alam city, Malaysia (4225 mg/kg) by Darus *et al.* (2012) although, it was higher than the value from classrooms dust (13.7 mg/kg) in Abeokuta by Olujimi *et al.* (2015).

The concentration of Lead (3.304 mg/kg) from the study is lower than the values reported for Japan (57.9 mg/kg) (Yoshinaga *et al.*, 2014), Sydney, Australia (199 mg/kg) (Israel *et al.*, 2019) and Xi'an, China (34.6 mg/kg) (Chen *et al.*, 2014). The concentration of Nickel (0.516 mg/kg) and Cadmium (0.076 mg/kg) reported is very low compared to various reports given from other studies, Abeokuta, Nigeria reported (Ni=12.7 mg/kg, Cd=855 mg/kg) (Olujimi *et al.*, 2015). Damaturu, Nigeria reported (Ni=9.53 mg/kg, Cd=7.11 mg/kg) (Fatima and Derrick, 2013), Jeddah, Saudi Arabia reported (Ni=35.7 mg/kg, Cd=2.09 mg/kg) (Mansour *et al.*, 2019). The concentration of Copper (2.43 mg/kg) has a similar pattern to Pb although lower. The value of lead from the study is very low in comparison to studies from Xi'an, China (70.8 mg/kg) (Chen *et al.*, 2014), Jeddah, Saudi Arabia (87.9 mg/kg) (Mansour *et al.*, 2019), Sydney, Australia (272 mg/kg) (Israel *et al.*, 2019).

The concentrations of Manganese (72.5 mg/kg) and Zinc (81.6 mg/kg) are relatively similar, although Mn is lower than Zn. In comparison to other studies, Zn is higher than the concentration reported from Damaturu, Nigeria (0.96 mg/kg) (Fatima and Derrick, 2013) but lower than other studies reported from Istanbul, Turkey (832 mg/kg) (Kurt-Karakus, 2012), Southern-Nigeria (825 mg/kg) (Iwegbue *et al.*, 2019) while Mn is lower than the report made by other authors from various studied as presented in table 2, Sydney, Australia (220 mg/kg) (Israel *et al.*, 2019), Jeddah, Saudi Arabia (391 mg/kg) (Mansour *et al.*, 2019), Xi'an, China (565 mg/kg) (Chen *et al.*, 2014).

Table 1: Statistics of PTMs in dust from worship centres in Abeokuta, Nigeria

n=24; mg/kg	Potential Toxic Metal						
	Fe	Pb	Ni	Cd	Cu	Mn	Zn
Mean±SD	1050±281	3.304±4.24	0.516±0.339	0.076±0.122	2.43±4.30	72.5±60.3	81.6±105
Minimum	6816	0.56	0.10	0.01	0.38	22.3	10.67
Maximum	16132	15.7	1.60	0.47	16.0	222	413
UK, Environment Agency (2013)	-	450	200	150	-	-	-
Dutch Value (Qing *et al.*, 2015)	-	530	210	12	190	-	720

Note: Fe=Iron, Pb=Lead, Ni=Nickel, Cd=Cadmium, Cu=Copper, Mn= Manganese and Zn=Zinc

Table 2: Concentrations of PTMs in indoor dust from different studies

Study Locations	Potential Toxic Metal						
	Fe	Pb	Ni	Cd	Cu	Mn	Zn
Abeokuta, Nigeria **(Present study)**	1050	3.304	0.516	0.076	2.43	72.5	81.6
Sydney, Australia (Israel *et al.*, 2019)	-	199	50.9	-	272	220	1,876
Southern-Nigeria (Iwegbue *et al.*, 2019)	23,499	144	468	32.0	233	541	825
Jeddah, Saudi Arabia (Mansour *et al.*, 2019)	8751	121.2	35.7	2.09	87.9	391	342.7
Sri Serdang, Malaysia (*Sarva et al.*, 2015)	-	89.05	-	1.89	53.27	-	-
Abeokuta, Nigeria (Olujimi *et al.*, 2015)	13.7	27.6	12.7	855	40.9	-	121
Xi'an, China (Chen *et al.*, 2014)	-	180.9	34.6	-	70.8	565	461.5
Japan (Yoshinaga *et al.*, 2014)	-	57.9	-	1.02	304	266	920
Damaturu, Nigeria (Fatima and Derrick, 2013)	-	50.82	9.53	7.11	33.87	-	0.96
Istanbul, Turkey (Kurt-Karakus, 2012)	-	26	263	0.80	158	136	832
Shah Alam city, Malaysia (Darus *et al.*, 2012)	4225.33	31.24	9.00	-	30.19	-	148.71

