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RESEARCH ARTICLE

Waste Generation and Exposures and its Effects on Cardiovascular Health Status of Kwali Township Residents in Abuja, Nigeria

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Abstract

Over time, human activities have always generated wastes which pose deleterious effects on the physiologic and anatomical modalities of vital organs / systems. In this study, the effect(s) of exposures to wastes was investigated on the cardiovascular health status of Kwali township residents in Abuja, Nigeria. Three hundred and eighty (380) subjects, consisting of 200 residents who have been exposed (for 3 years or more) to waste disposals were selected (experimental group). Study also recruited a total of 180 non-resident / unexposed subjects (control) from the study area. Following selection, participants were assessed for cardiovascular parameters [Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP) and Pulse Rate (PR)] based on different exposure durations [3-5, 6-7 and 8-10 years], after obtaining their medical history with a questionnaire. Following statistical analysis (using the student t-test), study found a statistically significant increase ($p < 0.05$) in the SBP of exposed than non-exposed subjects; with DBP, MAP and PR increasing insignificantly. Gender-based comparisons also returned a significant increase in males the females, with an apparent, significant increase in cardiovascular variables for increased duration of exposures. Also, a significant, positive correlation was observed for SBD and DBP with increased exposure duration, implicative that the longer the duration of exposures, the higher the SBP and DBP. Thus, prolonged exposure of Kwali township residents to environmental waste increased most cardiovascular variables as compared to non-exposed individuals. More corroborative studies on this are recommended.

Keywords: Cardiovascular health, Waste Exposure, Waste Generation, Blood Pressur

Introduction

Since antiquity, human activities have always generated waste, and were never a major issue when their population was relatively small and nomadic. As humans evolved however, this has become a serious problem with urbanization and the growth of large conurbations [1]. Unarguably, poor management of wastes, coupled with exposures to waste products have caused contamination of water, soil and atmosphere, with major impact on public health. In medieval times, epidemics associated with water contaminated with pathogens decimated the population of Europe and even more recently (19th century), cholera was a common occurrence. Some of the direct health impacts of the mismanagement of waste are well known and can be observed especially in developing countries [2].

Currently, there are epidemiological based reports on high prevalence of environmental related health diseases, such as, silicosis, asbestosis, and pneumoconiosis among workers and inhabitants of different areas/environments across the globe, ravaged by improperly disposed wastes [3]. Globalization and increased population has also caused an increase in the number of waste disposals, and is reportedly worsened each day. This in turn increase the demand and need for proper management and also, the waste management workers [4].

Solid waste management systems cover all actions that seek to reduce the negative impacts on the human health. Developing countries are seriously facing the associated health problems in the collection, transportation and disposal of communal solid waste. In Nigeria for instance, due to unplanned communities and developments in major cities, environmental health related problems have become popular, often affecting the cardiovascular, respiratory health indicators of exposed subjects [5].

Epidemiological studies on the impact of waste management activities on human health are normally observational, as opposed to experimental, due to ethical reasons. Experimental studies are more typical of clinical trials carried out by/for the

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pharmaceutical industry, involving a test population (exposed to a specific substance, or drug) and a control (not exposed) population [6]. In this case, the expected outcome is normally a positive one (e.g. good health outcomes as a result of administration of vitamins, reduction of high blood pressure with hypotensive drugs).

The decomposition of waste into constituent chemicals is a common source of local environmental pollution. This problem is especially acute in developing nations. Very few existing landfills in the world's poorest countries would meet environmental standards accepted in industrialized nations, and with limited budgets there are likely to be few sites rigorously evaluated prior to use in the future. The problem is again compounded by the issues associated with rapid urbanization [7]. A major environmental concern is gas release by decomposing garbage. The Indirect health effects due to the contribution of greenhouse gases from waste disposal activities could be significant. Rising temperatures (and low level ozone levels) due to climate change would affect old people with cardiovascular problems and both old and young people with respiratory problems such as asthma. Diseases (e.g. malaria) that are spread by vectors such as mosquitoes could become more common. Rising sea levels, flooding and extreme weather events are also likely to cause destruction and casualties. The main cause of global warming is the increasing amount of greenhouse gases (CO_2, CH_4 and N_2O) in the atmosphere [8].

