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IS BISPHENOL A (BPA) A PUBLIC HEALTH CONCERN? A CROSS-SECTIONAL STUDY OF PUBLIC KNOWLEDGE, ATTITUDE AND RISK PERCEPTION IN SOUTHWESTERN PART OF NIGERIA

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ABSTRACT

Bisphenol A (BPA) is a chemical produced in large quantities for use primarily in the production of polycarbonate plastics and epoxy resins. Exposure to BPA is a public health concern because studies since the last decade have consistently linked BPA with several physiological disorders such as cardiovascular diseases, neurological, obesity, and some forms of cancers. Hence, this study assessed the level of BPA knowledge and awareness among randomly selected individuals in the Southwestern part of Nigeria. This study employed a mixed-methods approach, utilizing a survey specifically designed to collect data for the research. Different statistical methods were utilized including descriptive and inferential to analyze the data and to assess exploratory variables such as public knowledge, attitude, and risk perception. Findings revealed that though 96.2 % knew chemicals in plastics could cause adverse health effects, the level of knowledge on BPA and its attendant health risks among the sample population was abysmally low (only 35% knew this subject). However, most of our respondents interestingly expressed great attitude in terms of willingness to share information learned about BPA to others in the community. Based on the findings of this study, a massive awareness campaign about BPA and associated health risks would be required through effective scientific communication to improve public health outcomes.

Keywords: Emerging Contaminants, Bisphenol A, Public health awareness, Advocacy, Nigeria

INTRODUCTION

Humanity is at stake when information on the state of the environment and wellbeing is lacking, compromised, or not prioritized. Human anthropogenic activities such as mining, metal processing and recycling, coal burning, sewage disposal, production and injudicious use of pesticides and fertilizers, etc. have drastically altered the nature's biogeochemical cycle and thus, resulting to ecological contamination with heavy metals (Pb, Cd, Ni, etc.), pesticides, poly aromatic hydrocarbons, etc. (Ogunyebi *et al.*, 2019, Omoyajowo *et al.*, 2024). Within this foregoing context is the discourse on emerging contaminants (ECs), also known as contaminants of emerging concerns (CECs) (Dulio *et al.*, 2018, Omoyajowo *et al*., 2021a, b). ECs could be described as a group of natural and synthetic chemicals and chemical metabolites which are presently not monitored in the environment but are perceived to portend a high threat to the health of human and other ecological receptors (Geissen *et al.*, 2015). A few chemicals such as bisphenol A (BPA), alkylphenols (APs), parabens, perfluoroalkyl substances (PFASs), phthalates, polybrominated diphenyl ethers (PBDEs) among others, fall under this category (Siddique *et al.*, 2016). Indeed, the list of compounds and chemicals within this category is notably extensive and continually growing due to the introduction of new commercial chemicals, shifts in usage, disposal of widely used chemicals, and ongoing discovery of new molecules belonging to this classification (Rodriguez-Narvaez *et al*., 2017). The continuous release of ECs has been projected to persist over an extended period and originate from various sources (Geissen *et al.*, 2015), with concentrations ranging from µg/L to a few ng/L and sometimes even below. The discovery, detection, and monitoring of such low concentrations of these persistent compounds have only been made possible due to recent advancement in analytical technologies (Xu *et al.*, 2011; Gasperi *et al.*, 2014; Geissen *et al.*, 2015).

A foremost example of ECs, Bisphenol A - 4, 4′-(propane-2, 2-diyl) diphenol), commonly abbreviated as BPA, is a synthetic structural component of polycarbonate plastics, epoxy resins and other food storage containers (Tassinari *et al.*, 2020; Fouyet *et al.*, 2021). It was first discovered in 1891 by Russian chemist, Aleksandr Dianin who synthesized it by injecting phenol and acetone into a reactor filled with a cation-exchanger (Caliendo, 2012; Corrales *et al.*, 2015). BPA is a high production volume chemical often used not only as an intermediate (binding, plasticizing, and hardening) in plastics, paints/lacquers, but also as an additive for flame-retardants, brake fluids, and thermal papers (Careghini *et al.*, 2015). Most BPA produced in industry is used to make plastics for different uses (Careghini *et al.*, 2015). For example, it could be found in the lining of canned foods and drinks, water bottles; plastic cups, medical utensils, toys, cash register receipts, personal protective equipment, and many other products (Caliendo, 2012; Tassinari *et al.*, 2020; Patisaul, 2020). BPA has been listed as a substance of very high concern, because of its endocrine-disrupting properties and different possible exposure pathways for humans (Careghini *et al.*, 2015). Studies have reported the presence of BPA in