Heavy metal correlation in dust

PTMs inter-relationship unveils important information about their source in the environment (Umoren *et al.,* 2024a). Pearson's correlation conducted among PTMs presented in Table 3, shows that Pb were significantly related to Cu (r=0.864, p<0.01). Ni is significantly related to Cu and Pb (r= 0.896 and r=0.672 respectively at p<0.01). Cd was strongly related to Cu (r= 0.951), Pb (r= 0.877) and Ni (r= 0.889) at P<0.01. Zn were significantly related to Cu (r=0.953), Pb (r=0.887), Ni (r=0.878) and Cd (r=0.984) at P<0.01 while Mn was significantly related to Fe (r= 0.698 p>0.01). The strongly or significantly related heavy metal indicates a similar source of origin. The significant correlation between Zn and Pb, indicates their common origin, especially from the anthropogenic (Man-made) sources, this is also in agreement with the result of Yadav *et al.* (2019) who report a significant relationship between Zn, Pb and Sb and also between Pb and Cu. The obvious positive significant relationship between Mn and Fe suggests both metals may be from lithogenic sources.

Table 3: Pearson correlation coefficient matrix

PTMs	Fe	Cu	Pb	Ni	Cd	Zn	Mn
Fe	1						
Cu	0.051	1					
Pb	0.012	0.864**	1				
Ni	0.149	0.896**	0.672**	1			
Cd	-0.060	0.951**	0.877**	0.889**	1		
Zn	-0.097	0.953**	0.887**	0.878**	0.984**	1	
Mn	0.698**	0.018	0.021	0.073	-0.025	-0.128	1

** Correlation coefficient is significant at p<0.01

Pollution characterization

The pollution indices presented in Table 4, indicated that the contamination factor of PTMs in dust reveals that Zn (0.859), Cd (0.253), Pb (0.165), Mn (0.085), Cu (0.054), Fe (0.022) and Ni (0.0076) are of low contamination in the dust. CF value has a descending pattern of Zn>Cd>Pb>Mn>Cu>Fe>Ni. Geo-accumulation index estimation showed that Zn (-0.242), Cd (-0.772), Pb (-0.958), Mn (-1.25), Cu (-1.44), Fe (-1.83) and Ni (-2.29) shows that the worship centres are uncontaminated with a decreasing trend pattern of Zn>Mn>Cd>Pb>Cu>Fe>Ni. While the Enrichment Factor shows similarity with CF value. All metals in the dust from worship centres have no enrichment with a descending pattern of Zn>Cd>Pb>Mn>Cu>Fe>Ni.

Table 4: CF values, I-geo values and EF values of PTMs in dust

PTMs	CF value	I_{geo} value	I_{geo} grade	EF value	EF Scale	Level of Pollution
Fe	0.022	-1.83	1-2	1	<2	Moderately contaminated /Minimal Enrichment
Pb	0.165	-0.958	<0	7.43	<2	Uncontaminated / No Enrichment
Ni	0.0076	-2.29	<0	0.34	<2	Uncontaminated/No Enrichment
Cd	0.253	-0.772	<0	11.4	<2	Uncontaminated / No Enrichment
Cu	0.054	-1.44	<0	2.43	<2	Uncontaminated/Minimal Enrichment
Mn	0.085	-1.25	<0	3.83	<2	Uncontaminated / No Enrichment
Zn	0.859	-0.242	<0	38.6	<2	Uncontaminated/ No Enrichment