The toxic effects of waste disposals on the various haematological indices and liver have been studied in waste management on workers and exposed individuals with documented neurotoxicity [9, 10]. Prolonged exposure to air pollution and constituent wastes reportedly causes broncho-constriction [11]. Mucosal irritation and alveolar swelling. This ultimately leads to obstructive and restrictive disorders of lungs. Hence, present study will evaluate the cardiovascular, respiratory health functions of Kwali township residents who work with, and/or are continuously exposed to environmental wastes in the federal capital territory, Abuja, Nigeria.

Aim of Study

The general objective of this study was to investigate the cardiovascular health effects of waste generation and exposures on Kwali township residents in Abuja, Nigeria. Specifically, the study;

I. Investigated the effects of waste exposures on residents and waste management workers in Kwali township area of the federal capital territory, Abuja, Nigeria

II. Evaluated the effects of waste exposure on selected cardiovascular health markers (Systolic Blood Pressure, Diastolic Blood Pressure, Mean Arterial Pressure, Pulse Rate, and Rate Pulse Product) of inhabitants of Kwali township area in the federal capital territory, Abuja, Nigeria

Materials and Method

Study Location

This study was carried out in the Department of Public and Community Health, Novena University, Ogumeh, Delta State, Nigeria. The study was community based, obtaining data from the Kwali Area Council of the Federal Capital Territory (FCT), Abuja, Nigeria. Kwali is an area council in the Federal Capital Territory in Nigeria. Its headquarters is in the town of Kwali. It has an area of 1,206 km² and a population of 85,837 at the 2006 census (Figure 1).

Kwali Area Council plays host to a number of important monuments including Federal Government College National Mathematical Center Sheda Kwali, Sheda Science and technology complex, Nigeria Education Research and Development Center, National Fire Academy Centre, Nigerian National Petroleum Corporation (NNPC) pump station and several other government functionaries [12].

Study Design

The study was designed to investigate the cardiovascular health implications of prolonged exposures to environmental wastes on inhabitants of Kwali Township area, Abuja, Nigeria. The study recruited a total of three hundred and eighty (380) subjects, consisting of 200 samples who have lived in the study area for three (years) or more, and are apparently residing close to waste dump sites, and/or working in the waste management board of the said area (experimental group) as well as 180 non-resident / exposed subjects (control). Participants were then grouped by gender, years of experience at the job (for workers) and years of resident in the study area (for inhabitants). This grouping criteria was necessary to understand the effects of duration of exposures on the cardiovascular health. In each case, participants' cardiovascular health status was obtained, using questionnaire and appropriate medical instruments and compared for differences in mean where necessary.

Population of Study

The population of this study comprised of humans, and was

Figure 1: Google mapping of study area Source: Google map, 2020.

targeted at the residents of the Kwali township area, FCT, Abuja only be they indigenous or non-indigenous by origin to the study area. This area reportedly has a population of 85,837 at the 2006 census.

Sample and Sampling Technique

Using the stratified random sampling technique, a total of three hundred and eighty (380) participants were pulled out from the above population. The decision to sample 380 subjects was informed by the 2004 statistical relation of sample size calculation for a known population. The sample size was calculated using the computer program for epidemiologists (PEPI), version 3.01, employing the formula (below) for estimating sample size for single proportions as described by Armitage and Berry and cited in Abramson and Gahlinger [13].

$$SS = \frac{Z^2P \times (1 - P)}{C^2}$$

Where →

SS = Sample Size

Z = confidence level as z-score (95% = 1.96 from z-table)

P = Population proportion variance. (Maximal at 0.5 from binomial distribution table)

C = Confidence interval or margin of error (0.05).

Data Collection

Measurement of Cardiovascular Parameters

Sampled participants were required to rest in a quiet atmosphere for 30 minutes shortly before cardiovascular parameters [Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), Pulse Rate (PR), and Rate Pulse Product RPP] were assessed and/or determined. This was necessary to ensure that concerned variables reset to resting values that may have been altered by any noisy activity [14].

