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Sudden Natural Death in Owerri Imo State, a 10 Years (2003-2012) Retrospective Postmortem Study

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Abstract

Abstract: Sudden unexpected natural death (SUND) was uncommon in our environment; with the adoption of western life style and societal pressures this mode of death is becoming more common. Understanding the causes of sudden natural death is important for prevention and improving treatment outcomes.

Aim: The aim of this study was to describe the demographic data, the immediate cause of death and associated risk factors in the sudden unexpected natural death (SUND) cases in Imo state.

Methodology: The archived case notes, Post-mortem registers and reports in the data bases of Departments of Pathology and Medical records and Biostatistics of Federal Medical Centre (FMC) Owerri were used as the sources of data for this study from January 2003 to December 2012. Full post-mortem examinations were performed by consultant pathologists in the department using laid down protocols.

Results: The male to female ratio was 3.3:1 with mean age of 45.2 ± 17.0. The age range was 15 to 80 years. The peak age of incidence was in the 41-50 years age group. The leading causes of SUND were the cardiovascular system (CVS) 55.4%, followed by central nervous system (CNS) which made up 23.1%, gastrointestinal system (GIT) constituted 8.5%, the Respiratory system (4.2%), Vascular disorder (4.2%) and undetermined causes (6.4%). The associated risk factors included dietary factors 14 cases (29.8%), alcohol use 9 cases (19.15%), cigarette smoking (17.02%), Diabetes mellitus 6 cases (12.76%), family history 5 cases (10.64%), those without associated factors 3 cases (6.38%) and congenital anomalies 2 cases (4.25%).

Conclusion: In Nigeria, with increased western lifestyle, changes in dietary habits and rise in socioeconomic status, cardiovascular diseases especially complications of hypertension has become the most important cause of sudden unexpected natural death in our society. This calls for immediate and effective management of hypertension

through effective clinical and public health policy implementation.

Keywords: Demographic; Cardiovascular; Natural death; Postmortem

Introduction

The World Health Organization (WHO) defined sudden unexpected natural death (SUND) as deaths which occur within 1 to 24 hours after the onset of symptoms [1-3]. This event is not only tragic to the deceased relations and of concern to the coroner but may also have some predictive genetic implications for the surviving relatives [4]. Under the British system, all cases of sudden death which is not seen by a doctor within 14 days preceding death should be autopsied [5]. It is noteworthy that not all SUND has identifiable cause even after extensive investigation [5,6]. Several reports from developed countries indicate that the diseases of cardiovascular system are the most common cause of SUND. For instance, the incidence of sudden cardiac death in the USA, Ireland, China, Japan, UK/Wales and South Africa is 153, 51.2, 41.8, 37, 1.8 and 6.4 per 100,000 respectively [7-12]. Chugh et al. [13] reported that the global burden of sudden unexpected natural death accounts for an estimated 4-5 million deaths annually [13]. Despite the dominant involvement of the cardiovascular system, disease of any other organ system can result in SUND. For instance, majority of the sudden unexpected deaths reportedly involved the respiratory, central nervous, gastrointestinal and urogenital systems [14,15].

In Nigeria, there is paucity of reports of SUND. The available reports reflect the major causes of SUND in three of the six geopolitical zones of which the southeast Nigeria is yet to be inclusive [4,16-20]. Similar to the reports from developed countries, with the increasing modernization of lifestyle and dietary habits, cardio-vascular system diseases-particularly complications of hypertension have become the leading cause of sudden unexpected natural death (SUND) in our environment [16].

The aim of this study was to describe the demographic data, the immediate cause of death and associated risk factors in the sudden unexpected natural death cases in Owerri, Imo state, southeast Nigeria.

Methodology

Study design

This is a retrospective postmortem study.

Study area

Owerri is the capital city of Imo State in Nigeria, set in the heart of Igboland [6]. It is also the state's largest city, followed by Orlu and Okigwe as second and third respectively. Owerri consists of three Local Government Areas including Owerri Municipal, Owerri North and Owerri West, it has an estimated population of about 1,401,873 as of 2016 and is approximately 100 square kilometres (40 sq mi) in area. Owerri is bordered by the Otamiri River to the east and the Nworie River to the south [21].

