Thesis

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UNIVERSITY OF IBADAN

A GEOGRAPHICAL ANALYSIS OF CANCER INCIDENCE IN NIGERIA

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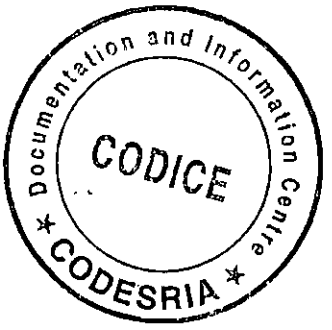

BY

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ABSTRACT

The scarcity of geographical studies of non-communicable diseases (NCDS) is noticeable in the sub-Saharan Africa, particularly Nigeria. This situation arises from the view that the non-communicable diseases are exclusively health problems of the advanced societies of the world. However, the scourge of these diseases especially cancer, is severe in this part of the world due to a gradual but significant epidemiological transition going on in the third world Countries. It is evident that all shades of lifestyles common in the advanced societies are already imported into Nigeria.

The present study is a comprehensive analysis of the spatial and temporal patterns of major cancer groups in Nigeria in order to explain their associative risk factors. To achieve these objectives, the study (i) identifies and analyses the spatial patterns of cancer groups at the regional and intra-urban levels; (ii) analyses the socio-demographic characteristics of cancer patients; (iii) identifies and compares the significant socio-economic, pathogenic and environmental risk factors associated with the cancer patterns and (iv) examines the Nigerian cancer profile over time and (v) analyse the trend of the specific cancer groups from 1960 to 1996.

The conceptual framework of this study is the ecological model of disease causation within the ambit of the epidemiological transition theory. Epidemiological Transition theory provided the basis for the shift of attention from predominantly infectious–parasitic diseases to the chronic-degenerative ones due to the transformation of the socio-demographic structure of the society. The ecological model of disease causation focuses the spatial variation in the occurrence of diseases due to variations in risks concentration in specific places.

The study is based on retrospective data on cancer morbidity (1960-1996) collected from the 5 existing National Cancer Registries at Ibadan, Ilorin, Ile-Ife, Enugu and Zaria. The bio-data: age, sex, marital status, occupation, and other vital information such as cancer site, and residency were collected on each cancer patient. While the bio-data provided information for the socio-demographic and lifestyles characteristics of the patients, the residential addresses were aggregated to portray the spatial pattern of cancer incidence. Data on the parameters of urbanisation, socio-economic development, demographic factors and pathogenic conditions of the 30 States and the Federal Capital Territory (FCT) in Nigeria were retrieved from the annual reports of the relevant Ministries and Agencies. These parameters were utilized to explain the regional pattern of cancer groups in Nigeria.

Primary data employed to explain the intra-urban pattern of cancer in Ile-Ife were collected through a household survey conducted to elicit information on the socio-environmental characteristics of the selected areas. In addition, data on the bio-chemical quality of water sources were collected from a report made available at the Obafemi Awolowo University, Ile-Ife.

This study revealed that all the cancer sites identified by the WHO disease classification were reported in Nigeria with varying magnitudes. The cancer sites grouped into 15 categories (excluding the ill-defined sites) tend to portray distinct socio-demographic characteristics. Sex differentials in cancer occurrence showed that, apart from cancer groups that are exclusive to the male and female physiology, the males were generally afflicted more (54.4 percent) than their female counterparts. Age cohort 46-60 accounted for the highest occurrence (30.0 percent) of cancers, followed by age cohort 30-45. These two age cohorts which constitute the nations labour force selectively suffered from cancers.

There are significant variations in the temporal characteristics of cancer groups in Nigeria. Whereas the overall cancer portrays an increasing trend into the future, the specific cancer groups that show rapid increase are breast, prostate and liver. On the other hand, leukaemia/lymphomas has been decreasing over the study period. Other cancer groups appear to show no remarkable pattern (increase or decline). Essentially, the temporal analysis of cancer occurrence in Nigeria shows a mutual existence of increasing trends of cancer groups that associate with socio-economic development on one hand and under-development on the other.

States in Nigeria that have outstanding cancer incidence are Oyo, Osun, Enugu, Kwara, Ogun, Ondo, Abia and Lagos. There is generally a high concentration of the States that reported high cancer incidence in the south-western part, followed by the south-east while the least incidence rates are recorded by the northern states. Aggregation of these regional cancer incidences into the 3 broad ecological zones shows variations in the pattern of predominant cancers in each zone. Cancer groups that appear relatively important in the Sudan-Sahel Savanna zone comprise liver, gastro-intestine, oral, cervical, leukaemia/lymphomas and bone. In the (southern) Forest zone, breast, cervical, gastro-intestine, prostate and glands tend to be more predominant than others. On the contrast, mixed Wooded Savanna zone (middle belt) appears to combine cancer groups that are predominant in the Sudan-Sahel Savanna and Forest zones. These are breast, leukaemia/lymphomas, bone and liver cancer.

Regional pattern of cancer incidence has significant positive association only with percent of urbanisation. Moreover, the regression of cancer incidence on the associative variables shows that percent of urbanisation singly accounted for about 20.0 to 40.0 percent of the pattern (model 1). The addition of number of industries to percent of urbanisation in the regression

analysis (model 2) explained between 40.0 to 61.5 percent of cancer pattern in Nigeria.

There is a significant spatial variation in the pattern of cancer incidence among wards in Ile-Ife city. Specific cancer groups that tend to be predominant in the core (indigenous) area are liver, glands, gastro-intestine and cervical. The occurrences of breast and glands cancers are quite outstanding in the newer (modern) area of the city. Interestingly, the predominant cancers in the transition (semi-urban) area tend to feature partly those of the core and the newer residential areas. These are bone, prostate, liver and cervical cancers. Hence, the intra-urban distribution of cancers among the residential zones appears to reflect disparity in their socio-economic status.

Risk factors that explain the predominance of specific cancer groups in selected areas within Ile-Ife city are their socio-economic characteristics (status) and chemical parameters in groundwater. High socio-economic residential areas identified by factor analysis include O.A.U Staff quarters, Moore, Fajuyi and Eleyele. They have high percentage of income, formal education, housing quality, possess modern household facilities and good sanitary condition. Predominant cancer cases in these areas are breast, prostate and gastro-intestine. Additional predisposing factor besides this socio-economic level may be traceable to the high level of iron in the groundwater at some sites in the area.

On the contrast, areas that show evidence of low socio-economic status are Ode-Atan and Ajamopo. Their low level of income, high percentage of resident with no formal education, poor housing quality and sanitary condition appear to explain the predominance of cervical cancer and leukaemia/lymphomas cases. While the level of calcium, magnesium and total hardness appear

too low to provide any protection against cancer initiation, the high iron level in the pegmatite bedrock underlying Ode-Atan may be implicated in the high cases of gastro-intestine cancer reported in this area.

In conclusion, this study has demonstrated that epidemiological transition is on course in this part of the world. The transition has both temporal and spatial peculiarities in that Nigeria's experience shows a mutual co-existence of cancers of the economically advanced societies and those that characterise the underdeveloped societies. Indeed, cancer risk factors in Nigeria are predominantly socio-behavioural in nature, although these may be synergistic with the ecological/environmental factors. All these have implications for the planning of cancer intervention programme and the efficient allocation of bio-medical facilities needed for cancer management to the various geo-political zones in Nigeria.

CERTIFICATION

I certify that this work was carried out by Mr. Olusegun Oguntoke in the Department of Geography, University of Ibadan.

Supervisor

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MAY 2002.

DEDICATION

This thesis is dedicated to the Glory of the Almighty God.

For is " ...not by might,

nor by power,

but my spirit, saith the Lord ..."

The Holy Bible: Zechariah 4 v 6.

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CHAPTER ONE

BACKGROUND TO THE STUDY

1.1 Introduction

The current trend of research in medical geography focuses on health and its association with development and environmental changes. This includes the health effect of physical environmental changes on global, national or local scales and the consequences of socio-economic changes. Nowhere has this been more manifested than in the Third World, as "globalisation" processes, ranging from rapid urbanisation and accelerated industrialisation to the diffusion of new technologies and the consumption pattern that is common to Western societies, have altered lifestyles and triggered the dynamics in human health and disease. Hence, an important approach to the study of lifestyle diseases is the concept of epidemiological transition (Verhasselt, 1993; Phillips, 1991). The diseases of concern in this regard are the chronic-degenerative diseases such as cancer, cardiovascular or heart diseases and diabetes mellitus among others. It is noteworthy that medical geographic studies in this area are substantial in the developed countries while the developing countries are apparently understudied (Verhasselt, 1990). This position derives from the fact that the degenerative diseases are considered as exclusively the diseases of the western societies when in actual fact their scourges are severe in countries of the third world (Olweny, 1990).

However, there is a gradual but significant epidemiological transition on course in the developing countries since virtually all aspects of the western lifestyles are already

imported into these societies. Such lifestyles include smoking, drinking of alcohol, consumption of high fat diet and canned meat and food normally treated with chemical preservatives. These dietary practices are seen as indicators of affluence in this part of the world and therefore are highly esteemed and pursued. In the words of Solanke (1992), Olasinde (1992) and Stjernsward (1992) many acculturating people suffer (these) western diseases to a far greater extent than do the Western people themselves. This observation is truer of Nigeria than many other sub-Saharan African countries since the beginning of the 20th century (Akinkugbe, 1995; Iyun, 1992; Phillips, 1991).

The less developed countries (LDCs), which in the early part of this century put greater effort on the control of parasitic and infectious diseases, now witness the prevalence of non-communicable diseases as lifestyles and socio-economic characteristics of the population change. This experience is in conformity with the idea that modernisation of society transforms the demographic, economic, social and consequently the environmental structures, which change disease patterns (Zimmet and Whitehouse, 1981). With modernisation, most of the infectious diseases are brought under control, leading thereby to reduction in infant and child mortality. This net gain in childhood death increases life expectancy giving the population an old age structure that consequently exposes them to the risk of degenerative diseases with increasing age (Meades, Florin and Wesler, 1988).

In Nigeria for instance, life expectancy was put at 47 years in the 1980s, but currently the figure has increased to 60 years (National Population Report, 1996).

Similarly, health statistics which recorded just 236 cancer cases in 1927 (though this was not global) presently puts the figure at 100,000 cases per annum (History of Nigeria's Medical Records/Services 1904 - 1963; and Solanke, 1992). Additional evidence is the increasing number of studies on heart diseases and hypertension, which suggest that non-communicable diseases are gradually becoming the most important cause of morbidity and mortality in the developing countries (Commission on Health Research for Development, 1990; Feachem, Murray, Over and Phillips, 1992; The World Bank, 1993).

The transition of epidemiological profile from "old" to "new" disease pattern occurs in the first place in cities. The rate of urbanisation and the magnitude of urbanized population therefore have implications for this "new" disease profile. Though the developing countries are the least urbanized, yet their urban population already exceeds that of Europe, America and Japan combined (WHO, 1993). Coupled with this, is the high rate of urbanisation in these countries, which was put at 44 percent till the close of 20th century. In Nigeria, urban centres with population of not less than 20,000 inhabitants were just 56 in 1952/53; presently the figure is about 400 centres while 1,774 settlements have over 5,000 inhabitants each. Indeed, these urban centres do not breed the diseases of transition, but they provide favourable ecological conditions for their development. This situation is exacerbated by changes in lifestyle, diet and the acquisition of predisposing habits, which take place in these centres. These lifestyle changes are frequently related to advertising and new social pressures, which exist in cities. It is therefore not surprising, that a positive relationship has been found to exist between urbanisation rate and status,

and the prevalence of the diseases of affluence (Jamison, Mosley, Measham and Bobadilla, 1993). Of these diseases, cancer is occupying an outstanding position as a public health problem in Africa (WHO, 1985), and Nigeria, in particular (Akinkugbe, 1995).

1.2 The Research Problem

An overview of the spatial epidemiology of cancer in Nigeria is worthwhile since much of the available information relates to specific interest of the medical professionals. There is little documentation of the cancer situation in Nigeria, which perhaps perpetuates our inadequate awareness of its inter-regional patterns let alone the intra-urban variations. In other words, there has been an apparent neglect of geographic studies of cancer in the West African sub-region. Hence, there is dearth of information on the spatial variability, temporal dynamics and the identification of risk factors associated with cancer occurrence. As a result of paucity of relevant information about cancer, its prevention appears intractable. Essentially, before an intervention programme could succeed, identification of risk factors that are often location specific is indispensable.

Furthermore, comprehensive empirical studies that locate the disease profile of the developing countries of the Sub-Saharan Africa within the epidemiological transition model are scarce. The model postulates that the disease experience of a community starts with the predominance of the infectious and parasitic diseases; it later changes to another stage of the displacement of the former diseases by those of chronic and degenerative

types which eventually become more prevalent. This model, like the demographic transition model according to Notestein (1953), is essentially the experience of the European societies whose applicability has to be carefully examined in the third world countries. Indeed, the position of Nigeria's disease profile should be located within the broad spectrum of this model. According to Schell, Smith and Bilsborough (1993), "there is the need for the investigation of the urban pathogenesis which will allow Omran's epidemiological transition model to be adequately tested in Third world urban setting". This call poses a challenge to geographers since the disease experience and invariably the stage a country occupies within the model is determined by the biosocial and environmental milieu that surround its inhabitants.

1.3 Justification for the Study

The outstanding position of cancer as a public health problem amidst all chronic and degenerative diseases is predicated on its high case fatality. For example, an estimate of 5.9 million cases of cancer occurs per annum worldwide. Out of this figure, 4.3 million cases (73 percent) result in death (Olweny, 1990). This portrays the fact that even with advances in medical sciences, less than one-third of all cancer cases are successfully managed. This pathetic trend has come to stay in most developing countries including Nigeria. According to the health statistics, cancer occurrence in Nigeria is about 100,000 cases per annum with its selective scourge of the affluent in our society (Solanke, 1992).

It is also depressing to note that cancer tops the list of causes of mortality at our University Teaching Hospitals in Nigeria (Iyun, 1985). According to Solanke (1992), cancer was the 9th major killer disease in the 1970's in Ibadan, but it has now moved to 2nd position. It equally accounts for about 60 percent of all admissions in all hospitals in Ibadan. All these indicate the enormous dimension that this terminal health problem assumes presently in this country. Unfortunately, the public health policies in Nigeria are largely irresponsive to the geographical patterns, temporal dimension and the synergism between human and risk factors involved in the aetiology of this disease in our society.

Cancer is basically an environmentally induced health problem in about 80-90 percent of all cases (Verhasselt, 1992). In Nigeria, 95 percent of all cancers diagnosed annually are related to the physical and social environment (Solanke, .1992). By implication, genetic factors appear to play a negligible role in the aetiology of cancers in the Nigerian society. The strong association with the elements of the physical environment and largely, the social environment underscores the appropriateness of a spatio-ecological approach to identifying possible preventive measures against the diseases. Researchers such as Nash (1944), Shannon and Dever (1974), Giggs (1983), Iyun (1983), McGlashan and Harington (1985), among others have demonstrated the usefulness of this approach in disease study.

The spatio-ecological approach has been found useful in providing necessary information that aids the allocation of health care facilities for disease control and management to the at- risk communities. In order words, it has potential to pinpoint risk

factors that could be targeted in cancer intervention programmes. This is imperative in the face of the gross ineffectiveness of the bio-medical attempts, which focus on clinical management rather than prevention to solving the cancer problem.

The cost of cancer as a social blight is high throughout the world but unbearably higher in the developing world. Hitherto, only two-thirds of all cancer cases are manageable globally, coupled with the inactivity of the patients even where sophisticated technology is available. For the less developed countries (LDCs) where the available health resources are inadequate to cope with the treatment of infectious and parasitic diseases, the additional burden of the cancer infection will definitely offset the health care resources. Consequently, the populace is exposed to additional risk of the degenerative disease without a hope of receiving adequate care. These points therefore underscore the need for a research within the context of a biosocial environment to investigate cancer in this part of the world.

This present study intends to provide a comprehensive analysis of cancer morbidity in Nigeria, which will be useful to the West African sub-region as a whole. Besides, it will document and analyse the patterns of cancers and their associative risk factors. This type of analysis will assist us to identify the environmentally related conditions that tend to promote cancer in Nigeria. Moreover, it attempts to highlight more sensitive associative factors to scrutinize in the search for cancer aetiology, particularly in the Third world. Finally, it will provide information on the dimension of cancer within the general health profile of Nigeria.

1.4 Aim and Objectives of Study

1.4.1 Aim

The broad aim of this study is to provide a comprehensive analysis of the spatial patterns of cancers in Nigeria so as to identify and explain their associative environmental and behavioural risk factors. It equally intends to investigate the temporal dimension of cancers occurrences in order to identify their trends.

1.4.2 Objectives

The specific objectives of study are as follows:

i To identify and analyse the spatial patterns of cancer groups at the regional and intra-urban levels across the three broad ecological zones in Nigeria.

ii. To analyse the demographic characteristics of cancer patients in Nigeria that tend to predispose them to infection.

iii. To identify and compare the significant environmental and behavioural factors associated with the observed spatial patterns of cancer groups, so as to recommend preventive measures.

iv. To examine the Nigeria cancer profile over time and

v. To analyse the trend of specific cancer groups from 1960 to 1996.

1.5 Working Hypothesis

The study sets to test the following hypotheses:

(i) There is spatial variation in the incidence of cancers in Nigeria.

(ii) Cancer groups are sex and age specific in Nigeria.

(iii) The level of socio-economic development explains the regional and intra-urban pattern of cancer incidence in Nigeria.

(iv) There has been an increase in the trend of cancer and hence its contribution to the general health profile of Nigeria.

1.6 The Area of Study

The whole of Nigeria constitutes our area of study while on a micro- scale, Ile-Ife city was purposely selected for the intra-urban analysis of cancer incidence.

1.6.1 Nigeria

The territory of the Federal Republic of Nigeria lies within latitude 4^0 $1'$ and 13^0 $9'$ north of the Equator and between longitude 2^0 $2'$ and 14^0 $30'$ east of Greenwich Meridian. It is bordered in the north by the Republic of Niger, in the east by the Republic of Chad and Cameroon and in the west by the Republic of Benin. About 800km of the Atlantic Ocean coastline forms the southern border that stretches from the Badagry inlet in the west to the Rio del Rey River, just east of the Cross River estuary.

Nigeria has a total surface area of approximately 923,768 km^2, which makes it the tenth largest country in Africa. It is however, by far the most populous country with 88.5 million people in 1991 and current estimate of 100 million (FOS/NPC Report, 1996). Almost one in every five African is a Nigerian. There are more than 350 ethnic linguistic groups and a variety of social groups (Udo, 1970). In 1991, the country was divided into 30 administrative states and a Federal Capital Territory of Abuja (FCT). Currently, there are 36 states and the Federal Capital Territory. In this study the 30 administrative regions (states) and a Federal Capital Territory is the spatial framework adopted for use (Fig 1.1).

The prominent landforms in Nigeria include the Jos Plateau, which rises to between 600m - 1200m above the surrounding plains, the Nsukka - Enugu - Okigwe escarpment and the rugged high hills topography of the borderlands stretching from Adamawa to Obudu. The Niger - Benue trough divides the country into 3 major physical blocks, namely, the northern (north east and north west), south-western and south-eastern blocks.

In general, the rain bearing southwest monsoon wind from the ocean and the dry, dusty northeast trades from the Sahara desert influence the climate. There are two significantly seasons, the rainy season and the dry season. The duration of each varies from north to south. Indeed, there is a general decrease in the actual amount and reliability of the rainfall as well as the duration of the rainy season from south to north. The heaviest rainfall of over 2,650mm per annum is recorded in the Niger Delta area in the south, while less than 850mm is recorded in the far northern part

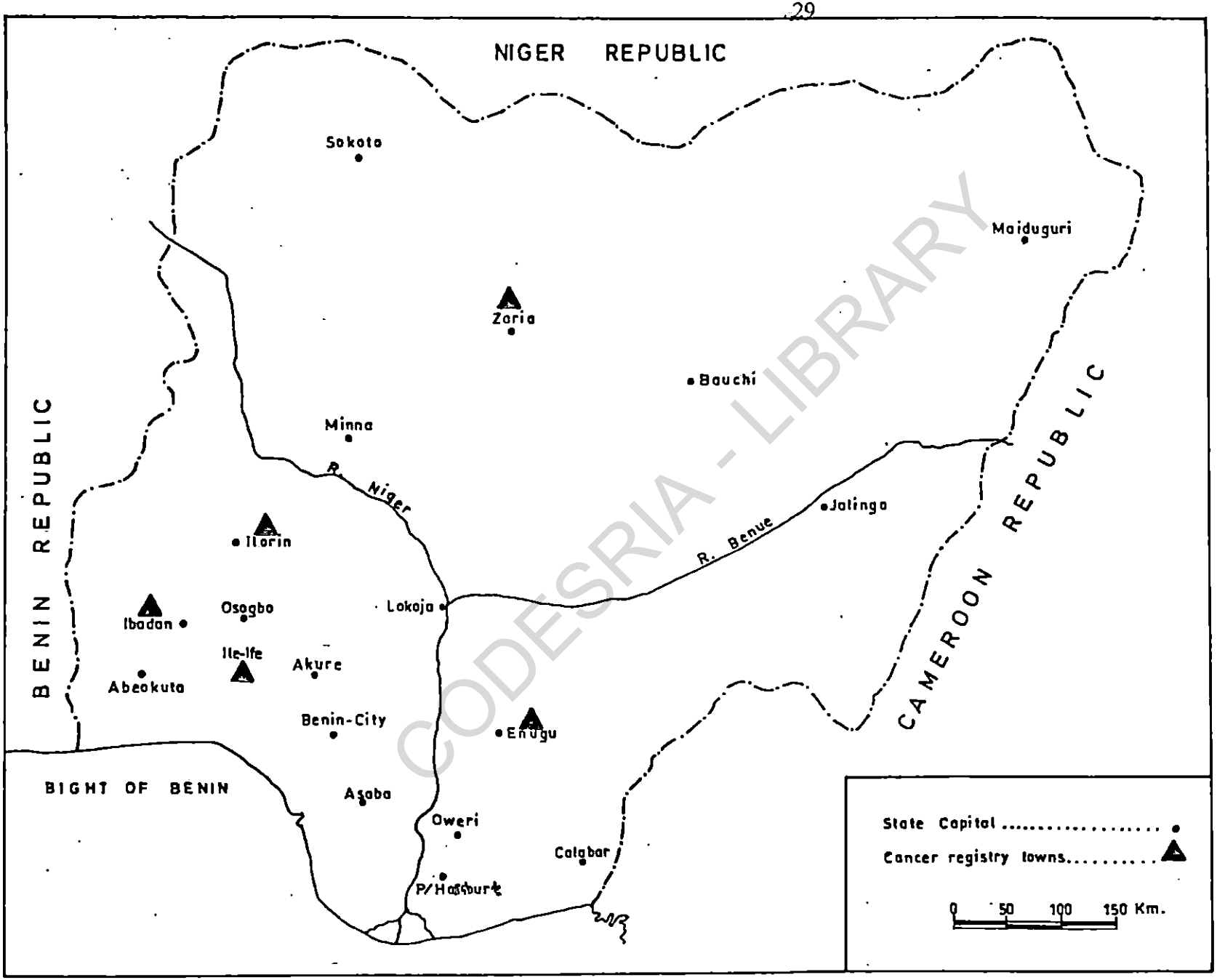


Fig. 1.1: Map of Nigeria showing the locations of Cancer Registry towns (1995).