Blood Pressure

Using oscillometry method, participants' Systolic and Diastolic blood pressures (SBP and DBP) were obtained with the aid of the electronic sphygmomanometer (Omron Intelli sense M6 Comfort, Japan). A pressure cuff with about 60% coverage on the preferred limb (right arm) was wore round the brachium (arm) with the goal to monitoring the pressure change in the brachial artery under a pressured setting. The procedure was conducted at sitting and standing positions while recording the average values after three (3) repetitions

Heart Rate (HR)

The heart rate was concomitantly measured and recorded (in beats per minute) from the sphygmomanometer reading during blood pressure measurement.

Rate Pressure Product

The rate pressure product (RPP) which is a good measure of a subject's myocardial oxygen consumption (VO_2 max) was calculated by finding the product of systolic blood pressure and heart rate (RPP=SBP X HR) [15].

Pulse Pressure

This was calculated by subtracting the diastolic blood pressure from the systolic blood pressure (PP = SBP - DBP).

Mean Arterial Pressure (MAP)

This was obtained from the sum of diastolic pressure and one-third of pulse pressure (DBP+1/3PP).

Selection Criteria

Selection of subjects for participation was based entirely on available findings from reviewed literatures that are related to this work. Inclusion criteria were based on those that meet the selection criteria, while excluding subjects who do not meet the criteria. Stringent eligibility for participation was based on subject being an inhabitant of the Kwali township are, FCT, Abuja of at least 18 years old.

Ethical Considerations

Ethical consent was sought from the Research and Ethics committee of the Department of Community and Public Health, Novena University, Ogume, Delta State. Also, before actual investigation, consent forms was administered to seek participants' permission. Only subjects whose consent is obtained will actually be examined.

Questionnaire

An open questionnaire was carefully designed to assess the cardiovascular health and socio-demographic status of participants before investigation. Based on the answers gotten, subjects were either excluded or included in the study as a way of eligibility for their participation

Statistical Approach

The results were calculated using mean and standard error of means (SEM) respectively. The data from the obtained cardio-pulmonary variables were analyzed using one way ANOVA test and for significant level of ($p < 0.05$) as taken below variables. All statistical analysis and data presentation were automated with the graph pad prism version 8.

Results

(Figure 2-5)

Key: SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, MAP = Mean Arterial and Pressure

$^{*+}$ = Statistically Significant increase in Exposed (Experimental Grp) Compared with Unexposed (Control) Subjects at p-value < 0.05

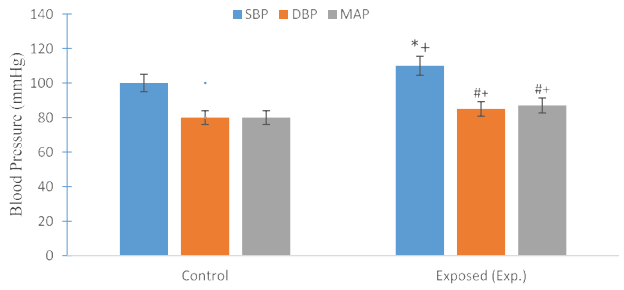

Figure 2: Comparative Changes in Blood Pressure Waste Exposed and Unexposed Subjects.

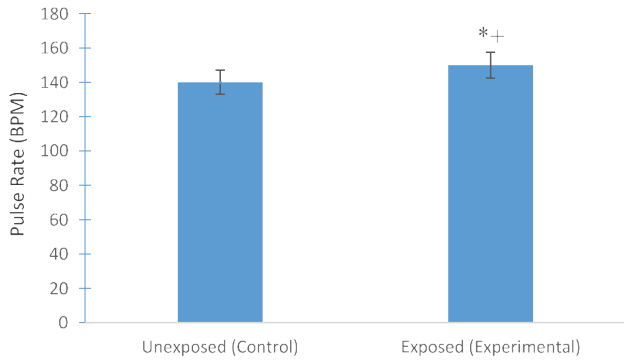

Figure 3: Comparative Changes in Average Pulse Rate of between Waste Exposed and Normal Subjects.

