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Knowledge of Risk Associated with Exposure to Per- and Polyfluoroalkyl Substances in Abuja, Nigeria

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Abstract

Per- and Polyfluoroalkyl Subsbtances (PFAS) are a group of chemical compounds that contain mostly carbon and fluorine in their structure. They don't occur freely in nature but are produced industrially. Recent Studies have shown that PFAS exposure to the environment is persistent, bio accumulative and poisonous to all life forms. Also reports indicates that some of these products are being phased-out in America and Europe but some of them still find their way to African markets and other parts of the world. The challenge is that a great number of people in Abuja, the study area don't know what PFAS is and the risk associated with the use of products that contain PFAS. Therefore the study is to ascertain the knowledge of PFAS in Abuja and highlight the risk of PFAS exposure. A self designed questionnaire was used to obtain data using random sampling technique. A total of 400 questionnaires were distributed and only 365 were collected. The result revealed that 91% of the sampled population knew nothing about PFAS and its associated health risk while 9% have knowledge of PFAS and its associated health risk. This may point to the fact that PFAS exposure in Abuja may not pose only localized risk but may progress to be a global risk. Therefore this paper recommends massive study and awareness programmes on PFAS and also appeals for the support and collaboration of industrialized nations towards programmes that will ensure sustainability.

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Introduction

Per- and polyfluoroalky Substances (PFAS) are a group of chemical compounds that contain mostly carbon and fluorine in

their structure.

The release of PFAS, a fluoro-organic chain chemical compound into the biosphere, occurs by human anthropogenic activities of production, use and waste generation (liu and Avendano, 2013).

PFAS are a large group of chemicals which may be toxic to humans, especially Perfluorooctane Sulfonate (PFOS) and Perfluoroctanoic Acid (PFOA). The two are widely used and easily contaminates the environment with the potential of depositing in the food chain (Betts, 2007).

A lot of studies have being carried out on PFOS and PFOA and are found to be persistent in the ecosystem and also unsusceptible to normal environmental deterioration process (USEPA 2017, OECD 2002). They are not found naturally in the earth surface but are man-made compounds (ATSDR 2015, USEPA 2009b).

PFOS and PFOA being organic molecules, highly fluorinated, are known to have the highest volume of production in the United States of America (ATSDR 2005; EFSA 2008). They are very stable chemical compounds comprising of chains of eight carbon atoms with a distinctive ability to block oil and water, therefore they are used in the production of a wide range of house-hold and industrial products that are very durable (ATSDR, 2015). Some of these products include nonstick cookware, industrial surfactants, chemical and fire resistant plumbing tubes, waterproof clothing materials, firm cardboard packaging, leather materials and carpets.

Due to the wide usage of PFOS and PFOA, there is dissemination along various levels of the food chain, contaminating also the air, soil, surface and groundwater (USEPA, 2017). The presence of PFOS and PFOA in organisms high up the trophic level is a strong indication of the potentiality for bio-accumulation/bio-concentration (USEPA, 2017). Studies have linked PFAS to various types of cancer; endocrine damage, reproductive system defects, and is potentially toxic to animals (Betts, 2007). There is suggestive evidence by USEPA that PFOS and PFOA may cause cancer (USEPA 2016d, 2016de). The Presence of PFOS and PFOA in the blood samples of studies in humans and wildlife is an indication that the exposure to these chemical substances can be prevalent (ATSDR 2015; USEPA 2015).

Summarizing the effects of PFAS in Heartland community engagement, animal exposure can damage the liver, endocrine system, immune system, neurological systems while in humans the exposure can affect the general well-being, damaging the reproductive systems, musculoskeletal systems, blood vessels and also reducing the potency of some drugs and vaccines(Mills, 2018).

The sources of exposure include ingestion of food or water contaminated with the chemicals, use of consumer products containing PFAS and inhalation of PFAS-containing particulate matter in the air (ATSDR 2015; USEPA 2009b).

Furthermore exposure can be through goods imported from countries where PFOS and PFOA are still in use (USEPA 2016b, 2016c, 2016f).

There are reports indicating that some of these products are being phased-out in America and Europe but some of them still find their way into African markets and other parts of the world.

The challenge is that a great number of people in Nigeria and Abuja, the study area don't know what PFAS is and the risk associated with the use of products that contain PFAS.

Materials and Methods

Abuja the study area is in the north central region of Nigeria, a tropical Sudan savannah with approximate coordinates of, latitudes 8° 21′ and 9° 18′ N, longitudes 6° 46′ and 7° 37′ E (Etuk et al. 2022). Random sampling technique using self designed questionnaire was used to obtain data; the survey was carried out between January and May, 2022. A total of 400 questionnaires were distributed and only 365 were collected. Data collected were analyzed using percentages (Akpomi, 2010).

Results

Results from completed questionnaire were show in Tables 1 and 2.