human blood, urine, placenta, and amniotic fluids (Fouyet *et al.,* 2021). BPA enters human bodies mainly through food and beverages that have had contact with polycarbonate. People who eat mostly canned foods have higher chances of being predisposed to health risks associated with BPA exposure, because most metal cans are lined with sealants containing BPA (Ribeiro *et al.,* 2017).

Since the late 1990s, information about BPA toxicological significance, its ecological fate and transport have started receiving public attention after it was found to leach out of plastics into an experimental animal subjects. This resulted in prevalence of chromosomal anomalies (Hunt *et al.,* 2003). It is estimated that 93 % of the world's human population has traces of BPAs in their bodies and can be detected in breast milk (Calafat *et al.,* 2008), urine (WHO/FAO, 2009), serum, amniotic fluid, follicular fluid, placental tissue, umbilical cord, and blood (Matsumoto *et al.,* 2003). The main route by which humans could be exposed to BPA is mostly through food ingestion. According to the World Health Organization (WHO) / Food Agriculture Organization (FAO), the estimated dietary intake values range from 1 to 1.5 mg/kg bw/d (Christensen *et al.,* 2015). Other possible sources of exposure include air, dust, and water. Scholars also reasoned that since BPA is not produced naturally, then it could be released into the ecosystem during production and transportation of BPA containing products; during use or after disposal in landfills; and through effluent and sewage sludge from municipal and industrial wastewater treatment plants (Huang *et al.,* 2012; Langdon *et al.,* 2012; Michalowicz, 2014; Careghini *et al.,* 2015). The degree to which BPA leaches from polycarbonate containers into the content may depend on the temperature and pH of the liquid or food content, and the temperature and age of the container (Corrales *et al.,* 2015). Consequentially, the risk of food contact surface contaminants, particularly toxic chemicals from metals and plastics, is a critical issue for food safety and hygiene. This is due to the unintentional leaching of toxins from plastic materials to the food we eat (Rufai and Wartu, 2023)

There is more than ample evidence that BPA exposure may elicit severe health issues such as diabetes, liver enzyme abnormalities, cardiovascular disease (Lang *et al.,* 2008), teratogenicity (Sugiura-Ogasawara *et al.,* 2005), nervous system disorders (Porterfield, 1993; Schantz and Widholm, 2001), and brain disorder (Patisaul, 2020). Endocrine disruption from environmental exposure to structural analogues of 17bestradiol is hypothesized to cause an array of diseases, including breast and prostate cancer, neurobehavioral disorders, heart ailments, and obesity (Lakind *et al.,* 2012), It is suggested that BPA exerts several estrogenic effects on rodent mammary gland (Richter *et al.,* 2007).

BPA can be released from polycarbonate or epoxy resin particles via two potential mechanisms: diffusion or chemical breakdown (hydrolysis). In humans and most primates, BPA is readily metabolized into BPA glucuronides, which are then excreted in urine and feces (Lee *et al.,* 2015). Therefore, due to its short half-life span in humans however, it is considered a relatively less bio-accumulative chemical. BPA as an endocrine disruptor elicits cellular responses in at least three different ways: First, by acting directly as ligand for steroid hormone nuclear receptors (e.g., oestrogen, androgen, thyroid hormone receptors, etc.). For instance, BPA may bind with oestrogen receptor (17ß-oestradiol) to induce a cellular response. Secondly, by stimulating the endogenous production of 17ßoestradiol. And thirdly, by acting as an androgen receptor antagonist and inducing the excretion of 17ß-oestradiol (Preethi *et al.,* 2014). More so, BPA exposure could modulate gene (PPAR, C/EBP, LPL, GLUT 4, CYP19, GPAT and DGAT, and Leptin expression PPAR, C/EBP, LPL, GLUT 4, CYP19, GPAT and DGAT, and Leptin OB) during adipocyte differentiation, thus subsequently modulating adipose tissue functions (Singh, 2012, Menale *et al.,* 2015).