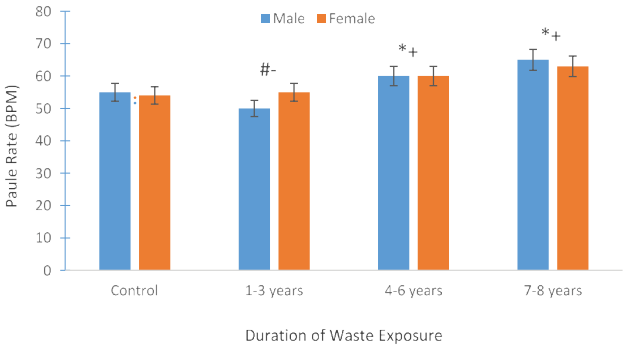

Figure 4: Comparative Changes in Average Pulse Rate of Subjects by Duration of Exposure to Waste.

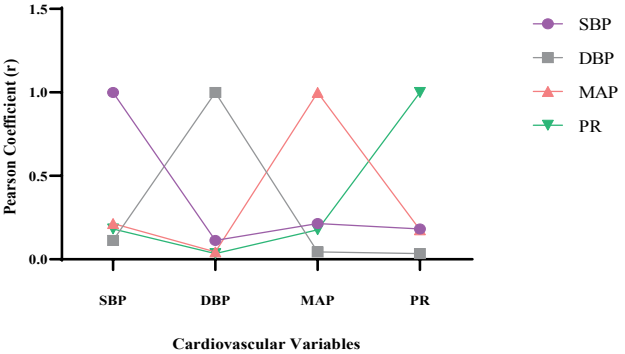

Figure 5: Relationship between Cardiovascular Variables in Waste Exposed Subjects.

#⁺ = Statistically Insignificant increase in Exposed (Experimental Grp) Compared with Unexposed (Control) Subjects at p-value < 0.05

**⁺ = Statistically Significant increase in Waste exposed (Experimental Grp.) Compared to Unexposed (Control) subjects at p-value < 0.05*

**⁺ = Statistically Significant increase ($p < 0.05$) in Pulse Rate for prolonged exposures (4-6 years, 7-8 years) of Kwali residents to waste disposals as compared to control. # = insignificant decrease ($p > 0.05$) between 1-3 years of exposures to generated waste as against the control*

Key: SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, MAP = Mean Arterial Pressure, PR = Pulse Rate and r = Pearson Product Moment Correlation Coefficient

$r = 1$ = perfectly correlated; $r < 0.5$ or > 0.0 = positively correlated; $r < 0.0$ = negatively correlated

Discussion

The purpose of this study was to investigate selected cardiovascular variables in the waste exposure of residents of Kwali, Abuja. The discussion thus focuses on round and highlights studies on the physiological changes in selected cardiovascular health indices of subjects exposed to environmental waste, as well as the length of exposures, both in current and previous findings. A total of three hundred and eighty (380) subjects residing in the district council of Kwali, FCT, and Abuja between the ages of 18 and 41 were ethically recruited for the study following due consultation and approval by the authorities concerned. Selected cardiovascular parameters were obtained for each resident and observed for improvements, after socio-demographic information was obtained using a questionnaire. Overall, 380 participants consisting of 180 controls (unexposed) and experimental (exposed) classes were involved in the entire process.

One hundred and ninety-seven (197) women (67 percent) were also included in this analysis of the total sampled subjects, whereas one hundred and forty-three (143) of them (43 percent) were males. Participants in this study were found to be less vulnerable to cardiovascular disease, which is evident in their blood pressure values (Figure 2). The average systolic blood pressure (SBP) and diastolic blood pressure (DBP) of Kwali residents who were exposed to environmental waste were also found to be within normal baseline limits. This was expected as it was one of the selection criteria for removing individuals with any type of complications and/or abnormalities in cardiovascular health. Panel studies (1998) indicated that when the mean SBP is greater than 120 mm Hg, or mean DBP is greater than 80 mm Hg, or when a person is currently on antihypertensive medication, blood pressure is "high" (HBP). He also recorded the prevalence of HBP in adults with more than 30 BMI as 38.4% for males while 32.2% for females.