(Sokoto, Kano, Maiduguri). The mean annual relative humidity varies over 80 percent around the coast to less than 50 percent in the far north. Diurnal variations are relatively minor when compared with the seasonal variations.

Maximum temperatures of over 40°C have been recorded in the northeast stations around Maiduguri, while frost has also occurred during the dry season. In other parts of the country, especially in the south, temperatures are fairly constant. The mean daily maximum temperature in the south rarely exceeds 32°C (February and March) and never below 28°C during the rainy season. The corresponding figures for the much drier and hotter heartland of the north are about 41°C for the hottest month (March and April), and about 25°C for the colder harmattan month (November - January). The climatic parameters outlined above indicate the tropical nature of Nigeria and they may have an implication for the aetiology of some cancers.

Important minerals found in Nigeria either in real or potential economic value are iron and ferro-alloy metals, non-ferrous metals, precious metals, radio-active minerals, metallurgical and refractory minerals, and the industrial minerals. The most important metal mined in Nigeria is tin ore. It is found with Zircon, Beryl and Tantalite in Jos Plateau and its environs. The two major regions of iron-ore deposits in Nigeria are in Agbaja Plateau (north of Lokoja), and the other near Nsude village on the Plateau west of Enugu. Coal is a major mineral fuel produced in Nigeria. The Nigerian coals are sub-bituminous and lignite. Sub-bituminous coals occur in seams in the scarplands of southeast Nigeria, Kabba province of the Kogi state and the adjoining Benue state.

Another major minerals fuel in Nigeria is mineral oil and natural gas. These are extensively found in the Delta region.

The radioactive minerals of Nigeria are quite small. Popular ones are uranium and thorium, which are found in Jos Plateau tin fields and Liruei Hills in Kano area. Limestone used in the manufacture of cement occurs widely in Nigeria. Large quantities of crystalline limestone have been located at Jakura near Lokoja and the adjoining parts of former Bendel state further south. Other major places are Shagamu – Ewekoro (Ogun State), Nkalagu (Anambra) Ukpilla (former Bendel State), south of Sokoto town, Ashaka (Bauchi State) and Yandev in Benue state. Most of these minerals are capable of contaminating underground and surface water either as natural deposits or in the process of transforming them into usable forms. This becomes more serious in Nigeria where water supplied for domestic uses are poorly treated.

While it is true that the broad features of the hydrology of Nigerian rivers are well known, the consideration of their qualities is very relevant to this study. Many factors determine the quality of the water including its chemical composition, the presence or absence of pathogenic organisms, the amount of sediments and its freedom from pollutants (natural or artificial). Routine analysis of water quality in Nigeria is poorly done. Nevertheless, some essential chemicals have been considered by Areola (1991). The level of dissolved salt in most Nigerian rivers is comparatively low. This is due to the nature of the underlying rocks which are either Basement complex crystalline rocks or sandstone. Deriving from this underground rock, water from most Nigerian rivers is

slightly acidic. Therefore, lime is usually added to domestic water supplies so as to reduce the acidity. Another chemical characteristic of river water in Nigeria is its deficiency in fluoride and requires that domestic water supplies be chlorinated before distribution. This will help to avert the health problem associated with fluoride deficiency. On the other hand, water from most Nigerian rivers is slightly acidic deriving from the nature of the underlying rocks. Else, it may impart negatively on the health of the people who consume such.

The vegetation of Nigeria has been classified broadly into forest and savanna. The forest zone covers the southern part of the country where the mean annual rainfall is at least 1150mm. Within the forest zone, density and height of trees reduce as one moves northwards. The savanna zone is made up of guinea savanna, which is the largest vegetation cover in the sparsely populated central part (middle belt) of the country. The Sudan savanna, features the predominance of short and feathery grasses. Similar vegetation is in the Sahel savanna which locates in the north-eastern part of the country.

The forest vegetation comprises of swamp forests, tropical forests and secondary forest regrowths. The swamp forests are found in coastal and deltaic regions and may be subdivided into the mangrove and the freshwater swamp forests. The mangroves are dominated by varieties of some tree species such as *Rhizophora, Avicennia, Gaminans nitida* and the shrub *Lagmicularia racemoza*. In case of the freshwater which occurs extensively in the Niger delta, also in the Ogun Forest Reserve, the Osun, Siluko and Osse valleys. Trees commonly found in them are *Symphonia globuliferia, Xanthoxylum*

zanthoxyloides, and Piptadeniastrum africanum, among others. The lowland tropical rain forest has been described by Keay (1952), as 'a complicated mosaic of communities of different status and floristic composition'. The humid forest around Benin region contains species of the families *Meliaceas* and *Leguminosae, Lophira alata, Nauclea diderrichii, Mimusops spp.* and *Omphalocarpum spp.* In the drier forests, *Sterculiaceae, Ulmaceae, Moraceae* are found. Secondary forest zone is largely a degraded forest zone which occupies the northern fringes of the tropical rain forest (Keay, 1952). In South-eastern Nigeria, this zone is represented by the oil palm bush which covers hundreds of square kilometres in Imo, Anambra and parts of Akwa-Ibom states.

Savanna vegetation covers nearly three-quarters of the land area of Nigeria but it contains very few tree species. In the northern Guinea Savanna, gallery forests occur along the watercourses. The most abundant and characteristics trees are *Isoberlinia doka, I. tomentosa, Monotes kerstingii* and *Uapaca togonensis*. The most abundant trees in the Sudan Savanna zone are *Anogeissus leiocarpus, Sclerocarya birrea, Balanites aegyptiaca, Lannea microcapa* and *Prosopis africana*. In the Sahel Savanna zone, *acacia* are the most abundant tree species especially, *A. raddiana* and *A. senegal.* These various tree species are of economic value in each of the zones as they are felled as timbers. Besides, their barks and leaves are used as herbal tea and concoction. Traditionally, the substances are used as alternative medicine for the treatment of ailments. Unfortunately, some plants found in this area have been identified to be carcinogenic (Uwaifor, Bababunmi and Emerole, 1982).

Nigerian soils are highly variable even within short distances, but they show marked correlations with relief and the underlying rocks. The major soil groups in the country are the highly ferruginous tropical soils, ferrisols, ferralsols, regosols and hydromorphic soils. The most important group of soils in Nigeria is the highly ferruginous soils. They cover the greater proportion of the country and support most of the important cash and food crops. The soils are derived mainly from Basement complex and old sedimentary rocks. Ferruginous soils are distinguished from the ferrasols by the marked differentiation of horizons, and the abundance of free oxides usually deposited as red or yellow mottles. Ferrisols have developed on sandstone formation such as Nupe, in the Guinea Savanna zone. They are transitional soils resembling the ferrasols but having less well-developed profiles. In the case of ferrasols, they are deep intensively weathered and highly leached soils with little horizon differentiation. They are well developed on the coastal sedimentary rocks and deposits comprising mostly sandstones, clay, shale and limestone. The soils have a very high content of iron, aluminium, manganese and other oxides diffused throughout the profile.

Regosols are largely immature and weakly developed soils. These soils occur mainly on the coastal sand ridge barriers and in Chad basin where they develop on desert sand – drift. Most of the groundnut produced in Nigeria is grown on these soils. The last major soil type are hydromorphic soils which are common along coastal creeks, valleys, depressions and estuaries.

The combined influence of climate, vegetation and soils determine the pattern of agriculture practice and products in Nigeria. It is therefore, possible to recognise distinct crop-ecological zones from the humid south to sub-humid north. In the southern forest zone, tree crops, are cultivated including cocoa, kolanut, oil palm, rubbers, coconut, plantain and banana. Of the food plants grown mainly for home consumption and internal trade are yam, cassava, cocoyam and sweet potato. In addition to these tree and root crops, numerous fruits are grown including pineapple, pawpaw, guava, citrus, mango and cashew. Maize, rice and cowpea are the principal grain crops of the zone, and melon, okro, groundnuts and vegetables are also widely cultivated.

The derived and southern Guinea Savanna zones of the Nigerian Middle Belt combine the root crop economy of the forest region and the grain crop economy of the Savanna regions further north. The major food crops are yam, potatoes, guinea corn, maize, rice and acha. The common cash crops include soya beans, benniseed, shea nuts, cotton and tobacco. In the drier, open Savanna grasslands of the north, grains, legumes and livestock are the principal products.

Like the rest of tropical Africa, Nigeria is poor in indigenous food plants, staples such as maize, cassava, groundnuts; some varieties of yams and several fruits have been introduced during the last two and a half centuries. Guinea corn and the oil palm are however indigenous food plants (Udo, 1970). Food habits vary with various ethnic groups, grains being the staple in the north, while root crops such as yams and cassava

form the staple foods of the south. Nevertheless, there has been considerable flow of foodstuffs from food surplus areas of middle belt to food deficit areas in the cocoa belt or forest belt and mineral exploration areas. This situation is further encouraged by migrants who keep the status quo of their native diets in their various destinations in the country.

Furthermore, with the current rapid rate of urbanisation and civilisation, the indigenous Nigerian society has been acculturated to the dietary habit which features the consumption of synthesised foods, canned meat with chemical preservatives, high fat diet and such like (Solanke, 1992). This dietary habit, which largely belongs to the economically advanced societies, has become the preference of the third world elites, being considered as a sign of affluence in our society. Assorted food items, which are imported from the developed countries, are now common in Nigerian supermarkets and local stores. This scenario has implication on the prevalence of cancers that associate with this dietary habit in our community.

Nigeria is composed of many ethnic groups, each of which has its own culture, traditions, customs and language. The larger groups are the Hausas, Fulanis and Kanuris in the north, the Tivs and Nupes in the middle belt, and the Yorubas, Ibos and Edos in the south. Prior to 1970, less than 10 percent of the population lives in towns that have more than 50,000 inhabitants. Most of these towns are concentrated in Yorubaland, where there were 6 urban centres with more than 100,000 people. The larger indigenous towns include Ibadan, Ife, Ogbomosho in the west, Kano, Zaria and Katsina in the north. Others include the colonial transformed or created towns of Jos, Kaduna, Enugu, Port Harcourt,

Ikot Ekpene and Umuahia in the east. Presently, the number of urban centres in Nigeria has increased to 359 while 1,774 other settlements have at least 5,000 inhabitants. About 28.8 percent of the population lives in towns in the east, 22.8 percent in the north and 66.0 percent in the west (FOS/NPC Report, 1996). This pattern indicates that urbanisation is highest among the Yorubas who are the main ethnic group in the west.

Nigeria has always practised a mixed economy, starting from colonial days till now. Prior to the oil boom of the 1970s, agriculture contributed a greater percentage of the Gross Domestic Product (GDP) and employed most of the working population. However, since the 1970s, export of crude oil has become dominant accounting for more than 80 percent of total revenue. This oil boom sparked off considerable rural-urban drift, which further worsened the decline in agricultural production, besides the apparent neglect of the agricultural sector. From 1982, there was a considerable downturn in the economy arising mainly from falling oil prices, declining sales due to energy conservation strategies and worldwide recession. This economic decline led to the adoption of Structural Adjustment Programme (SAP) in 1986. The economy was deregulated and a large number of government enterprises were privatised and commercialised. The government of Nigeria is still pursuing this economic programme, though with some modifications.

1.6.2 Ile-Ife city

The city of Ile-Ife was purposively selected for the intra-urban (micro-scale) analysis of cancer pattern in Nigeria. This ancient city represents a typical urban centre in Nigeria and also the sub-Saharan Africa with its dual residential structures. Ile-Ife was considered appropriate since it is a cancer Registry town, which has a relatively manageable area (size) extent for a micro-scale analysis. Moreover, the quality of data documentation in the Ile-Ife cancer registry is much more impressive when compared with the other registries in the country. The Ile-Ife registry uses the reporting format of the International Cancer Association (IARC) Geneva. Also, the data recorded in the Ile-Ife registry have the least number of missing information on the patients' records.

The Ife Urban area is located approximately between latitudes 7^0 27.5^{l}N and 7^0 29.7^{0}N and longitudes 4^0 32^{l}E and 4^0 34.3^{l}E on an elevation range of 250 – 300m above mean sea level. Ile-Ife is a University town and the headquarters of Ife central Local Government Area. It is about 80km northeast of Ibadan, the capital of Oyo State of Nigeria (Fig. 1.2)

River Shasha, one of the major rivers in Ogun-Oshun River Basin rises from this area. The other important rivers in the area include River Opa and Mokuro, both of which are impounded to provide pipe-borne water to some parts of the municipality.

The climate of the area is moist monsoon type (after Papadakis, 1961 cited Ojo, 1977). Temperatures are generally high even in the wet months (with values ranging from 20^0 to 32^{0}C) while annual rainfall is between 150cm and 180cm. The climate of Ile-Ife is

typically tropical as described by Holden and Green (1960) and Lowenberg and Hunzel (1992). It is characterised by distinct wet and dry seasons. The dry season extends from late October to March, while the wet or rainy season lasts or the remaining part of the year (April to September). There are two rain peaks – the minor occurs in June/July and the major one either in September or October.

The Pre-Cambrian Basement Complex rocks of Nigeria underlie the area. The major bedrock types include gneiss, pegmatite, pegmatite schist and undifferentiated schist (Adepoju, 1981) and they are distributed as shown in Fig 1.2. Apart from the University Campus and parts of Modakeke, rock outcrops are rare. Rather, weathering cover usually referred to as laterites, the properties of which are determined by the underlying parent rock types (Loehnert, 1981) is common.

The population of Ife town has been increasing steadily since 1967 (from available record) to date when the then University of Ife (now Obafemi Awolowo University) was established in the town. The population of Ile-Ife was 36,200 in 1911, dropped to 22,000 in 1921; it rose only to 24,200 in 1931, to 130,050 in 1963 (1963 Census Figure). A population projection from the 1963 figure of Ile-Ife (based on 2.5 growth rate) gives the population figure of 214,527 by 1989. Meanwhile, the 1991 population Census puts the population figure of the city at 207,856 people (including Modakeke) and 236,937 is projected for 1996 (FOS/NPC Report, 1996). This increase in the population has led to a substantial expansion of the city.

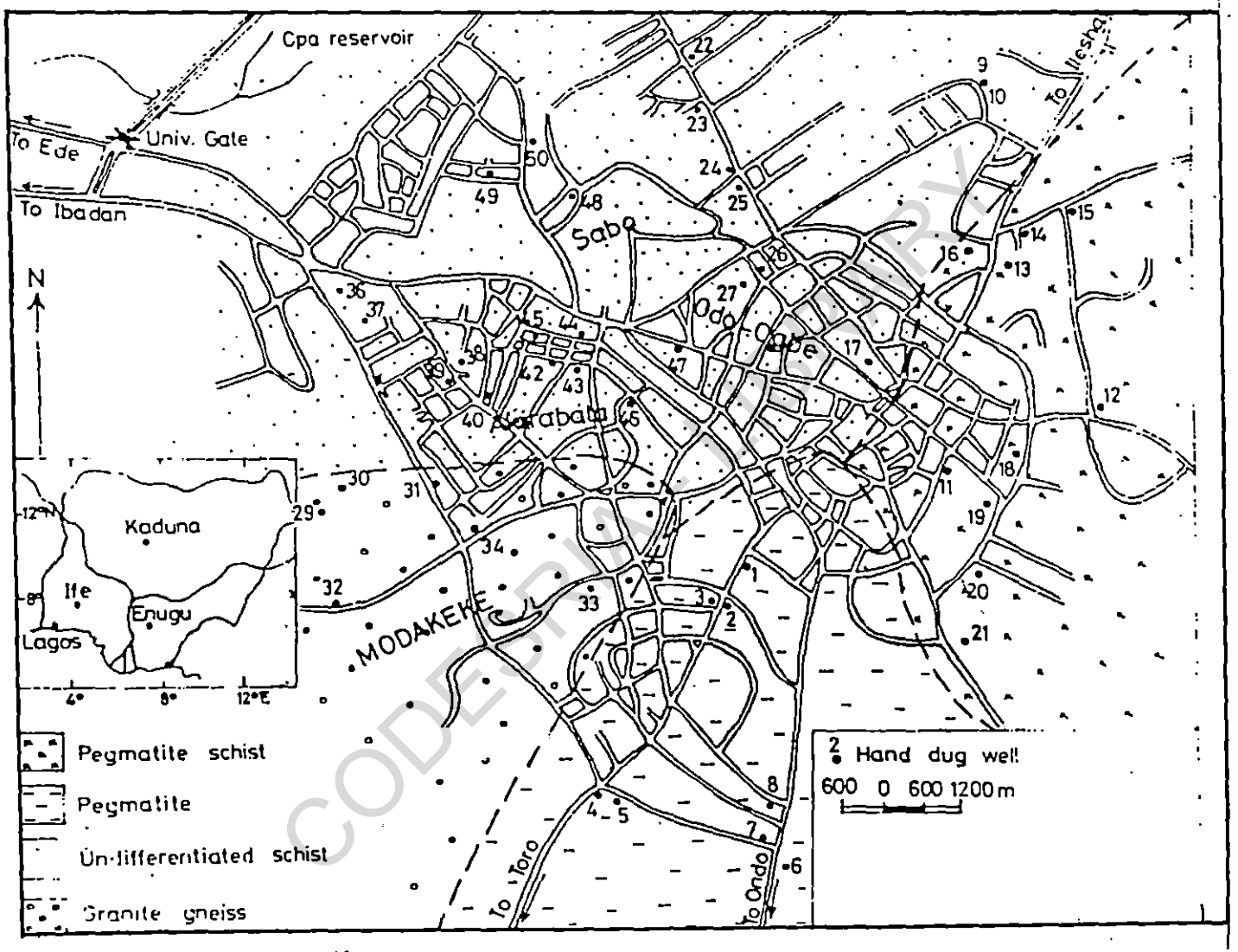


Fig. 1.2: Map of Ile-Ife showing its Geological Composition.

Ile-Ife City divides into 3 broad zones following the historical evolutionary stages. These are the first and second phases (pre 1875 and 1875-1947) which coincide with the core area, the third phase (1948-1966) coincides with the transitional zone, and the fourth phase (1967 to date) coincides with the new urban area. The 3 main expansion stages conform to the concentric urban structure proposed by Park, Burgess and Shevky (1933). The innermost or core area houses the Ooni's palace and most of the indigenes also live here. This area is largely traditional and most buildings are built with mud, though some may be plastered with cement. The second zone is the transitional (high density) area, which consists of a mixed population of the indigenous people and migrants from other towns and states in the country. This is a modernised section of the city with fairly high population density. The third zone is the new urban area, which lies in the outer-most part of the city. The new urban area includes the scattered estates, newly developing areas and the Obafemi Awolowo University campus. This zone comprises mostly the urban elites who are largely non-indigenes and a few indigenes who have relocated from the traditional-compound houses to new houses which they built.

Ile-Ife has an urban dual-centre structure, which is common to most cities in Nigeria (Mabogunje, 1968; Ayeni, 1989). This structure results from the interaction between two histories of urbanisation, the pre-industrial urbanisation and the industrial or modern urbanisation. The product is a twin city with a marked traditional section, one inhabited predominantly by the indigenous people and the modern section which is occupied by migrants. The traditional section of the town include areas (neighbourhoods) such as Okerewe, Eyindi, Okejan, Akui, Onipetu, Agbedegbede compound, Lokore,

Atiba, Ilara, Gbelenkan, Odo-Ogbe, Edena, Obalejugbe, Ogboni-lane, Akogun, Igbodo, Moore, Ilare, Ilode, Kule, Iraye and Oke -Amola. The modern section includes Iremo, Alapata, Koiwo, Ita-asin, Fajuyi, Ajegunle, Igboya, Eleyele, the Estates (Oduduwa, Ajanaku, Omole, Akosile, Sijuwade), and the Obafemi Awolowo University Campus.

The whole town had earlier been divided into six principal wards and a core area for administrative convenience (Fig. 1.3). These are Iremo, Moore, Ilode, Ilare, Okerewe, Modakeke and the core area (which houses the Oba's palace). Recently, Ile-Ife and its environs were divided into two local government areas; Ife central and Ife east local government areas. These two LGAs have been sub-divided into wards. Ife central LGA was divided into 11 wards while Ife east LGA has 10 wards. Wards in the Ife central LGA are Ilare 1, 2, 3, 4, Iremo 1, 2, 3, 4, 5, Akarabata and Moore-Ojaja. In Ife east LGA, the wards in the urban "proper" are Moore, Okerewe 1, 2, 3, Modakeke 1, 2 and 3. The three other wards are in the rural area. It is important to note that the recent local government area and wards divisions have been the scenes of prolonged communal clashes. Hundreds of lives and property worth billions of naira have been destroyed. The people of the two communities (the Ifes and the Modakekes) have been living under suspicion and strained social relations. This situation poses a serious constraint to the use of these new administrative divisions in the present study.

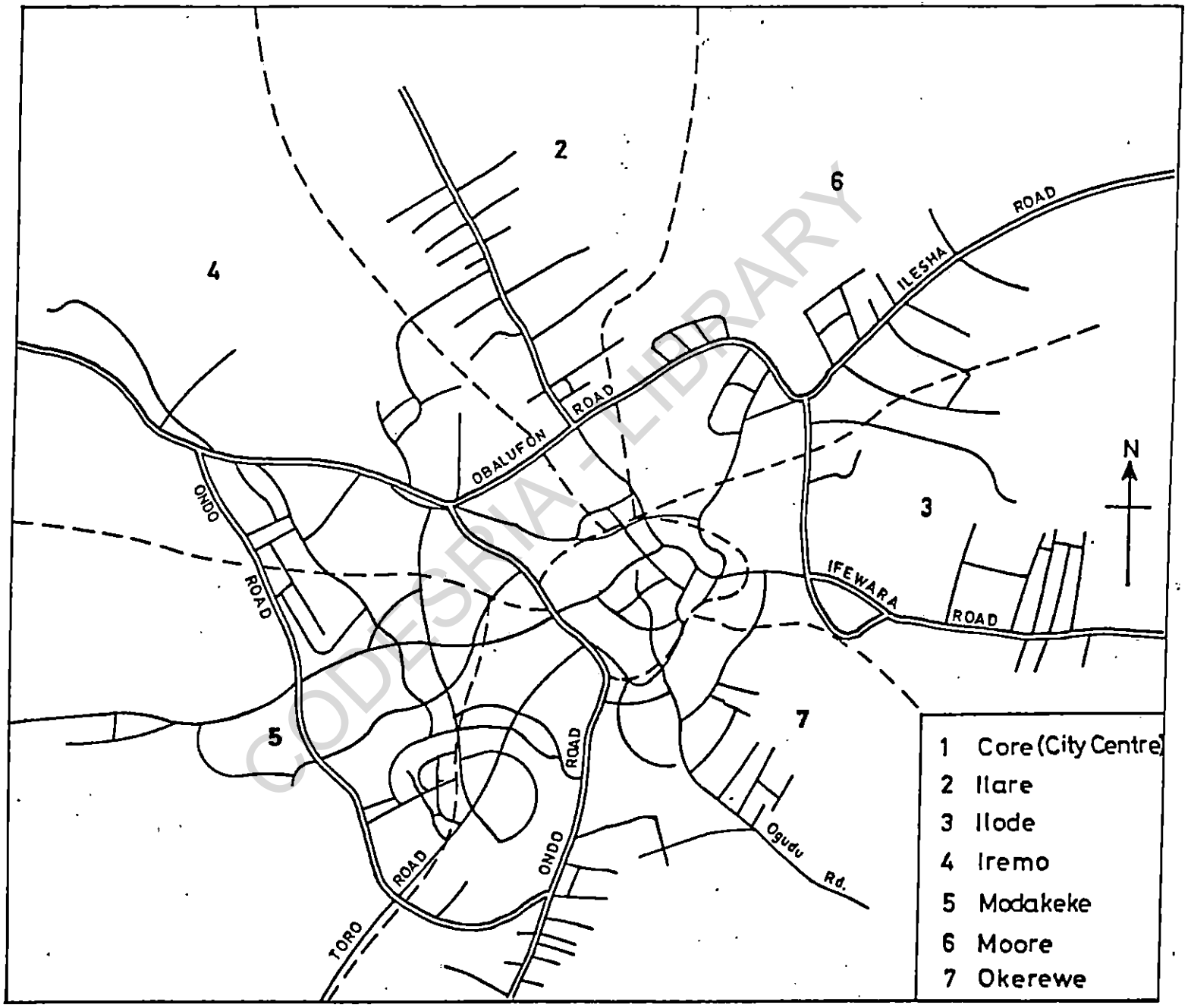


Fig 1.3: Map of Ile Ife showing the Administrative Wards

Furthermore, no map was available to show the various boundaries of the new wards in Ile-Ife. The information made available at the National Electoral Commission Office in Ile-Ife was only from a written document. In the light of these two constraints, the old ward divisions were adopted in the analysis of cancer incidence in Ile-Ife. In addition to this, cancer pattern was also examined among the residential areas in the city.

