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Research Article

Awareness, Perception and Preventive Practices About Environmental Risk Factors Associated with Neurodegenerative Diseases Among Geriatric Patients in a Tertiary Hospital, Ibadan

Adejumo Mumuni*, Idowu Emmanuel Ayotomiwa

Department of Environmental Health Sciences, Faculty of Public Health, College of Medicine, University of Ibadan, Ibadan, Nigeria

Abstract

Environmental risk factors have been implicated in the pathogenesis of neurodegenerative diseases (NDDs) conditions, particularly among the elderly. In Nigeria, the elderly population is steadily increasing while there is limited information on awareness, perception and preventive practices regarding these environmental risks. Therefore, this study was conducted to document the awareness, perception and preventive practices about environmental risk factors associated with NDDs among the elderly attending geriatric clinic in a tertiary hospital, Ibadan. A cross-sectional study was conducted among the 217 consented elderly aged 60 years and above attending Chief Tony Anenih Geriatric Centre, University College Hospital (UCH), Ibadan. A validated interviewer administered questionnaire was used to collect data. Data were analyzed using descriptive statistics and Chi-square test with level of significant set at 0.05. Respondents' mean age was 73.8±8.7 years, 61.3% were female, 59.4% had tertiary education while 78.8% were living in their own house. All (100%) had heard about neurodegenerative diseases while the three major environmental risk factors reported were heavy metal exposure (79.7%), pesticides exposure (74.2%) and households' toxins (70.5%). The mean perception score was 7.7±1.3, 80.6% had positive perceptions about environmental risk factors associated with neurodegenerative diseases. Some of the preventive practices reported by the respondents were purchasing eco-friendly household products (59.9%) and the use of non-toxic households' products (58.1%). The mean preventive practice score was 6.9±0.9, 60.2% engaged in unhealthy practices. Respondent's ages ($\chi^2 = 22.621$; p=<0.001), house ownership ($\chi^2 = 4.061$; p=0.034) and perception regarding environmental risk factors ($\chi^2 = 6.448$; p=0.027) were associated with respondents' preventive practices. The three major reported barriers against preventive practice were limited access to health resources (100.0%), physical limitation (64.6%) and lack of awareness of risks (53.5%). Majority of the respondents were aware and had positive perception about environmental risk factors associated with neurodegenerative diseases, but engaged in unhealthy preventive practices. There is need for interventions focusing on environmental risk reduction to mitigate the burden of neurodegenerative diseases among the elderly in Nigeria.

Keywords

Neurodegenerative Diseases, Environmental Risk Factors, Preventive Practices, Geriatric Health

*Corresponding author: adejumo_mumuni@yahoo.com (Adejumo Mumuni)

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1. Introduction

Neurodegenerative diseases (NDDs), including Alzheimer's disease (AD), Parkinson's disease (PD), and amyotrophic lateral sclerosis (ALS), are progressive conditions characterized by the gradual degeneration of the nervous system, leading to cognitive decline, motor dysfunction, and diminished quality of life. The global prevalence of NDDs is rising, largely due to increased life expectancy and aging populations. The World Health Organization (WHO) has projected a sharp rise in dementia cases, particularly in low- and middle-income countries (LMICs) due to rapidly aging populations, urbanization, and the growing prevalence of environmental and lifestyle-related risk factors [1]. In sub-Saharan Africa, including Nigeria, the elderly population is expanding rapidly, yet research on NDDs remains limited [2]. In Nigeria, there were approximately 2.1 million individuals aged 60 and above in 1999, which increased to about nine million by 2016 [3]. This upward trend is projected to continue, with estimates suggesting that the number of older persons will reach 26 million by 2050 [4]. Urban centers like Ibadan mirror this national trend.

While genetic factors contribute to the onset of NDDs, environmental exposures play a significant role. For instance, studies have linked exposure to air pollution, heavy metals, pesticides, and industrial chemicals to an increased risk of developing NDDs [5, 6]. Inhaled particles can activate microglia and astrocytes, leading to the release of pro-inflammatory cytokines and reactive oxygen species (ROS), which contribute to neuronal damage and dysfunction [7]. Also, higher levels of long-term exposure to both $PM_{2.5}$ and PM_{10} were associated with faster rates of cognitive decline [8-10]. Exposure to heavy metals such as lead, mercury, and manganese can result in oxidative stress and neurotoxicity, which may accelerate neurodegenerative diseases in the aging population [11]. Pesticide exposure represents another critical risk factor. Agricultural practices in Nigeria rely heavily on the use of pesticides, many of which are neurotoxic and linked to Parkinson's disease and other neurodegenerative conditions [12]. These chemicals are frequently used in rural areas, and as urbanization brings rural and urban communities closer, there is an increased likelihood of exposure among urban populations as well. Also, in rural and urban Nigeria, the use of leaded paints, contaminated water, and improper waste management are ongoing concerns, adding to the environmental burden on public health. The neurotoxic impact of heavy metals is further exacerbated by inadequate infrastructure and limited public awareness, posing a particular threat to the elderly, whose neurological resilience may already be compromised by age-related vulnerabilities [13].