The cardiovascular system is important for the optimal and successful maintenance of sufficient blood flow/pressure to maintain adequate tissue and organ perfusion in humans. Their work depends on myriads of physiological interactions that may be disrupted in disease state. In order to understand the dynamics of the cardiovascular system, the current study compared changes in selected cardiovascular and respiratory health markers between exposed and unexposed environmental waste in the Kwali township region of Abuja, Nigeria, with a view to exploiting an understanding of the complex effects on blood pressure of exposure to environmental waste.

One of the most common clinical methods of determining the circulatory state of humans is blood pressure. The research measured and contrasted Systolic, Diastolic and Mean Arterial Pressures (SBP, DBP and MAP) for exposed and non-exposed residents of Kwali. From our findings (Figure 2), a statistically significant increase ($p < 0.05$) in SBP was observed for exposed subjects (Experimental) relative to standard unexposed subjects (Control). Whereas, when compared to placebo, statistically insignificant changes in DBP were observed for exposures (at p-value <0.05). In contrast to non-exposed participants, the comparative difference in MAP significantly increased ($p < 0.05$) for exposed participants. Therefore, it can be deduced that SBP and MAP were higher in Kwali area residents who were exposed to environmental waste than in non-exposed individuals as key cardiovascular health markers. Apparently, DBP is more important and therefore it is more advantageous to have this decreasing capacity. As a result, modifications are required in exposed subjects for the prevention and management of high blood pressure than in non-exposed subjects.

In view of the above, it would be right to conclude that individuals subjected to environmental waste have a more chaotic (or less linear) cardiovascular function activity than normal subjects, because within the concept of health disease, the former, who do not have well-balanced sympathetic-parasympathetic systems, may also be considered 'less safe.' This reasoning is easily clarified since certain intrinsic or extrinsic variables must occur before the term to justify delivery (37 weeks). The effects of the assayed variables (SBP, DBP and MAP) used in the assessment of the normal cardiovascular trends in this study are also expected to change with different age groups and the presence or absence of comorbidities. This result is consistent with past studies by Huikuri et al (2003).

Cardiovascular function has been substantially impaired by PR and is a vital proxy for cardiovascular risk assessment. In their study entitled 'Longitudinal Shifts in Mean and Pulse Pressure (PR) and All-Cause Mortality; Data from 71,629 Untreated Normotensives' ordinarily, a rise in central PR or brachial PR has a risk of about 200 percent, while a decrease in PR has a relative risk of 15 percent. In this study, PR was shown to have significantly increased ($p < 0.05$) in exposed environmental waste as opposed to non-exposed subjects (Figure 3). This demonstrates its tremendous advantage in reducing the cardiovascular risk in normal subjects than in exposed subjects.

The average PP in normal subjects also did not improve in this study, although there was an insignificant reduction in time in waste-exposed subjects. RPP (rate pressure product), which is the index representing the rate of activity and the pressure of the cardiovascular muscle, is also involved in exposure to environmental waste. Therefore, variations with respect to heart pressure and the coronary artery in the RPP are important. Therefore, decreased cardiovascular muscle RPP contributes to long-term cardio-myocyte exercise that influences blood flow in the coronary artery and reduces heart overload.

Mean Arterial Pressure (MAP) is essential in the clinical context because it is known to assist in determining the blood flow rate and speed in the circulatory system. Decreased MAP relied on the capacity of the artery, arteriole, and vein to automatically adjust, and improvements in the ability to adjust and redistribute venous blood. A decline in MAP over time, comparable to the findings in the current research.

Conclusion

In this study, the cardiovascular variables were higher in non-exposed participants in younger and middle aged males and decreased significantly in individuals exposed to environmental fume who were exposed for a longer period of time. This research thus supports other studies that demonstrate that blood pressure is lower in waste exposed than non-exposed subjects. There is also limited evidence that long-term exposures to environmental waste can, with limited evidence in animals, cause cardio-pulmonary changes. The average values of the SBP and DBP of participants were also found from this analysis to be within acceptable limits at baseline, except for those who had been exposed to environmental waste for some time. This suggests, by definition, that with growing age exposures to environmental pollution, cardiovascular related ailment is likely to increase than younger generations of subjects.

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