Myriads of suggestions on possible mitigation approaches vis-à-vis reducing risk of BPA exposure have been made by researchers. These include avoiding household products that contain BPA totally if possible, or proper disposal of BPA plastics since they are not reusable. Others include eating fresh and frozen foods instead of foods stored in cans, avoiding microwaving foods in plastics containers, and keeping hot liquid in pet bottles, and maintaining good personal hygiene (hand washing) after handling cash receipts, and so on (Fouyet *et al.,* 2021; HWMP, 2021).

Some studies conducted in Nigeria have found traces of BPA in canned foods, bottled water, and sundry other food related items (Adeyi and Babalola, 2019; Adeyemi *et al.,* 2020; Ugboka *et al.,* 2020). To the best of our knowledge however, there is a dearth of information on public awareness about BPA in plastics, and other items that have contacts with foods and water in the country. With a population more than 200 million, this predisposes many Nigerians to the risks associated with this chemical. Thus, raising public health awareness about this course in the country will go a long way in managing and/or reducing the potential health risks associated with BPA exposure among her people. As pointed out by an earlier study, public health awareness is the strongest precursor to define, predict and resolve health issues more quickly and substantially (Nawaz, 2017). Effective communication on public health issues must take into cognizance the active engagement of all actors, Scientists-Regulators-Industry (SRI) in ensuring science and emerging issues are in a policy context, well communicated in a timely and efficient manner to the public, early and often (WHO, 2012).

This study therefore intends to evaluate the level of public awareness of the risks associated with BPA exposure, public willingness to advocate for food safety and its predictors, as well as to identify the source of public health information. This study considered exploring the level of awareness about BPA and willingness to advocate for safety among a selected population based on two key points. First, BPA is ubiquitous in the environment, leading to widespread human exposure through numerous BPA-containing products. Second, a multitude of animal studies have consistently shown toxicological effects of low BPA doses on fetal development and newborns (NTP, 2010), as well as on brain development and behavior (WHO/FAO, 2009).

Further, this study hopefully provides an insight about the groups of people who are likely to be most susceptible or at highest risks of BPA exposure perhaps because of their level of awareness on this subject or unhealthy behavior and/or general lifestyle). The essence of this is to guide policy makers through preparedness, response, and recovery phases of a critical BPA exposure, and to encourage informed decision-making and positive behavior change.

MATERIALS AND METHODS

Brief Description of Study Locations

Nigeria is Africa's most populous country (Omoyajowo *et al.,* 2023) with a unique climate ranging from arid to humid equatorial, and with a rich deposit of valuable minerals such as crude oil, natural gas, coal, tin, columbite, and gold. This study was conducted in four metropolitan cities of Southwestern States in Nigeria. These cities were Ikeja,

Abeokuta, Akure and Ado-Ekiti. Ikeja is the capital of Lagos State, and Lagos is the commercial and economic nerve of Nigeria. It is also the most populous and densest state in the country. Abeokuta is the city capital of Ogun State, while Akure and Ado-Ekiti are the capitals of Ondo and Ekiti States, respectively. Ogun, Ondo, and Ekiti States are of relatively moderate population and population densities compared to Lagos. Apart from Lagos, which is highly industrialized, the remaining three are relatively agrarian with a mix of tropical forest (south) and Savannah (north), which supports arable farming and livestock rearing. In terms of population, Lagos, Ogun, Ondo, and Ekiti States have about 9 million, 3.7 million 3.4 million and 2.3 million respectively with each State having a fair distribution of males and females (NBS, 2006).