Despite the clear connection between environmental risk factors and neurodegenerative diseases, preventive practices related to these factors remain limited among elderly populations in Nigeria. Limited awareness hinders the adoption of preventive practices that could mitigate their exposure to neurotoxic elements in their daily environments [14]. Further, many healthcare facilities, including geriatric clinics in Nigeria, do not prioritize educational resources or interventions focused on environmental health risks for the elderly. Healthcare providers may also lack training and resources to counsel patients effectively on such preventive practices. This gap underscores a significant missed opportunity for preventive care within the healthcare system, as well as a need for more accessible public health information on environmental risks. Without adequate awareness, elderly individuals are at a higher risk of continued exposure to harmful environmental agents, which may worsen cognitive decline and hasten the onset of neurodegenerative conditions [14]. Therefore, the lack of intervention or preventive guidance on these environmental risks represents a significant public health challenge. The study was therefore conducted to document the perception and preventive practices regarding environmental risk factors associated with neurodegenerative diseases among the elderly attending a geriatric clinic in a tertiary hospital, Ibadan.

2. Methodology

2.1. Study Area

The study was carried out at a geriatric center in the University College Hospital (UCH), Ibadan, Nigeria. UCH is the premier tertiary healthcare institution which was established in 1957. It serves as a teaching hospital for the University of Ibadan and is recognized as a leading medical center in Africa, providing comprehensive healthcare services and playing a critical role in medical research and training. The University College Hospital, Ibadan was initially commissioned with 500-bed spaces. Currently, the hospital has a total of 1,445 bed spaces: 1,072 beds at the main hospital, 100 beds at Otunba Tunwase National Paediatrics Centre, 60 beds at Okuku Comprehensive Healthcare Centre, 50 beds at Sepeteri Comprehensive Healthcare Centre and 163 examination couches. With 80 departments, nine units and over 30 Wards, UCH offers a wide range of medical specialties. The hospital also houses the Chief Tony Anenih Geriatric Centre (CTAGC), which is dedicated to the care of elderly patients. The study took place at the Chief Tony Anenih Geriatric Centre (CTAGC), University College Hospital (UCH), Ibadan—a facility providing specialized care to the elderly. The Chief Tony Anenih Geriatric Centre (CTAGC) is the pioneer geriatric healthcare facility in Africa, officially commissioned on November 17, 2012. The centre commenced patient management on December 13, 2012, with initial patient registration of 2,559 and has since registered 19,300 patients aged 60 years and above by the end of 2020 [15]. Daily clinical ac-

tivities at CTAGC include Geriatric Outpatient Clinics, Neurology Clinics, Memory Clinics, and Healthy Ageing Clinics.

2.2. Study Design

This study used a quantitative approach to collect data with a cross-sectional design. Interviews were conducted with consenting elderly patients at the Chief Tony Anenih Geriatric Centre at University College Hospital (UCH), Ibadan. Participants were selected from the center's several specialist clinics, including the Memory Clinic, Neurology Clinic, and Geriatric Outpatient Clinic. Participants with unstable medical states or those with acute, life-threatening illnesses were excluded from participation in the study.

2.3. Sample Techniques and Data Collection

A two-stage sampling method was used to select clinics and 217 geriatric patients who participated in the study. A validated semi-structured interviewer administered questionnaire was used to elicit information on respondents' socio demographic characteristics, awareness and perception about environmental risk factors associated with neurodegenerative diseases, preventive practices against environmental risk factors and barrier to the adoption of preventive practices. Perception was measured on 11-point scale while preventive practices was measured on 13-point scale. Perception scores of >5 was categorized as positive while preventive practices of >6 were rated as healthy preventive practices. The instrument was developed from review of literature and a pilot study was conducted. Ambiguous and misinterpreted questions identified during the pilot study were modified.

2.4. Data Collection Procedure

Prior to the commencement of data collection, the investigator visited the Chief Tony Anenih Geriatric Centre to introduce the study objectives and obtain informed consent from the authority in charge. During the visit, a meeting was held with the administrative officer, who provided all relevant information and outlined the requirements for gaining access to the clinic for the study. Upon securing the necessary permissions, the data collection plan was finalized, including the scheduling of appropriate dates and times for questionnaire administration, particularly during early clinic hours when elderly patients were available. The entire process was handled in a manner that respected the clinic's routine operations, ensuring minimal disruption. Data collection was conducted for six weeks, during which the questionnaire copies were administered to eligible participants at the Geriatric Centre. Efforts were made to ensure that respondents did not influence each other in their responses. Also, data collection took place in a designated area within the clinic to guarantee privacy and convenience for the participants. Completed and signed informed consent forms were retrieved from each respondent. Interviews were conducted by three (3) Research Assistants who were conversant with survey. They were recruited and trained on efficient administration of questionnaire to respondents at the hospital setting.

2.5. Data Management

The collected data were reviewed daily for accuracy and completeness during fieldwork. Then they were cleaned, coded and entered into Statistical Package for Social Sciences (SPSS Statistics version 22) for analysis. Prior to analysis, the dataset was examined for errors, discrepancies, and missing values, which were addressed to ensure data integrity. Descriptive statistics was carried out to obtain frequencies, percentages, means, and standard deviations. Chi-square tests were conducted to assess relationships between categorical variables, such as education level and knowledge levels, as well as knowledge and preventive practices. The level of statistical significance was set at $p < 0.05$.

2.6. Ethical Considerations

Ethical approval was collected from the UI/UCH joint Ethical Review Board with a registration Number: UI/EC/24/0928. Also, permission was granted by the Chairman, Medical Advisory Committee (CMAC), UCH to conduct the study. Informed consent was obtained from all participants before the commencement of data collection.

