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## I. Introduction

### *a) Background to the Study*

The connection between the use of a building either as a workplace or as a dwelling place and the appearance, in certain cases, of discomfort and symptoms of illness is a fact attributable to indoor air pollution (WHO, 200, EPA, 1987). Indoor air pollution (IAQ) is a phenomenon recognized to be a major health problem worldwide because more than 3 billion people around the globe depend on solid fuel (WHO, 2007). The use of solid fuel within indoor environment for purposes including cooking and heating among others has been known to produce noxious fumes which are injurious to human health (Bruce 2005; Ettati, 2005; WHO, 2007; WEC, 1999; EPA, 1987). This pollution largely affects a considerable number of dwellers, mostly women and children, because it has been established that they spend between 58 and 78% of their time in an indoor environment (Hoffman, 2003). These problems have been worsened with the construction of buildings that are poorly ventilated and badly aerated such that the circulation of fresh air is marred. Consequently, buildings with inadequate natural ventilation present risks of exposure to severe air-borne diseases and infection.

Indoor air pollution however, is not limited to use of biomass fuels. Other sources include particles from household materials (synthetic carpets and furniture, paints, asbestos), pesticides, insecticides, air fresheners (naphthalene ball) domestics appliances, and cosmetics products (body spray, perfumes anti aspirant) among others (Adigun et al 2011). Unknown to many dwellers, exposure to and inhalation of these fumes and dangerous gases from workplaces, homes and other indoor environments have been responsible for severe health cases such as respiratory infections (WHO, 1997), chronic lung diseases such as asthma and bronchitis, lung cancer, nose and throat irritation, and still-birth (Ayars, 1997), eye disorder, conjunctivitis, blindness and low birth weight (Traynors et. al., 1985), low ventilation rates (Menzies et al., 1993) and physiological discomfort among others (Tawari and Abowei, 2012).

Though outdoor air pollution poses severe health risks most of which are linked with the urban environment, yet, some of the highest concentrations of risks have occurred in indoor environment especially in most Sub-Saharan African countries like Nigeria (Oguntoke et. al., 2010; Theuri, 2009 and EPA, 2003). Smith and Mac (2009) also opined that the devastating effects of air pollution in the indoor environment are more flagrant than the outdoor environment owing to the length of stay in the former.

The World Resource Institute (WRI) in 1998 established that threats to human well-being are constantly being generated from two categories of human-environment interactions. Firstly, lack of development; owing to man's inability to maximize natural and environmental resources sustainably.

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Secondly, through threats produced when the bye-products of resource exploration and transformation are not manageably rid of in a manner that will forestall its negativities.

Against this background , the problems of indoor air pollution becomes of great concern in this paper because those affected are less aware, ill-equipped and ill prepared for the menace and there are little or no provisions (facility-wise) in their communities to help cope with the impact. Consequently, the level of vulnerability and susceptibility to the scourges are pronounced (Akande and Owoyemi, 2008; Hoffman, 2003). An observable level of variations in what is experienced across geographical space as cited in existing literature have some cultural, demographic and environmental undertone among other things (ISOCAP, 2008). The need to investigate empirically, the resident's knowledge on sources and associated negativities of indoor air pollutant as well as the vulnerability of urban residents in a medium sized city is of both scientific and practical importance and therefore the major purview of this paper.

## II. Literature Review

Indoor Air pollution has often been described as an urban problem globally. As dangerous as polluted outdoor air can be to human health, indoor air pollution actually poses a greater health risk on a global level. About 2.8 million deaths per year results from breathing elevated levels of indoor smoke from dirty fuel. Although, many people associate air pollution with outdoor urban environment, some of the highest concentrations actually occur in rural areas (Sinton and Weller, 2003; Mac, 2009 and Theuri, 2009).

The greatest threat of indoor air pollution occurs in the developing countries of the world, where some 3.5 billion people mostly in rural areas continue to rely on traditional fuel for cooking and heating. According to a World Bank Report, indoor air pollution in developing countries is designated as one of the four most critical global environmental problems (Carter, 1998 and Mac, 2009). Burning biomass fuel indoor is a major source of large amounts of smoke and other pollutants in the confined space of the home, thereby providing a perfect avenue for human exposure. Liquid and gaseous fuels such as kerosene and bottled gas, although not completely pollution free, are many times, less polluting than unprocessed solid fuels.