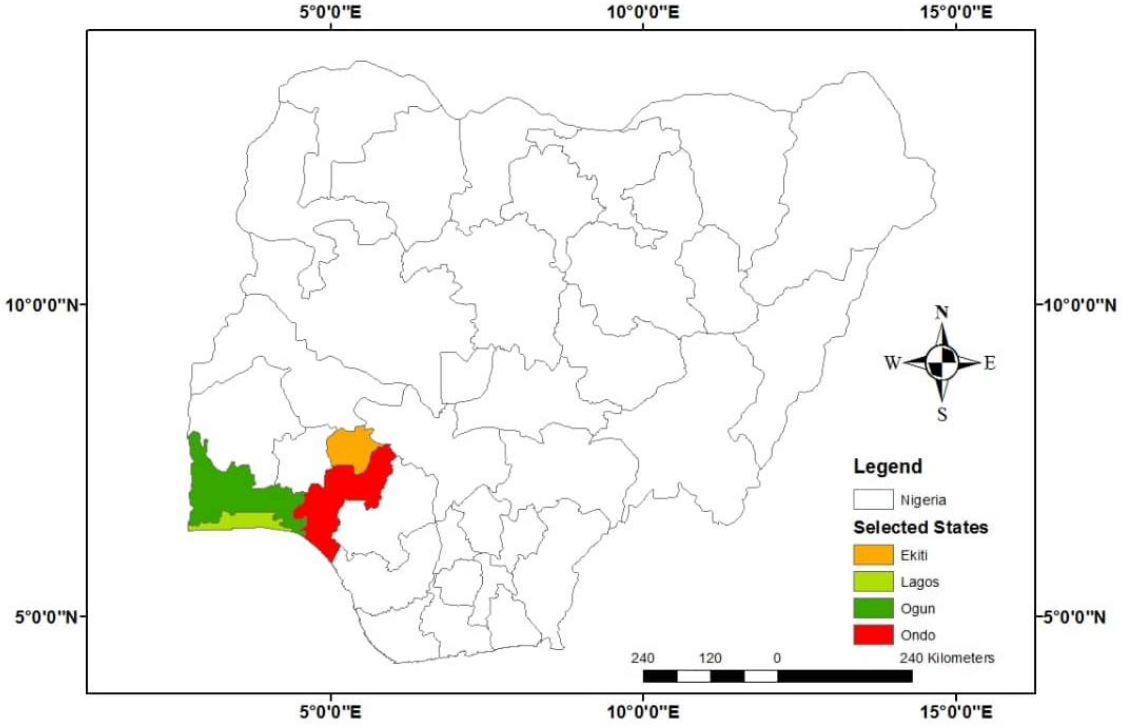

Figure 1: Map of Nigeria Showing the Study Areas

Data Collection

A 10-question online survey created using Google Forms, a web-based survey management tool, was digitally administered to 1040 randomly selected households across four metropolitan cities in Lagos, Ogun, Ondo, and Ekiti States. This resulted in 260 respondents sampled from each geographical location (100% response rate). This survey (well-structured) generally contains information on respondents' socio-demographics, and questions measuring level of awareness about BPA and willingness to share BPA safety information. The survey comprised of "yes/no/not sure" type questions, closed ended, one Likert scale type and questions to elicit open responses at the end of the survey for general suggestions. Two scholars were consulted to examine the validity of the research instrument (questionnaire) in terms of language, clarity, and content in line with the intended purpose of the study. Further, the expertise of two Information Technology (IT) consultants were called upon to examine the design and user-friendliness of the online tool, using standard guidelines recommended by an earlier report (Regmi *et al.,* 2016). We tested the compatibility of the online survey on iPhones, androids, desktops, and different software and hardware configurations. After carefully checking the online survey for typological and operational errors, the data collection process proceeded in two phases. In the first phase, we recruited and trained a total of 50 volunteers residing in our study locations to help conduct face-to-face interviews and collect responses with Google Forms with the aid of their mobile phones and tablets. Detailed information about BPA and its associated health risks were first shared with respondents in English and African Pidgin languages. This phase allowed us to interview as many respondents with barely any education and those who are not digitally inclined as possible. In the second phase, the snowball method was used. The snowball sampling is a non-probability sampling technique where existing study participants recruit future participants from among their acquaintances, like the method in previous study (Omoyajowo *et al.*, 2023). In other words, the same set of volunteers were asked to send direct links to the online survey to friends, families and relatives, colleagues, and randomly selected individuals via emails, and social media, and asked them to respond at their convenience within a stipulated deadline. This was done to reach a wider and varied sample. We also sent gentle reminders to respondents every 72 hours.