Study population

Owerri consists of three Local Government Areas including Owerri Municipal, Owerri North, and Owerri West. It has an estimated population of about 401,873 as of 2006 [22] and has area of approximately 100 square kilometers (40 sq m). Owerri is bordered by the Otamiri River to the east and the Nworie River to the south [23,24].

Materials and Methods

The duration of this study was from January 2003 to December 2012. The archived case notes, post-mortem registers and reports were retrieved from database of the Medical records and biostatistics as well as the Department of Pathology of Federal Medical Centre (FMC) Owerri respectively. Cases of sudden unexpected deaths investigated through autopsy with complete post-mortem examinations performed by consultant pathologists in the department using laid down protocols were included in the study. However, autopsy reports with inconclusive cause of death, poorly documented findings, cases that stayed on admission beyond 24 hours and those without prerequisite ancillary investigations were excluded from the study. The demographic characteristics of the patients, social and medical histories, immediate cause of death and co-morbidities with corresponding histology findings, microbiological, ancillary clinical and postmortem investigations to confirm the diagnoses seen by naked eye inspection were collected. All the anthropometric variables were measured with metric rules and weighing scales. The most important associated risk factor detected in the patients was selected for the study. The data were analyzed with respect to age, sex, associated risk factors, primary disease and immediate cause of death.

Analytical process

The data was analyzed using SPSS version 16.

Ethical considerations

Ethical clearance for this study was obtained from Research ethics committee Federal Medical Centre Owerri. The certificate number is FMC/OW/HREC/138.

Results

In the period under review (January 2003 to December 2012) 486 medico-legal autopsies were performed. The cases that satisfied the inclusion and exclusion criteria of this study were 47 accounting for 9.7% of all post-mortem carried out in the Department of Pathology FMC Owerri within the period. The male to female ratio was 3.3:1 with mean age of 45.2 ± 17.0 . The age range was 15 to 80 years. The peak age of incidence was in the 41-50 years age group. 17.6% of the subjects were obese and 28.8% has complicated atherosclerosis of thoracic aorta. The age groups involved were 10-20, 21-30, 31-40, 41-50, 51-60, 61-70, 71-80 which constituted 4.3% (2 cases), 21.3% (10 cases), 17.0% (8 cases), 25.5% (12 cases), 12.8% (6 cases), 10.5% (5 cases), 8.5% (4 cases) respectively. These age group distributions of the SUND in Owerri are shown in the Histogram below.

Sudden death related to hypertensive cardiovascular disease and its complications occurred in twenty-six subjects. This accounted to for 55.4%. The average cardiac weight and left ventricular wall thickness were 519.3 ± 80.7 with a range of 375-650 g and 2.5 ± 0.4 cm with a range of 2.0 to 3.0 cm respectively. Males constituted 73.33% (19) of cases giving a gender disparity of 2.75:1 and involved people from 22 to 80 years. The mean age for both sexes was 51.0 ± 15.4 . Males had a lower mean age of 48.65 years compared to 56.75 years for females. 17.02% (8 cases), 27.66% (13 cases) of the subjects were obese and had complicated atherosclerosis of thoracic aorta respectively. Other associated risk factors included dietary factors 29% (14 cases), alcohol use or misuse 19.15% (9 cases), Cigarette smoking 17.02% (8 cases), diabetes mellitus 12.76% (6 cases), family history of sudden death 10.64% (5 cases), congenital anomalies 4.25% (2 cases) and those without identifiable risk factors 6.38% (3 cases) respectively. These risk factors may be single or in multiples in a single patient. These risk factors are illustrated in the pie chart below.

Three patients died of gastrointestinal tract-related diseases. These patients were aged 23, 48 and 52 years respectively. The youngest died of perforated gastric ulcer with massive haemoperitoneum, peritonitis and haemorrhagic shock. The remaining two died of ruptured esophageal varices consequent upon chronic liver disease with liver cirrhosis and portal hypertension. Other anatomic pathologic finding was haemorrhagic shock evident on the marked corticomedullary differentiation of the kidneys. One of the patients diagnosed with chronic liver disease also had lobar pneumonia as co-morbidity.