Indoor air pollution can be traced to prehistoric times when humans first moved to temperate climates and it became necessary to construct shelters and use fire inside them for cooking, warmth and light. Fire led to exposure to high levels of pollution, as evidenced by the soot found in prehistoric caves (Albalak, 1997). Approximately, half the world's population and up to 90% of rural households in developing countries today, still rely on unprocessed biomass fuels in the form of wood, dung and crop residues (World Resources , 1998). These are typically burnt indoors in open fires or poorly functioning stoves. As a result, there are high levels of air pollution, to which women, especially those responsible for cooking, and their young children, are most heavily exposed. However, in developed countries, modernization has been accompanied by a shift from biomass fuels such as wood to petroleum products and electricity ; while in developing countries, households often continue to use simple biomass fuels, despite the fact that, cleaner and more sophisticated fuels are available, (Smith,1987). Although the proportion of global energy derived from biomass fuels fell from 50% in 1900 to around 13% in 2000, there is evidence that their use is now increasing among the poor (Albalak, 1997).

Poverty is one of the main barriers to the adoption of cleaner fuels. The slow pace of development in many countries suggests that biomass fuels will continue to be used by the poor for many decades. Biomass fuel is any material derived from plants or animals which is deliberately burnt by humans and wood is the most common example, but the use of animal dung and crop residues is also widespread (De Koning et al, 1985). China, South Africa and some other countries also use coal extensively for domestic needs and despite the significance of exposure to indoor air pollution and the increased risk of acute respiratory infections in childhood, the health effects have been somewhat neglected by the research community, donors and policy-makers (Smith, 1997 and Chen et al,1990).

In general, the types of fuel used become cleaner and more convenient, efficient and costly as people move up the energy ladder (Smith, 1994). Animal dung, on the lowest rung of the ladder, is succeeded by crop residues, wood, charcoal, kerosene, gas and electricity; thus, people tend to move up the ladder as socio-economic conditions improve. Other sources of indoor air pollution in developing countries include smoke from nearby houses, the burning of forests, agricultural land, household waste and the use of kerosene lamps (Smith, 1994; and McCracken and Smith, 1998) as well as industrial and vehicle emissions. Also, indoor air pollution in the form of environmental tobacco smoke can be expected to increase in developing countries. It is worth noting that fires in open hearths and the smoke associated with them often, have considerable practical value, for instance in insect control, lighting, the drying of food, fuel, and the flavouring of foods (Smith,1997).

## III. Research and Methods

Structured questionnaire was employed to obtain information relating to morphology and environmental characteristics of the study area from residents in various residential densities. This information include: perception of residents on level of usage of sources of indoor air pollutants, and impacts of indoor air pollution particularly on the vulnerable group.

The whole of Ogbomoso Township constitute the sample frame for this research. This comprises of two local government areas (Ogbomoso North and Ogbomoso South). The local government areas form the hub of development of the city with dense heterogeneous population characteristics in terms of income, education background, tribe, and types of building among others. The city is observed to be a medium developing urban centre with unprecedented growth both in population and spatial extent (Adeboyejo and Abolade, 2006). The growth of the city has been undoubtedly attributed to its educational function which has attracted new generation banks and establishment of new hospitals. It is also recognized to be the second largest indigenous city in Oyo State after Ibadan; this further enhances its selection for the research.

Multistage method of sampling shall be employed for collection of primary information for this study. Using the existing spatial structure of the city, both stratified and systematic random sampling technique was employed. The inventory of localities from the twenty wards of both LGAs, their residential densities and population figures was sourced from National Population Commission (2006). The localities in the twenty (20) recognizable wards within the study area was identified by residential densities (high, medium and low) using ratio 3:2:1 in that order in consonance with Adeboyejo (2002); Afon (2005); and Singleton et.al. (1989).