CHAPTER TWO

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

This study relies largely on the epidemiological transition theory as well as the model of disease ecology. The epidemiological transition theory demonstrates in a basic way the dynamics of disease profile, helping to shift attention from the traditional diseases of underdevelopment (infectious and parasitic diseases) as the major cause of illness to those of degenerative diseases usually associated with the developed world. Again, the ecological model of disease causation provides a holistic explanation for the spatial pattern of diseases. The model also elucidates the mechanisms involved in disease causation and highlights the synergism of the parameters of environment on disease.

2.2 Epidemiological Transition Theory

The impact of environmental change on health has made the application of the epidemiological transition approach fashionable in medical geographical studies (Verhasselt, 1993; Phillips, 1995). It is therefore pertinent to note that, for a proper conceptualization of the effects of environmental change on health, the epidemiological transition approach is germane. It has assumed this position since it takes cognisance of the dynamics in the health profile of people as the elements of the human environment change. This approach enables us to understand how changes in human practices and lifestyles result into concomitant change in the disease profile of a population over time.

There has been an emergence of new diseases in different places, which years ago, were such a rarity.

In the 1970s, Abdel Omran proposed that information about patterns of disease and death could be more explicitly incorporated into population theory by adopting a framework he named "epidemiological transition". This concept was actually developed from a study of Swedish source material (experience). According to Omran (1971), the "epidemiological transition" stands for long-run changes in pattern of morbidity and causes of death that have been noticed in populations as they experience transformation in their demographic, economic and social structures. Well-known authors in medical geography such as Verhasselt (1977) and Philips (1991) have supported this viewpoint.

The first basic stage of epidemiological transition is, the age of "pestilence and famine". This is characterised by high and fluctuating mortality due to infections and famine, and a life expectancy of 20 to 40 years. Natural hazards that are prevalent coupled with rural poverty engender a high (traditional) risk, which is the most important determinant in human mortality. The second stage is the age of "infectious diseases and rural poverty" when poor sanitation and malnutrition keep life expectancy under 60 years. The great reduction in traditional hazard has led to a reduction in total mortality, as can be seen at both national and international levels. Also longitudinal and cross-sectional studies of infant mortality show a decreasing rate while life expectancy is increasing. Considering the indicators above, most developing countries are presently adjudged to be in this stage (Smith, 1990; Verhasselt, 1977).

The third stage is the age of "degenerative and human - caused diseases." The major diseases causing mortality at this stage have long latency periods between the assault and the effect. At this stage, urbanisation, agricultural modernisation, and industrialisation increase modern health risks in many countries. This is because people are exposed to various pollutants and also lifestyles which appreciate manufactured food and less of natural foods. These health risks predispose people to degenerative diseases such as cancer, heart diseases, and stroke, along with certain new types of accidents and occupational hazard. Moreover, this stage is characterized by life expectancy above 60 years.

In summary, this theory describes changes in the causes of death from predominantly infectious and acute maladies such as measles, chickenpox, pneumonia and the like, to the degenerative chronic diseases like hypertension, ischaemic disease, diabetes mellitus, cardiomyopathy and cancer. According to this theory, the health profile of societies was initially dominated by communicable diseases, which over time have been controlled thereby improving survival beyond childhood. This age selective gain paradoxically exposes the population to other risk factors associated with chronic and degenerative diseases and the relative contribution of these diseases to general mortality increases.

In the economically developed countries, the evidence of epidemiological transition is conspicuous by an examination of their health profile. The people in these countries now suffer mainly from heart diseases, cancer, diabetes and other causes of

deaths such as suicide, violence and accidents. This pattern is emerging in recently industrialising countries such as South Korea and former Yugoslavia (Meades, et al; 1988). Akinkugbe (1995) also noted that in Singapore, mortality has shifted from parasitic infections to cancer and cardiovascular problems in the past four decades. Furthermore, he noticed that ischaemic heart disease is becoming rampant amongst westernised and urban Africans. As far back as the 1960s, Akinkugbe and Ojo found that one in every fifteen adults in Nigeria suffered from hypertension. Iyun (1992) also pointed to the increasing prevalence of the degenerative diseases in the disease profile of Nigeria. While examining the mortality records of the University Teaching Hospitals, she found that cancer tops the list of the six major causes of death in Ibadan.

Generally in Africa, there is increasing evidence to show the gradual but significant change in disease profile. According to Verhasselt (1993), the developing countries are said to be in " displacement" stage. This describes the experience of a double burden of both the infectious and parasitic diseases and the degenerative diseases, which are gradually becoming significant as causes of death. This emerging trend will not be unconnected with the transformation of the predominantly rural lifestyle of the developing societies to that of urban and western lifestyle. As observed by Foster (1988a), the manifestation of civilisation and industrialisation is seen mainly in changes in diet and the greater consumption of refined, processed and canned food. On the other hand, there is decline in the intake of fresh food which contains vitamins and minerals. While former diet exposes the human body to contaminants that are dangerous to health,

the latter depletes the body immune system thereby creating conducive environment for the initiation of degenerative diseases.

Urbanisation in Africa is almost synonymous with widespread consumption of alcohol and tobacco. These habits have been found to predispose the population to a peculiar type of ill-health (Rowland and Cooper, 1983). For instance, it has been reported that smoking which is a major risk factor in the aetiology of heart diseases, lung and oesophageal cancers, begins at a very young age in some cities in Cote d'Ivoire and Nigeria. Two decades ago, the age range of smoking was found to be 15 - 24 years, while the prevalence of smoking was 20 - 24 percent. Currently, there has been a tremendous increase in the prevalence of smoking (Muna, 1993) even among women and a marked reduction in the age at which smoking starts. Similarly, industrialisation, an aspect of socio-economic transformation, increases pollution and exposes human beings to pollutants as against what obtains in pre-industrial society. All these synergistically operate to advance the course of degenerative diseases.

The theory of epidemiological transition is pertinent to the study of degenerative diseases, especially cancer in a third world country. Indeed, it provides the possible explanation for the shift of attention from solely traditional parasitic and infectious maladies to degenerative and chronic diseases. Therefore this study undertakes a comprehensive analysis of cancer groups in Nigeria in order to identify their trends over the years.

2.3 The Ecological Model of Disease Causation

The impact of the environment on the health status of human beings cannot be overemphasized. This is the more reason why the ultimate purpose of geographical approach to human ill health is to contribute to unravelling the complex web of environmental relationships that surround human beings (McGlashan, 1985). This aspect of health research is called environmental health, which simply refers to the aspect of public health concerned with all factors, circumstances and conditions in the environment of human beings that can exert an influence on their health and well being (Last, 1998). Similarly, Armstrong (1996) has defined it as the management of impacts of the environment on human population and vice versa. It is noteworthy, that the various factors of the environment, physical and or social, are synergistic, and do not operate in isolation towards an outcome. The model of ecological causation of disease becomes relevant as it takes a holistic approach to studying the association between health problems and their biosocial environment.

Jacques May developed the model of disease ecology in 1958. According to him, the ecology of human disease deals with the relationship between a disease and the geographical environment in which it occurs. The occurrence of a disease is therefore conceived as a convergence of environmental stimuli be it organic, and or inorganic / social-cultural, in time and space within a person. Explanation of the spatial variation of morbidity and mortality is proffered in terms of differences in geographical areas while that of disease occurrence is provided on the basis of environmental associative factors.

2.3.1 Natural Foci of Disease

The first major concept developed under the disease ecology model is the "natural foci" of disease (NFD). According to Shannon and Spurluck (1975), the NFD is an assemblage of disease pathogens inhabiting an area or region. The human being therefore puts himself/herself at a risk of disease infection whenever the dwelling and other places with which he/she interacts are concentrated in easily polluted or high-risk area. The concept considers the physical environment as the principal determinant of human health status (Meades, Florin and Wesler, 1988). As a result, all organisms, man and pathogens strive to maintain an equilibrium or homeostatic relationship with the environment. A process of change, whether of the environment or human's adaptive behaviour, disrupts this balance leading to disease or ill health. This notion has influenced the various definitions and conceptualisations of disease either as maladjustment of man to his environment or an interaction of agent, host and environment (May, 1958; Dubos, 1965). The NFD concept becomes valuable in identifying the natural foci of specific cancer sites across the broad ecological regions in Nigeria. In other words, the biophysical environmental factors in the delimited geographical regions, which could predispose the inhabitants to specific risks of cancer, could potentially be identified.

One obvious defect of the NFD concept is its inability to provide detailed explanation for most diseases that are caused by human behavioural (lifestyle) factors. This derives from the over-dependence on physical environmental factors to account for

variation in the diseasedness of an area while under-rating the role of socio-environmental factors. The causation of diseases such as STDs, heart diseases and certain cancers that are attributable to human lifestyle factors vividly illustrate the inadequacy of the NFD in explaining disease distribution.

In summary, this discussion has drawn attention to the fact that an application of NFD concept provides an explanation for specific cancer groups that appear localized in the ecological regions. This is done by considering the biophysical elements of the environment. Such bio-physical elements include the climate, relief, trace element in rocks, hydrology and vegetation.

2.3.2 **Environmental Risk Cells**

Consequent upon the inability of the NFD and its associated viewpoint, to provide a holistic understanding of disease causation and pattern (Mayer, 1992), the "environmental risk cell" (ERC) has been evolved. This concept simply indicates that in any settlement, human beings are influenced by "artificial" factors to such an extent that indicators of ill health can be interpreted by considering different living conditions and lifestyles. The concept therefore recognizes the important role of human beings in man-environment interaction (Johnston, 1979). Indeed, it is well known that human beings are becoming more and more ecologically dominant, thereby affecting the environment, altering the balance between the environmental elements as well as between himself and the environment. A cultural environment is consequently created and man becomes

exposed to some repercussionary or backwash effects from the altered environment. In short, ERC concept exemplifies the predominant role of human rather than the physical environment (Johnston, 1983) in health status determination.

Thus within a given settlement, it is more appropriate to speak of ERC instead of the NFD. A city for instance, may contain different ERCs with some more hazardous than others depending on the regularity of the inhabitants interaction with the cells [high-risk zones] (Shannon and Spurluck, 1975). Here, emphasis is placed on secondary agents, which are related to human lifestyles or host factors. The term "host factor" is used to encompass those socio-domestic factors (habits and lifestyle practices), which predispose people to health risks or make them more vulnerable to disease agents.

The concept of "environmental risk cell" helps us to put cancer in its proper perspective in the present study since it is largely a lifestyle disease (Iversen, 1987). Hence, it is expected that variations in cancer distribution may exist on a micro-scale, (within a city) due to difference in the lifestyles of the residents. In other words, different cancer patterns may occur among the residential zones in the cities as a result of dissimilar socio-economic characteristics of the residents.

Integrating both the natural foci of disease (NFD) and environmental risk cells (ERC) concepts provides a holistic perspective for studying cancer in this part of the world. This is because of the co-existence of natural forces (physical environmental factors) and behavioural (lifestyle) factors in the determination of health profile in

Nigeria. This scenario has implication for cancers that are induced by the physical environmental factors and those largely associated with human lifestyles.

2.3.3 Model of Environmental Carcinogenesis

The application of the model of "environmental carcinogenesis" reveals the paramount role that the various environmental (biosocial) factors play in cancer aetiology. Cancer occurs as a result of exposure and maladjustment of the body system to physical, biological and chemical agents in the environment (Rowland and Cooper, 1983). When a "cancer-causing agent" enters the human body, instead of being detoxified by body enzymes, that agent is activated. A cancer gene is thereby created if the agent successfully binds to the Deoxyribonucleic acid (DNA) in the body cell. If the DNA is replicated thereafter before the carcinogen is removed, the carcinogen then affects the new cell information, creating a cancer gene. This process needs to be repeated before cancer can emerge.

Substances called "promoters" such as metallic substances, fractions of hydrocarbon chain, fatty acids, benzene, nicotine, tar and the like, provide impetus to the altered cells thereby making them to grow faster than normal body cells (Priestman, 1977). These promoters gain access into the human body through the various unhygienic behavioural practices that expose humans to substances containing them. These practices include eating and drinking habits, risky occupation, unhealthy sporting activities and use of chemicals for body beautification. It is therefore the environmental agents that act as

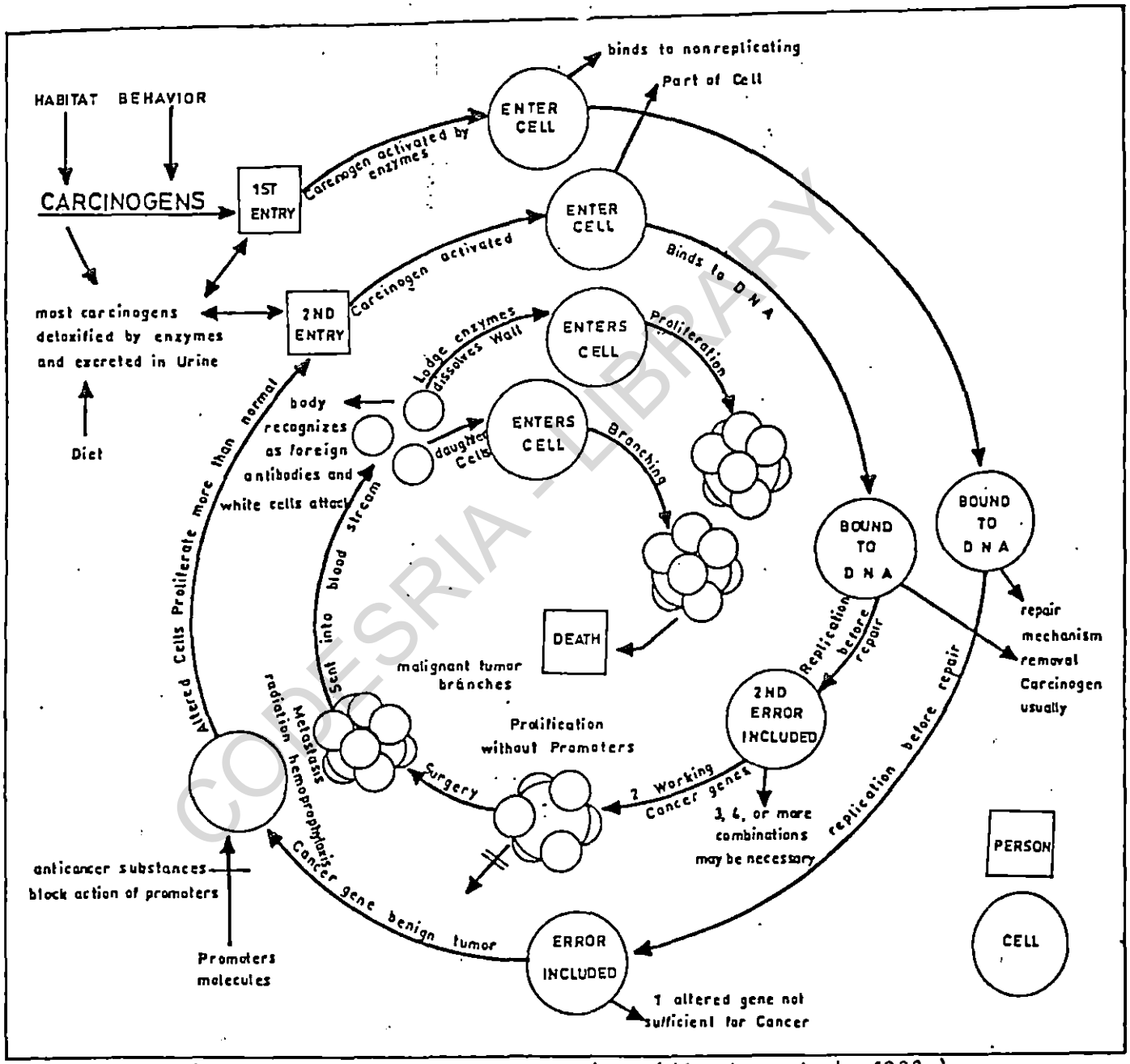


Fig 2.1 : Model of Cancer causation (Meades, et al ; 1988)

the "bullets" which eventually inflict the wounds, whereas human activities provide the medium of exposure (Rowland and Cooper, 1983, Uwaifor, 1995).

Eventually, these promoters encourage the altered cells to proliferate faster than normal cells. This process creates an increasing number of targets for another carcinogen that enters into the body system. Proliferation increases the number of cells containing the altered genetic information and subsequently carcinogen enters the body. Repeated alterations of the same genetic material are necessary before the potent combination occurs and the cell begins to proliferate without control. It may form a benign tumour or a malignant tumour. It is the malignant type that constitutes a public health problem. If the malignant tumour is not detected and treated early, "daughter" cells develop and migrate through the bloodstream to initiate a new growth in other sites in the body. This process is known as metastasis (Figure 2.1).

Our study is focussed on those physical and social agents within the environment, which the human body may become exposed within our study area. Using the concept of "natural foci of disease" and the "environment risk cell" within the model of disease ecology could provide some indicators of the factors within the physical environment coupled with the parameters of human lifestyle practices which predispose individuals to suffer from the identified cancers in Nigeria. The subsequent distributive pattern could provide pointers to the ecology of the disease, which is a key concept in the geography of health.

2.4 Literature Review

2.4.1 Cancer and associated symptoms

Cancer is an uncontrolled division of the replicative cells of the body, which usually affects a specific site resulting in the growth of malignant or benign tumours. Cancers are described as tumours because, more often than not they present swellings. It is the malignant tumour that actually constitutes public health problem among societies. Generally, cancer development results in the breakdown of the tissue with the consequence of bleeding and secondary infections as 'daughter' cells released to other sites in the body start new growth (Meades et al; 1988; Rowland and Cooper, 1983). The end result of this process is organ failure, through infection, or by massive haemorrhage leading to exhaustion and frequently, death. Malignant neoplasm (cancer) is composed of two groups; those of epithelial cells called carcinomas and those composed of connective tissues referred to as sarcomas (Olweny, 1990). These two broad groups are further divided into 65 site-specific cancers according to the International Classification of Diseases by WHO (9th edition). The ICD list is presented in Appendix 1.

Generally speaking, cancer development results into the break down of body tissues. The clinical features presented by cancers vary with the specific site in the body. For instance hepatocellular carcinoma, which is dominated by liver cancer, present with right upper quadrant pain and mass, weight loss, ascites, and jaundice. In the case of uterine cervix, most women in developing countries have fungating, foul-smelling cauliflower-like growth. Once there is a direct invasion of the surrounding viscera,

fistulas result. The commonest manifestations of burkitt's lymphoma in the endemic areas include jaw swelling, abdominal masses, paraplegic or multiple cranial nerve palsies. The locally aggressive forms of kaposi's sarcoma especially in Africa, presents in pleural effusion, oral candidiasis, diarrhoea and wasting.

Cancer is feared more than any other fatal illness except AIDS because it is perceived as synonymous with a slow and painful death, following a period of disfigurement, suffering and dependence. Immediately cancer is diagnosed, a 'cancer career' starts. There is indeed, a whole lot of socio-psychological processes that associate with this stage of life. The beginning of 'cancer career' is a crucial point of 'biological disruptions', which turns a person first into a patient and later, a survivor if not killed immediately (Bury, 1991). This situation changes the course of life and the outlook for the future.

Cancer news (after diagnosis) is normally associated with shock and disbelief, followed by acute distress, turmoil and depression. Psychologically, the patients' thought centres on pain and death. They subsequently suffer insomnia, loss of appetite, poor concentration and inability to carry out normal routines. In the course of their cancer 'career' most patients undergo prolonged series of treatments, often more than once. The three principal modalities used in cancer management, alone or in combination, are surgery, radiotherapy and chemotherapy. Each of these modalities has its side effects. For instance, the side effects normally associated with chemotherapy include nausea and vomiting, intestinal problems and depression. The multi-modality treatments always

adopted for cancer because of its systemic nature constitute another problem to the patients. They have to deal with many specialists and also, hospital departments.

Socially, cancer brings about social isolation and deterioration of social network more than any other life-threatening disease. These often happen when the affected person (sufferer) needs intimate social relationships. The social isolation arises because healthy people who are supposed to give the support unconsciously tend to distance themselves from those who are stricken with this fatal condition. There are two possible reasons. One is that the healthy people feel as if they are fearful of contagion. Secondly, there is always the difficulty of not knowing what topic to discuss with them. It is important to mention that the poor psychosocial environment, which surrounds cancer patients in the less developed countries, inhibits the fruitfulness of the various bio-medical modalities often used for their treatment. The implication is for the introduction of a new approach to the treatment of cancer patients in the less developed countries, including Nigeria. Specifically, palliative care that recognises the crucial role of community support (traditional support system) is currently needed in order to achieve better results.

2.4.2 The Temporal Dynamics of Cancers

Hoel, Davis and Miller (1992) have analysed the trend of cancers mortality in fifteen industrialised countries (drawn from the United States, Western Europe, Eastern Europe, Nordic countries, East Asia and Oceania) between 1969-1986. The cancers

specifically focussed on comprise stomach, lung, prostate, breast and intestine. They discovered that deaths due to stomach cancer are highest in East Asia, followed by Eastern Europe, and are lowest in the United States. In the case of lung cancer deaths, there has been a substantial increase in the Eastern Europe and East Asia countries. Looking at the sex specific lung cancer mortality, females in the United States leads other country females. This finding is adduced to higher prevalence of smoking among females in the United States. Prostate as well as breast cancer mortality is found to be increasing in all the regions with the exception of East Asia where breast cancer among females is gradually decreasing. Oceania and Eastern Europe have the highest rates of intestinal cancer mortality while in contrast, the United States and Western Europe displayed the lowest rates.