3. Results

3.1. Demographic Characteristics

Respondents' mean age was 73.8±8.7 years while 36.9% were within the age of 70 and 79 years as seen in Figure 1. Majority (61.3%) were female, 67.7% were married while 59.4% had tertiary education. About one-third (33.6%) said they were engaged in income generating activities which include farming (10.9%), industrial work (19.2%) and trading (69.9%) as presented in Table 1. Several (48.8%) were living with spouse, 81.1% were living in flat apartment while 78.8% owned the house in which they were living.

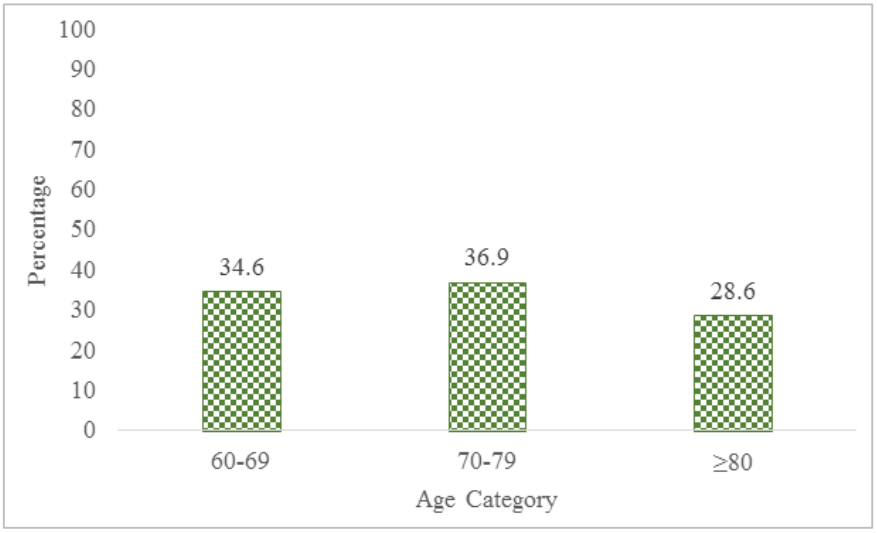
Table 1. Demographic Characteristics of Respondents.

Characteristics	Frequency	Percentage
Gender		
Male	84	38.7
Female	133	61.3
Marital Status		
Single	17	7.8
Married	147	67.7
Widowed	39	18.0
Divorced	14	6.5
Education Level		
No Formal Education	9	4.1
Primary Education	26	12.0
Secondary Education	53	24.4
Tertiary Education	129	59.4
Engagement in income generating activity		
Yes	73	33.6
No	144	66.4
Income Type		
Farming	8	10.9
Industrial worker	14	19.2
Trading	51	69.9
Living arrangement		
Alone	14	6.5
My spouse	106	48.8
My relatives	74	34.1
Caregiver	23	10.6
House Type		
Face-to-face apartment	41	18.9
Flat	176	81.1
House ownership		
Rented	46	21.2
Owned	171	78.8

3.2. Awareness About Neurodegenerative Diseases and Associated Environmental Risk Factors

Table 2 presents the respondents' awareness and knowledge about neurodegenerative diseases associated with environmental risk factors. It was found that all (100%) had heard about neurodegenerative diseases, 75.1% reported that they were familiar with Alzheimer's disease while 89.9% had familiar with Parkinson's disease. The three major sources of information about neurodegenerative diseases among the

respondents were health professionals (79.7%), family/friends (74.2%) and community health programs (70.5%). The reported major environmental factors which may increase the risk of neurodegenerative diseases were heavy metal exposure (79.7%), pesticides exposure (74.2%), households' toxins (70.5%), air pollution (64.5%) and industrial chemicals (53.9%).



Mean ± SD = 73.8±8.7 years.

Figure 1. *Age category of the Respondents.*

Table 2. *Awareness about Neurodegenerative Diseases and Environmental Risk Factors.*

Awareness	Frequency	Percentage
Awareness		
Heard of Neurodegenerative Diseases	217	100
Familiar With Alzheimer's Disease	163	75.1
Familiar With Parkinson's Disease	195	89.9
Source of information		
Health Professionals	173	79.7
Family/Friends	161	74.2
Community health programs	153	70.5
Media (TV, Radio, Internet)	72	33.2
Environmental risk factors		
Air Pollution (e.g., vehicle emissions, etc.)	140	64.5
Pesticide exposure (e.g., insecticides, herbicides)	161	74.2
Heavy metal exposure (e.g., Lead, Mercury)	173	79.7
Industrial chemicals (e.g., solvents, formaldehyde, etc.)	117	53.9
Chronic exposure to loud noise	155	71.4
Household toxins (e.g., cleaning agents, asbestos, etc.)	153	70.5

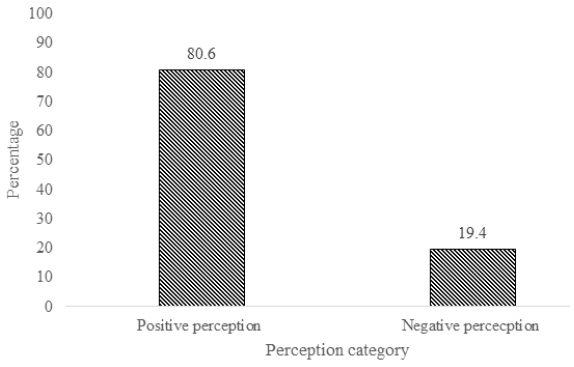
3.3. Perception About Environmental Risk Factors Associated with Neurodegenerative Diseases