The central nervous system recorded ten cases. Two were cases of acute bacterial meningitis in a 15 and 45 year old male patients. The male to female ratio was 2.3:1 with mean age of 38.4 ± 10.7 years and age range of 15 to 47 years. The peak age of incidence was 41-50 years with a modal age of 45 years. These patients had prominent leptomeningeal vascular

congestion, purulent exudates on the cerebral hemispheres and base of the brain respectively and raised intracranial pressure with tonsillar herniation into the foramen magnum. The microbiology culture yielded *Klebsiella spp* and *Streptococcus pyogenes*. The second anatomic pathologic findings in the CNS were intracranial haemorrhage. The subarachnoid haemorrhage had male preponderance with a male to female ratio of 2.5:1. Most (87.5%) of the subjects who were victims of intracranial haemorrhage were obese and had complications of systemic hypertension. Moreover, there is a berry aneurysm circle of Willis in two cases.

Two cases of respiratory diseases were observed. One patient had chronic lung disease (Bronchial asthma) with pulmonary fibrosis, adhesion of the visceral to the parietal pleura with plugging of the bronchioles by thick, tenacious mucus and right atrial and tricuspid valve dilatation. A second case was acute alcoholic intoxication with aspiration of gastric content into the lungs. This patient also had marked cerebral edema (Table 1).

Table 1 Classification of causes of sudden unexpected natural death and the gender distribution.

s/n	Organ system	Cause of death	M	F	Freq	%	Sub total
1	CVS*	Hypertensive heart disease	11	3	14	29.8	55.40%
		Acute left ventricular failure	5	3	8	17	
		Congestive heart failure	1	1	2	4.3	
		Hypertrophic cardiomyopathy	1	1	2	4.3	
2	GIT*	Chronic liver disease with ruptured esophageal varices	2	1	3	6.4	8.50%
		Peptic ulcer disease with perforation	1	0	1	2.1	
3	CNS*	Acute bacterial meningitis	2	0	2	4.3	21.30%
		Intracranial haemorrhage	5	3	8	17	
4	RESP*	Chronic lung disease	1	0	1	2.1	4.20%
		Aspiration of gastric content	1	0	1	2.1	
5	Vascular	Complicated atherosclerosis with aortic dissection	1	0	1	2.1	4.20%
		Obesity with pulmonary embolism	0	1	1	2.1	
6	Undetermined		3	0	3	6.4	6.40%
Total			34	13	47	100	100

*CVS: Cardiovascular System, GIT: Gastrointestinal System, CNS: Central Nervous System, RESP: Respiratory System, M: Male, F: Female

Vascular diseases accounted for 4.2% (2 cases) of the cases involving two individuals who had complicated atherosclerosis with aortic dissection and cardiac tamponade. The second case had morbid obesity with pulmonary embolism. The cause of death in 6.3% of the cases (3) was not concluded after a comprehensive postmortem examination. All were between the age of 20 and 30 years with mean age of 25.67 years (Figures 1 and 2).

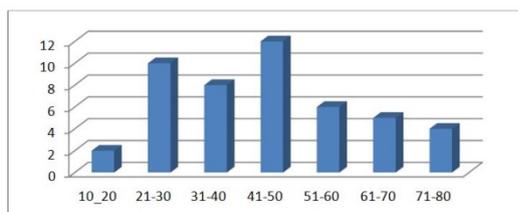


Figure 1 Histogram showing the distribution of sudden unexpected natural death among different age groups.

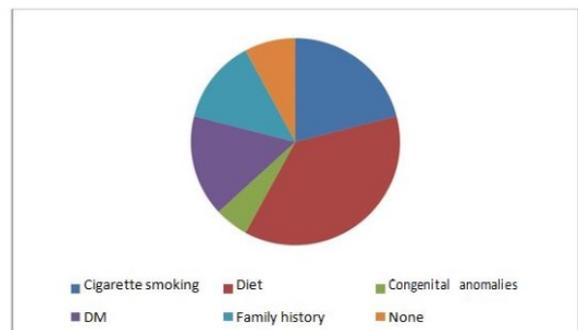


Figure 2 A pie chart showing the risk factors of sudden natural death in Owerri, Imo State.