Forty eight (48) localities stratified into high, medium and low residential densities was randomly selected and systematically sampled for questionnaire administration. The first resident was picked at random and subsequent ones at an interval of two (2) buildings apart. A total number of three hundred and seventy three (373) structured questionnaires was administered to the residents in the selected localities. This represents 0.1% of the projected population for 2013. To examine resident's perception of the impacts of indoor air pollution on their health, certain indices shall be developed. These include: Awareness Index (i.e. IIEA) to examine its level of awareness on its associated impacts within the indoor environment. This was measured through Likhert scale rating from Not agreed (0), Agreed (3), Very much agreed (5). The average weight for each variable shall be computed as individual index required for the study.

## IV. Discussion of Findings

### a) *Residents' Perception on Usage of Household Materials and Indoor Air Pollution*

Likhert scale rating was employed to ascertain the frequency of the use of house materials that generate indoor air pollution in the area. The responses of the respondents' were rated into four classes respectively to calculate Residents' Usage Index (RUI). Thirty four identified variables were examined to determine the frequency of residents' usage of materials that generates indoor air pollution. Each of the variables will be rated in respect to Likhert Scale (1961) as either "very frequent", "frequent", "not frequent"," none", to indicate the level of respondents' usage and each of the rating was assigned a weight value of 4,3,2, and 1 respectively in decreasing order of relevance.

Resident Usage Index (RUI) was each variable, was calculated, the weight value was summed up and divided by the total number of the respondents. The usage weight value (UWV) was obtained by adding the products of the numbers of responses in each of the identified variables and the weight attached to each rating. The mean of RUI distribution was derived by dividing the total UWV by total number of questionnaire. The deviation about the mean was calculated. The standard deviation (S.D) and variance of the distribution were also calculated to measure how they are scattered around the mean as illustrated in Figure I and 2 (i.e how small or large the observations fluctuate below or above the mean). The co-efficient of variation was determined to measure the usage in the data relative to the mean in percentage. A positive calculated deviation indicates a high level of usage of the interested variables. When the deviation is negative it denotes a poor level of usage of the concerned variables.

RAI= Residents Usage Index
UWV=Usage Weight Value
NR=Number of Respondents
$\sum$ (UWV/N) =RAI
Or RUI=a/NR (a=UWV)
S/N=Number of materials that generate indoor air pollution as deodorants

### b) *Usage of Cosmetics*

The use of" perfume" as cosmetics have the highest index value of (2.30) compared to other categories. This implies that it is the most frequently used in the study area that contributes to indoor pollution. This is probably because larger proportions of the respondents are female and they use perfume to expel body odour. This is followed sequentially by the use of "perfumed cream" (2.18), and use of Deodorants (1.90). The use of "roll on" is the least used among the identified variables under deodorants (1.60). The RUI distribution recorded a variance of 0.2024 and the standard variation of 0.22. The coefficient was 18.33% (table 1).

*c) Usage of Cleaning Agents*

Among the variables employed to examine level of usage of cleaning agents, "germicides" has the highest index value of (2.61) as shown in Table1, which implies that it is the most frequently used household materials that constitute indoor air pollution in the study area. Most respondents use it because it helps in the prevention of germs especially in toilets and bathrooms. It is followed by the use of "bleach" (2.00). Harpic is the least used among the identified variables (1.76). This is because harpic is only common with the high income earners and those with high education standard. who use modern toilet as against those with low socioeconomic status. The excess use of such materials will lead to respiratory disorder and sometimes skin irritation most especially when it comes in contact with skin. The RUI distribution recorded a variance of 0.3841 and the standard variation of 0.31. The coefficient was 19.38%.

*d) Usage of Odour Expeller*

The usage of odour expeller was also examined as one of the categories of household materials liable to generate indoor pollution. Among the variables identified, in the use of air fresheners which recorded the highest usage index value of (2.30) as shown in Table 1. This implies that it is most frequently used household materials that constitute indoor air pollution in the study area. This is followed by the use of naphthalene having (1.97). Incense is least used among the identified variables under odour expellants (1.79). The excess use of all these materials has serious health implications. The RUI distribution recorded a variance of 0.1338 and the standard variation of 0.18. The coefficient was 11.11%.