The data in Table 3 present respondents' perceptions about environmental risk factors associated with neurodegenerative diseases. It was found that 46.5% of the respondents strongly agreed that industrial pollution is a major contributor to neurodegenerative diseases, 41.5% strongly agreed that physical exercise reduces the risk of neurodegenerative diseases while 45.2% agreed that government regulations on air quality should be stricter to prevent brain health issues. Several (46.1%) of the respondents agreed that avoiding smoking can reduce the chances of cognitive decline, 44.7% agreed that excessive exposure to secondhand smoke can increase the chances of cognitive decline while 50.2% strongly agreed that living near factories could increase the risk of neurodegenerative diseases. More than half (56.2%) strongly agreed that dwelling close to busy highways has no link with neurodegenerative diseases, 52.5% strongly agreed that a healthy diet can prevent or delay the onset of neurodegenerative diseases while 40.1% agreed that exposure to pesticides in food is a serious concern for brain health. The mean perception score was 7.7±1.3; 80.6% had positive perceptions about environmental risk factors associated with neurodegenerative diseases.

Table 3. *Perceptions on Environmental and Lifestyle Factors Influencing Neurodegenerative Diseases.*

Perception Statements	SA (%)	A (%)	NAND (%)	D (%)	SD (%)
Industrial pollution is a major contributor to neurodegenerative diseases in communities.	101 (46.5)	75 (34.6)	30 (13.8)	11 (5.1)	0 (0.0)
Physical exercise can reduce the risk of neurodegenerative diseases.	90 (41.5)	79 (36.4)	48 (22.1)	0 (0.0)	0 (0.0)
Government regulations on air quality should be stricter to prevent brain health issues.	61 (28.1)	98 (45.2)	38 (17.5)	20 (9.2)	0 (0.0)
Avoiding smoking can reduce the chances of cognitive decline.	67 (30.9)	100 (46.1)	40 (18.4)	10 (4.6)	0.0 (0.0)
Excessive exposure to secondhand smoke can increase the chances of cognitive decline.	89 (41.0)	97 (44.7)	31 (14.3)	0.0 (0.0)	0.0 (0.0)
Living near factories could increase the risk of neurodegenerative diseases.	109 (50.2)	76 (35.0)	32 (14.7)	0.0 (0.0)	0.0 (0.0)
Dwelling close to busy highways has no link with neurodegenerative diseases.	122 (56.2)	83 (38.2)	0.0 (0.0)	5 (2.3)	7 (3.2)
A healthy diet can prevent or delay the onset of neurodegenerative diseases.	114 (52.5)	65 (30.6)	10 (4.6)	18 (8.3)	10 (4.6)
Exposure to pesticides in food is a serious concern for brain health.	70 (32.3)	87 (40.1)	30 (13.8)	9 (4.1)	21 (9.7)

N.B: SA=Strongly Agree; A=Agree; NAND= Neither Agree Nor Disagree; D=Disagree; SD=Strongly Disagree



Mean ± SD = 7.7±1.3.

Figure 2. *Category of respondents' perception score.*

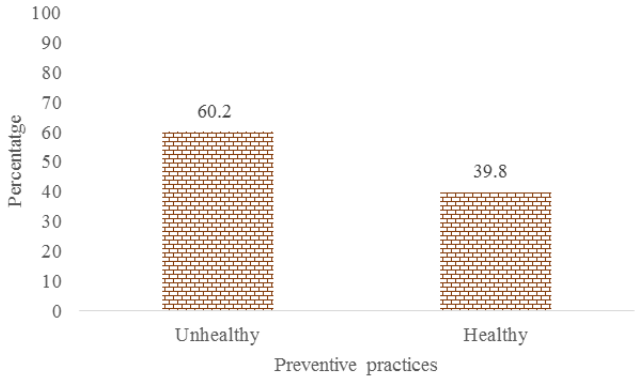
3.4. Preventive Practices Against Environmental Risk Factors for Neurodegenerative Diseases

Information on preventive practices to reduce exposure to environmental risk factors for neurodegenerative diseases is presented in Table 4. The major preventive practices reported by the respondents were reduction of exposure to noise pollution (82.0%), purchasing eco-friendly household products (59.9%), use of non-toxic households' products (58.1%) and avoiding outdoor activities during high pollution days (57.1%). Other preventive practices mentioned were minimizing insecticide use in home (55.3%), regular use of protective equipment (e.g. masks, gloves) when handling chemicals (44.7%), regularly checking for pollutants (e.g., lead,

asbestos) in household materials (39.6%) and reduction of pesticide use in garden (30.0%). The mean preventive practice score was 6.9±0.9; 60.2% engaged in unhealthy practices as depicted in Figure 3.

Table 4. Preventive Practices against Environmental Risk Factors Associated with Neurodegenerative Diseases.

Preventive Practices	Yes (%)	No (%)	Can't say (%)
Reducing exposure to noise pollution	178 (82.0)	25 (11.5)	14 (6.5)
Purchasing eco-friendly household products	130 (59.9)	56 (25.8)	31 (14.3)
Using non-toxic household products	126 (58.1)	70 (32.3)	21 (9.7)
Avoiding outdoor activities during high pollution days	124 (57.1)	83 (38.2)	10 (4.6)
Minimizing insecticide use in home	120 (55.3)	70 (32.3)	27 (12.4)
Regular use of protective equipment (e.g., masks, gloves) when handling chemicals	97 (44.7)	98 (45.2)	22 (10.1)
Regularly checking for pollutants (e.g., lead, asbestos) in household materials	86 (39.6)	116 (53.5)	15 (6.9)
Reduce pesticide use in garden	65 (30.0)	132 (60.8)	20 (9.2)



Mean ± SD = 6.9±0.9.