In a similar analysis of international trends in cancer mortality (France, West Germany, Italy, England and Wales and the United States), Davis, Hoel, Fox and Lopez (1990) showed the changing pattern of certain cancer sites. These authors have found some remarkable shifts in cancer patterns across several major industrialised countries. Specifically, lung and stomach cancers that accounted for 20 percent to 43 percent of all cancers in males in these countries showed increase among men and women over 54 years. The increase was more rapid for men and women aged 75 – 84 years. It is obvious from these patterns that cancer associated with eating and smoking habit are the predominant types in the western societies.

A further analysis of cancer mortality data from England and Wales showed longstanding decline in cancers of stomach, colon and rectum, and continuing increases in lung, pancreas, prostate, ovary, and breast. Similar decline in the mortality of cancer sites which were once predominant since the 1950s are evident in the USA. The specific cancers are stomach cancer, colon, rectum, thyroid and Hodgkin's diseases. In contrast, cancer of the lung, breast, uterine cervix and corpus and kidney, and non-Hodgkin lymphoma are increasing. Generally, within the past two decades, scholars have noticed some remarkable decline in the trend of stomach cancer in all the developed countries except in Italy and Japan.

From the foregoing it is obvious that cancer changes within the broad spectrum of health profile of countries and also specific cancer sites in their own courses. The shift is largely connected with changes in the preponderance of the various behavioural practices that may induce the specific cancer sites. Also attention should focus on specific cancer groups (sites) in order to highlight the characteristics of each cancer over a period of time. Information such as this may assist in setting priority on cancer intervention in any country.

2.4.3 **The Spatial Distribution of Cancer**

The global pattern of cancer occurrence features the predominance of stomach, lung, breast, colorectal and cervix cancers. These are followed, in descending order, by mouth/pharynx, oesophagus, liver, lymphoma and prostate cancers for both males and

females. Differences emerge when the two sexes are separately considered for their predominant cancer patterns. The two leading cancers for males are lung and stomach while breast and cervix lead in the case of females (Table 2.1).

Table 2.1 Twelve Commonest Cancers in the World

Rank	Males	Females	Both Sexes
1	Lung	Breast	Stomach
2	Stomach	Cervix	Lung
3	Colorectal	Colorectal	Breast
4	Mouth/Pharynx	Stomach	Colorectal
5	Prostate	Corpus Uteri	Cervix
6	Oesophagus	Lung	Mouth/Pharynx
7	Liver	Ovary	Oesophagus
8	Bladder	Mouth/Pharynx	Liver
9	Lymphoma	Oesophagus	Lymphoma
10	Leukaemia	Lymphoma	Prostate
11	.....	.....	Bladder
12	.....	.....	Leukaemia

Source: Olweny, 1990. Neoplasms and Malignancies. In Tropical and Geographical Medicine (Eds.) Warren and Mahmoud. Pg 48.

The incidence of cancers has been found to vary over space at the global, national and local scales depending on whether the risk factors are environmentally ubiquitous or localized. Such variations are already observed between urban and rural populations and within a small locality, as indicated by Dever (1972) and Rowland and Cooper (1983) in their studies of Buffalo city in the United States. There is an established geographical variation in the distribution of cancers worldwide (Verhasselt, 1977; McGlashan, 1982 and Verhasselt and Timmermans, 1987). Generally, there is a clear distinction between the industrialized and the under-developed nations of the world. According to Olweny

(1990), the most common cancers in developing countries are liver and uterine cervix while in the developed countries, lung and colorectal cancers top the list. Invariably, cancers of the developed nations are linked to cigarette smoking; asbestos pollution and dietary fat whereas cancers associated with food contamination, and infectious diseases are more common in the developing world (Waterhouse, Muir, Shanmugaratuam and Powel, 1989).

In addition, spatial variation in cancer occurrence is clearly demonstrated in the world maps of cancer mortality produced by Verhasselt and Timmermans (1987). The western part of Europe carries the heaviest burden of cancer mortality (male and female) followed by the United States, Canada and South America. The picture of cancer mortality in the Asian and African continents is grossly underrepresented due to the unavailability of data. Even then, cancer such as the oesophagus and liver cancer are common in Sub-Saharan Africa (Ahmed and Cook, 1969; Glick, 1982 and McGlashan, 1990) and China (Norie, 1980; Rukang, 1986) while testis cancer is rare in these regions. Furthermore, cancers of the lung, stomach, colon and rectum are more prevalent in Europe and North America (Boyd, Doll and Guard, 1973). Environmental factors such as climate have been found to aid and explain the patterns of cancer occurrence. For instance, the humid tropical climate favours the growth of aflatoxin on mouldy groundnut in the Sub-Saharan Africa, which tends to promote liver cancer in this region (Ahmed and Cook, 1969).

The infective agents of the predominant cancer in the developing countries are basically viruses as shown in Table 2.2. Specifically, the occurrence of hepatocellular

Table 2.2 Infective Agents of the Predominant Cancer in the Developing Countries.

Type of Cancer	Infective Agent
Hepatocellular Carcinoma	Hepatitis B Virus
Cancer of Uterus Cervix	Human Papilloma Virus
Burkitt's Lymphoma	Epstein – Barr Virus
Nasopharyngeal Carcinoma	Epstein – Barr Virus
Kaposi's Carcinoma	Human Immunodeficiency Virus
Squamous Cell Carcinoma of the Urinary bladder	Schistosoma haematobium

Source: Olweny, 1990. Neoplasms and Malignancies. In tropical and Geographical Medicine (Eds.) Warren and Mahmoud. Pg 48.

carcinoma (liver cancer), cervical cancer, lymphomas, and cancer of the urinary bladder is often associated with viral-parasitic infections. For instance, Ojo (1992) attributed the predominance of liver cancer among people in Ife/Ijesha (south-western Nigeria) community to hepatitis B infection. This finding has been confirmed by several clinical investigations of the reported cases of liver cancer in the area.

In China, Rukang (1986) discovered variations in the distribution of cancer mortality, especially cancers of stomach, oesophagus, liver, lung, intestine and uterine. The areas of highest mortality concentration are found in the Jiansu, Fujian and Zhejian

provinces and Shanghai city. This intra-country pattern has been adduced to variations in environmental factors.

A study by Hazra (1984) demonstrated marked spatial pattern in the cancer mortality particularly, in West Bengal. The two major areas of concentration are the central plains of West Bengal and Duars of North Bengal, with one minor pocket in the northeastern part of West Dinajpur district. Moreover, there is a marked rural -urban differential for cancers mortality rates with a 60 percent incidence in the urban areas and 40 percent in the rural areas. Of all these rates, Calcutta city alone accounted for 50 percent, which is due largely to its high urban characteristics and the presence of industrial infrastructures.

Based on available studies of the illness in Africa, cancer displays a marked spatial pattern. The mortality from lung cancer amongst the black people of South Africa (1978 - 1981) showed the dominance of urban cases over the rural (McGlashan and Harington, 1985). According to these authors, the rural areas of northern Transvaal have low occurrence in contrast with high occurrence in the inland areas of Cape Town, Port Elizabeth, Kimberly, Bloemfortein, Durban-Pinetown, Johannesburg and Pretoria cities in South Africa. This urban dominance is attributable to the highly industrialised nature of the cities including the presence of asbestos mining industries in the two northwestern Cape Economic Areas.

Studied on a micro-scale, the patterns of occurrence of rare cancers can be better highlighted than when studied on a large (continental) scale (Dever, 1972). An example

of such rare cancers is leukaemia, which has been discovered to cluster among communities on Ohio River in the United States (Dzik, 1991). A similar analysis of leukaemia in England by Whitelegg and Gorst (1987) also found a reasonable pattern only at a very small scale. These patterns normally point to the presence of a localized environmental factor that may actually be promoting its aetiology (Hazra, 1984). According to Dever (1972), the aetiology of leukaemia was found to be associated with the indexes of congestion in Buffalo. Similarly, In England and Wales, White (1972) found a higher prevalence of leukaemia in urban centres than rural areas. Urban air pollution emerged as the single most important factor implicated in the distribution of this cancer.

The variations so noticed by the various authors are largely due to the factors of physical environment and lifestyle practices, more than genetic composition of the population in different parts of the globe (Akhtas, 1983). More specifically, it is the people's lifestyle practices that are the most outstanding factors in determining and explaining cancer distribution.

2.4.4 Socio-Demographic Characteristics of Cancer Patients

Age as a demographic factor associates positively with most cancers because the disease is an aging health problem with the exception of leukaemia, which is common in childhood (Zimmet and Whitehouse, 1981). According to Tawaih (1989), leukaemia was found to afflict mostly children (ages 1 to 14) in northern Nigeria while the occurrence of

stomach, oesophagus, uterine and lung cancers are prevalent in people between 35 and 55 years. Apart from the fact that the aetilology of leukaemia is suspected to be largely congenital in nature, the other cancers take about two decades before an initial assault culminates into the actual disease. This may explain why the age group 40-55 years tends to carry the heaviest burden of most cancers. In addition, the constant exposure of this age group to pollutants is the course of their occupation may also be responsible (Remmenick, 1998).

The relationship between age and cancer occurrence varies with sex. Men on the whole have been found to suffer more from cancers than women except in female specific cancers (breast and cervical cancers) according to King and Harris (1987), Hazra (1984), and McGlashan (1982). The higher occurrence in men is probably due to the greater stimulation of DNA in men than women. This process also increases with age for both sexes, but higher in all ages for men (Meades, Florin and Wesler, 1988), thereby predisposing them to higher cancer infection, especially cancers of the oesophagus (Tuyns and Masse, 1973; Armstrong, 1980), and lung (Glick, 1980; Rukang, 1986). This is not unconnected with the higher prevalence of smoking and exposure to occupational hazard among men. In recent time, the occurrence of lung cancer is rapidly increasing among women and youths. This emerging trend has been attributed to the increase in smoking even at earlier ages and involvement in industrial activities observed among women in many regions of the world.

Generally, the physiology of women tends to predispose them to specific cancers, particularly, breast cancer due to their susceptibility to benzene and other fat-soluble organic chemicals (Calabrese, 1985). Consequently, women stand greater risk of breast cancer with increasing consumption of high fat diet.

2.4.5 **Environmental factors Associated with Cancer Aetiology**

The biophysical elements of the environment that are involved in the distribution of cancer are the soil, vegetation and water. Soil bulk and trace elements, either excesses or deficiencies have strong influence on the distribution of cancers of digestive, respiratory and reproductive systems. Nitrates, which may be present in different forms in the soil and water, have been implicated in the occurrence and distribution of certain cancers. According to Armijo, Orellaa and Medina (1981), the abundance of nitrosamines in the tropical soil is associated with the occurrence of liver cancer while McGlashan (1972), and Kui and Liang (1982) have found the same element as a confounding factor in the occurrence of oesophageal cancer.

In a similar way, nitrate presence of up to 30mg/litre in drinking water is suspected to influence stomach cancer in northern Jutland in Denmark (Jensen, 1982). It is also found to promote both male and female stomach cancer of the small intestine in British Columbia, Canada. In addition, nitrate fertilizer and its natural deposits induce gastric cancer (Rowland and Cooper, 1983). Laboratory analysis has shown the carcinogenic role of dimethyl-N-nitrosamine (DMN), which is a chemical compound of

the N-nitrosamine group in specific body sites particularly, liver and oesophagus (McGlashan, 1972). Moreover, the presence of high mercury content in the soil tends to associate with the occurrence of digestive (tongue, mouth, pharynx, oesophagus, intestine, rectum and bladder) cancers. It is also true of high iron content in the soil (transferred into the human body through the consumption of plants grown in the area), which was discovered to induce the digestive cancers in British Columbia (Foster, 1992).

On the other hand, high content of calcium, magnesium, lithium and selenium in the soil have protective effects against the cancers of the colon, oesophagus, pancreas and breast (Norie, 1992). Selenium contains enzymes which function in the cell as part of defence system against oxygen induced damage. Its function is site specific because it is absorbed only into the body through the digestive channels. Selenium discourages the accumulation of harmful elements such as arsenic and mercury in the body. Calcium is a medium for all cell communication. Hence, it carries vital messages between cells. In low serum calcium environments, cell division is stimulated which leads to hyperplasia, which also appears to be an initial precancerous stage.

Water is another medium through which trace elements invade human body. The health implication of such substances become noticeable when they contaminate drinking water and eventually find their way into the human body. According to Foster (1992) high lead content is common in areas where the occurrence of digestive cancers is frequent. Similarly, it has been found that high level of organic substances in drinking water tend to induce oesophageal and pancreatic cancers (Carlo and Mettlin, 1980), and

gastric cancer (Howe, 1981) in human beings. Also drinking water with high alkaline, chlorine and nitrate induces various digestive cancers (Tuthill and Moore, 1978; Norie, 1992).

These trace elements are either found in untreated drinking water (Beresford, 1981) or drinking of reused water which are usually contaminated (Doll, Muir and Waterhouse, 1972). These substances accumulate in specific parts of the body over time and eventually, initiate cancer in the bladder or urinary tract. Practical examples are the studies carried out on the Mississippi and Ohio (Page and Harris, 1976; Kuzma, 1977) in the United States. The source of contamination was linked to the citing of chemical manufacturing industries upstream. Chemical wastes from these rivers contaminate the drinking water of the communities located downstream.

However, trace elements, which constitute water hardness, have been identified to play an important role in reducing mortality from cancers of the tongue, mouth, stomach, colon and rectum. A study carried out in British Columbia shows that water hardness appears to provide a protective cover from digestive cancers (Norie, 1992). This is in agreement with the metabolic role of calcium, which may convert fatty acid and free bile in the colon, to insoluble soaps, thereby reducing the postulated carcinogenic process in the human body.

Plants also have been shown to be of some significance. Their role as a risk factor of cancer is two-fold. Plants grown on soil with certain trace elements transfer such elements into the human body when the plants are consumed. Examples are potatoes

carrying selenium, maize in nitrate-excess region, vegetable containing calcium among others (McGlashan, 1972; Norie, 1992). In a more direct way, the consumption of certain medicinal plants transfers the chemical properties of such into the body system, which consequently have effects on health status. According to Uwaifor, Bababunmi and Emerole (1987), plant species such as *senecio, crolario clausena* and *heliotropium* used as herbal teas in southern Nigeria have been identified to contain carcinogenic properties, which induce primary liver cancer. The protective effect of leaves of 'black tea' (British favourite tea) was discovered by Conny's team in 1995 at Rutgers University in the USA to be useful in cancer control. The leaves are said to contain a substance, which is able to reduce the spread of cancer by blocking the cancer-causing agents in the blood stream. Other studies have also supported the protective role of tea in the case of breast, colon and pancreas cancers.

Pollution is not easily defined. It can be taken as the presence of an abnormal quantity of materials due to the disturbance of the natural state of equilibrium. The effects of air pollution on health have been observed over time. Indeed, the transition of a society into an urban industrial society from a rural and agricultural setting has aggravated the problem. The common air pollutants are smoke from the combustion of gases, fossil fuel among others, to produce poisonous carbon-monoxide; emitted grit and dust, lead, sulphur dioxide and particulates, nitrogen oxides, asbestos among others. Residents and workers in polluted zones are placed at high risk levels. The major sources of the pollutants are industries, motor vehicles and mines (Olweny, 1992). These

pollutants mainly affect the respiratory tracts thereby inducing cancers of the respiratory system.

Furthermore, specific substances borne by the air in abnormal quantities have been suspected to induce cancer of specific sites. The effect of high concentration of Polycyclic Aromatic Hydrocarbon (P. A. H), asbestos and zinc has been implicated in the aetiology of lung cancer (Campagna, 1960; Mauskopf, 1987). Apart from influencing lung tumour, these pollutants have been found to associate with the high incidence of the upper digestive tract cancers (Neuberger and Hollowell, 1982; Minder and Beer-porizek, 1992). Due to the high level of pollutants and congestion, the urban environment increases the risk of certain cancers (Greenberg, 1983). In a study conducted in England, different indices of congestion were found to associate with the occurrence of leukaemia (Whitelegg and Gorst, 1987), while the location of power plants in the area was identified as a confounding factor. As can be expected, some cancer such as lung cancer is nicknamed "urban cancer" (Waller, 1981) because of its strong association with the ways of life prevalent in cities.

The potential for distribution of chemical pollutants into the environment comes from accidental leaks or spillages, evaporation during storage, transport accidents or escape from the manufacturing process. Sulphur acids and Vinyl chloride common in rubber and plastic industry are implicated in the causation of laryngeal cancer (Rowland and Cooper, 1983). The hazardous effects of chlorine-based chemical have been revealed

as in Dichloro-diphenyl trichlororethane (DDT), Polycyclic Byphenyls (PCBs), Chloro-Flouro Carbons (CFCs), and dioxins, which are used as pesticides and herbicides, on agricultural plantations. These chlorine-based compounds are known to cause cancer in human being (directly or indirectly). DDT for example promotes existing cancers while dioxins suppress immune system in the body thereby enhancing the carcinogenic effects of other chemicals (Paulson, 1993). Tumours of the bladder are known to be induced by α-Naphthylamine which is compound of aromatic amino found in the dye industry. Similarly, there are evidences that soot, tars and mineral oils which contain Polycyclic Aromatic Hydrocarbon, produce skin and lung cancers (Rowland and Cooper, 1983) among those who are frequently exposed to them (Verhasselt, 1992). In this respect, the role of occupation in the manufacturing and petrochemical industries is significant, since it provides the avenue for constant exposure.

In actual fact, the impact of occupation on human health with respect to cancer is more complex than the discussion above tends to suggest. This is because occupational hazards are often aggravated by harmful life habits of working-class people, particularly smoking and alcohol abuse. The synergism between unhealthy lifestyle and occupation hazards often makes it difficult to unravel the relative contribution of each to cancer causation (Remmenick, 1998).

2.4.6 Behavioural and Lifestyle Practices Associated with Cancer Aetiology

The roles played by socio-cultural factors in the aetiology of cancer are quite tremendous. This is true of virtually all degenerative diseases, which are more often referred to as lifestyle diseases (Akinkugbe, 1995). Lifestyles, reflected in the form of dietary habits, smoking, piping, snuffing, alcoholism, skin beautification, sporting activity, unhealthy religious practices, and occupation tend to determine the occurrence of cancer regardless of the ubiquity of carcinogenic substances present in a given society. This explains why a risk factor in one society may not necessarily constitute cancer risk factor in another society. Indeed, the behavioural factors serve as the links between the cancer inducing substances and the human body, so that the removal or avoidance of these predisposing factors will yield good result in cancer prevention.

Human diet contains a variety of natural carcinogens, promoters and antigens (Meades, Florin and Wesler, 1988), which may influence the incidence of specific cancers. Generally, high fat and low fibre diet consumed by the industrialized nations increase cancer risk while plant-based diet, rich in whole grains, legumes, fruits and vegetables are protective. Specifically, there is an established link between high fat diet and the occurrence of colorectal cancer (Norie, 1992). The explanation is that an elevated fat intake may increase the secretion of bile acids, which are needed to digest fat thereby altering bacteria population in the large bowel. This alteration increases the level of secondary acids, which in turn promote lesions that encourage carcinogenesis in the

bowel. Supporting this hypothesis, Verhasselt (1977) and Davis, Hoel, Fox and Lopez (1990) have identified consumption of excessive margarine, high fat and animal protein to influence the occurrence of cancers of the breast, colon, rectum and prostate.

Furthermore, the eating of "opium" and the smoking of its wastes that are common in the Asiatic societies has been found to associate with the incidence of oesophageal cancer (Sadeghi and Behmar, 1987; Ghadirian and Thouez, 1991). High caloric intake of carbohydrate or starch food strongly correlates with stomach cancer. This category of diet, deficient in vitamins and minerals, generally reduces the body immunity against assaults. In addition, frequent release of the bowels (characteristic of starchy diet) reduces the digestive bacteria, thereby exposing the body to carcinogenic processes. Similarly, the chewing of "nass" (Chacklin, 1962; Habib, 1975), "betel quid" (local condiments) common in the Oriental societies and the use of local additives (brackens) in diets relate closely with oral cancers (Learmonth, 1988).

Another category of diet, which is common among industrialized societies, equally has implication for certain cancers. For instance, specific association exists between the consumption of highly refined foods and stomach cancer. Countries in this category include the United States, England, Germany, France, and Japan among others. Refined foods such as baked foods, canned meat and drinks are more easily contaminated in the process of manufacturing, packaging and preservation. They take longer time to digest so the contaminants are deposited in the digestive tract during the course of metabolism thereby inducing stomach cancers.

Smoking is about the most popular risk factor known worldwide in the causation of cancer, more so with the epidemics of tobacco smoking in all societies. This habit is the most pronounced risk factor of bladder, kidney and oesophagus (Bradshaw and Schonland, 1974) and the most notorious of all, lung cancer (Bellew and Wayne, 1992). It is the lung, kidney and oesophagus in the human bodies that are often affected by smoking, piping and snuffing. In a micro-scale study carried out in Transkei (South Africa) among the different ethnic groups including Mfengu, Xhosa, Pondo, Thenbu among others, smoking was found to have significantly influenced cancer distribution in the region (Bradshaw, McGlashan and Harington, 1983). The most hazardous aspect was related to the continuous use of pipes without cleaning the accumulated dirt and the consumption of commercial tobacco with high tar and nicotine contents. The earlier introduction of smoking among the Xhosas who have become addicted explained the higher occurrence of lung cancer among them compared with the Zulus who also smoke tobacco (McGlashan and Harington, 1985). The citing of asbestos industry in the area occupied by the Xhosas must have added to their recorded higher incidence of lung cancer. The reason is because, asbestos manufacturing generate pollutants into the air, which eventually have harmful effect on the people when they breathe in such air.

Similarly, the consumption of tobacco when chewed with "betel quid" (local ingredient derived from plants) induces about 90 percent of oral cancer in the Oriental societies. According to Olweny (1990), these substances used as additives are toxic, thereby inducing cancer in the mouth region where the chewing is done.

Another habit closely related to smoking is the consumption of alcohol. More often than not, these habits are practised together and therefore synergistic in their influences. Generally, the colon, rectum and oesophagus are the regions directly affected by frequent consumption of alcohol. In essence colorectal and oesophageal cancers are induced. (Armstrong and Doll, 1975; McGlashan, 1972). From studies carried out in Central Africa (McGlashan, 1972) and South Africa (Bradshaw, et al, 1983), it was not just the drinking of any spirit liquor that induced cancer but those that are contaminated. In the Transkei province of South Africa, areas where the local drinks are often patronized have high incidence of oesophageal cancer. It was the chemical analysis of the drinks that showed high levels of contamination. Also in Central Africa, investigation showed that one of their popular spirit liquors called "Kachasu" or "Malawi gin" was contaminated by copper and zinc from the metallic containers used for its fermentation. Further analysis has also detected the presence of Dimethy-N-nitrosamine (DMN), which is a chemical compound of N-nitrosamine group in the spirit liquor. This chemical compound is a proven cancer-inducing agent in the liver and oesophagus according to McGlashan (1972).