*e) Usage of Insecticides and Rodenticides*

The use of insecticides like mobil, raid among others, has the highest index value of (2.29). The incidence of high index value is premised on the poor hygienic and unsanitary nature of most houses and other environment which allows for infestation of insects like mosquitoes, cockroaches and flies. Consequently, the need for insecticides of various grades and types is necessitated. On the other hand some household have employed the use of mosquito coils which has index value of 2.23 and mosquito repellant leaf RUI (1.79.) where available because it is cost free and less harmful. Similarly rodenticides have been put in use to control; the breeding of rodents and other pests. Rodenticides use had an index value of 2.14 as indicated in table 1. The Residents Usage Index with a mean value of 2.11 has a standard variation value of 0.33 and corresponding coefficient of variation of 15.64%. The exposure of humans to such materials like insecticides without adequate ventilation in building will lead to several respiratory problems, which will undoubtedly lead to irritation of the lung.

*f) Usage of Fuels and Lightening Materials*

The use of kerosene, lanterns, charcoal and generators all have high RUI index values of 2.57, 2.38, 2.20, and 2.15 respectively which imply that they are frequently used in the study area. All these are however sources of noxious indoor pollutants. Others like candle, firewood and sawdust have a relatively low RUI value (1.75) when compared with the mean value. Exposure of eyes and nose to cooking fuels can generate oxides of carbon, which often results to eyes and lung problems. The RUI distribution recorded a variance of 1.127 and the standard variation of 0.22. The coefficient was 12.87.

*g) Usage of Household Equipments*

Among other variables employed for measurement for household equipments, use radio has the highest index value of (3.09). It is followed sequentially by the use of "electric iron" having (3.00), the use of television (2.97), the use of standing fan (2.71), and the use of refrigerator (2.57). The use of "air conditioner" has the least RUI value of 1.78. This is because it can only be afforded by the high income earners. The high usage of household equipment like radio television, use of electric iron will increase indoor temperature and sometimes emit waves that may likely heat up the body, this consequently leads to damage of cells in the body. The RUI distribution recorded a variance of 1.214 and the standard variation of 0.42. The coefficient was 15.79

*h) Usage of Building Materials*

Among variables examined under the use of building materials " asbestos" as building material have the highest index value of (2.71). It is the most frequently used household materials that constitute indoor air pollution in the study area. It is followed sequentially by the use of paints having (2.49). The use of POP is the least among the identified variables in the use of building material with (1.36). The least proportion recorded for POP is expected because it is highly expensive when compared with other roofing materials like asbestos or modern roof; consequently it is mostly used by affluent or rich people. Exposure to particles from asbestos and POP can results to cancer of the lung. The RUI distribution recorded a variance of 0.0783 and the standard variation of 0.020. The coefficient was 6.39%.

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*Table 1 :* Perception on Usage of Household Material and Indoor Pollution