Standard guidelines observed by (Bhoopathi *et al.,* 2019) were used to improve the response rates, thus: 1) varying messages across reminders, 2) repeated contacts, and 3) determining if the online survey was compatible with different devices and software. We also took detailed notes of several informal interviews and comments submitted throughout this period. These informal interviews and comments allowed us the opportunity to review the original interviews, and to cross-examine responses for additional facts. Prior to asking questions, we gave a laconic but detailed introduction on BPA and its health risks with the goal of sensitizing respondents and sought consent from respondents in written form. In brief, survey was completed by random volunteers between April and Mid-May 2021 while data obtained were properly collated, coded and rechecked for quality assurance on Excel sheet before proceeding to statistical analysis. Descriptive analyses were performed to

understand the study sample's characteristics. In addition, we conducted a logistic regression model to determine the characteristics of the populace who were willing to share information about BPA, particularly its associated health risks and possible mitigation approaches. Variables that were included in the adjusted multivariate logistic regression model include: age (years), gender, religion, level of education, level of awareness, and attitude (i.e., willingness to share BPA-health risks information with others)

RESULTS AND DISCUSSION

The Sociodemographic characteristics of respondents are presented in Table 1. The percentage of male respondents (59.1%) outnumbered that of females (40.9%). Most of the respondents (55.7%) were between (26-35years) while other age categories assumed the order: 18-25years (23.4%)> 36-45years (12.9%)> 46-55 years (3.9%)> 56-65 years (3.0%)> above 65 years (1.2%). The proportion of respondents who were single (60.2%) outnumbered the married category (39.1%), while 0.7% represented those who were either divorced or separated. In terms of educational attainment, most of the respondents (ca 86%) had at least a bachelor's degree or equivalent, while those with ordinary national diploma and high school were represented by 12.9% and 1.1% respectively.

Table 1: Socio-demographic Characteristics of Respondents

Variables/Categories (n=1040)		Frequency	Percentage (%)
Gender	Male	615	59.1
	Female	425	40.9
Age (Years)	18-25	243	23.4
	26-35	579	55.7
	36-45	134	12.9
	46-55	41	3.9
	56-65	31	3.0
	Above 65	12	1.2
Marital Status	Single	626	60.2
	Married	407	39.1
	Divorced/Separated	7	0.7
Education	PhD	63	6.1
	Masters	147	14.1
	Bachelors	685	65.9
	OND/equivalent	134	12.9
	High School	11	1.1
Religion	Christianity	877	84.3
	Islam	153	14.7
	African Traditional	10	1.0

OND= Ordinary National Diploma/ College associate degree equivalent

Figure 1 graphically illustrates the level of awareness about Bisphenol-A and its associated health risk. Only 35% (n=1040) of the respondents sampled had the knowledge on this subject while vast majority (65%) were unaware.