Discussion

Sudden unexpected natural deaths (SUND) are public health problems accounting for 15-20% of all death worldwide [25]. In

this study, SUND constituted 9.7% of all medico-legal autopsies in Owerri within the period under review. The disease of the cardiovascular system (CVS), central nervous system (CNS) and the gastrointestinal system were the leading primary causes of death and constituted 55.4%, 21.3% and 8.5% respectively. Other organ systems involved were the vascular and respiratory tract diseases which together contributed 8.4%. There was significant gender disparity in the incidence of SUND in our study with male to female ratio of 3.3:1. The mean age was 45.2 ± 17.0 years with peak age of incidence in the 41-50 years age group. The commonest risk factor was dietary factors which constituted 29%, followed by alcohol use or misuse (19.15%), cigarette smoking (17.02%), diabetes mellitus (12.76%) and family history of sudden unexpected death (10.64%).

The contribution of SUND (9.7%) to medicolegal autopsies in Owerri appeared relatively small compared to reports from other parts of Nigeria. This observation is similar to those reported from Port-Harcourt, Ile-Ife and Oshogbo where SUND constituted 10.3%, 13.4% and 4% respectively [4,16,17]. However, in Benin City, Makurdi and South Africa SUND constituted 30.3%, 46.4% and 79.0% respectively of all medicolegal autopsies [14,16,20].

The gender disparity in this study is similar to those reported from Makurdi, Ireland, Turkey, Spain and India [8,20,25-28]. Other reports from Nigeria, USA, China, Turkey and Kingdom of Saudi Arabia indicated that the gender disparity were less marked and ranged from 1.7:1 to 2.2:1.4 [16,17,19,29-31]. However, reports from southwest Nigeria were akin to those of India, Iran and Jamaica with a wider male to female ratio ranging from 5:1 to 10:1 [17,19,32,33]. Hayashi et al. [24] reported that these sex differences in sudden death may not easily be explained. However, it may be the result of certain demographic and physiologic differences in the gender that confers relative protection to females. For instance, women especially at younger ages, appear to have higher rate of successful cardiopulmonary resuscitation and survival from arrhythmias, possibly due to favorable effects of smaller body size and/or estrogen on success of defibrillation and/or post-resuscitation hemodynamics. Secondly, in cardiac arrest survivors and sudden cardiac death autopsy series, coronary heart disease was found in 45–50% of women compared to 80–90% of men. Moreover, cardiac events occur in women at older age (postmenopausal age) compared to men [24]. In USA, Zheng et al. [28] observed that the gender differences disappeared after the age of eighty-five.

The peak age of incidence in our study was in the 41-50 years age group, with a mean age of 45.2 ± 17 and a range of 15-80 years. This agreed with previous studies from most parts of Nigeria, Turkey and South Africa [4,13,16,17,25]. However, Ngbea et al. [20] reported that the peak age of incidence of SUND in Markurdi, north-central Nigeria was in the 50-60 year age groups. This report agreed with studies from Ireland, USA, India and China where there is a steady rise in the age at which most victims had sudden death [7-9,17,34]. China Society of Pacing and Electrophysiology (CSPE) reported an average age at sudden death to be 58.5 ± 13.8 years compared to 67.2 ± 12.1 years reported by the USA Obesity, Metabolism and Nutrition

Institute (US OMNI). The differences reflect the impact of genetics, race and social environment in the development of cardiac diseases and subsequent sudden death [9]. Carnethon et al. [35] reported that the cause of the earlier age in the black population is due to the prevalence of the risk factors for sudden cardiac death such as hypertension, heart failure and peripheral vascular diseases. They also noted that despite the tailored pharmacotherapies for the African-Americans the management of cardiac diseases is less effective. This disparity is multifactorial and stems from individual to the social environment especially the poor health seeking behaviors among African-Americans [35]. However; Anderson et al. [36] observed that the major risk factor for American-Indians is alcohol abuse.