| Household Materials | Respondents Opinion | | | | NR | AWV | RAI | (A-A) | $(A-A)^2$ |
|---|---|---|---|---|---|---|---|---|---|
| | 4 | 3 | 2 | 1 | | | | | |
| Perfume | 78 | 76 | 83 | 123 | 360 | 829 | 2.30 | -0.3 | 0.00 |
| Perfumed cream | 100 | 85 | 55 | 120 | 360 | 785 | 2.18 | -0.18 | 0.0324 |
| Deodorants | 34 | 72 | 70 | 184 | 360 | 676 | 1.90 | 0.1 | 0.01 |
| Roll on | 35 | 51 | 72 | 202 | 360 | 567 | 1.60 | 0.4 | 0.16 |
| Germicides | 113 | 89 | 61 | 97 | 360 | 938 | 2.61 | -0.49 | 0.2401 |
| Bleach | 32 | 89 | 86 | 153 | 360 | 720 | 2.00 | 0.12 | 0.0144 |
| Harpic | 42 | 56 | 77 | 185 | 360 | 633 | 1.76 | 0.36 | 0.1296 |
| Air Fresheners | 90 | 67 | 65 | 136 | 360 | 827 | 2.30 | -0.28 | 0.0784 |
| Naphthalene | 50 | 70 | 60 | 180 | 360 | 710 | 1.97 | 0.05 | 0.0025 |
| Incense | 47 | 51 | 43 | 219 | 360 | 646 | 1.79 | 0.23 | 0.0529 |
| Insecticides | 45 | 129 | 71 | 115 | 360 | 824 | 2.29 | -0.18 | 0.0324 |
| Mosquito coil | 62 | 92 | 74 | 132 | 360 | 804 | 2.23 | -0.12 | 0.0144 |
| Rodenticides | 55 | 87 | 72 | 146 | 360 | 771 | 2.14 | -0.03 | 0.0009 |
| Mosquito Repellant leaf | 36 | 70 | 36 | 218 | 360 | 644 | 1.79 | 0.32 | 0.1024 |
| Rechargeable Lantern | 144 | 93 | 38 | 85 | 360 | 1016 | 2.82 | -0.66 | 0.4356 |
| Kerosene | 111 | 91 | 49 | 109 | 360 | 924 | 2.57 | -0.41 | 0.1681 |
| Lantern | 88 | 96 | 41 | 135 | 360 | 857 | 2.38 | -0.22 | 0.0484 |
| Charcoal | 67 | 87 | 56 | 150 | 360 | 791 | 2.20 | -0.04 | 0.0016 |
| Generator | 94 | 93 | 41 | 132 | 360 | 775 | 2.15 | 0.01 | 0.001 |
| Candle | 43 | 69 | 48 | 199 | 360 | 674 | 1.87 | 0.29 | 0.0841 |
| Firewood | 60 | 48 | 33 | 219 | 360 | 669 | 1.86 | 0.3 | 0.09 |
| Naked Fire | 42 | 61 | 40 | 217 | 360 | 648 | 1.80 | 0.36 | 0.1296 |
| Saw Dust | 50 | 39 | 43 | 228 | 360 | 631 | 1.75 | 0.41 | 0.1682 |
| Radio | 172 | 107 | 23 | 59 | 360 | 1114 | 3.09 | -0.43 | 0.1855 |
| Electric Iron | 157 | 108 | 32 | 63 | 360 | 1079 | 3.00 | -0.34 | 0.1154 |
| Television | 177 | 75 | 29 | 79 | 360 | 1070 | 2.97 | -0.31 | 0.0988 |
| Standing Fan | 131 | 85 | 51 | 93 | 360 | 974 | 2.71 | -0.05 | 0.0025 |
| Refrigerator | 135 | 63 | 35 | 127 | 360 | 926 | 2.57 | 0.09 | 0.001 |
| Coal Iron | 102 | 94 | 37 | 125 | 360 | 889 | 2.47 | 0.19 | 0.0361 |
| Air conditioner | 62 | 36 | 23 | 239 | 360 | 641 | 1.78 | 0.88 | 0.7744 |
| Asbestos | 141 | 80 | 31 | 108 | 360 | 974 | 2.71 | 0.02 | 0.004 |
| Painting | 108 | 87 | 39 | 126 | 360 | 897 | 2.49 | -0.3 | 0.09 |
| Furniture | 106 | 89 | 45 | 12 | 360 | 793 | 2.20 | -0.01 | 0.0001 |