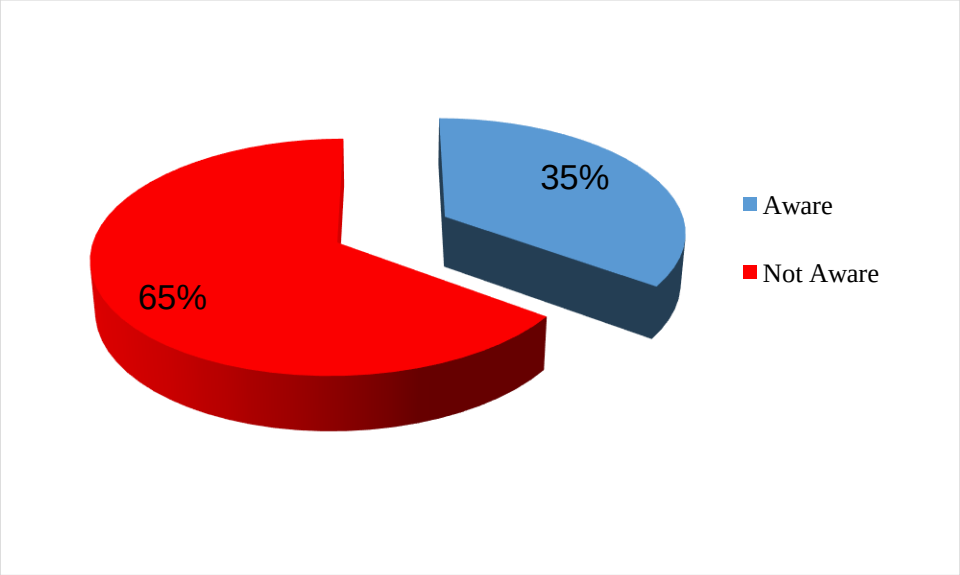

Figure 2: Level of awareness about Bisphenol-A and its associated health risk

When respondents were interviewed about their willingness to share health and safety information about Bisphenol-A: majority (87.7%) expressed willingness, 9.3% were indecisive while only 3% expressed unwillingness (Fig. 2).

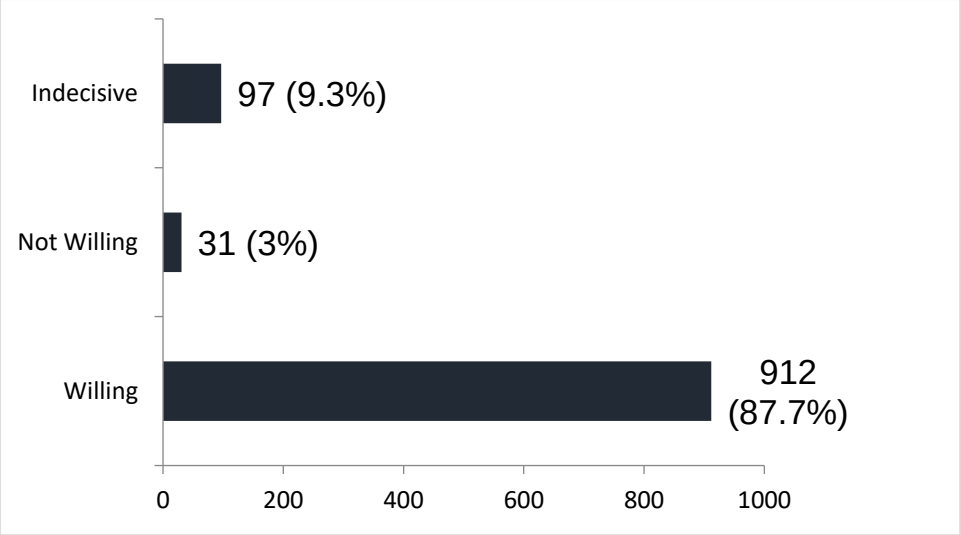

Figure 3: Level of Willingness to advocate safety about BPA

Table 2 illustrates respondents' sources of knowledge about Bisphenol-A and associated health risk. Majority of respondents (47%) got information about Bisphenol-A via Internet followed by social media (18%). Others got information via word of mouth/ family and friends (11%), workshop/trade fairs (10%), manufacturers (3%), government agencies (1%), and learning institutions (4%).