Lifestyle practice, such as sunbathing has been found to associate strongly with skin cancer (Meades, et al; 1988). This practice is a common sporting activity among the whites that expose their skin to direct radiation and ultraviolet rays over long period. It is the absence of melanin in their skin to synthesize vitamin D under such intense sunshine that induces cancer of the skin. In Nigeria, where sunbathing is not popular the category

of people who are at greater risk of skin cancer are the albinos who unduly expose their skin and those who bleach their skin with chemicals (Olweny, 1990) for beautification purpose. This practice of skin bleaching is more prevalent among the females in the urban centres than their male counterparts. Consequently, we may expect more skin cancer among the latter group in our societies.

Generally speaking, unhealthy lifestyles expose one to the risk of certain cancers (Iversen 1987). According to McGlashan (1972), there is a significant relationship between cancer of the cervix uteri and the absence of male circumcision in Malawi. Similarly, early and frequent sexual experience, especially with multiple sexual partners and lack of personal cleanliness associate with the inception of cervical cancer in women (Olweny, 1990). This may explain why women in the low socio-economic group tend to have higher risk of cervical cancer in the developing societies. Conversely, breast cancer tends to associate with women in the high socio-economic status since the risk factors are more related to high consumption of animal fat and other highly refined food (Verhasselt, 1977; Armstrong, 1980) which dominate the diet of the affluent.

The most immediate risk from air borne toxic chemicals and chemical pollution into the environment faces those who are exposed to them in the course of their work (Rowland and Cooper, 1983). This occupational risk will depend on the substance emitted, contacted and the organ on which the effect is easily manifested (Verhasselt, 1992; Jun-Yao, 1984). For instance, when workers in chemical industries and oil refineries expose their skin to contaminants, skin cancer may be induced. This also

applies to workers on plantations where herbicides, pesticides and insecticides are used regularly. Workers in smelting plants, mines, quarries, gas burning stations and operators of heavy-duty machines are also exposed to the risk of lung and oesophageal cancers.

In conclusion, it is clear that both the elements of the physical environment and the human lifestyle practices play significant roles in cancer aetiology. These two perspectives are rarely considered in most empirical work available in Nigeria. While a few of the studies simply analyse the demographic characteristics of cancer patients, others focus on the bio-chemical analysis of substances suspected to be carcinogenic. By and large, the spatial perspective has not received any considerable attention from these researchers. The present study therefore seeks to provide an insight into the environmental and behavioural factors that could be considered in an ecological analysis of cancer distribution in Nigeria. Moreover, a multiple geographical scale is employed in order to identify possible risk cells for the various cancers. This is the value of a geographical approach, which could be of invaluable assistance to health policy makers in designing a timely intervention programme for the at-risk population in the appropriate regions.

CHAPTER THREE

RESEARCH METHODOLOGY AND SOURCES OF DATA COLLECTION

The main concern of this chapter is to highlight the required data, sources and procedure for collecting them. In addition, the appropriate statistical techniques employed to analyse the data collected from the various sources are presented. These analyses became necessary in order to test the working hypotheses of this study.

3.1 Types and Sources of Data

The first phase of the fieldwork for the present study was conducted between January and December 1997. The second phase took place in July 1999. Essentially, two types of data were utilised for the study: primary and secondary data. The primary data were collected through questionnaire survey of households in Ile-Ife and personal observation. With respect to secondary data, information on cancer cases was collected from the five existing cancer registries in Nigeria. These registries are located at Ibadan, Ilorin, Ile-Ife, Enugu and Zaria. Moreover, relevant information was retrieved from the documents and reports of Agencies such as the Federal Office of Statistics (FOS), National Population Commission (NPC) and United Nations Development Programme (UNDP).

3.2 The Nigerian Cancer Registry

Unlike most diseases, cancer data are best collected from the registries (Spinnelli, Band, Gallagher, Threfall and Ng, 1992) whose pre-occupation is to document cancer information. Moreover, we depend mainly on morbidity data in this study since they give an optimum estimation of disease generation in any community than mortality data (Giles, 1983). Hence, the present study utilises the cancer morbidity data in order to show the pattern of cancer incidence in Nigeria.

Although criticisms have been levelled against the use of facility data alone to analyse the disease pattern of a community, yet they remain the best alternative. The main concern of the critics is that only the patients treated at the hospitals are documented, while those who do not attend hospitals are left out. It is often claimed that the ideal procedure is to carry out a full epidemiology investigation of the specified disease(s) in the community. With particular reference to cancer, no other procedure can provide information on its diagnosis other than biopsy and other rigorous medical investigations. These services are only provided in specific tertiary hospitals, which undertake the diagnosis, monitoring and documentation of cancer cases. The roles of registries in cancer control include; involvement in basic research, evaluation of intervention programmes implementation, and monitoring of cancer in communities.

There are two types of cancer registry in Nigeria. These are the hospital based cancer registry and the community based cancer registry. While the activities of the hospital base registry is limited to cancer cases brought to the hospital, the later type goes

further to retrieve cancer cases from other hospitals within its zone. Out of the five cancer registries in Nigeria, only the Ibadan, Ile-Ife and Enugu are still 'struggling' to remain community based. The activities of the two remaining registries at Ilorin and Zaria are largely limited to their respective hospitals.

The Ibadan, Ilorin, Ile-Ife, Enugu and Zaria registries are located in the University Teaching Hospitals in their respective towns. Each of the registries operates under the Department of Pathology and or Morbid Anatomy. Cancer registry undertakes the documentation of cancer separately from the conventional medical records department. The procedure for documentation is such that cancer is entered into the record card immediately biopsy confirms presence of malignant tumour in a patient. All the five registries in Nigeria are integrated into a network (association) with the Ibadan registry as the headquarters. This arrangement allows for continuous dissemination of information on new developments in cancer management and documentation among members in the country.

It is pertinent to note that all the registries in Nigeria were not established in the same year. The foremost cancer registry at Ibadan was established in 1960 and the other four registries within the second half of the 1980s. Specifically, Enugu registry was established in 1986, Ilorin in 1987, Ile-Ife and Zaria in 1989. In the Zaria centre, documentation of cancer information became active again in 1991 after being dormant for some months. An overview of the patients' register at this centre showed that most addresses of the patients were not properly documented. As most residential addresses of patients were

written as Kaduna or Zaria town without an indication of their specific ward, area or compound within the cities.

The Ibadan registry is worthy of special and separate consideration in this study because of its long record and existence in cancer management and documentation. Furthermore, the preliminary analysis of cancer data in Nigeria showed that the Ibadan registry documented more than 50 percent of all cancer cases in the country.

3.2.1 **Ibadan Cancer Registry**

The registry at Ibadan which was established in 1960 covers cancer cases found by notification to the registry by hospitals and regular visit of registry staff to all the hospitals and laboratories in the city. In addition, lists of surgical operations and pathology records are consulted and visits made to wards within the University College Hospital. Outside Ibadan City, most cancer patients and biopsies of cancer cases are normally referred to the College Hospital. Also, the registry staff members visit other hospitals within the zone in order to retrieve cancer records. These activities explain why the Ibadan registry documents more than 50 percent of all annual cancer cases in Nigeria.

The Ibadan cancer registry had risen to a place of renown as early as 1975 when it received the designation of the WHO as one of the three sub-regional cancer centres in Africa. The responsibilities of the sub-regional headquarters include overseeing cancer-related activities among member countries, training and research, compilation and dissemination of information and also references and referral services. They are also

mandated to stimulate cancer-related activities in the network of countries under their jurisdiction.

The administrative structure of the Ibadan registry comprises medical and paramedical professional such as epidemiologists, medical doctors, scientist, registrar and abstract clerks. Cancer patients are normally registered as Ibadan or non-Ibadan residents for the purpose of calculating rates at the centre. An Ibadan resident is defined as a person who has been living in the city for at least one year prior to diagnosis of cancer. This outstanding position occupied by the Ibadan registry informed the separate analysis of its annual cancer data from the other four centres.

3.2.2 **Cancer Registry Data**

The relevant information commonly recorded by most registries about the cancer patients is sex, age, occupation, tribe, residential address and cancer site. Additional information such as local government area and state of origin were recorded at the Enugu centre while Ilorin centre reported the patients' religious affiliations. Generally, the bio-data and the residential address needed for the demographic and spatial analysis were focused during data collection at the centres. All cancer records without cancer sites and residential addresses were removed from the data used in various analyses conducted in this study.

Two categories of cancer data were collected from each of the registries. The first was the annual summary of all cancer cases documented in each registry from 1960 to

1996. It is only the Ibadan registry that has records from 1960 to 1996, while others joined from about 1986 to 1996. Therefore, the annual cancer data from Ibadan registry were analysed and discussed separately from those of the other four centres. In all, this data set provided information on the temporal characteristics of the specific cancer groups.

The second category of data was detailed information from the record of each cancer patient documented from 1987 to 1996 (10 years). These data are the age, sex, occupation, residential address and cancer site of each patient. The choice of 1987 to 1996 was informed by the need to use data from all the centres at a period when almost all of them had commenced cancer documentation. The preliminary analysis of the annual cancer cases in each of the registries did not indicate any significant difference. Hence, the most recent 10 years cancer record, which equally accounted for about 30 percent of all the cancer cases documented in Nigeria (1960-1996) was adjudged adequate. During the fieldwork, each cancer patient's record was scrutinized and information on age, sex, occupation, marital status, religion, state of origin, residential address and cancer site were recorded in appropriate columns of a prepared hospital format (Appendix 2). All the cases that did not have adequate information, especially on cancer site and residential address were removed from the analysis. About 1,000 cases (6.5 percent) were found inadequate from all the centres. In all 15,343 cases were properly recorded for the 10-year period from all the cancer centres in Nigeria. It is important to note that there were instances when a centre may not have complete

information on a particular cancer case in its records. This account for the unequal total number of cases recorded for each of the categories, say, the total cases for sex compared with age and occupation. Nonetheless, the quality of data recorded in the registries is appreciable, compared with that of the conventional hospital records departments (personal communication).

All the cases recorded in each of the 5 cancer registries were treated separately and subsequently aggregated to show the broad national cancer pattern using the 30 states as unit of observation in Nigeria. The residential addresses on the patients' records served as the basis of the spatial distribution. A concerted effort was made to aggregate such residential addresses into their appropriate states. In this study, the 30 states created in 1991 formed the regional framework for cancer analysis. This 30 states structure was adopted instead of recent 36 states because it was easier to calculate cancer incidence rates using the NPC 1991 census figure, which was available only on 30 states basis.

3.2.3 Ile-Ife Cancer Registry Data

In order to analyse the intra-urban pattern of cancer incidence in Nigeria, the city of Ile-Ife was chosen. The cancer data retrieved from the registry located in the city were used to depict the pattern of cancer among the various wards within the city.

The choice of Ile-Ife City was based on the fact that the city is a cancer registry town with a manageable area extent within which a micro-scale investigation could be conducted. This sort of investigation carried out with the aid of questionnaire and

observation helped to identify the factors which explain the intra-urban pattern of cancer in Ile-Ife. Moreover, the preliminary analysis of cancer cases from each of the centres showed that the Ile-Ife cancer registry had the least numbers of records with missing information (incomplete entries). This implies that results based on the analysis of the cancer cases documented at this centre are very reliable.

The Ile-Ife registry is a community based cancer registry which oversees cancer documentation in the communities in the Ife-Ijesha zone of South-Western Nigeria. It was established in 1989 to register cancer cases from patients obtaining care in the Obafemi Awolowo University Teaching Hospital Complex and those on referral to the hospital from other less equipped hospitals in its zone.

The procedure followed to show the intra-urban pattern of cancer involves scrutinizing cancer records and extracting cases reported from the city. The documentation of the Ile-Ife centre is solely depended on since most cancer cases in the city were assumed to be reported to the centre. Information on age, sex, occupation, cancer site and the residential address of the patients who reside in Ile-Ife were extracted and recorded in a prepared hospital record format (Appendix 2). The residential address generally showed the compound or street or residential area within the city. Automatically, these expressions of residential locations constituted the smallest unit of area aggregation in this study. From these units, cancer cases were subsequently aggregated into wards within the city while the total number of each of the 15 cancer groups formed the city cancer profile. Cancer cases documented at the Ile-Ife registry

from 1989 to 1996 were 2,027 cases. Out of this number, about 500 cases were traceable to Ile-Ife City. A thorough screening of these cases showed that only 380 cases were recorded with specific residential addresses within the city. Hence, the intra-urban analysis of cancer incidence in Ile-Ife was based on these 380 cases. As a follow-up of the cancer pattern depicted by the registry data, a questionnaire survey was conducted on household basis in each of the randomly selected areas within the city so as to elicit information that explained the intra-urban cancer pattern.

3.3 Cancer Categorisation

Cancer as a family of diseases consists of about 65 sites (including specific, unspecified and ill-defined sites) according to the International Classification of Diseases (ICD 9th revision) by WHO (see Appendix 1). Most studies on cancer isolate a few of the 65 specific sites for analysis while some others aggregate them into a few groups. This is because of the cumbersome nature of dealing with 65 sites in a comprehensive analysis. The two principles that guide the grouping are the proximity of sites in the body and the similarity of risk factors. According to the former principle, cancer sites that are physiologically related are classified into a single group. The second principle categorizes cancer types that are associated with similar risk factors into a group.

The medical classification basically considers the proximity of the specific sites in the human body to arrive at 7 groups. These are as follows:

(i) Malignant neoplasm of lip, oral cavity and pharynx (T140-149)

(ii) Malignant neoplasm of digestive organs and peritoneum (T150-159)

(iii) Malignant neoplasm of respiratory and intrathoracic organs (T160-165)

(iv) Malignant neoplasm of bone, connective tissue, skin and breast (T169-175)

(v) Malignant neoplasm of genito-urinary organs (T179-189)

(vi) Malignant neoplasm of other ill- defined and unspecified site (T190-199)

(vii) Malignant neoplasm of lymphatic and haematopoietic tissue (T200- 208).

This grouping method becomes too broad for any meaningful ecological research. The main objective of this grouping method is to bring cancer sites that are inter-connected for ease of treatment. But then, some of the groups consist of cancers that have distinct and unrelated aetiological factors. For instance, bone, skin and breast cancer categorised as group (iv) are actually induced by unrelated risk factors.

Apart from the selection of a few cancer sites for analysis by some authors (Howe, 1983; Meades, et, al; 1988 and Learmonth, 1988), a comprehensive work that grouped cancers was by Verhasselt and Timmans (1987). The cancer groups that evolved from their consideration of the two principles mentioned above were employed for the production of world maps of cancer mortality. The 14 groups so derived are lip, oral cavity and pharynx (T140-149), oesophagus (T150), stomach (T151), intestine (except rectum) (T152-153), rectum, recto sigmoid junction and anus (T154), liver (T155), larynx (T161), trachea, bronchus and lung (T162), breast (T174), cervix uterus (T180), uterus (T179,181,182) prostate (T185), bladder (T188), and leukaemia (T204-208). The

adoption of this classification in Nigeria presents some problems as it covered only 40 percent of all reported cancer cases (Fieldwork, 1997).

The inappropriateness of the second grouping derives from the fact that majority of cancers of the developed countries were used in the mapping exercise thereby excluding those that are prevalent in the developing countries. Notable among such cancer sites are lymphomas, glands, bone, skin and the urinary organs. Since the Nigerian cancer experience tends to be partly at variance with those of the developed societies, (Olweny, 1990; Verhasselt, 1977), a grouping method, which is compatible with the cancer experience in this part of the world, is needed. Hence, the present study adopted a grouping method which takes into consideration the differentials of cancer types in Nigeria from the developed societies'. Sixteen cancer groups were derived based on the principles of site proximity and common risk factors. The value of this grouping method is that all reported cases of cancer are represented.

The evolving cancer groups are as follows:

(i) Oral cancer (lip, tongue, salivary glands, gum, floor of mouth, other parts of mouth, oropharyx, nasopharyx, hypopharyx and other sites within the lip, oral cavity and pharynx: T140-149),

(ii) Gastro-intestine cancer (oesophagus, stomach, small intestine; including duodenum, colon, rectum, recto-sigmoid junction and anus: T150-154),

(iii) Liver cancer (liver and intra- hepatic bile duct: T155),

(iv) Cancer of the internal organs (gall, extra hepatic bile duct, pancreas,

retro-peritoneum and peritoneum, pleural, thymus, heart and mediastinum: T156-158, T163-164),

(v) Cancer of the glands (thyroid glands, other endocrine glands, secondary and unspecified lymph nodes: T193, 194 & 196),

(vi) Cancer of the respiratory system (nasal cavities, middle ear and accessory sinuses, larynx, trachea, bronchus and lung: T160-162);

(vii) Bone cancer (bone and articular cartilage, connective and other soft tissues: T170,171);

(viii) Skin cancer (melanoma of skin and skin tumours: T172,173);

(ix) Breast cancer (female breast and male breast: T174, 175);

(x) Cervical cancer (uterus, cervix uteri, placenta, body of uterus, ovary and other uterine adnessia and other unspecified female genital organs: T179-184) ;

(xi) Prostate cancer (prostate, testis, penis and other male genital organs: T185-187);

(xii) Cancer of the urinary system (bladder, kidney and other unspecified urinary organs: T188, 189);

(xiii) Eye cancer (eye: T190);

(xiv) Brain and other nervous system (brain, other and unspecified parts of nervous system: T191, 192);

(xv) Leukaemia and lymphomas cancer (lymph sarcoma, reticulosarcoma, Hodgkin's diseases, lymphoid and histiocytic tissues, multiple myeloma and immunoproliferative neoplasm, lymphoid leukaemia, myeloid leukaemia, monocyclic cell types leukaemia: T200-208);

(xvi) Others (ill-defined site and those not included in the other groups: T195, 199 and 209).

Note: Figures in parentheses are Disease Code according to WHO (9th Edition).

The first 15 cancer groups were adopted for the various analyses in this study. This is because the last group exempted from the study refers to ill-defined sites, which have no specified risk factor. This implies that meaningful explanation cannot be offered for their pattern if included. Moreover the 15 groups adopted cover 95 percent of all the reported cases of cancer in Nigeria (Fieldwork, 1997).

3.4 Field Interview

Primary data were collected to investigate the environmental risk cells of cancer in Ile-Ife city. For this purpose, a questionnaire survey and observations were adopted to elicit information on the relevant environmental factors and behavioural practices in the different areas within the city. The variables included in the questionnaire are housing and general environmental condition, waste dump site, indices of modernisation, behavioural and lifestyle practices, dietary preference, sources of drinking water and

water handling methods and the socio-economic and demographic information of the areas (see Appendix 4a).

The questionnaire was administered to male or female heads of each household sampled in the selected areas in the city. A multi-stage random sampling procedure was used to select respondents in this survey. In the first stage, a map of Ile-Ife city on a scale of 1: 10,000 obtained from the office of the National Population Commission, Ile-Ife was divided into cells of 500 X 500 metres. The total number of the cells covering the built-up area in the city is 276, excluding the areas of intense communal hostility within the city. Although Neuman (1994) has proposed that specific sample ratios should be chosen for given population sizes, Burt and Barber (1996) have argued that the sample ratio is not as important as the representativeness of the elements of the sub-groups in the population. Hence, the random sampling method has been used to select the cells in this survey in order to remove most shades of subjectivity and ensure the representativeness of the results from the analysis. The random process involved in the selection of cells ensures that all cells, into which the city was divided, have an equal probability of being selected. This is because the various parts of the city were represented in the randomly sampled cells. Ten percent of the total number of cells was targeted in this study. The findings of this survey are capable of being applied to similar cities in Nigeria. These afore-mentioned benefits, of the random sampling method, makes it more appropriate in this study than any other sampling method.

Twenty-eight make up 10 percent of the two hundred and seventy-six cells. These cells were selected randomly to give cells 3, 5, 37, 45, 54, 68, 74, 78, 85, 92, 93, 110, 114, 123, 130, 135, 136, 158, 161, 168, 171, 188, 198, 199, 213, 236, 257 and 267. These were then carefully traced on the map (1:3,000) to their specific areas within the city. From this exercise, cells such as 3, 5, 54, 74, 78, 114, 171, 199, 236, 257 and 267 fall into non-residential areas. Eventually, only seventeen cells remained feasible for our questionnaire survey. The cells with their corresponding areas and the number of questionnaire successfully administered and accurately completed are presented in the Table 3.1.

Table 3.1 **Distribution of Completed Questionnaire among the Sampled Areas**

S/NO	Cell	Area/Residential Neighbourhood	Number of completed Questionnaire
1	37 and 45	Mayfair	13
2	68 and 85	Akarabata	18
3	92 and 93	Eleyele	12
4	110	Olonade (Oluorogbo)	10
5	130	Idi-Obi/Gateway	13
6	135	Iremo	13
7	158	Aderemi	10
8	161	Oduduwa College Area	10
9	168	Fajuyi	10
10	188	Ajamopo	11
11	123 and 136	O.A.U. Staff Quarters	10
12	198	Moore	12
13	213	Ode-Atan/Odiolowo	11
		Total	150

Two final year students of Obafemi Awolowo University and two secondary school teachers, who have good knowledge of the various areas in Ile-Ife were recruited as field assistants. The assistants were given a short training on the procedure for administering the questionnaire after the goals of the survey have been discussed with them. Afterward, copies of the questionnaire were given them for specific areas in the town.

In each of the selected seventeen cells (thirteen residential areas), thirteen respondents were to be interviewed. The procedure was such that the first house was picked randomly while the other subsequent houses were picked systematically. One house in every five was selected and then the head (male or female) of one household in the house. A concerted effort was made to cover every part of each selected cell. The educated (literate) respondents were allowed to fill the questionnaire by themselves while the questions were interpreted in Yoruba language to the illiterate respondents. Over 90 percent of the questionnaires were filled immediately in the presence of the interviewers while the remaining 10 percent were given to respondents to fill. These copies were later collected from the respondents the following day when the interviewers visited their respective houses. The information collected from this questionnaire survey were analysed for the explanation of cancer pattern in Ile-Ife city and the predominance of specific cancers in each cell (area) in the city.

3.5 Problems of the Study

Most of the problems encountered in the course of this research emanated from the data required, sources of the data and perception of the people about cancer. In the first instance, the study requires that cancer records which are documented at the national cancer registries be retrieved. Since these data are recorded by medical practitioners whose objectives are not exactly the same with those of the current study. For instance, information on the migration history and how long a cancer patient has resided in the current residential address that would have been of interest to us, were not documented. By implication, we have only little control over the variables documented because they consulted in retrospect. The only control was that documented cancer cases without essential information such as residential addresses and sites, were excluded from the analysis.

At the Ile-Ife registry, it took a long time before permission to retrieve the needed information was granted despite the submission of a copy of the research proposal and a letter of introduction. Even then, the permission so granted by the "ethical committee" of the hospital (OAUTHC) excluded visits to cancer patients at home in order to obtain further useful information from then. Hence, cancer pattern within the city was explained on the basis of the information colleted from the household survey and supplementary (secondary) data on water quality.