Figure 3. Category of respondents' preventive practices score.

3.5. Comparison Between Sociodemographic Characteristics, Perception Category and Preventive Practices Category

Table 5 presents the association between respondents' sociodemographic characteristics, perception category and preventive practices category. Significantly, 61.3% of respondents within the age of 70 and 79 years had healthy preventive practices compared to those in other age group. Gender, marital status, educational level, living arrangement and house type were not significantly associated with respondents' preventive practices. However, 44.4% of respondents who owned their house significantly had healthy preventive practices compared to 28.3% of their counterpart who were living in rented apartment. Significantly, 44.0% of the respondents who had positive perception had healthy preventive practices compared to 28.6% of those with negative perception.

Table 5. Comparison between Sociodemographic Characteristics, Perception Category and Preventive Practices Category.

Characteristics	Preventive practices category			χ^2/*Fishers Exact* (p value)
	Unhealthy (%)	Healthy (%)	Total (%)	
Age category (in years)				
60-69	50 (66.7)	25 (33.3)	75 (100)	
70-79	31 (38.8)	49 (61.3)	80 (100)	22.621 (<0.001)
80 and above	47 (75.8)	15 (24.2)	62 (100)	
Gender				
Male	52 (61.9)	32 (39.1)	84 (100)	0.483 (0.291)

Characteristics	Preventive practices category			χ^2/*Fishers Exact* (p value)
	Unhealthy (%)	Healthy (%)	Total (%)	
Female	76 (57.1)	57 (42.9)	133 (100)	
Marital Status				
Single	13 (76.5)	4 (23.5)	17 (100)	
Married	82 (55.8)	65 (44.2)	147 (100)	3.860 (0.277)
Widowed	23 (59.0)	16 (41.0)	39 (100)	
Divorced	10 (71.4)	4 (28.6)	14 (100)	
Education Level				
No Formal Education	6 (66.7)	3 (33.3)	9 (100)	
Primary Education	20 (76.9)	6 (23.1)	26 (100)	2.762 (0.460)
Secondary Education	25 (47.2)	28 (52.8)	53 (100)	
Tertiary Education	52 (40.3)	77 (59.7)	129 (100)	
Living arrangement				
Alone	8 (57.1)	6 (42.9)	14 (100)	
My spouse	65 (61.3)	41 (38.7)	106 (100)	0.684 (0.879)
My relatives	41 (55.4)	33 (44.6)	74 (100)	
Caregiver	14 (60.9)	9 (39.1)	23 (100)	
House Type				
Face-to-face apartment	21 (51.2)	20 (48.8)	41 (100)	1.260 (0.292)
Flat	107 (60.8)	69 (39.2)	176 (100)	
House ownership				
Rented	33 (71.7)	13 (28.3)	46 (100)	4.061 (0.034)
Owned	95 (55.6)	76 (44.4)	171 (100)	
Perception Category				
Negative	30 (71.4)	12 (28.6)	42 (100)	6.448 (0.027)
Positive	98 (56.0)	77 (44.0)	175 (100)	

3.6. Barriers Against Adopting Preventive Practices

Figure 4 depicts information on respondents' barriers from engaging in effective preventive practices against environmental risk factors for neurodegenerative diseases. The three major reported barriers were limited access to health resources (100%), physical limitations (64.6%) and lack of awareness of risks (53.5%). Other obstacles mentioned by the respondents were personal thoughts (49.3%), inconvenience (48.4%), cost of eco-friendly products (38.2%) and cultural beliefs (17.5%).