Table 2: Respondents' Sources of Knowledge about Bisphenol-A and associated health risk

Various Sources (n=364)	**F**	**%**
Internet (Search engine sites) /Websites	171	47
Newspaper/Magazine	20	5
Social media	65	18
Word of Mouth/Family and Friends	39	11
Workshop/Trade fairs	37	10
Manufacturers (Plastics and Packaging Companies)	11	3
Government Agencies	5	1
Learning Institutions	16	4

F=frequency, n= number of responses, %=Percentage

Majority of the respondents expressed serious concern if diagnosed with any of the health disorders linked to BPA human exposure; (33.7%) expressed "concerned" and 51.9% expressed "very concerned" on this subject. All respondents who had knowledge about BPA safety (n=364, 100%) consider BPA not safe for the public. When respondents were interviewed on the use of plastics in the microwave, 57.9% confirmed they use plastics in the microwave either in their homes, offices, or restaurants.

Table 3: Perceived risk, Food-Plastic's use, and Opinion about BPA safety

		f	**%**
Perceived Risk (n=1040)	Not at all concerned	66	6.3
	Not concerned	33	3.2
	Slightly concerned	51	4.9
	Concerned	350	33.7
	Very concerned	540	51.9
Plastic's use in the microwave (once in a week or more) (n=1040)	Yes	602	57.9
	No	438	42.1
Chemicals in plastics may cause adverse health effects	Yes	1000	96.2
	No	34	3.3
	Not Sure	6	0.6
Public Opinion about BPA Safety (n=364)	BPA is not safe	364	100

F=frequency, n= number of responses, %=Percentage

No significant relationship (P<0.05) exists between willingness to advocate safety and respondents' Sociodemographic characteristics, especially among the category of respondents who were not ready to advocate safety. However, significant relationship exists between gender, education, and willingness in the category of respondents who were indecisive about their willingness to advocate safety. Those respondents who had masters, bachelors and OND and were equally indecisive about willingness in advocating safety were less likely to show willingness to advocate safety based on the full model.

Table 4: Willingness to advocate for safety and associated factors

Variable		NOT WILLING		INDECISIVE	
		Co-efficient	**p-value**	**Co-efficient**	**p-value**
Gender	Male	28.490	0.959	0.442	0.100*
	Female	N/A	N/A	N/A	N/A
Age (years)	18-25	20.337	0.987	15.981	0.992
	26-35	6.636	0.995	16.850	0.992
	36-45	36.491	0.983	16.673	0.992
	46-55	69.706	0.977	1.371	0.999
	56-65	71.822	0.967	1.959	0.999
	Above 65	N/A	N/A	N/A	N/A
Marital Status	Single	15.166	0.997	0.272	0.353
	Married	-5.556	0.999	1.611	N/A
	Others	N/A	N/A	N/A	N/A
Education	PhD	-16.435	.997	-18.120	0.981
	Masters	-29.846	.994	-2.957	0.000*
	Bachelors	-36.707	.992	-3.371	0.000*
	OND/NCE	-35.723	.993	-2.492	0.002*
	High School	N/A	N/A	N/A	N/A
Religion	Christianity	-36.526	0.990	15.939	0.992
	Muslim	-46.953	0.988	16.602	0.992
	African Traditional	N/A	N/A	N/A	N/A

Reference category "were those who expressed willingness to advocate for safety (coded as 1)". N/A: Value represented zero (0) due to redundancy. "Others"

Discussion

Exploring the respondents' socio-demographics in this study may provide insight into whether social identity has influence on public knowledge or awareness about BPA and willingness to advocate safety, being our variable of interest (Abdelal *et al.,* 2009). The demographic profile of respondents indicates a sample population that is positively skewed towards educated, young, gainfully employed individuals. This suggests a greater likelihood of accessing reliable information from an actively engaged social group perceived to have a high level of knowledge across various subjects. Moreover, educated and socially aware individuals within this group are more inclined to actively seek health and safety information and prioritize the well-being of themselves and their families (Nawaz, 2017; Ahmad, 2020, Omoyajowo *et al.*, 2021).