Human Health Risk Assessment

Non-carcinogenic and carcinogenic health risks of PTMs were estimated for children using different pathways represented in Tables 5 and 6, The result revealed that inhalation was the major pathway of heavy metal exposure to both adult and children populations in the worship centre, followed by the dermal contact. This is in contrast with previous studies reported by Mehr *et al.* (2017) and Devi and Yadav (2018). Investigation shows that the susceptibility of the children population to heavy metal exposure is higher than the adult population. Hazard index values for PTMs were less than 1 for both populations which indicates a non-significant, non-carcinogenic risk in the dust from worship centres. Carcinogenic risk due to exposure shows that Pb, Ni and Cd known to be a potential carcinogen were less than $1x10^{-6}$ indicating negligible carcinogenic risk to both populations, Although Lead (1.58E-07 and 6.78E-08) for children and adult populations respectively, is slightly lower than $1x10^{-6}$. Since lead is described as a classified carcinogen (Olujimi *et al.,* 2015) it is a PTM of concern to the population.

Table 5: Worship centres dust carcinogenic and non-carcinogenic risk for Children

PTMs	D_{ing}	D_{inh}	D_{derm}	HQ_{ing}	HQ_{inh}	HQ_{derm}	$\sum HQ_i$=HI	CR (Total)
Fe	2.62E-09	6.90E-02	1.93E-04	-	-	-	-	-
Pb	8.26E-12	2.17E-04	6.08E-07	2.75E-11	-	1.74E-04	1.74E-04	**1.58E-07**
Ni	1.29E-12	3.39E-05	9.50E-08	1.17E-11	5.74E-01	2.16E-04	5.74E-01	**2.19E-12**
Cd	1.90E-13	5.00E-06	1.40E-08	1.90E-10	5.00E-03	5.60E-04	5.56E-03	**1.03E-13**
Cu	6.07E-12	1.60E-04	4.47E-07	1.52E-10	-	1.12E-05	1.12E-05	-
Mn	1.81E-10	4.77E-03	1.33E-05	1.29E-09	9.54E-02	9.50E-05	9.55E-02	-
Zn	2.04E-10	5.37E-03	1.50E-05	6.80E-10	-	5.00E-05	5.00E-05	**-**

Table 6: Worship centres dust carcinogenic and non-carcinogenic risk for Adults

PTMs	D_{ing}	D_{inh}	D_{derm}	HQ_{ing}	HQ_{inh}	HQ_{derm}	$\sum HQ_i$=HI	CR (Total)
Fe	1.48E-09	7.40E-03	1.71E-04		-	-	-	-
Pb	4.66E-12	2.33E-05	5.38E-07	1.55E-08	-	1.54E-04	1.54E-04	**6.78E-08**
Ni	7.27E-13	3.64E-06	8.40E-08	6.61E-11	6.16E-02	1.91E-04	6.18E-02	**4.96E-12**
Cd	1.07E-13	5.35E-07	1.24E-08	1.07E-10	5.35E-04	4.96E-04	1.03E-03	**2.31E-13**
Cu	3.42E-12	1.71E-05	3.95E-07	8.55E-11	-	9.88E-06	9.88E-06	-
Mn	1.02E-10	5.11E-04	1.18E-05	7.29E-10	1.02E-02	8.43E-05	1.03E-02	-
Zn	1.15E-10	5.75E-04	1.33E-05	3.83E-10	-	4.43E-05	4.43E-05	-

CONCLUSION

Potentially toxic metals (Zn, Cd, Pb, Mn, Cu, Fe and Ni.) were estimated from worship centre dust in Abeokuta, Southwestern, Nigeria. Zn concentration with high value might be from anthropogenic sources. All metals were within the estimated value stated by international regulatory authorities on PTMs. PTMs' exposure to the worship centre dust is through an inhalation pathway followed by dermal and ingestion. Potentially toxic metals show no significant non-carcinogenic effect and cancer risk for the local population. Although, Lead might be an element of concern for cancer risk to the local population exposed to the worship centre dusts.

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