*Source: Authors' Field Survey (2014)*

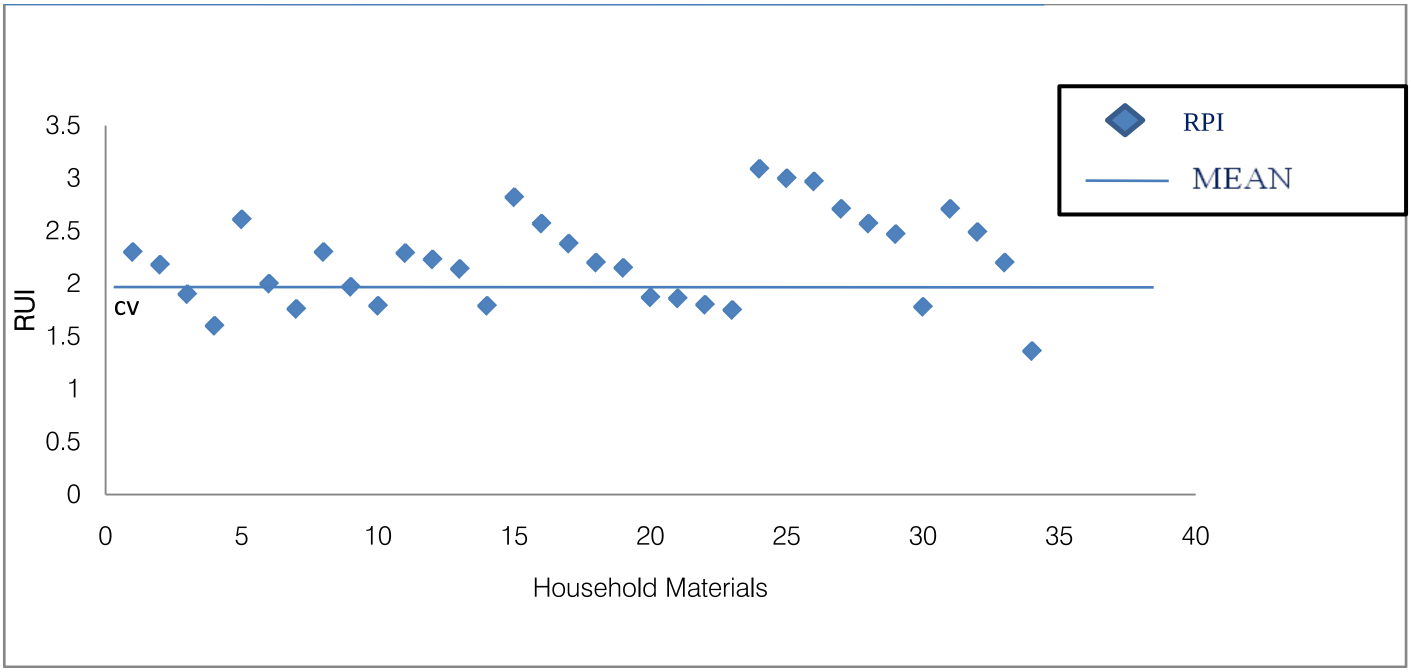


*Figure1 :* Scattered diagram on Usage of Household Materials and Indoor Pollution

*i) Health Effects Associated with Household Sources of Indoor Air Pollution*

Table 2 summarizes responses of residents and their vulnerability to various ailments from the use of selected household materials. The results of analysis reveals that use of Odour expeller such as air fresheners, incense and naphthalene by residents in the study area causes discomfort such as sneezing (47.0%) and eye irritation (35.3%) problems The same pattern of ailment was observed for fuel and lightning materials like charcoal, firewood, saw dust, kerosene, generators, naked fire lamps, lantern and others where larger proportion of residents also experience sneezing (47.8%) and eye irritation (43.9%). Similarly the responses on effect of building materials (asbestos, pop plywood among others) and cleaning reagents like bleach, happic etc reveals that most residents experience sneezing, eye irritation, dizziness while some reported symptoms of headache. On the contrary, the ailments experienced from the use of insecticides and rodenticide differs slightly from the pattern recorded for other household materials. It is equally revealed from result of analysis in Table 2 that use of insecticides causes sneezing (40.5%), dizziness (33.0%), breathing problems(31,4%) while use of electrical equipments like radio often cause headache (23.2%) compared to proportion of other aliments experienced by residents. This is expected because of the high noise level mostly produced when the instrument its put to use. Generally, the ailment experienced by use of household materials liable to cause indoor pollution varies from sneezing, eye irritation, dizziness headache and breathing problems. The symptoms of sneezing associated with most household materials is established in literature that nasal irritation and neurological damage is associated with the use of asbestos ceilings. Further analysis reveals that the proportion of ailment among residential density varies and decreases from brazillian, flat compound and flat residential unit. The distribution of diseases among different building type is an indication of building characteristics vis a vis design pattern type of sources of household materials and socioeconomic characteristics of residents.

*j) Residents' Perception on the Level of Exposure of Household Members to Indoor Air Pollution*

Analysis on household members' vulnerability to indoor air pollution in the study area, was analyzed using the Likhert scale. Four level of perception were used to rate respondents' level of agreement on selected household members' exposure to indoor air pollution. They include "Strongly agree", "Agree", "Strongly disagree" and "Disagree" with the ratings being from 4 to 1 in order of agreement. Residents' responses to these were rated numerically to calculate Residents' Agreement Index ($RA_gI$). Four basic household members were identified (namely fathers, mothers, male and female children). These was cross matched to derive seven different suppositions on which respondent's level of agreement can be queried and rated using the Likhert scale. Resident's Agreement Index ($RA_gI$) of each supposition and the calculated weight value (WV) of each was summed up to get the Total Weighted Value (TWV). This was divided by the total number of the respondents. Calculated Weighted Value (WV) was derived by adding the products of the numbers of responses for each supposition was and the weight attached to each rating.