A more serious problem was faced at the Zaria registry. The head of Pathology department was not favourably disposed to allow us access to cancer document

in the unit in spite of the letter of introduction presented to him. He was of the opinion that the northern part of Nigeria be excluded from the study. It took the courage and diligence of the researcher to access a similar record from another unit within the same hospital.

Furthermore, the calculation of cancer incidence rate which should use the 1991 population figures of the wards as denominator, faced a setback. This is because the 1991 census figures for Ile-Ife city were not available on ward basis, whether on old or new ward demarcation. According to the zonal co-ordinator of the National Population Commission (NPC) at Ile-Ife, the wards were not the basis for demarcating enumeration area (EAs) boundaries in the city. So one EA could cut across the boundaries of wards. As a result of this setback, the 1991 population figures used for the calculation of cancer incidence in each ward were estimated from the 1963 census figure based on 2.5 growth rate per annum (Appendix 7).

Some of the areas with less than 13 completed questionnaires were found to be hostile and so some of the respondents were not disposed to grant any interview. In fact, two of the recruited field assistants, met with stern opposition in Akarabata area (see Fig. 1.2). We were also challenged at Ode-Atan area because the respondents in these areas suspected that we belong to their "enemy" community. It is important to note that hostility in Ile-Ife at the time of this survey was between the Ifes and the Modakekes who are the two major communities in the town. Their disagreement on some political issues has degenerated into killings and wanton destruction of properties. Another problem

encountered in the core areas, especially with some illiterate respondents, was their wrong perception of cancer. Indeed, the Yoruba interpretation of cancer must have added to this problem. Cancer is called *"Jefun-Jedo"* or *"arun jejere/ Aisan Jejere"*. These literally mean "the disease that eats up the intestine and the liver" or "disease of degeneration". Some of the respondents did not want to hear or answer any question on cancer and known cancer patients. They still perceive cancer as a dreadful health problem and any discussion of it is tantamount to discussing death. The strategy employed in such situations was that we asked respondents question about cancer when all other questions had been answered.

3.6 Analytical Technique

The past few decades have witnessed a marked increase in the application of different descriptive and inferential statistical techniques to geographical problems. In this study, both the descriptive and inferential statistics were employed to analyse the various categories of data collected.

Mapping of cancer pattern is very pertinent to medical geography studies including this study. Hence, the incidence rate of the overall and the specific cancer groups was calculated. The result of this cancer incidence rate was subsequently used to produce a cancer map of Nigeria. The cancer incidence rate (CIR) according to Spinnelli, and others (1992) is of the form:

$$CIRrj = n_{ij} / p_{ij} \ (k)$$

Where r_j = region j

„ n_{ij} = number of cancer cases (all ages i) in region j

„ p_{ij} = population at risk (all ages i) in region j

k = constant (100,000).

The cancer incidence rate is preferred to the cancer occurrence rate in this study. This is simply because the occurrence figure (number of cases) does not take cognisance of differentials in the population at risk in the regions. By implication, meaningful comparison of cancer pattern among the regions cannot be done on the basis of occurrence figure. The cancer incidence in each region is expressed as specific number per 100,000 people.

Again to test for variation in the pattern of cancer incidence between the 30 regions (states) in Nigeria the chi-square test was employed. This test simply examined the variability of observed cancer incidence from the expected one (Hypothesis 1). It is expressed as:

$$X^2 = \Sigma \frac{(o - e)^2}{o}$$

Where o = the observed cancer incidence in each state (region)

e = the expected cancer incidence.

The computer statistical package that calculated the value of the chi-square test equally indicated the level of significance of the result.

In order to investigate the ecological associative factors of cancer incidence in Nigeria, the Pearson correlation technique was employed. This technique measures the

level of association or relationship between variables. The procedure simply shows the co-efficient of association (correlation) between cancer incidence in each region and some selected explanatory variables. Hence, the degree of relationship or association between the two sets of variables is indicated. The associative variables were male population, female population, total population and life expectancy at birth (demographic factor) of each region. Others were population density, percentage of urbanisation (urbanisation factor), number of manufacturing industries, level of education/literacy (development and westernisation factor) and the magnitude of schitosomiasis cases (pathogenic factor) in each of the 30 regions in Nigeria (Appendix 3).

In addition, the multiple regression analysis was carried out to examine if the socio- demographic and pathogenic factors explain the pattern of cancer incidence among the states (regions). Here, the incidence of the cancer groups in the 30 regions (states) stood as the criterion while the predictors were the various associative or explanatory variables.

The various variables chosen above were in line with propositions of both the conceptual framework and the findings of past works. For instance, magnitude of schistosomiasis cases was employed as a pathogenic factor since the infestation of the fluke induces cancer in the urinary bladder (Learmonth, 1988). Generally, socio-economic development of any region has been shown to have positive influence on the incidence of certain cancer groups such as breast, prostate and skin among others. (Verhasselt, 1977; Vigneron, 1989). Life expectancy is specifically identified to relate

positively with most cancer cases (Rowland and Cooper, 1983 and Vigneron, 1989, Verhasselt,1993). This is because cancers are seen as an ageing health problem (Smith, 1990).

At the micro-level (intra-urban analysis), the factor analysis technique was employed to reduce or collapse the numerous socio-environmental variables of the sampled areas to few dimensions. This became necessary so as to arrive at principal factors that significantly explain the risk potential of each sampled area vis-à-vis its cancer pattern. Ranking method that seems to be an alternative method was inappropriate since it cannot reduce the numerous variables into fewer dimensions. In other words, the ranking method unlike factor analysis does not achieve parsimony of description, which is pertinent to this study.

Factor analysis technique recognises that all measurements (variables) are not of equal weight but that many of them may overlap and tell us the same story about the ways in which a set of areas may vary (Haggett, 1965). As a multivariate statistical technique, factor analysis is used to collapse a set of variables (X_1, X_2, $X_3 \ldots X_n$) to a new set of fewer factors (Y_1, Y_2, $Y_3 \ldots Y_m$) which account for much of the possible variation among the original variables. Parsimony of description is achieved by reducing the original set of variables to a smaller ($Y < X$) number of basic variables or factors (Cole and King, 1970). From the data collected in the questionnaire survey, thirty variables were specified over the thirteen residential areas (13 by 13 matrix). The variables range from housing qualities, environmental condition, socio-economic status, indices of

modernization, behavioural practices and pollution (See Appendix 4b). The SPSS computer package was employed to factor analyse these thirty variables and seven principal factors were generated. These principal factors were subsequently used to explain the pattern of predominant cancer groups in each area/cell.

The chi-square test was employed to test the variability (difference) in cancer cases among sex and age groups (Hypothesis 2) in this study. This test simply examined the variability of observed cancer occurrence from the expected one. It is expressed as:

$$X^2 = \Sigma \frac{(o - e)^2}{o}$$

Where o = the observed frequency of cancer cases

e = the expected frequency of cancer cases.

The computer statistical package that calculated the value of the chi-square test equally indicated the level of significance of each result (value).

To determine the trend of cancer groups from 1960 to 1996 and their future pattern (Hypothesis 4), the time series analysis was employed. The annual cancer data from 1960 to 1996 in Ibadan registry and from 1986 to 1996 in the other four registries served as the database for this analysis. The separation of the Ibadan registry data from the data of the other registries was done to mark differences in the duration of data collection between them. While Ibadan registry consistently documented cancer cases from 1960 to 1996, the other centres started from the mid-1980s to 1996. This separation

also afforded us the opportunity to compare the temporal characteristics of cancer groups in the registry categories.

Time series technique is a sequence of observations (Y_1, Y_2, $Y_3 \ldots Y_n$) that are collected over successive increments of time. This technique is used to obtain a concise description of the features of a particular phenomenon. It is the trend components of time series analysis that is very relevant to the present study. This component enables one to identify the specific long-time movement of the phenomenon in consideration. The trend line which indicates the direction of movement is used for forecasting purpose (Burt and Barber, 1996).

To depict the temporal pattern of the cancer groups the trend line option of time series was selected. Subsequently, the 'line of best fit' or least squares regression line was plotted for the cancer groups. One reason for plotting this line was to enable the estimation of future trend of the cancer cases to be made. The equation is of the form:

$Y = a + bX$

Where Y and X are variables (say cancer cases and time)

a is the intercept of the regression line

b is the regression co-efficient of Y on X.

This present study recognised the limitation of employing regression line for estimating values outside the range of the observed values of cancer cases. Yet, this method gave a fair indication of the future trend of cancer occurrence in Nigeria.

CHAPTER FOUR

THE SOCIO-DEMOGRAPHIC CHARACTERISTICS OF CANCER PATIENTS

4.1 Introduction

This chapter provides an overview of the socio-demographic characteristics of cancer patients in Nigeria. This analysis also helps us to identify the major principal lines of bio-social categorisation that tends to influence cancer occurrence. Important bio-social characteristics which often influence cancer risks are age, sex, marital status, religion and occupation. In this study, the identification of specific relationship of any of these socio-demographic characteristics with cancer groups has potential for pinpointing salient risk factors and the population groups to target in Cancer Intervention Programme in our society.

The socio-demographic data collected from the records of the cancer patients between 1987 and 1996 are presented in this section. The intention for choosing 1987 to 1996 (10 years) was to ensure that almost all the registries had commenced documentation of cancer information. While the aggregate data (from all the 5 registries) depicts the national picture, the pattern in each centre is equally considered. This is done in order to reveal possible differences between the national and regional patterns. Moreover, in any case where information required for a particular socio-demographic characteristic is not available in all the registries, only the registries that recorded the information is treated on a regional basis.

The numbers of overall cancer cases reported in each of the five registries are not equal in Nigeria and so are the registries contributions to each cancer group analysed for the socio-demographic variables. From Table 4.1, the cancer registry at Ibadan recorded 68.0 percent (10,430 cases) of all the cancer cases reported between 1987 and 1996. The other four registries accounted for 32.0 percent of the reported cancer cases. Specifically, Enugu had 2416 cases (15.7 percent) followed by Ile-Ife (11.8 percent). With reference to the Ilorin registry and that of Zaria, they recorded less than 5.0 percent of all the cases of cancer in Nigeria within the chosen period.

Table 4.1: Reported Cancer Cases in the Registries (1987 – 1996)

Registry	Number of Cases	Percent
Ibadan	10,430	68.0
Enugu	2416	15.7
Ile-Ife	1814	11.8
Ilorin	581	3.8
Zaria	102	0.7
Total	15,343	100.0

4.2 Age Distribution of Cancer Patients

Age of the cancer patients is one of the bio-social variables that was well documented in all the registries. As shown in Table 4.2 an interval of 15 years has been chosen for the age groups. This seeming large interval is needed for showing possible difference among distinct age groups which may exist for a degenerative disease such as

cancer. A 15 years interval was used by Tawaih (1989) to analyse the occurrence of leukaemia in northern Nigeria. In the case of the American Cancer Society (1994), an interval of 20 years was used in calculating probability of specific age group to develop cancer.

The general picture of cancer distribution among the age groups shows that age group 46 to 60 years had the highest number of cases (4593 cases). This accounted for about 30.0 percent of the total cancer cases. Age group 31 to 45 closely followed the age group it precedes with 3983 cases (26.0 percent). These two age groups jointly accounted for 56.0 percent of the total cases of cancer between 1987 and 1996. The age group with the lowest number of cancer cases were 76 years and above (3.3 percent), 0 to 15 years (11.1 percent) and 61-75 years (16.5 percent).

Table 4.2: **Reported Cancer Cases Among Age Groups (According to Registries)**

Age Group	All Registries	Ibadan	Ile-Ife	Ilorin	Zaria	Enugu
0-15	1697 (11.1)	1137 (10.9)	160 (8.8)	104 (17.9)	8 (7.8)	288 (11.9)
16-30	2035 (13.3)	1392 (13.3)	233 (12.8)	71 (12.2)	12 (11.8)	327 (13.5)
31-45	3983 (26.0)	273 (26.2)	393 (26.7)	129 (22.2)	35 (34.3)	690 (28.6)
46-60	4593 (29.9)	3155 (30.2)	567 (31.3)	155 (26.7)	29 (28.4)	687 (28.4)
61-75	2533 (16.5)	170 (16.3)	357 (19.7)	97 (16.7)	16 (15.7)	362 (15.0)
76 and Above	502 (3.3)	309 (3.0)	104 (5.7)	25 (4.3)	2 (2.0)	62 (2.6)
Total	15,343 (100.0)	10,430 (100.0)	1814 (100.0)	581 (100.0)	102 (100.0)	2416 (100.0)

Source: Fieldwork, 1997.

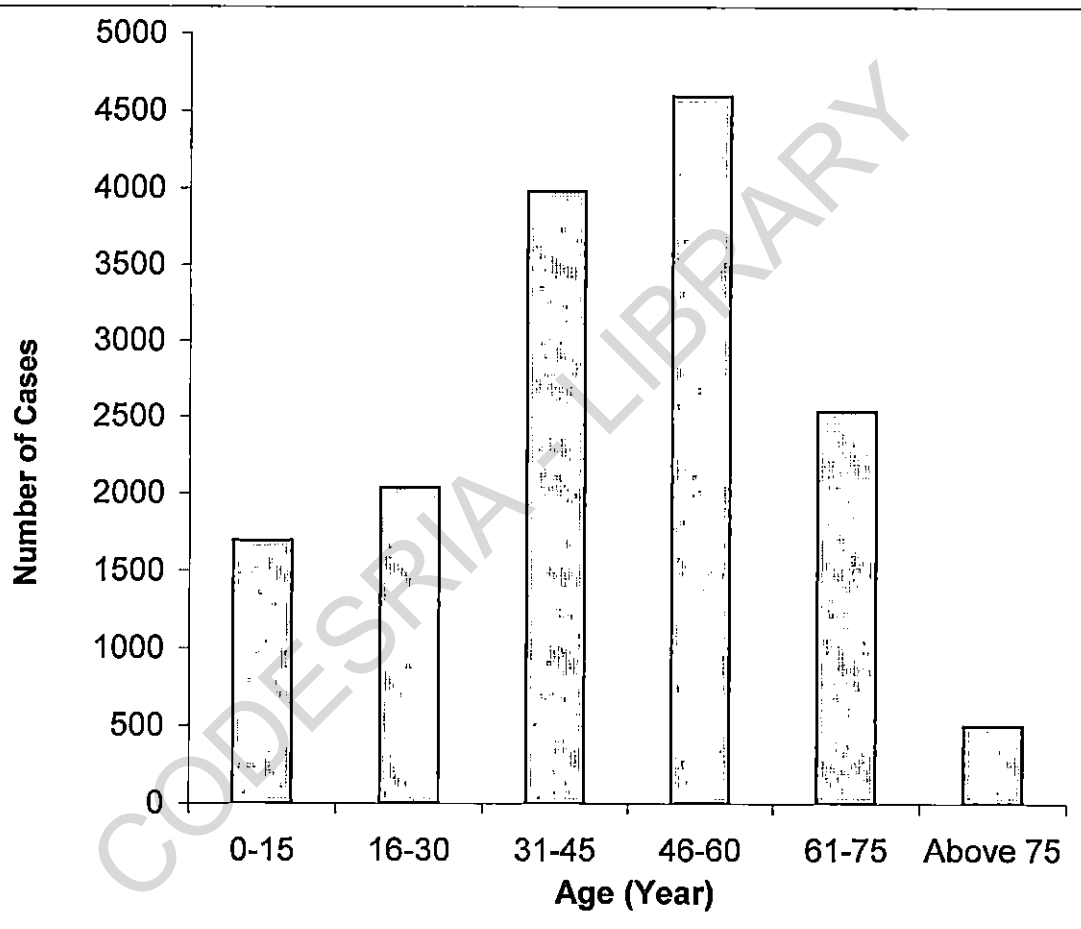


Fig. 4.1 : Cancer Occurrence Among Age Groups

A graphical representation of the distribution of cancer cases among the age groups depicted an increase from age group 0-15 years to 46-60 years. Thereafter, it declined till the last age group (76 years and above) as shown in Figure 4.1. A minor deviation from this general picture is noticed in the age group that tops cancer occurrence in Zaria. Age group 30-45 years accounts for the highest number of cases while age group 46 to 60 years follows. This picture is at variance with the national (overall) picture where the reverse of Zaria situation was noticed.

The leading position of age groups 31-45 years and 46-60 years in cancer morbidity has been supported by Tawaih (1989) who identified the prevalence of cancer cases among people aged 35-50 years in northern Nigeria. Cancer cases in Nigeria therefore appear concentrated in the middle-age groups. This finding agrees with the pattern of overall cancer composition by site which has been hypothesized to be skewed toward the middle-age in the developing world (Remmenick, 1998). The decline among age groups 61-75 years and 76 years and above may result from the difficulty involved in diagnosing cancer among the elderly (Remmenick, 1998). Also, the fact that life expectance is lower in this part of the world, so that people who actually get into the last two age groups are always very few.

In order to have a better picture of the age characteristics of patients who suffered from specific cancer group, Table 4.3 is considered. With respect to breast cancer, age group 31-45 years had the highest number of cases (36.6 percent). The age group that accounted for the next highest proportion was 46-60 years while the other age groups

Table 4.3 **Age Characteristics of Specific Cancer Groups in Nigeria**

Age Group	Breast	Cervical	Leukaemia /Lymphoma	Gastro-intestine	Bone	Prostate	Liver	Oral	Glands	Respiratory	Skin	Urinary	Internal organ	Brain	Eye
0-15	123 (4.4)	160 (6.1)	314 (24.5)	27 (2.2)	182 (15.3)	19 (1.9)	35 (3.5)	41 (5.4)	69 (9.8)	31 (4.7)	24 (3.9)	38 (7.6)	11 (3.0)	51 (14.7)	26 (8.5)
16-30	324 (11.5)	349 (13.4)	230 (17.9)	137 (11.2)	247 (21.4)	49 (4.9)	121 (12.1)	132 (17.5)	113 (16.1)	71 (10.9)	91 (14.7)	33 (6.6)	29 (7.8)	69 (19.8)	40 (13.0)
31-45	1034 (36.6)	778 (29.9)	257 (20.0)	305 (24.8)	247 (21.4)	81 (8.1)	323 (32.2)	172 (22.8)	175 (24.9)	151 (23.1)	149 (24.1)	94 (18.8)	84 (22.6)	94 (27.0)	39 (12.7)
46-60	954 (33.8)	862 (33.1)	253 (19.7)	430 (35.0)	244 (21.2)	271 (27.2)	341 (34.0)	222 (29.4)	227 (32.3)	229 (35.1)	188 (30.5)	110 (22.0)	143 (38.4)	71 (20.4)	48 (15.6)
61-75	340 (12.0)	403 (15.5)	129 (10.1)	252 (20.5)	126 (10.9)	421 (42.3)	149 (14.9)	130 (17.2)	79 (11.2)	126 (19.3)	117 (19.0)	102 (20.4)	83 (22.3)	39 (11.2)	37 (12.1)
76 and above	49 (1.7)	54 (2.1)	23 (1.8)	54 (4.4)	20 (1.7)	133 (13.4)	21 (2.1)	23 (3.1)	21 (3.0)	23 (3.5)	31 (5.0)	27 (5.4)	13 (3.5)	1 (0.3)	9 (2.9)
Total	2824	2606	1282	1282	1152	995	1002	754	703	653	617	500	372	348	307
Percent	18.4	17.0	8.4	8.0	7.5	6.5	6.5	4.9	4.6	4.3	4.0	3.3	2.4	2.3	2.0

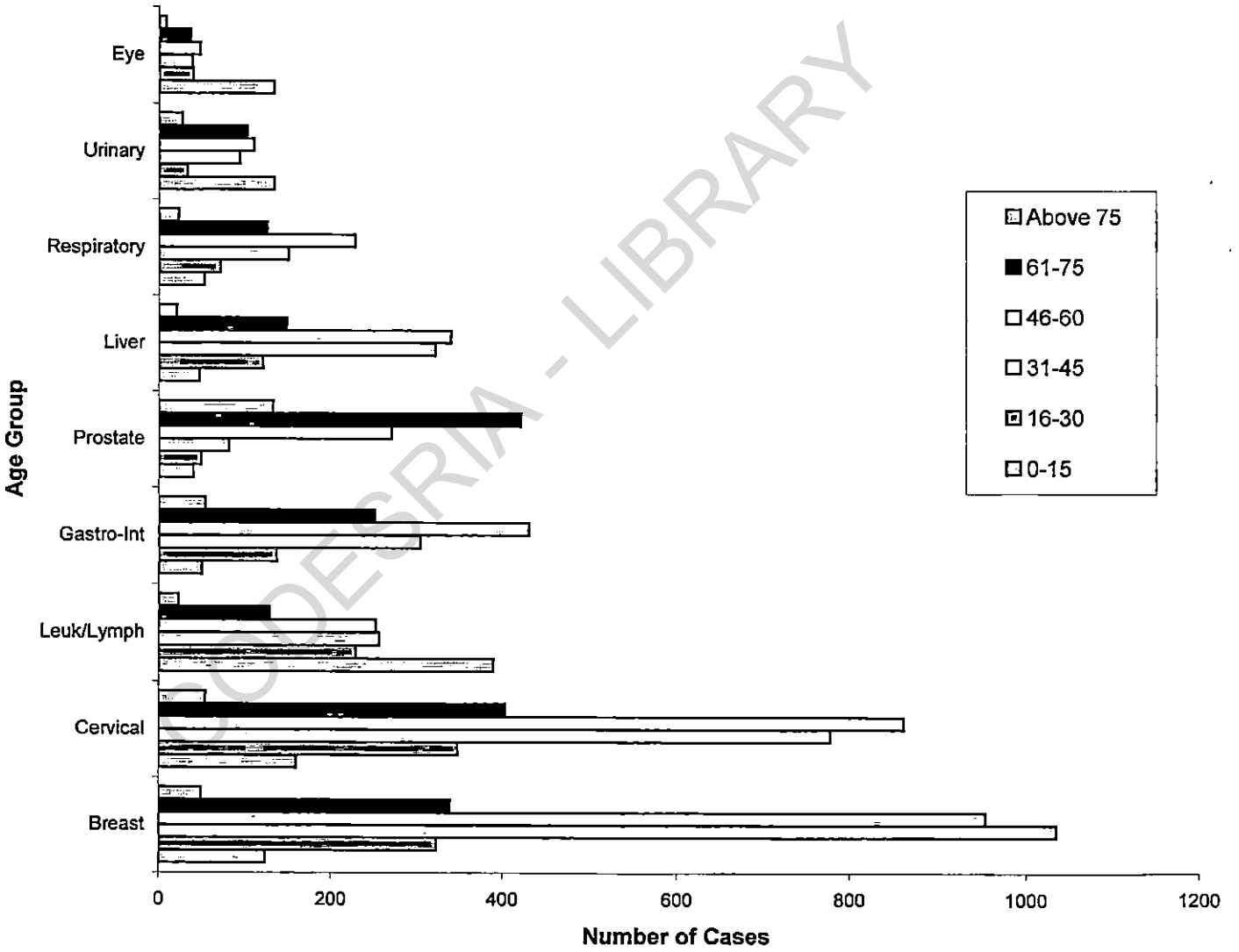
Source: Fieldwork, 1997.
Note: Figures in parentheses are percentages

had small number of cases. Age group 61-75 years had 12.0 percent followed by 16-30 years (11.5 percent), 0-15 years (4.4 percent) and 76 years and above (1.7 percent).