Public health awareness is the strongest precursor to define, predict and resolve the health issues more quickly and substantially (Nawaz, 2017). Hence, individual having adequate knowledge of preventive healthcare especially with emerging food contaminants can prevent associated health risks thereby reducing the need for curative healthcare (Omoyajowo *et al.,* 2021). Poor level of awareness about BPA and its associated health risks was generally observed in this study and thus, implying that the public would not be able to prevent associated health risks due to BPA exposure. A similar study observed that fewer people (50%) had knowledge on the subject (Bucci *et al.,* 2010). Building an educated and well-informed community on issues of public health importance implies taking better care of health with concomitant great reduction in vulnerability to diseases (Kolok *et al.,* 2011; Nawaz, 2017; Omoyajowo *et al.*, 2021a, b).

Based on the observation in this study, the majority (57.9%) reported the use of plastics in the microwave (at least once a week). The implication of this outcome is that they are likely exposed to the danger of BPA because of their plastic use and lack of knowledge on BPA and its associated health risk. However, an earlier study even observed that more proportion of survey participants reporting the use of plastics in the microwave (81.3%) (Bucci *et al.,* 2010).

With regards to attitude as measured by "willingness to share health and safety information about BPA", a vast majority (87.7%) expressed willingness on this subject. Certainly, the implication of having the majority able to volunteer in the wide dissemination of healthy tips on possible mitigation approaches to BPA exposure would result in a massive awareness on the possible ways to reduce health risk associated with the compound. Positive attitude such as willingness to share safety information about issues of public health concern, and community participation in public health programs are widely considered as positive indicators to achieving a sustainable healthy environment (Omoyajowo *et al.,* 2021, Omoyajowo *et al.,* 2023). Similar study observed similar great attitude in public willingness to co-operate with the government on mitigation efforts towards reducing Microplastic pollution (Alkyildiz *et al.,* 2015, Omoyajowo *et al*., 2021a).

The public may utilize different information sources to learn about new and emerging health risks via internet, social media, government agencies, etc. because the tool of public

awareness about their potential health risk and mitigation measures on issues of public health concern could help a lot in better handling health of a nation. The internet has proved to be one of the most powerful tools in disseminating health-related information to citizens and policy makers because it supports human communication via social media, electronic mail (e-mail), "chat rooms," newsgroups, and audio and video transmission. Not surprisingly, a vast majority of respondents who had prior knowledge about BPA and its attendant risks sought sourced this information from the web (47%) followed by social media (18%), words of mouth/ family and friends (11%) and workshop/trade fairs (10%) However, Bucci *et al.*, (2010) observed that the majority of participants learned about BPA through words of mouth (50.9%), newspaper (35.7%) and television (28.6%). Another recent study observed the public mostly source health information through family and friends/word of mouth (Omoyajowo *et al.,* 2021). Hence, words of mouth was reported as the most valuable tool for disseminating information regarding environmental health hazards in their study. Another vivid observation in this present study was that only very few respondents sought information via government agencies (1%), and institutions of learning (4%). Hence, measures must be taken by the public health authorities to display up to date information on emerging contaminants and other issues of public health concern while integration of internet and other information sources such as print media, social media, Billboards, etc. would ultimately help to promote public health awareness if used for this purpose.

CONCLUSION

There is a significantly poor level of awareness on the health risk of BPA among respondents and vast majority perceived a high level of concern for BPA exposure. Hence, it is imperative to sensitize the public on health risks of BPA and the available steps to reduce individual exposure. "Knowledge is power". It is important to explore and promote diverse methods of communicating environmental health information to the public. Strong advocacy programs on the potential dangers of BPA and possible ways to avoid exposure may help prevent the scourge of cancer, and other related health risks. The government should ban the importation, sale, and advertisement of polycarbonate baby bottles, made with BPA monomers and hence, encourage safer alternatives. In order words, the government should put in place stringent measures on the use of BPA especially in majority of consumer products such that producers and/or profiteers of BPA would have to ask for permission to use it. More rigorous research is required to immensely drive innovation for safer alternatives and to understand fully the intricacies about BPA as endocrine disruptor. Government should fund research and put more efforts at creating public awareness about BPA and its associated health risks.

AVAILABILITY OF DATA AND MATERIAL

The data and material that support the findings of this study are available with Koleayo Omoyajowo (please email ko.omoyajowo@koozakar.com) upon reasonable request.

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