TWV = Total Weight Value = (WV X rating)

NR = Number of Respondents
WV = Weighted Value
$RA_gI$ = TWV/NR
$RA_gI$ = Residents Agreement Index

Table 1 shows the respondents' level of agreement on which household members are most susceptible to indoor pollution. A critical examination of the result of analysis reveals low Agreement index ($RA_gI$) of 1.85 for response "on male children are more exposed to indoor air pollution than the female". This implies that majority of the sampled population do not agree that male children are more exposed to indoor air pollution compared to the female. This explains why the supposition that female children are more exposed to indoor air pollution has a very high ($RA_gI$) of 2.72. The same trend is shown in the third supposition with majority not agreeing that fathers ($RA_gI$ of 1.81) are more exposed than mothers but agreeing that mothers are the ones really exposed with a very high $RA_gI$ value of 2.97. Moreover, the table further suggests that parents ($RA_gI$ of 2.28)) are more exposed to indoor air pollution than children ($RA_gI$ of 2.21) in the study area. Conclusively and deducing from the ($RA_gI$) values in order of decreasing magnitude, the most susceptible to indoor air pollution within the residential environment are mothers with the highest $RA_gI$ value of 2.97. Next are the female children with ($RA_gI$) of 2.72. This certainly owes to the fact that girls whether directly or indirectly share the mother's duty in the home. Then the male children are next to the female in susceptibility with $RA_gI$ value 1.85 while the fathers are the least affected probably because they are less involved with household chores. The distribution of of calculated RPI is illustrated in Figure 2, where majority of RPI values fluctuate above the mean. This implies they were highly perceived by residents as vulnerable group to indoor pollution

*Table 3 :* Household Materials and the Associated Ailments

| Odour Expellers | Frequency | Percentage |
|---|---|---|
| Dizziness | 85 | 25.0% |
| Eye Irritation | 120 | 35.3% |
| Sneezing | 160 | 47.0% |
| Head Ache | 74 | 21.8% |
| Breathing problems | 66 | 19.4% |
| Fuel and Lightening materials | | |
| Dizziness | 73 | 21.7% |
| Eye Irritation | 148 | 43.9% |
| Sneezing | 161 | 47.8% |
| Head Ache | 82 | 24.3% |
| Breathing problems | 100 | 29.7% |
| Building Materials | | |
| Dizziness | 24 | 7.1% |
| Eye Irritation | 62 | 18.2% |
| Sneezing | 88 | 25.9% |
| Head Ache | 42 | 12.4% |
| Breathing problems | 35 | 10.3% |
| Insecticides/Rodenticides | | |
| Dizziness | 78 | 23.1% |
| Eye Irritation | 62 | 18.3% |
| Sneezing | 137 | 40.5% |
| Head Ache | 61 | 18.0% |
| Breathing problems | 89 | 26.3% |
| Cosmetics | | |
| Dizziness | 114 | 33.0% |
| Eye Irritation | 111 | 32.1% |
| Sneezing | 142 | 41.1% |
| Head Ache | 42 | 15.7% |
| Breathing problems | 106 | 31.4% |
| Cleaning Reagents | | |
| Dizziness | 104 | 30.9% |
| Eye Irritation | 101 | 29.7% |
| Sneezing | 123 | 36.2% |
| Head Ache | 56 | 16.5% |
| Breathing problems | 52 | 15.3% |
| Electrical Equipment | Frequency | Percentage |
| Dizziness | 43 | 12.7% |
| Eye Irritation | 68 | 20.1% |
| Sneezing | 59 | 17.4% |
| Head Ache | 79 | 23.2% |
| Breathing problems | 41 | 12.0% |