In the occurrence of cervical cancer, age group 46-60 years recorded the highest proportion (33.1 percent). Age group 31-45 years followed this proportion with 29.9 percent, while small numbers of cases were found in liver cancer with 34.0 percent for both age group 46-60 years and 31-45 years. Moreover, the cases of respiratory cancer appear most common among age group 46-60 years (35.1 percent), followed by 31-45 years age cohort and age group 61-75 years (19.3 percent). This pattern is also observed in the occurrence of the gastro-intestine, skin and cancer of the internal organs. Age group 46-60 years accounted for 38.4 percent of internal organs, 35.0 percent of gastro-intestine and 30.5 percent of skin cancer. Age group 61-75 years occupied the second position in the cases of cancer of the internal organs (22.3 percent) and skin cancer (19.0 percent).

Generally, the distribution of breast, cervical, gastro-intestine, liver, oral, glands, respiratory and skin cancer shows that age group 31-45 years and 46-60 years accounted for the highest proportion. Age groups 0-15 years, 16-30 years, 61-75 years and 76 years and above on the other hand, tend to record small number of cases. This pattern agrees with the distribution of the overall cancer cases among the age groups in Table 4.2. Cancer groups that appear different in age characteristics from the overall cancer pattern

Fig. 4.2: Age Distribution of Specific Cancer Groups



were leukaemia/lymphomas, bone, urinary, brain, eye and prostate cancer. Prostate cancer cases were highest in age group 61-75 years (42.3 percent). The age group that recorded the next highest number of cases was the preceding age group (46-60 years) with 27.2 percent while age group 76 years and above ranked third (13.4 percent). This cancer group appeared predominantly among the elderly people because age groups 61-75 years and 76 years and above accounted for 55.7 percent of the total number of cases. This finding is supported by the result of prostate cancer risk estimated for a normal population by the American Cancer Society (1994). While the society estimated one case in 10,000 men below 40 years, it was as high as one case in 9 men between age 60 and 79 years.

In the case of leukaemia/lymphomas, age group 0-15 years reports 30.4 percent of the occurrence. The age group that had the second highest proportion is 31-45 years, followed by 16-30 years age cohort (17.9 percent). Again, age group 0-15 years accounts for the highest proportion of the cases of eye cancer (43.6 percent), urinary (26.8 percent), bone (23.3 percent) and brain cancer (21.3 percent). The second highest proportion of eye cancer (15.6 percent) was reported by patients in ages 46-60 years, followed by those in age groups 16-30 years (13.0 percent) and 31-45 years (12.7 percent). Age group 46-60 years (20.4 percent) and 61-75 years (20.0 percent) occupied the second and third positions in the age distribution of urinary cancer cases. With respect to bone cancer age group 16-30 years and 31-45 years occupy the second position with 21.4 percent each. The age group that followed in the magnitude of reported cases of

bone cancer was 46-60 years (21.2 percent). For brain cancer, age group 31-45 years also occupied the second position (27.0 percent), 46-60 years the third while the 16-30 years ranked fourth in proportion of reported cases.

From Table 4.3, it appears the cases of leukaemia/lymphomas, bone, urinary and eye cancers were most common among children. Among these four cancer groups, the predominance of leukaemia/lymphomas has been observed by authors such as Tawaih (1989) and Olweny (1990). Oyemade and Junnaid (1982) have also shown that bone cancer (osteosarcoma) is most common among ages 10 to 20 years in Ibadan. The high occurrence of brain cancer among children (21.3 percent) has also been discovered by Olumide and Adeoye (1982) and ACS (1994). The first author found 53.8 percent of brain cancer cases among patient aged 0-20 years in Ibadan.

The high cases of eye and urinary cancers among children which disagree with the finding of Lawani, Nkoposong, Aghadiuno and Akute (1982) may be due to congenital infections rather than the causes among adults. This is probably true of the few cases of other cancer groups such as breast, cervical and prostate cancer which are not expected among children. For instance, the cases of cervical cancer among children (girls) in Zaria have been attributed to a similar factor which manifests in yolk sac tumours (Mabogunje, Lawrie, Harrison and Edington, 1982).

The finding of Lawani, Nkoposong, Aghadiuno and Akute (1982) supports the outstanding cases of prostate cancer among patients aged 61-75 year. According to them, the mean age of prostate cancer patients in Ibadan was 63.5 years with age group 51-70

years reporting the highest number of cases. The susceptibility of older men to prostate cancer may be associated with genetic factor (Remmenick, 1998).

Findings from the analysis carried out by some authors have also corroborated the high cases of breast, cervical, respiratory and internal organs cancer among age groups 31-45 years and 46-60 years. For instance, lung cancer was found to concentrate in age group 50 – 60 years in Enugu by Anyanwu (1982). Likewise, ovarian cancer and cervical cancer have been shown to peak among patients in ages 40 to 49 followed by 50 to 59 years (Agboola, 1982). Finally, cancers of the kidney and bladder have been found to be predominant among age groups 31-50 years and 41-60 years respectively. (Lawani, et al; 1982).

In order to examine if there is any significant difference in the occurrence of the cancer groups among the various age groups, the chi-square test was employed.

Results of chi-square test on the distribution of cancers among different age groups.

Statistics	DF	Value	Probability
Chi-square	98	3893.291	0.001
Likelihood Ratio Chi-square	98	2914.659	0.001
Mantel-Haenzel Chi-square	1	228.970	0.001
Phi Coefficient		0.504	
Cramer's V		0.450	
		0.190	

The chi-square result is 3893.3, which is significant at 99.0 percent confidence level. This implies that there is a significant difference in the distribution of cancers among the age groups in Nigeria.

4.3 Sex Composition of Cancer Patients

Out of the 15,749 cancer cases analysed on the basis of sex categories, 9,757 (61.9 percent) cases were reported by females while males reported 5,992 (38.1 percent) cases. Table 4.4 shows further that the predominant cases of cancer reported by females in Nigeria were not the same in each of the 5 national cancer registries. For instance, the highest proportion of female cancer cases were reported at the Ibadan centre (67.6 percent). On the other hand, females who reported cancer cases were less in Zaria (26.5 percent), followed by Enugu (42.2 percent) and Ilorin (46.9 percent). It is only at Ile-Ife and Ibadan registries that the cancer cases reported by the females were generally above 50 percent.

Table 4.4 Sex Composition of Cancer Patients According to Registries

Registry	Male	Percent	Female	Percent	Total
Ibadan	3425	31.7	7375	68.3	10,600
Ile-Ife	790	42.6	1065	57.4	1855
Ilorin	307	53.1	271	46.9	578
Zaria	75	73.5	27	26.5	102
Enugu	1395	57.8	1019	42.2	2414
All Registries	5992	38.1	9757	61.9	15749

Source: Fieldwork, 1997.

The overwhelming cases of cancers reported by females at the Ibadan registry may result from the excellent position of this centre in cancer management. Since the centre has more qualified (experienced) staff members and facilities, referral cases for female cancers (breast and cervical) from other centres are therefore likely to soar up the reported cases here. In the case of Zaria with outstandingly low proportion of female reported cancer cases, the already identified problem of delay in women visit to hospitals may be responsible. According to Adamu (1994), women in the northern part of Nigeria generally encounter constraints (delay phases) in their health seeking behaviour. Therefore, most cancer cases among women may remain unreported in this zone.

In Table 4.5, the sex composition of each cancer group is shown. It is noticeable that cancers of the breast, cervical and prostate which are reproductive cancers tend to be predominantly sex specific. The female sex accounted for 99.2 percent of all reported cases of breast cancer while cases of male breast cancer were negligible. Another important feature of the reproductive cancers, especially breast and cervical is their leading position among all cancers. Both of them accounted for 35.7 percent of all cancer cases reported in Nigeria from 1987 to 1996.

It is interesting to note that more males reported well above 50 percent of liver (62.0 percent), leukaemia/lymphomas (60.4 percent), respiratory (59.0 percent), internal organs (57.0 percent), gastro-intestine (54.2 percent), and oral (53.0 percent) cancer cases.

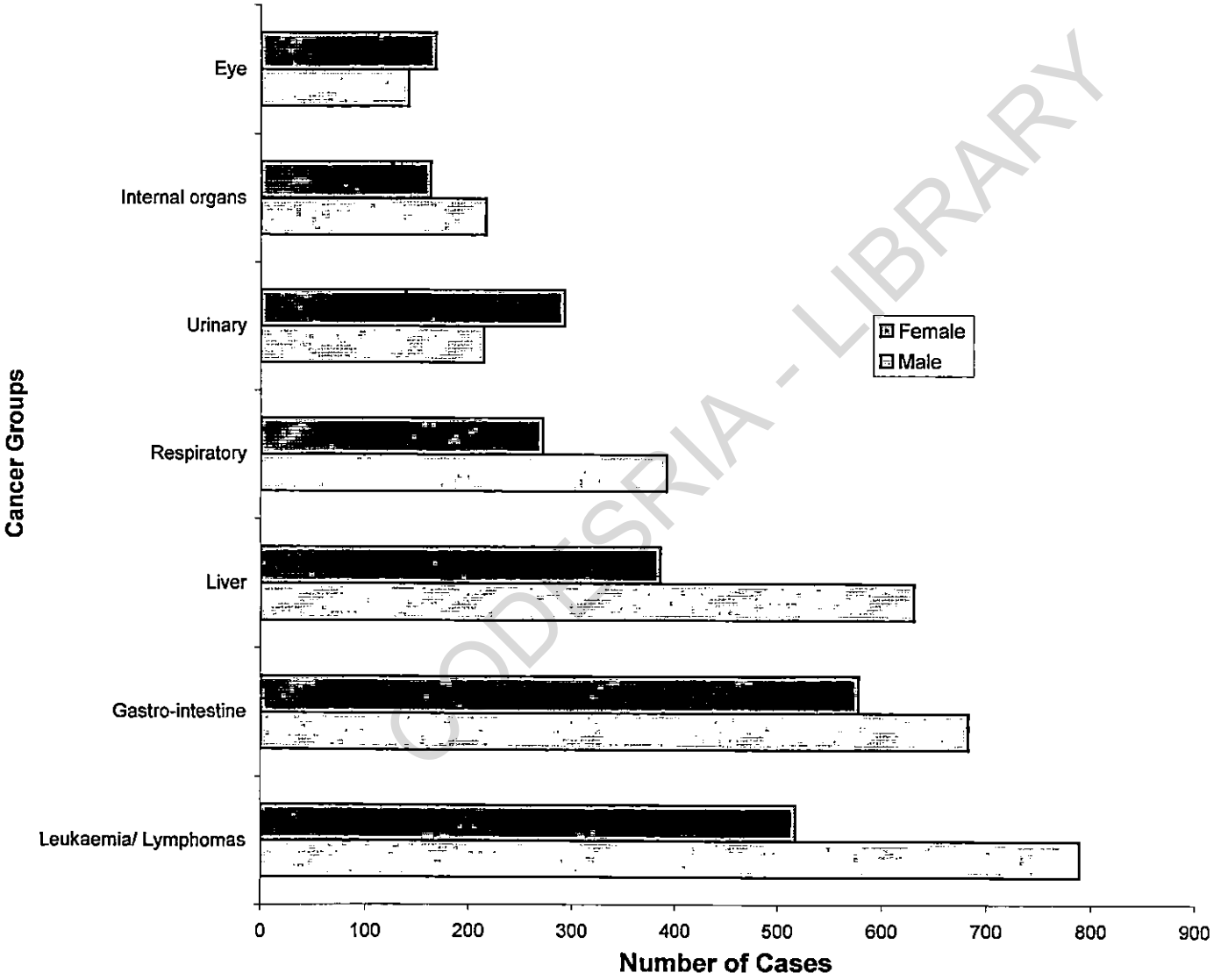
Table 4.5 Sex Composition of the Specific Cancer Group (All Registries)

Cancer Group	Male	Percent	Female	Percent	Total
Breast	24 (0.4)	0.8	2886 (30.9)	99.2	2910
Cervical	-	-	2303 (27.8)	100.0	2303
Leukaemia & Lymphoma	789 (13.2)	60.4	517 (5.3)	39.6	1306
Gastro-intestine	683 (11.4)	54.2	578 (5.9)	45.8	1261
Bone	591 (9.9)	50.9	571 (5.9)	49.1	1162
Liver	631 (10.5)	62.0	386 (4.0)	38.0	1017
Prostate	1022 (17.1)	100.0	-	-	1022
Oral	412 (6.9)	53.0	365 (3.7)	47.0	777
Glands	353 (6.0)	48.6	373 (3.8)	51.4	726
Respiratory	392 (6.5)	59.0	272 (2.8)	41.0	664
Skin	338 (5.6)	52.5	306 (3.1)	47.5	644
Urinary	215 (3.6)	42.3	293 (3.0)	57.7	508
Internal Organs	217 (3.6)	57.0	164 (1.7)	43.0	381
Brain	183 (3.1)	52.1	168 (1.7)	47.9	351
Eye	142 (2.4)	45.7	169 (1.7)	54.3	311
Overall	5992 (100.0)	39.0	9351 (100.0)	61.0	15343

Note: Figures in parentheses are percentages

Source: Fieldwork, 1997.

Fig. 4.3: Sex Composition of Cancer Groups



Similarly, females accounted for over 50 percent (apart from the reproductive cancers) in the reported cases of urinary (57.7 percent) and eye (54.3 percent) cancers.

The sex distribution of the specific cancer cases shows that besides the reproductive system cancers, males generally tend to lead in the occurrence of other cancers in Nigeria. Males generally account for 54.3 percent of the remaining twelve cancer groups while females reported 45.7 percent of the cases. This finding agrees with the observations of King and Harris (1987), Hazra (1984) and McGlashan (1982) that men have more cancer cases than women. The recent study by Remmenick (1998), supports the present findings and further states that, men's higher exposure to health hazards in the course of their occupation may be responsible.

On specific cancer group, some authors have also observed marked differences. For instance, males have been shown to report higher cases of lung (respiratory) cancer than females (ratio 2.6:1) in Enugu (Anyanwu, 1982). The plausible explanation is the exposure in the cause of their occupation coupled with higher prevalence of smoking among them. A similar observation which corroborates the finding of the present study is the higher burden of lymphomas cases found in males above females (Johnson and Williams, 1982). These authors have attributed the high occurrence of lymphomas to some preventable infections in our society. Furthermore, Lawani, Nkoposong and others (1982) have found higher cases of urinary cancer among women than men. The male and female ratio of 1:1.5 discovered for Nigeria agrees with the finding of this current study.

Probably, the exposure of women's urinary tract to infections or complications during child-birth may be responsible.

The gastro-intestine cancer which males reported more than females in this study, disagrees with the result of the analysis conducted by Okeowo and Ajayi (1982). Their study showed a male to female ratio of 2:2.1. This observed discrepancy may be attributed to the difference in the period of the two studies since most cancers are not static in occurrence among population groups. Hence, the present study may point to an emerging higher prevalence of the gastro-intestine cancer among males than females. The higher exposure of men to contaminants in the course of alcohol consumption, which is more common among them may explain the higher occurrence.

Finally, the chi-square test was used to examine if the difference in the occurrence of cancers among males and females is statistically significant (Table 4.5).

Result of Chi-square (X^2) test of the cancer groups by sex

Statistic	DF	Value	Probability
Chi-square	14	6214.307	0.001
Likelihood Ratio Chi-square	14	8252.038	0.001
Mantel-Haenszel chi-square	1	2850.630	0.001
Phi coefficient		0.628	
Contigency coefficient		0.532	
Cramer's V		0.628	

The result of the X^2 indicates that the difference is statistically significant. The X^2 value is 6214.3, which is significant at 99.0 percent confidence level. Therefore, cancer occurrence in Nigeria tends to be sex specific.

CHAPTER FIVE

SPATIAL PATTERN OF CANCER INCIDENCE

5.1 Introduction

Geographical region, be it province, ward or state has become a common basis for analysing the pattern of diseases in medical geography. This is because diseases have shown spatial variations which tend to reflect similar variations in behavioural, environmental and genetic factors. Such spatial variations may enhance the formulation of certain epidemiological hypotheses that may assist the identification of specific risks in the community in question. Consequently, an effective planning of health intervention programme for disease control will rely on such identified risk factors.

The regional variations of certain diseases in Nigeria are well established, going by the works of authors such as Adejuwon (1983), Iyun (1987) and Egunjobi (1993). They have shown that the morbidity and mortality of measles, malaria, pneumonia, tetanus, dysentery and tuberculosis vary among the states in Nigeria. However, little is known about the spatial pattern of non-communicable (degenerative) disease such as cancer in the country.

While the inherent problems associated with facility data are appreciated, the attempt here is to present a broad geographical picture of cancer morbidity in Nigeria in order to bridge the gap in our knowledge of the ecology of diseases in the country. This kind of exercise enhances the efficient allocation of the scarce (tertiary) medical resources in Nigeria which incidentally are required for cancer monitoring and control.

5.2 Distribution and Composition of Cancer cases (1987-1996)

The data used in this section were collected from the 5 national cancer registries from 1987 to 1996. The choice of this period is informed by the need to ensure that almost all registries have commenced cancer documentation and that sufficient number of cancer cases is already recorded. It is important to note that only Ibadan registry operated from 1960 to 1985, therefore the choice of a period earlier than 1986 will likely produce a regional biased morbidity data. Such data will definitely exaggerate cancer cases reported by states around Ibadan city while other states will be under-represented because of the inverse relationship which exist between distance and facility utilisation.

A notable feature of the Nigerian cancer experience is that all the 65 cancer sites according to WHO classification of diseases are reported in the various parts of the country. Table 5.1 presents specific groups of these 65 sites that are shown in Appendix 1. Out of the 15,343 cancer cases reported between 1987 and 1996 in Nigeria, breast cancer led all others with 2,824 cases (18.4 percent). The second leading cancer group was cervical, which accounted for 17.0 percent. Other cancers that contributed over 5.0 percent of the overall cancer cases were leukaemia/lymphomas (8.4 percent), gastro-intestine (8.0 percent), bone (7.5 percent), liver (6.5 percent) and prostate (6.4 percent). These seven cancer groups jointly accounted for 72.2 percent of all the reported cancer cases.

The remaining 8 cancer groups, that comprise glands, respiratory, skin, urinary, internal organs, brain and eye accounted for just 27.8 percent of the "overall" cancers.

Specifically, the cancer groups that recorded the least number of cases were eye (2.0 percent), brain (2.2 percent) and internal organs (2.3 percent). In short, Table 5.1 shows that the reproductive (breast, prostate and cervical), childhood (leukaemia/lymphomas) and digestive cancers (gastro-intestine) were the most common in Nigeria.

The position occupied by each cancer group at the national level tends to vary among the registries in the country. For instance, the 1st and 2nd positions assumed by breast and cervical cancers are interchanged in the Ibadan registry data. In other words cervical cancer assumed the first position at the Ibadan registry followed by breast cancer (Table 5.1).

Table 5.1 **Reported Cancer Cases in Nigeria Registries 1987 - 1996**

Rank	Cancer Group	All Registries (1987-1996)	Ibadan (1987-1996)	Ile-Ife (1989-1996)	Ilorin (1987-1996)	Zaria (1989-1996)	Enugu (1987-1996)
1	Breast	2824	1793 (2)	351 (1)	94 (3)	5 (7)	581 (1)
2	Cervical	2606	2110 (1)	208 (4)	5 (10)	1 (10)	281 (3)
3	Leukaemia/ Lymphoma	1282	1001 (3)	2 (15)	166 (1)	-	113 (8)
4	Gastro-intestine	1228	788 (4)	209 (3)	57 (4)	15 (2)	159 (4)
5	Bone	1152	532 (8)	191 (6)	23 (8)	8 (4)	398 (2)
6	Liver	1002	571 (7)	142 (7)	125 (2)	31 (1)	133 (7)
7	Prostate	995	600 (6)	194 (5)	37 (5)	7 (5)	157 (5)
8	Oral	754	601 (5)	63 (10)	2 (12)	4 (8)	84 (10)
9	Glands	703	368 (11)	258 (2)	3 (11)	6 (6)	68 (13)
10	Respiratory	653	529 (9)	18 (13)	25 (7)	2 (9)	79 (11)
11	Skin	617	403 (10)	73 (8)	-	4 (8)	137 (6)
12	Urinary	500	306 (13)	61 (11)	31 (6)	12 (3)	90 (9)
13	Internal Organs	372	207 (15)	68 (9)	13 (9)	6 (6)	78 (12)
14	Brain	348	326 (12)	4 (14)	-	1 (10)	17 (15)
15	Eye	307	242 (14)	20 (12)	-	-	45 (14)
	Total	15343	10,377	1862	581	102	2421

Note: Figures in parentheses are percentages.
Source: Fieldwork, 1997.

Generally, the leading position of breast cancer was maintained in almost all registries except at the Zaria centre where it occupied the 7th position. In a similar way, cervical cancer which ranked 2nd at the national level, occupied the 10th position in Ilorin and Zaria centres. Leukaemia/lymphomas' 4th position within the national cancer profile came last at the Ile-Ife registry. Cancer groups such as gastro-intestine, bone, prostate, oral, respiratory, internal organs, brain and eye tend to maintain a consistent relative position both at the national and individual registry levels. In other words, the proportion is largely the same in the national cancer profile and at the regional level.

The remaining cancer groups that consist of liver, glands, skin and urinary cancer tend to differ in proportion among the registries. On the national scale, liver occupied the 7th position while it led other cancers at the Ilorin and Zaria centres. In addition, cancer of the glands, which seems less significant at the national level ranked 2nd at the Ile-Ife centre. At the Enugu cancer registry, skin cancer ranked 6th compared to its 11th position at the national level. In a similar manner, urinary cancer that appeared insignificant within the national cancer profile ranked 3rd and 6th at the Zaria and Ilorin registries respectively.

A general overview of the cases of cancer groups at the national and regional (registry) levels reveals the predominance of breast, cervical, prostate, leukaemia/lymphomas and gastro-intestine cancers. These are reproductive, digestive and childhood cancers.

The 15,343 cases shown in Table 5.1 are distributed based on the patients' town of residence to appropriate States (called regions in this study) with the exception of the 3,008 cases, which did not have proper residential (town) addresses. In essence, only 12,335 cases were successfully distributed among the thirty States and the Federal Capital territory (Abuja). The composition of the cancer cases from the registries aggregated into States is shown in Table 5.3.

It is important to mention that the cancer profile presented in Table 5.3 portray a similar pattern to the pattern in Table 5.1, except that breast cancer (19.1 percent) replaced cervical cancer (16.7 percents), which occupied the first position in Table 5.1.

Table 5.2 **Composition Of Cancer Cases From The Registries (1987-1996)**

Cancer Group	Number of Cases	Percent
Breast	2361	19.1
Cervical	2061	16.7
Leukaemia/Lymphomas	1056	8.6
Gastro-intestine	986	8.0
Bone	907	7.4
Liver	837	6.8
Prostate	763	6.2
Oral	584	4.7
Glands	544	4.4
Respiratory	525	4.3
Skin	468	3.8
Urinary	408	3.3
Internal organs	300	2.4
Brain	273	2.2
Eye	262	2.1
Total	12335	100.0

Source: Fieldwork, 1997.