The commonest cause of death in our study was complications of hypertension which included hypertensive heart disease, congestive cardiac failure, and acute left ventricular failure. Hypertensive cardiovascular disease accounted for (26 cases) 55.4%. Similar observations were made in Benin City, Oshogbo, India respectively [19,14,37]. Studies in other parts of Nigeria showed that SUND related to hypertensive cardiovascular diseases constituted 28.3%, 39.3%, 87.5% in Ile-Ife, Benin City, and Port Harcourt respectively [4,16,17]. Moreover, 72.5% and 93.4% of cardiovascular-related SUND were reported from Iran and UK respectively [33,38].

The risk factors identified in this study had more direct impact on the cardiovascular system-related sudden unexpected deaths. They were dietary factors, alcohol use, cigarette smoking, diabetes mellitus and congenital malformations. In a couple of cases (6.4%), no real risk factor was identified. Dietary factor was the commonest risk factor as the clinical history of most victims did not reflect any pattern of healthy eating habits. Traditional diets in Sub-Saharan Africa which are low in fat and high in unrefined carbohydrates protect against cardiovascular diseases. However, there is huge nutritional transition in composition and structure of diet resulting in diet with high fat content - particularly saturated fat, low carbohydrates, fruit, and vegetables, as well as high salt intake which may lead to the emergence of cardiovascular risks [1]. There is an increase in the patronization or dependence on the fast food centres for burger, meat pies and polished white rice in Nigeria today. These western-type diets have less nutritional value than the whole grain and may have less effect on the lowering of blood pressures in the hypertensive patients than the brown rice and traditional African foods. Moreover, there is no much knowledge of the guide line to healthy eating in Nigeria and its attendant financial implication [39]. Moreover, cardiovascular causes of SUND are amenable to certain micronutrients used in the fortification of foods. For instance, Nishimura et al. and Fayed et al. [40,41] reported that γ -aminobutyric acid and isoflavones fortified foods can lower blood pressure. Isoflavones (natural micronutrients in vegetables), polyunsaturated fatty acids and magnesium help in the reduction of atherosclerosis and cardiovascular events [24,41]. Furthermore, mediterranean style diet pattern which contains high vegetable, fruits, nuts, whole grain, fish and low processed food is ideal in the control of most dietary related sudden unexpected natural deaths [24]. About 36.17% (17 cases) of the victim had history of alcohol and tobacco use though the quantification was difficult as it ranged

from occasional to moderate. These risk factors are important agents that accelerate atherosclerosis of blood vessels, increase the blood pressure, alter the lipid profiles and ultimately progress to cardiovascular death [42]. With the spread of malnutrition especially obesity, the prevalence of diabetes mellitus has been on the increase in Nigeria [42,43]. The prevalence of DM in Nigeria between 1963 and 1971 was less than 1% however, current reports indicate that it is between 8% and 10% [44-47]. In this study, 12.76% (6 cases) cases were hypertension co-existing with diabetes mellitus and obesity. Though DM may be a primary cause of SUND especially following its acute complications [31,48] in our observations DM was a co-morbid condition may be commoner in blacks. Reinier et al. [49] reported that African-Americans diagnosed with sudden unexpected natural death have higher prevalence of DM compared to the white counterparts. Moreover, Srivatsa et al. [48] observed that smoking, DM and obesity are important risk factors in India. Several reports indicated that diabetes mellitus, dyslipidaemia and obesity have summative adverse prognostic effect on hypertension and subsequent cardiovascular events [50-56].

The second most common cause of SUND in our study was gastrointestinal diseases which constituted 8.5% (4 cases). Majority of the gastrointestinal diseases were due to hepatic diseases especially cirrhosis with rupture of esophageal varices and perforated gastric ulcer. Reports from Benin City, Port Harcourt and Osogbo demonstrated that gastrointestinal diseases were the causes of SUND in 1.2%, 4% and 6% respectively [4,16,19]. Similarly, 6.7%, 10.7%, 13.8% of SUND in South Africa, India, Iran, and Thailand respectively were due to complications of gastrointestinal diseases [6,13,15,33].