*Source: Authors' Field Survey (2014)*

*Table 4 :* Residents' Perception on Vulnerability of Household Members to Indoor Pollution

| Vulnerable Group | WV for Respondents' Level of Agreement | | | | NR | TWV | RPI | Remark |
|---|---|---|---|---|---|---|---|---|
| | 4 | 3 | 2 | 1 | | | | |
| Male children are more exposed than female children | 88 | 135 | 108 | 125 | 246 | 456 | 1.85 | Low |
| Female children are more exposed than male children | 348 | 225 | 24 | 72 | 246 | 669 | 2.72 | Very High |
| Mothers are more exposed than fathers | 560 | 297 | 22 | 70 | 320 | 949 | 2.97 | Very High |
| Fathers are more exposed than mothers | 120 | 174 | 102 | 176 | 315 | 572 | 1.81 | Low |
| Children are more exposed than parents | 276 | 240 | 36 | 150 | 317 | 702 | 2.21 | High |
| Parents are more exposed than children | 228 | 297 | 78 | 123 | 318 | 726 | 2.28 | High |
| All are equally exposed | 340 | 156 | 110 | 148 | 340 | 754 | 2.21 | High |

*Source: Authors' Field Survey, (2014)*

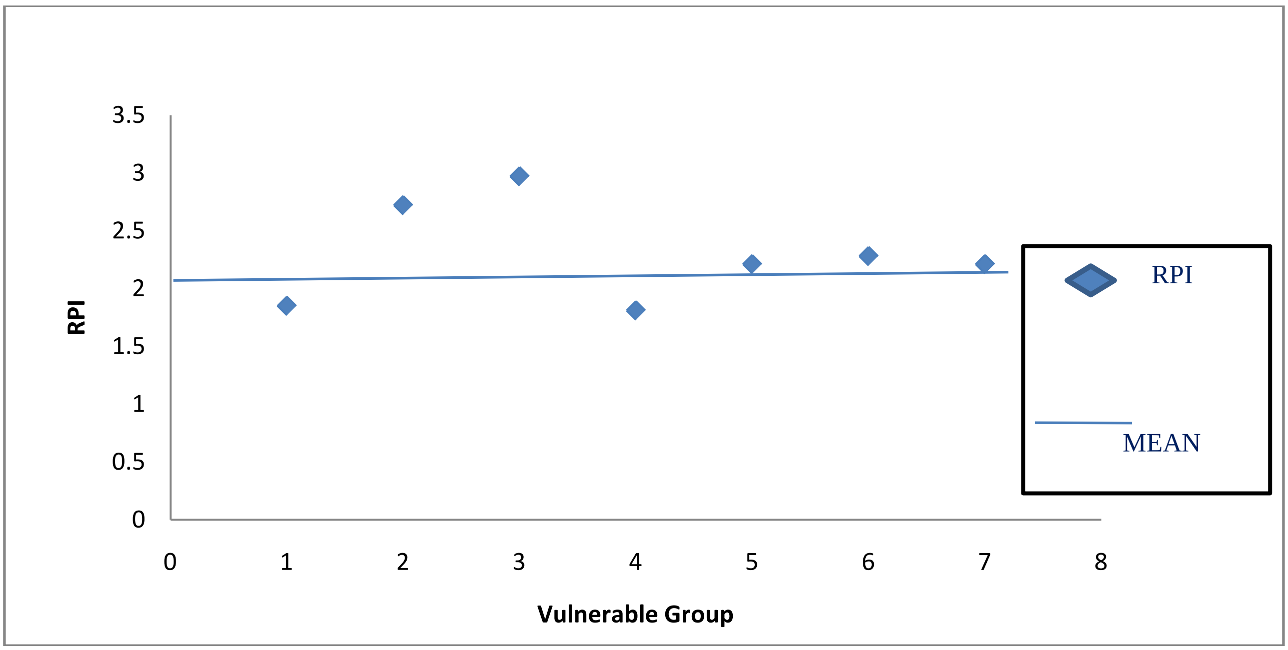


*Figure 2 :* Scattered Diagram of Residents Vulnerablility to Indoor Pollution

## V. Recommendation and Conclusion

The paper has established that usage of most household materials that are liable to generate pollution is mostly used by residents. Continuous usage and exposure to such household materials will undoubtedly cause major damage to organs of the vulnerable group if appropriate action are not put in place. The paper therefore, recommends use of local household material that are less free of pollutant and cleaner fuel should be made available by concerned government. Also proper awareness programme should be carried out to sensitize populace on associated danger on exposure to household materials the are prone to generate indoor pollution.

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