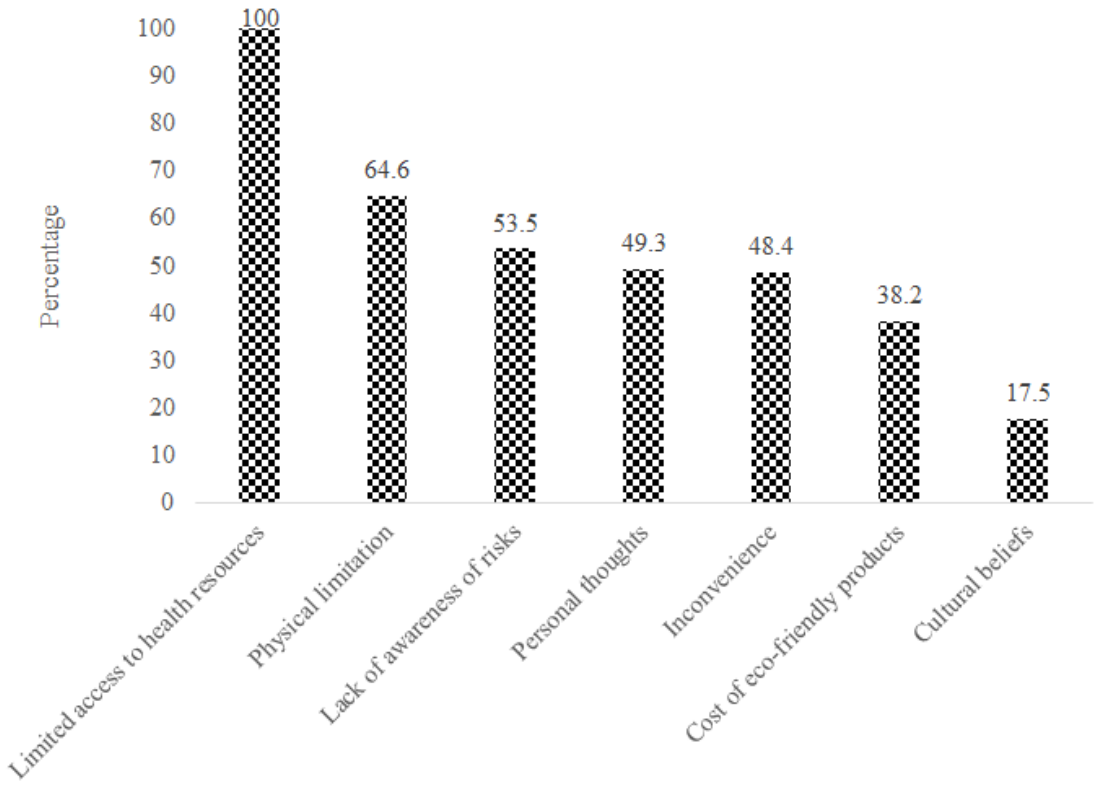


Figure 4. *Barriers against Preventive Practices.*

4. Discussion

This study documented the awareness, perception and preventive practices about environmental risk factors associated with neurodegenerative diseases among the elderly attending geriatric clinic in a tertiary hospital, Ibadan. The data revealed that the females outnumbered their male counterparts. This is consistent with findings that women have a higher life expectancy and a greater likelihood of experiencing neurodegenerative diseases such as Alzheimer's disease [16]. Large proportion of respondents were married. This is a social determinant associated with better health outcomes and stronger social support networks [17]. High percentage of respondents had tertiary education, a factor that likely contributed to higher levels of awareness regarding neurodegenerative diseases. Education level, age, and socioeconomic status had been associated with the adoption of healthier behaviors that can mitigate the risk of cognitive decline [18].

Existing literature highlighted the role of environmental risk factors in the development of neurodegenerative diseases. The current study reinforces this by demonstrating a high level of awareness (100%) among respondents regarding neurodegenerative diseases. However, variations were observed in awareness depth about environmental risk factors associated with neurodegenerative diseases. Although, heavy metal exposure and pesticide exposure were widely recognized as environmental risk factors, industrial chemicals were less frequently identified. This is similar to findings by Grandjean and Landrigan [19], who reported that public awareness of neurotoxic industrial chemicals remains limited despite their well-documented effects on brain health. The major source of information in this study were healthcare professionals while media sources were underutilized. This aligns with study suggesting that elderly populations rely more on direct healthcare consultations than on digital or mass media for health-related information [20]. Data from this study indicated that large percentage of respondents agreed that industrial pollution contributes to neurodegenerative diseases. This aligns with the research conducted by Calderón-Garcidueñas *et al.* [21] who demonstrated a strong link between air pollution and cognitive decline. Air pollutants increase the production of ROS and decrease antioxidant defenses, creating an imbalance that leads to neuronal injury and impairs the blood-brain barrier (BBB), facilitating the entry of harmful substances into the brain [7]. High percentage of the participants believed that residing near factories poses a significant risk. This is consistent with a study that links industrial pollution to increased oxidative stress and neuroinflammation [22, 23]. However, low percentage of the respondents disagreed that living near highways has no link to neurodegenerative diseases. The study found that high percentage of the respondents had positive perceptions about environmental risk factors associated with neurodegenerative diseases. A study on dementia prevention in China revealed that individuals with a positive perception of dementia pre-

vention were more likely to engage in preventive behaviors [24]. These present findings indicate a strong foundation upon which health promotion efforts can be built. Positive perception is a key determinant of behavior change, suggesting that this population may be more receptive to adopting healthier practices if exposed to the appropriate knowledge, motivation, and support.

The present study found that preventive measures are inconsistently practiced. While high percentage of the respondents actively reduced their exposure to noise pollution, other essential behaviors—such as using protective equipment when handling chemicals and checking household materials for pollutants—were less frequently adopted. These findings corroborate with the research by Burgos-Espinoza *et al.* [25], who found that knowledge of environmental risks does not always translate into behavioral change. In other words, there is a knowledge-practice gap. Furthermore, majority of participants in a research on market gardeners in Lomé, Togo, used pesticides, despite the fact that 27.1% of them had received pesticide use instruction [26]. The study found that majority (60.2%) of the respondents engaged in unhealthy preventive practices. This is an indication that there is a gap in preventive practices against environmental risk factors for neurodegenerative diseases suggesting a pressing need for targeted health education and behavioral interventions, particularly within geriatric populations. This further supports the need for behavioral interventions that promote sustained preventive measures, as recommended by the WHO [1]. Healthcare providers and policymakers should prioritize community-based programs that not only increase awareness but also actively support the adoption of healthy preventive practices through accessible resources, routine counseling, and integration of preventive education into routine geriatric care services. Data from the study revealed that respondents' age, ownership of house and having positive perception were significantly associated with their preventive practices about environmental risk factors. This finding suggests that age, ownership of house and having positive perception could influence engagement in healthy preventive practices against environmental risk factors associated with neurodegenerative diseases. Home owners often have more stable living conditions and resources, which can facilitate engagement in health-promoting activities [27].

