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

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Potential competing interests: No potential competing interests to declare.

The following is a list of 10 important points that may have a bearing on the scientific validity of this study.

[1] Since the aim of this study is to ascertain the knowledge of PFAS in Abuja and to highlight the risk of PFAS exposure, a self-designed questionnaire might not be appropriate in such circumstances. This is because a self-designed questionnaire (or a self-administered questionnaire) has two major disadvantages, namely: [i] the lack of control and feedback from the researcher can result in a low response rate, or in a possibly unrepresentative sample of the population that can limit the generalizability of the findings; and [ii] it is not possible for the researcher to ensure that the respondent who has received the questionnaire is the same person who will be filling it out.

[2] This questionnaire was used in this study to obtain data from study respondents who were recruited via a random sampling technique. However, as the aim of this study is to ascertain the knowledge of the residents in Abuja and there are approximately 4 million residents currently residing in the metro area of Abuja, it may not be practical to carry out random sampling in such a large sampling frame for this study.

[3] Since 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), as well as from exposure to PFAS through goods imported from countries where PFOS and PFOA are still in use (USEPA 2016b, 2016c, 2016f); the questionnaire must not only be able to assess the knowledge of the local residents in Abuja about PFAS, but also to determine the sources of supply of consumer products that contain PFAS, or any other environmental sources that can result in the exposure of local residents in Abuja to PFAS.

Hence, the questionnaire that was used by this study may not be adequate for achieving its study purpose. It is therefore recommended to conduct a follow-up study after the completion of this study, which aims to identify and delineate the estimate of the total quantity of exposure to PFAS from each of these sources (such as locally-produced consumer products, imported products, etc.).

[4] Per- and Polyfluoroalkyl Substances (PFAS) are a group of chemical compounds that contain mostly carbon and fluorine in their structure, which don't occur freely in nature but are produced industrially. 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). Hence, this study should focus on the determination of exposure to these chemical compounds via imported products from the United States of America, as well as those products that have been imported

from countries where PFOS and PFOA are still in use.

[5] The PFAS are very stable and are identified in various environmental matrices in many parts of the world, which indicates the potentiality of their long-range atmospheric movement (ATSDR, 2015). Hence, apart from assessing the level of knowledge of local residents in Abuja about PFAS, this study should also be designed to detect the presence of PFAS in the ambient atmosphere as well as any possible transmission in the food chain.

[6] 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). Hence, this study may be expanded to further evaluate the possible adverse effects of bio-accumulation/bio-concentration of PFAS.

[7] Results of this study had reported that 91% of the sampled population knew nothing about PFAS and its associated health and environmental risks, which might be due to true ignorance or lack of dissemination of relevant public information about PFAS to all local residents of Abuja. It is possible to conduct various inferential statistical tests to determine the degree of association between the independent variable (i.e., the level of knowledge of local residents in Abuja about PFAS) and the dependent variables (i.e., socio-demographic profiles of the respondents such as age, occupation, ethnicity, etc.).

[8] Apart from the very low level of awareness (i.e., 9%), the results of this study also found that 100% of the respondents also did not check the active ingredients or compositions of consumer products before use. Furthermore, 100% of the respondents had never discussed or attended any public discussion on the risk of PFAS exposure, and 93.2% blamed the government for the indiscriminate use of PFAS-containing products. It is therefore possible to conduct a series of inferential statistical tests to assess whether there is an association between practices (such as checking the active ingredients or compositions of consumer products before use, publicly discussing the risk of PFAS exposure) and attitudes (such as blaming the government for the indiscriminate use of PFAS-containing products) and the dependent variables (i.e., socio-demographic profiles of the respondents such as age, occupation, ethnicity, etc.).

[9] Results of this study found that 85.5% of the respondents were willing to attend an awareness program or enlightenment on PFAS and associated risks, so it is a good opportunity to probe further by identifying any other possible sources of their exposure to PFAS (so as to determine their cumulative exposure to PFAS as well as any possible adverse effects that have resulted from such an exposure).

[10] Results of this study found that as high as 92.6% of the respondents in this study had used products containing PFAS, which indicates that such products are easily and freely available in the study area. Most of these products containing PFAS have been imported from America, Europe, and Asia, and neither the Nigerian government nor any other agencies or NGOs in Nigeria have taken any enforcement or restrictive action on the supply of such products in the local market, which is probably due to an inherent belief among local residents in Nigeria that anything imported is good and authentic. Hence, this study should take a further step by exploring the various channels for market access of all products

containing PFAS and also determining whether adequate enforcement action has been taken to exert appropriate legal control of the supply and/or distribution of these products within Nigeria.