The Central nervous system constituted 21.3% (10 cases) of all the SUND in this study. Bacterial meningitis and intracranial hemorrhage were the causes of sudden CNS-related death. The intracranial haemorrhages constituted 80% of the CNS diseases in this study with a 62.9% occurring in males. This observation agrees with previous studies [4,13,16,17,37]. However, 7.5%, 7.6%, 12%, 17.1% were reported in Iran, Thailand, India, South Africa respectively. 13, 14, 6, 33 In Glasgow, Black and Graham [57] reported that intracranial haemorrhage and bacterial meningitis were the second and sixth commonest cause of sudden unexpected CNS-related death respectively. The cerebrospinal bacterial meningitis may be related to ineffective phagocytosis that pave way for fulminant bacterial infection especially in patients with defective immune system [58]. However, the victims of bacterial meningitis in this study had no family or personal history of a premorbid condition that could account for the infections. The organisms isolated from the intracranial exudates were *Klebsiella spp* and *Streptococcus spp*. These organisms have special characteristics especially the protective capsules which make phagocytosis difficult and in this case no effective medical attention was sort before the death. In developed countries infective causes of CNS diseases appear to be low. For instance, Epilepsy is the commonest cause CNS-related sudden death in Scotland and Ireland [8,57]. The eight cases with intracranial haemorrhage were known hypertensives except two cases with ruptured berry aneurysm. Bowen et al.

[59] reported that in 20% of cases rupture of berry aneurysms could be sudden and unexpected.

The respiratory system contributed 4.3% (2 cases), all occurred in males. The immediate causes of death were Cor Pulmonale following chronic lung disease and aspiration of gastric content respectively. Obiora et al. [4] made similar observation in Port Harcourt. However; several reports from other parts of Nigeria showed that diseases of the respiratory system contribute a significant number to SUND. For instance, 12.5%, 18.2%, 20.7% were reported from Benin City, Ile-Ife, and Oshogbo respectively [16,17,19]. Similarly, 16.4%, 22.4%, 26%, 34.2% in Thailand, Turkey, India, South Africa respectively [6,14,18,25]. Previous studies in USA, England, France, Italy, South Africa, Germany and Wales demonstrated that acute viral infection of the respiratory tract can be a cause of sudden death especially in children below the age of six years [60-65]. In this study, the aspiration of gastric content occurred in a patient with acute alcohol intoxication. Alcohol misuse is a common cause of SUND and this usually follow acute intoxication, alcohol ketoacidosis or alcohol-induced cardiac arrhythmias [66,67].

The vascular events leading to SUND in this study were aortic dissection and pulmonary embolism. They constituted 4.3% of all the observations in our study. These were rare causes of SUND in our environment [4,16-19]. Clouse et al. [68] reported that aortic dissection is an uncommon cause of sudden death with the reported incidence of 3.5 per 100,000 annually in USA. Similar reports were made from Ireland, India, Spain, Japan and Germany [8,25,69-71]. The second vascular cause of death in this study was a case of an obese young female who died of pulmonary embolism. Though most previous studies in Nigeria had no case of pulmonary embolism as primary cause of sudden natural death, Akinwusi et al. [19] reported that 10.4% of sudden unexpected natural death in Oshogbo was caused by pulmonary embolism. Moreover, several reports demonstrated that 4.3%, 4.7%, 7.4% and 7.5% of SUND were attributable to pulmonary embolism in Spain, Jamaica, India and Iran respectively [32,72-83].

Conclusion

Finally, not all cases of sudden natural death are resolved even after extensive postmortem examination. In our study, the causes of death in 6.4% (3 cases) of the deceased were undetermined. In Ghana, Holland, Thailand, India and Australia undetermined causes of SUND accounted for 1.87%, 8.8%, 9%, 14.6% and 31% respectively. Several reports demonstrated that most unexplained deaths were mostly due to sudden primary arrhythmogenic causes in people with structurally normal hearts hence, genetic defects may be involved.

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