The barriers identified in this study highlight structural and personal challenges that hinder the adoption of preventive behaviors. Limited access to health resources was cited as a barrier by all respondents, emphasizing systemic healthcare limitations that disproportionately affect the elderly. This is consistent with findings of an earlier study that had recognized multiple systemic obstacles like restricted resources, conflicting priorities, provider prejudices, etc., to executing dementia prevention strategies [28]. Physical limitations and lack of awareness were also reported as significant obstacles, reflecting the dual impact of physiological and informational barriers. This finding is similar to that of a previous study on aging populations [29]. Moreover, cost concerns were cited by several respondents, indicating that affordability of eco-friendly products remains a consideration in adopting preventive practices. However, cultural beliefs were the least recognized barrier, suggesting that resistance to preventive behavior is less influenced by traditional norms but more by accessibility and convenience. These findings reinforce the need for policy-driven solutions that enhance healthcare accessibility, affordability, and education.

5. Conclusion

This study has provided valuable insights into the awareness, perception, and preventive practices about environmental risk factors associated with NDDs among elderly attending geriatric clinic. The study revealed that awareness and perception about environmental risk factors were high, yet participants' preventive practices were unhealthy. The study also identified key barriers, including limited healthcare access and financial constraints that hinder the adoption of preventive behaviors. These findings highlight the need for multi-faceted interventions that combine education, policy initiatives, and community-based health programs. Addressing these gaps can contribute to improved public health outcomes and reduce the burden of neurodegenerative diseases among elderly. There is need for public health interventions focusing on environmental risk reduction to mitigate the burden of neurodegenerative diseases among the elderly in Nigeria.

Abbreviations

NDDs	Neurodegenerative Diseases
CTAGC	Chief Tony Anenih Geriatric Centre
UI/UCH	University of Ibadan/University College Hospital
WHO	Word Health Organization
LMICs	Low- and Middle-Income Countries
ROS	Reactive Oxygen Species
BBB	Blood-Brain Barrier

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Author Contributions

All authors contributed to the study conception and design. Material preparation and data collection were performed by E. A. Idowu supervised by M. Adejumo. E. A. Idowu prepared the draft; M. Adejumo performed the data analysis; while all authors read and approved the final manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] World Health Organization. (2021). Global status report on the public health response to dementia. Geneva: World Health Organization; Licence: CC BY-NC-SA 3.0 IGO.

[2] Akinyemi R. O., Owolabi M. O., Kuti O., Owoeye O., Ogunniyi A., Akinola O. and Odesanya, M. (2015). *Prevalence and risk factors of dementia in Nigeria: A systematic review and meta-analysis*. Journal of Alzheimer's Disease, 46(3), 701-711.

[3] Akintayo-Usman N. O. and Usman S. O. (2021). Comparative analysis of ageing in Nigeria and United Kingdom using life course approach: the implication for the Nursing profession in Nigeria. The Pan African medical journal, 38, 411. https://doi.org/10.11604/pamj.2021.38.411.22272

[4] Mbam K., Halvorsen C. and Okoye U. (2022). Aging in Nigeria: A Growing Population of Older Adults Requires the Implementation of National Aging Policies. The Gerontologist. 62. https://doi.org/10.1093/geront/gnac121

[5] Calderón-Garcidueñas L., Valencia-Salazar A. E., Rodríguez-Alcaraz M. A., Meléndez-Ramírez A. M., Kavanaugh C. A., and Perez-Villalobos C. A. (2008). *Air pollution and brain damage*. Toxicologic Pathology, 36(2), 289-310.

[6] Prince M., Comas-Herrera A., Knapp M., Guerchet M. and Karagiannidou M. (2016) World Alzheimer report 2016: improving healthcare for people living with dementia: coverage, quality and costs now and in the future. Alzheimer's Disease International (ADI), London, UK.

[7] Jankowska-Kieltyka M., Roman A. and Nalepa I. (2021). The air we breathe: Air pollution as a prevalent proinflammatory stimulus contributing to neurodegeneration. *Frontiers in Cellular Neuroscience*, *15*, 647643. https://doi.org/10.3389/fncel.2021.647643

[8] Power M. C., Adar S. D., Yanosky J. D. and Weuve J. (2016) Exposure to air pollution as a potential contributor to cognitive function, cognitive decline, brain imaging, and dementia: A systematic review of epidemiologic research. Neurotoxicology. 56: 235-253. https://doi.org/10.1016/j.neuro.2016.06.004

[9] Grandea G., Wua J., Ljungmanb P. L. S., Stafoggiab M., Bellanderb T. and Rizzutoa D. (2021). Long-Term Exposure to PM2.5 and Cognitive Decline: A Longitudinal Population-Based Study. Journal of Alzheimer's Disease 80 (2021) 591–599. https://doi.org/10.3233/JAD-200852

[10] López-Granero C., Polyanskaya L., Ruiz-Sobremazas D., Barrasa A., Aschner M. and Alique M. (2024). Particulate Matter in Human Elderly: Higher Susceptibility to Cognitive Decline and Age-Related Diseases. *Biomolecules*, *14*(1), 35. https://doi.org/10.3390/biom14010035

[11] [Gupta V. B., Rao S., Chitranshi N., Prasad S. and Athira N. (2018). The roles of environmental toxicants in neurodegenerative diseases: Mechanistic insights. Neurochemistry International, 115, 39-45. https://doi.org/10.1016/j.neuint.2018.01.015