Table 1. Socio – economic status of respondent

STATUS	MALE		FEMALE		TOTAL	
	NO.	% OF 365	NO.	%OF 365	NO.	% OF 365
Age Group (Years)						
18-29	62	17.0	75	20.6	137	37.6
30-39	37	10.1	61	16.7	98	26.8
40-49	35	9.3	53	14.5	87	23.8
50 and above	25	6.9	18	4.9	43	11.8
∑	**158**	**43.3**	**207**	**56.7**	**365**	**100**
EDUCATIONAL						
Tertiary	31	8.5	68	18.6	99	27.1
Secondary	66	18.1	73	20.0	139	38.1
Primary	47	12.9	45	12.3	92	25.2
Informal	14	3.8	21	5.8	35	9.6
∑	**158**	**43.3**	**207**	**56.7**	**365**	**100**
VOCATION						
Public Servants	36	9.9	51	14.0	87	23.9
Self Employed	49	13.4	33	9.0	82	22.4
Students	54	14.8	69	18.9	123	33.7
Unemployed	19	5.2	54	14.8	73	20.0
∑	**158**	**43.3**	**207**	**56.7**	**365**	**100**
Marital						
Married	65	17.8	68	18.6	133	36.4
Single	53	14.5	73	20.0	126	34.5
Divorced	11	3.0	27	7.4	38	10.4
Widowed	29	8.0	39	10.7	68	18.7
∑	**158**	**43.3**	**207**	**56.7**	**365**	**100**

Table 2. Response from completed questionnaires (n=365)

S/N	Question	Affirmative No.	%	Non- Affirmative No.	%
1.	Have knowledge of PFAS and associated risks	331	9.0	332	91.0
2.	Have used products containing PFAS	338	92.6	27	7.4
3.	Checking of products components to ensure PFAS free	0	0.0	365	100
4.	Discussed or attended discussion on the risk of PFAS exposure	0	0.0	365	100
5.	Government adequately informs the populace on health and safety issues	25	6.8	340	93.2
6.	Government to be blamed on the indiscriminate use of PFAS containing products.	298	81.6	67	18.4
7.	Willing to attend awareness program or enlightenment on PFAS and associated risks	312	85.5	53	14.5

Discussion

From Table 2, the result shows that 91% of the sampled population knew nothing about PFAS and its associated health and environmental risk. This may be as a result of ignorance or lack of information.

Then 92.6% of respondent have used products containing PFAS, which indicate the easy availability of such products in the study area.

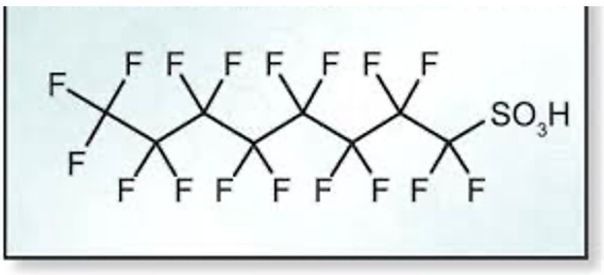
And with the very low level of awareness, 100% of the respondents don't check the active ingredients or compositions of consumer product before use.

Furthermore, 100% of the respondent have not discussed or attended any public discussion on the risk of PFAS exposure and 93.2% blame the government on the indiscriminate use of PFAS containing products.

In addition, 85.5% of the respondent were willing to attend awareness program or enlightenment on PFAS and associated risks. It was observed that:-

1. Most of these products containing PFAS are imported from America, Europe and Asia.
2. Nothing is being said or done by government, agencies or NGOs in Nigeria.
3. It is in general belief in Nigeria, that anything imported is good and authentic.

Looking at the structure of the most commonly used PFAS- (PFOS) and (PFOA) as shown in diagram 1 & 2.



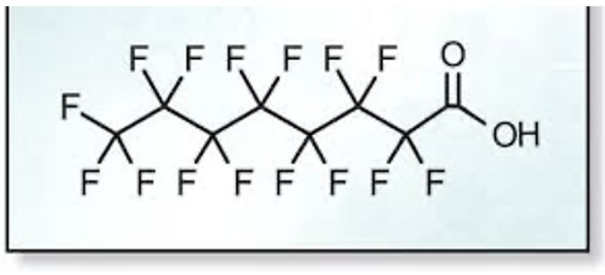


Diagram 1. (left) PFOS and **Diagram 2.** (right) PFOA

Source: *Trinity Consultants July, 2019*

They are very stable and are identified in various environmental matrix in many parts of the world, indicating the potentiality of long-range atmospheric movement (ATSDR, 2015).

This many point to the fact that PFAS exposure in Abuja, other parts of Nigeria and Africa may not pose only localized risk but may progress to be a global risk or problem. Abuja which is the capital city of Nigeria experiences on a daily basis influx of visitors from all over the world, ranging from heads of government, diplomats, top business men, chief executives of multi-national companies and tourists.

Recommendation

This paper recommends massive study and awareness programme on PFAS and also appealing for the support and collaboration of industrialized nations towards prorgamme that will ensure sustainability.

The major challenge we have in Africa is funding, therefore we call on the agencies or groups that fund studies and programmes on PFAS in America and Europe to extend such funding to Africa.

Research agencies and group working in America and Europe on PFAS should make readily available their research findings to individuals and groups in Africa.

United Nations Environment Programme (UNEP), Stockholm convention on persistent organic pollutants (POPs) offices should monitor effectively the movement of PFAS chemicals and products and apply sanctions as required.

On the local scene, Nigerian government through the relevant agencies should not allow the importation of PFAS chemical and Products. In addition, they should embark on studies and awareness programme at all levels (local, state, regional, and national).

Finally, we call on researchers and research institutes all over the world, as a matter of urgency to look for alternative chemicals in place of PFAS. Also governments and organizations across the globe should support the research, providing adequate funding.

Statements and Declarations

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Conflict of interest

The authors have no conflict of interest to declare that are relevant to the content of this article.

Ethical approval

Not applicable

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