[12] Ascherio A. and Schwarzschild M. A. (2016). The epidemiology of Parkinson's disease: Risk factors and prevention. The Lancet Neurology, 15(12), 1257-1272. https://doi.org/10.1016/S1474-4422(16)30230-7

[13] Armas F. V. and D'Angiulli A. (2022). Neuroinflammation and Neurodegeneration of the Central Nervous System from Air Pollutants: A Scoping Review. *Toxics*, *10*(11), 666. https://doi.org/10.3390/toxics10110666

[14] Manczak E. M., Danyluck C. and Chen E. (2021). Environmental risk factors and neurodegenerative disease awareness in aging populations. Neurotoxicology and Teratology, 85, 106956. https://doi.org/10.1016/j.ntt.2021.106956

[15] Adebusoye L. A., Olowookere O. O., Ajayi S. A., Cadmus E. O. and Labaeka E. O. (2021). Integrative Care of the Older Persons in Nigeria: An Appraisal of the Geriatric Centre, University College Hospital, Ibadan. West Afr J Med. 38(9): 839-844. PMID: 34675279.

[16] Prince M., Wimo A., Guerchet M., Ali G. C., Wu Y. T. and Prina M. (2015). World Alzheimer report 2015: The global impact of dementia—An analysis of prevalence, incidence, cost, and trends. Alzheimer's Disease International.

[17] Håkansson K., Rovio S., Helkala E. L., Vilska A. R., Winblad B., Soininen H., Nissinen A., Mohammed A. H. and Kivipelto M. (2009). Association between mid-life marital status and cognitive function in later life: population based cohort study. BMJ. 339: b2462. https://doi.org/10.1136/bmj.b2462

[18] Röhr S., Pabst A., Baber R., Engel C., Glaesmer H., Hinz A., Schroeter M. L., Witte A. V., Zeynalova S., Villringer A., Löffler M. and Riedel-Heller S. G. (2022). Social determinants and lifestyle factors for brain health: implications for risk reduction of cognitive decline and dementia. Sci Rep. 12(1): 12965. https://doi.org/10.1038/s41598-022-16771-6

[19] Grandjean P. and Landrigan P. J. (2014). "Neurobehavioural Effects of Developmental Toxicity." The Lancet Neurology 13 (3): 330–338. https://doi.org/10.1016/s1474-4422(13)70278-3

[20] Brzozek C., Abramson M. J., Benke G. and Karipidis K. (2021). Cellular Phone Use and Risk of Tumors: Systematic Review and Meta-Analysis. *International Journal of Environmental Research and Public Health*, *18*(10), 5459. https://doi.org/10.3390/ijerph18105459

[21] Calderón-Garcidueñas L., Leray E., Heydarpour P., Torres-Jardón R. and Reis J. (2016) Air Pollution, a Rising Environmental Risk Factor for Cognition, Neuroinflammation and Neurodegeneration: The Clinical Impact on Children and Beyond. Revue Neurologique, 172: 69-80. https://doi.org/10.1016/j.neurol.2015.10.008

[22] Block M. L. and Calderon-Garciduenas L. (2009). Air pollution: mechanisms of neuroinflammation and CNS disease. Trends Neurosci., 32 (9) 506-516.

[23] Schikowski T. and Altuğ H. (2020). The role of air pollution in cognitive impairment and decline, Neurochemistry International, 136: 104708, https://doi.org/10.1016/j.neuint.2020.104708

[24] Song D, Yu D. and Sun Q. (2022). Perception and knowledge of dementia prevention and its associated socio-demographic factors in China: A community-based cross-sectional study. Front. Neurosci. 16: 1093169. https://doi.org/10.3389/fnins.2022.1093169

[25] Burgos-Espinoza I. I., García-Alcaraz J. L., Gil-López A. J. and Díaz-Reza J. R. (2024). Effect of environmental knowledge on pro-environmental attitudes and behaviors: a comparative analysis between engineering students and professionals in Ciudad Juárez (Mexico). J Environ Stud Sci. https://doi.org/10.1007/s13412-024-00991-5

[26] Diallo A., Zotchi K., Lawson-Evi P., Bakoma B., Badjabaissi E. and Kwashie E. G. (2020). Pesticides Use Practice by Market Gardeners in Lome (Togo). J Toxicol. 22; 8831873. https://doi.org/10.1155/2020/8831873

[27] Rodriguez-Loureiro L., Gadeyne S., Bauwelinck M., Lefebvre W., Vanpoucke C. and Casas L. (2022). Long-term exposure to residential greenness and neurodegenerative disease mortality among older adults: a 13-year follow-up cohort study. Environ Health 21, 49. https://doi.org/10.1186/s12940-022-00863-x

[28] Mace R. A., Cohen J. E., Lyons C., Ritchie C., Bartels S., Okereke O. I., Hoeppner B. B., Brewer J., Joo J. H. and Vranceanu A. M. (2024). Socio-ecological barriers to behavior change-oriented dementia prevention: a qualitative study of healthcare professionals' perspectives. Aging Ment Health. 22: 1-10. https://doi.org/10.1080/13607863.2024.2430525

[29] Walsh S., Wallace L, Kuhn I., Mytton O., Lafortune L., Wills W., Mukadam N. and Brayne C. (2024). Population-level interventions for the primary prevention of dementia: a complex evidence review, eClinical Medicine, 70: 102538, https://doi.org/10.1016/j.eclinm.2024.102538