The difference observed in the magnitude of breast and cervical cancers is due to higher number of cervical cancer cases that were excluded from Table 5.3 because they do not have accurate residential addresses indicated.

Cancers such as leukaemia/lymphomas (8.6 percent), gastro-intestine (8.0 percent), liver (6.8 percent), and prostate (6.2 percent) appear to maintain their initial positions in the profile presented in Table 5.1. The other remaining cancer groups account for less than 5.0 percent each. These seven leading cancers are equally the most outstanding cancers in the 1960-1996 cancer profile. In other words, the profile of cancer cases chosen for regional analysis (1987-1996) largely identical with the profile cancer of 1960-1996.

5.3 Regional Pattern of Cancer Incidence (1987-1996).

As shown in Table 5.3, Oyo State tends to record the highest number of reported cancer cases (35.2) from 1987 to 1996. The other States according to magnitude of cases are Osun (12.5 percent), Enugu (8.4 percent), Lagos (7.0 percent), Ondo (6.8 percent) and Kwara (5.0 percent). Each of the other remaining 24 states recorded cancer cases less than 5 percent of the total reported cases. Apparently, the States that reported the least cancer cases are Yobe, Kebbi, Jigawa and Akwa - Ibom. They accounted for less than 0.5 percent of the total cancer cases each. From the cases of cancer presented in Table 5.3, the reported cancer cases tend to concentrate in the Southern part of Nigeria.

Table 5.3 **Distribution of Reported Cancer Cases according to States (1987-1996)**

State	Number of Cases	Percent
Abia	352	2.9
Adamawa	18	0.2
Akwa Ibom	11	0.1
Anambra	406	3.3
Bauchi	27	0.2
Benue	117	1.0
Borno	85	0.7
Cross River	49	0.4
Delta	197	1.6
Edo	197	1.6
Enugu	1032	8.4
FCT	34	0.3
Imo	366	3.0
Jigawa	9	0.1
Kaduna	135	1.1
Kano	93	0.8
Katsina	33	0.3
Kebbi	8	0.1
Kogi	55	0.5
Kwara	610	5.0
Lagos	858	7.0
Niger	45	0.4
Ogun	575	4.7
Ondo	835	6.8
Osun	1545	12.5
Oyo	4339	35.2
Plateau	44	0.3
Rivers	136	1.1
Sokoto	51	0.4
Taraba	16	0.1
Yobe	5	0.1
Total	12335	100.0

Source: Fieldwork, 1997.

It is noteworthy, that the states which appear to report few cancer cases are equally those separated by long distance from the nearest cancer registry. By implication cancer cases might remain unreported by the people in these states within the study period. Moreover, the presence of cancer registry in a State may create awareness about cancer diagnosis and treatment. Once this awareness is created, it will positively affect rate of cancer reporting. In addition, the level of health services provision in each State has important role to play in the utilisation and attitude or disposition of the people towards medical care. Hence, fewer cases reported in these distant States may be a reflection of the distance between them and the registries. While it is true that spatial inequality in the distribution of cancer registries might affect the pattern of case reporting, the emphasis here is on the profile of the cancer groups in each State.

An important caveat that must be observed at this juncture is that beyond showing a preliminary picture of cancer cases among regions, the absolute cases presented in Table 5.3 do not take cognisance of the differentials in state population figures. As a result of this deficiency, cancer incidence data are calculated with reference to the population figure of each State in order to portray a more realistic cancer pattern in Nigeria.

The cancer incidence rate (CIR) is of the form: $CIRrj = n_{ij} / p_{ij} (K)$

Where rj = region j

n_{ij} = number of cancer cases reported by population i in region j

p_{ij} = population i at risk in region j

K = constant (100,000).

It is important to note that the population figure used in the calculation of incidence rates for breast and cervical (sex specific cancers) are the female population and for prostate cancer, the male population (1991 population census figures) in each region. For instance, the calculation of incidence rates (IR) of breast, prostate and gastro-intestine cancer per 100,000 population for Oyo State are as follows:

IR of breast cancer = $\frac{774}{1743069}$ X 100,000 = 45 cases per 100,000 female population.

IR of prostate cancer = $\frac{247}{1745720}$ X 100,000 = 15 cases per 100,000 male population

IR of gastro-intestine = $\frac{354}{3488789}$ X 100,000 = 11 cases per 100,000 people

This same procedure was carried out in calculating the incidence rate for other cancers in Oyo State and the cancers of the other remaining 29 States and the Federal Capital Territory (FCT). The result of this calculation is presented in Table 5.4.

Table 5.4 reveals that the states that tend to record high cancer incidence are Oyo, Osun, Enugu, Kwara, Ogun, Ondo, Abia and Lagos (descending order). Grouping the States with appreciable incidence rate according to their location in the country, there was generally a high concentration of the states in the southwestern part. This is followed by the eastern part (Enugu, Anambra, Imo, and Abia). While the smallest incidence rates were recorded by the northern States, those with appreciable rates include Kaduna, FCT, Borno and Niger. Although, the States with cancer registry appeared to have outstanding cancer rates, the rate was higher among those that are likely to be influenced by westernisation.

Table 5.4 Pattern of Cancer Incidence According to States

State	Overall cancer	Breast	Cervical	Prostate	Leukemia/ lymphomas/ Bone	Gastro-intestine	Liver	Glands Internal - organs	Respiratory	Oral	Skin	Eye/Brain	Urinary
Oyo	125	45	49	15	18	11	8	8	7	8	5	9	4
Osun	71	25	21	13	8	9	6	9	3	4	3	2	3
Enugu	33	16	8	6	7	2	2	2	2	2	2	2	2
Lagos	16	9	10	1	3	1	1	1	1	1	1	1	1
Ondo	22	9	8	4	3	2	2	3	1	1	1	1	1
Kwara	39	12	3	7	12	4	8	2	3	1	1	1	2
Ogun	25	9	11	2	5	2	1	2	1	2	2	2	1
Anambra	15	6	3	2	4	2	1	2	1	1	1	1	1
Imo	13	9	4	3	3	1	1	1	1	1	1	1	1
Abia	16	9	5	2	3	2	1	1	1	1	1	1	1
Edo	12	2	3	2	4	1	1	1	1	1	1	2	1
Delta	8	2	2	1	2	2	1	1	1	1	1	1	1
Rivers	4	3	2	1	1	1	1	1	1	1	1	1	1
Kaduna	4	2	2	1	1	1	1	1	1	1	1	1	1
Benue	5	1	1	1	1	1	1	1	1	1	1	1	1
Kano	2	1	1	1	1	1	1	1	1	1	1	1	1
Borno	4	1	2	1	1	1	1	1	1	1	1	1	2
Kogi	3	1	1	1	1	1	1	0	1	1	1	1	0
Sokoto	2	1	1	0	1	1	1	1	0	1	1	0	0
Cross River	3	1	2	1	1	1	1	1	1	1	1	0	0
Niger	2	1	1	1	1	1	1	1	1	1	1	1	0
Plateau	2	1	1	1	1	1	1	1	1	0	1	2	1
FCT	9	6	4	0	2	1	0	1	1	1	1	0	1
Katsina	1	1	1	1	1	1	1	1	1	1	1	1	1
Bauchi	2	1	1	1	1	1	1	1	1	1	1	1	1
Adamawa	1	1	0	0	1	1	1	1	1	1	1	1	1
Taraba	2	1	1	1	1	0	0	1	1	1	0	1	1
Akwa-Ibom	1	1	0	0	1	1	1	0	1	1	0	0	0
Jigawa	1	0	0	1	0	1	1	0	0	0	0	0	0
Kebbi	1	1	1	0	0	0	1	1	0	1	0	0	0
Yobe	1	1	0	0	1	0	1	1	0	0	0	0	0

Source: Fieldwork, 1997.

In order to show a better picture of this situation the pattern of each cancer group among the States is examined.

Specifically, Oyo State (southwest) tends to lead all other States in the incidence of virtually all cancer groups except cancer of the glands (Table 5.4). Its contribution in the incidence of breast, cervical, prostate and leukaemia/lymphomas almost doubles the incidence in every other State. By implication cancer of the breast (45), cervical (49), prostate (15) and leukaemia/lymphomas (18) appear to be the most frequently reported cancers in the State. With reference to Osun State, cancer of the glands (salivary, thyroid, endocrine and lymph nodes) appears to be reported most frequently. It ranked second in the incidence of almost all other cancer groups except in leukaemia/lymphomas, liver and brain cancer.

Other States in the southwestern part of Nigeria that show appreciable cancer incidence are Ogun, Ondo and Lagos (5th, 6th, and 8th positions respectively). Ogun State which occupied the 5th position in the incidence of "overall" cancers is also 5th in the incidence of oral cancer. It assumes the 3rd position in the incidence of cervical, skin, eye, brain and leukaemia/lymphomas. Its position was below 5th in the incidence of other cancers apart from glands and respiratory cancers wherein it ranked 4th. The 6th position occupied by Ondo State in the incidence of "overall" cancers was equally maintained in the incidence of breast, cervical, respiratory, bone and internal organs. It tends to assume higher rank in the incidence of glands, brain (3rd), gastro-intestine (4th), liver, prostate, oral, skin, eye and urinary (5th). Lagos state ranked 8th in the incidence of "overall"

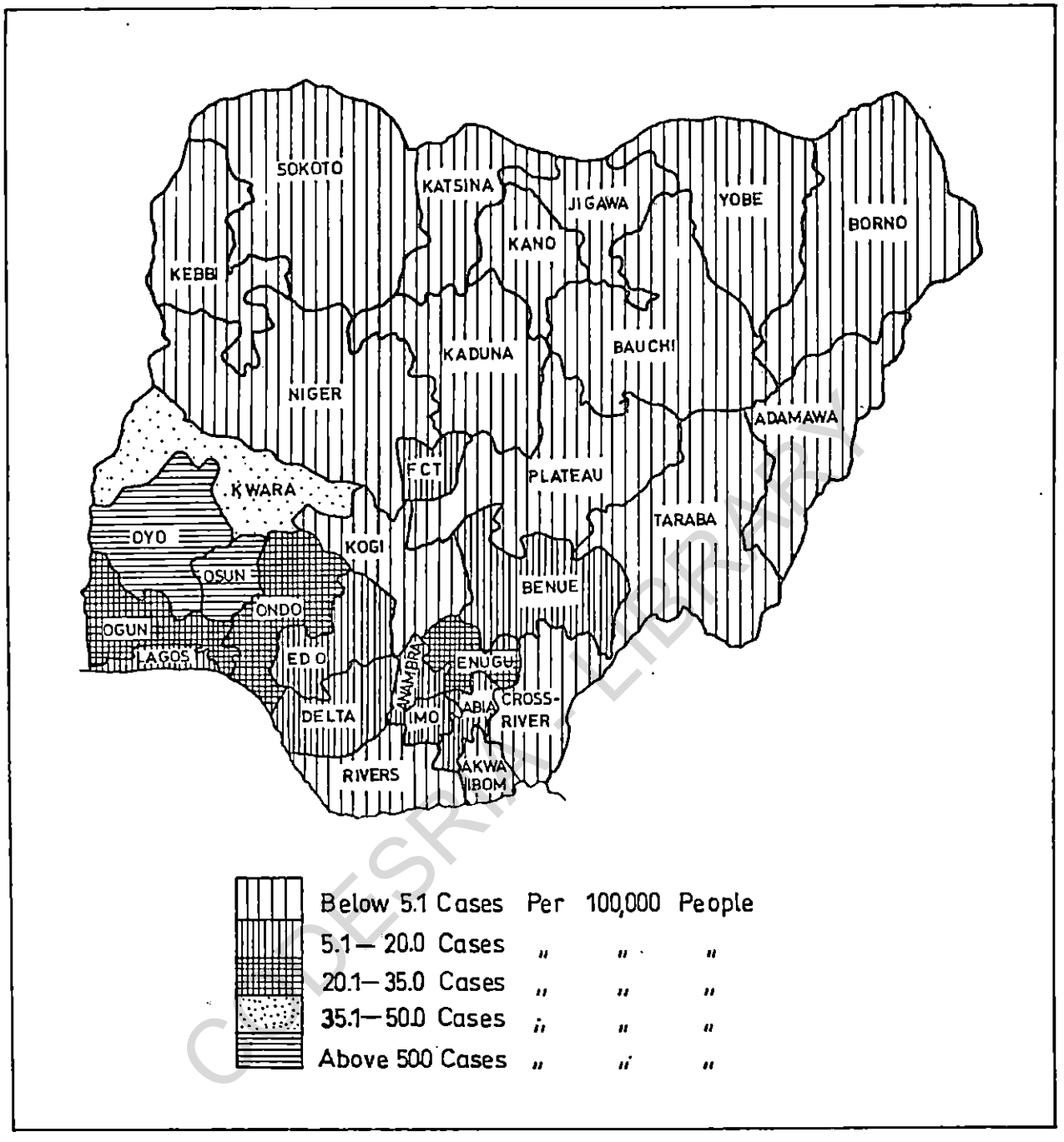


Fig. 5.1: Pattern of Overall Cancer Incidence.

cancers, liver, respiratory, oral, and skin cancer. Its position is slightly higher in the incidence of cervical (4th), brain (5th), breast and leukaemia/lymphomas (6th).

An overview of cancer pattern in the southwest shows that the leading cancer groups were breast, cervical, prostate, leukaemia/lymphomas, gastro-intestine and cancer of the glands. According to Vagero and Persson (1986) and Kogevinas (1992), cancer of the breast, prostate leukaemia/lymphomas and the gastro-intestine are prevalent in the socio-economically developed societies. On the other hand, cervical cancer is found predominant among poor societies. Among States in the southeast, Enugu recorded the highest incidence of most cancers in that region. It has the third highest incidence of breast cancer (16 cases per 100,000 females), bone, respiratory and oral cancer in Nigeria. Moreover, it ranked fourth in the incidence of leukaemia/lymphomas, prostate, liver and the gastro-intestine cancers. Apart from the predominance of breast in most of the States, bone and the respiratory cancers appear outstanding in Enugu state. This observation may point to the role of local factors besides the general factor of smoking. The most plausible factor is the presence of coal mine and the associated activities which may predispose the people in the area to the risk of respiratory cancer. Grillo and Sofowora (1972) have identified similar risk among railway workers in Nigeria. In addition, Anyanwu (1982) discovered that cancer patients who work in coal mines had additional risk of lung cancer in Enugu area besides their smoking habit.

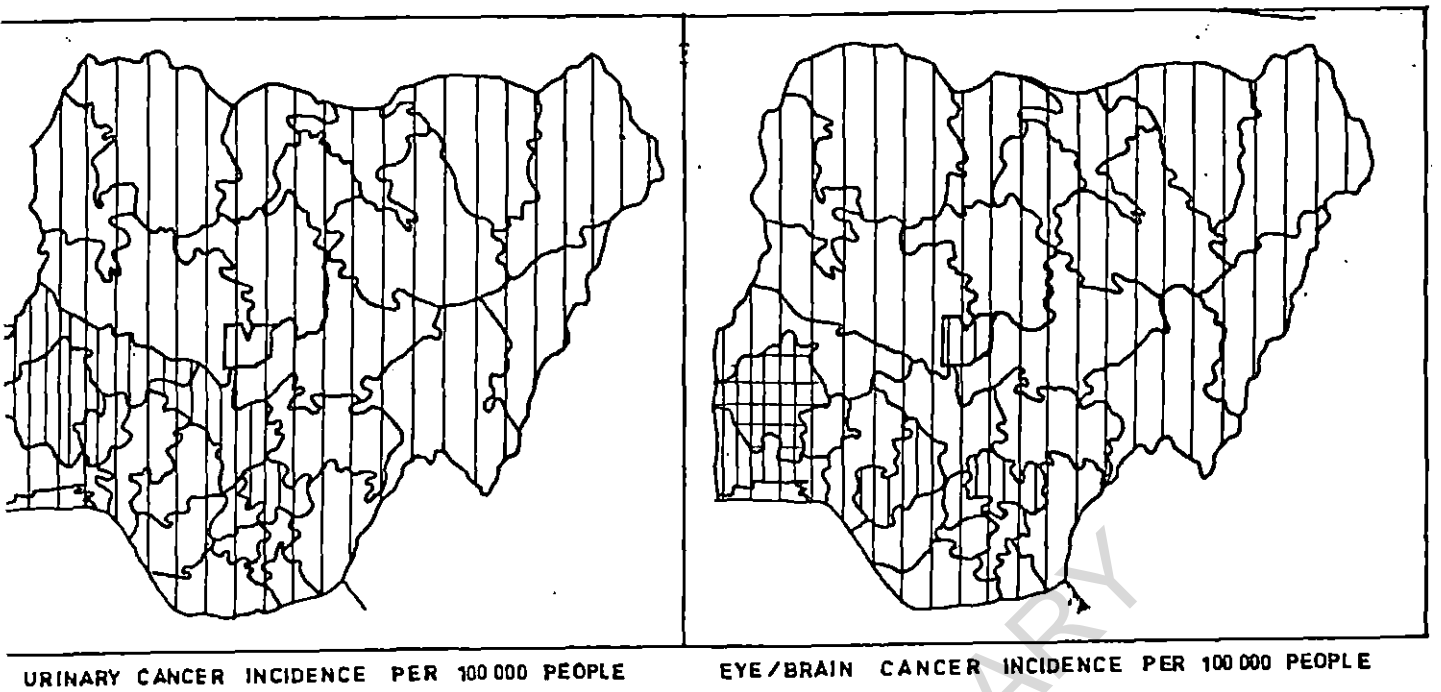
The incidence rate of cancers in Abia, Imo and Anambra States was generally low. Cancer groups that appear outstanding among these southeastern States were

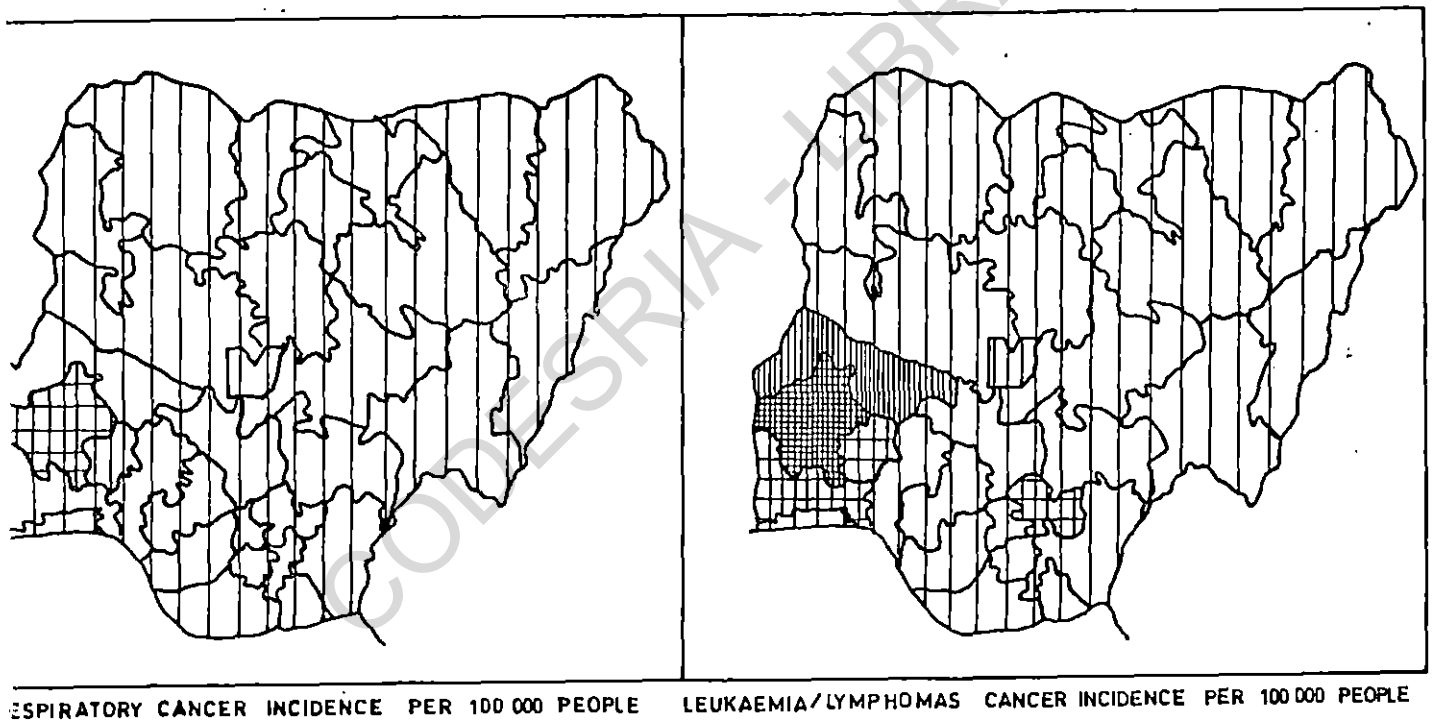
cervical, breast, leukaemia/lymphomas, prostate, liver and the gastro-intestine cancers. Cancer groups that are aetiologically induced by infective agents (liver, leukaemia/lymphomas and cervical) have the same magnitude of incidence as those due to western lifestyle practices (breast, prostate and gastro-intestine). Hence, the influence of the two "forces" seem to run concurrently in the southeastern States in Nigeria.

In the middle belt of Nigeria, Kwara appears to be the only State that recorded high cancer incidence besides FCT (13th position). With respect to Kwara State, the incidence of the "overall" cancer and breast was 4th in rank. Furthermore, it assumed a higher position in the incidence of leukaemia/lymphomas, liver (2nd), prostate, gastro-intestine, internal organs and urinary (3rd position). Kwara State occupied relatively lower position in the incidence of the remaining cancers. The leading position of liver cancer and leukaemia/lymphomas was conspicuous in this State. These cancers are largely due to infections and poverty especially liver (Remmenick, 1998). Nevertheless, cancers attributed to westernisation were also found.

Despite the low incidence recorded by most northern states in the overall cancer cases, Borno and Kaduna States tend to have a relatively higher incidence. For instance, each of the two States recorded two cases of cervical cancer per 100,000 females. Other cancers generally record low incidence in most States in the northern part besides breast and cervical (see Table 5.4 and Figures 5.2a, b and c).

Cancer groups that appear relatively common in the profile of each State include cervical, leukaemia/lymphomas, breast and liver cancer. This means that in spite of low





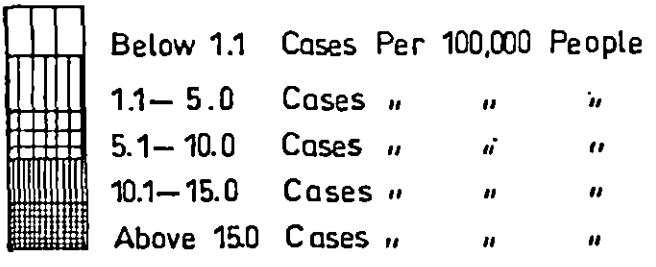
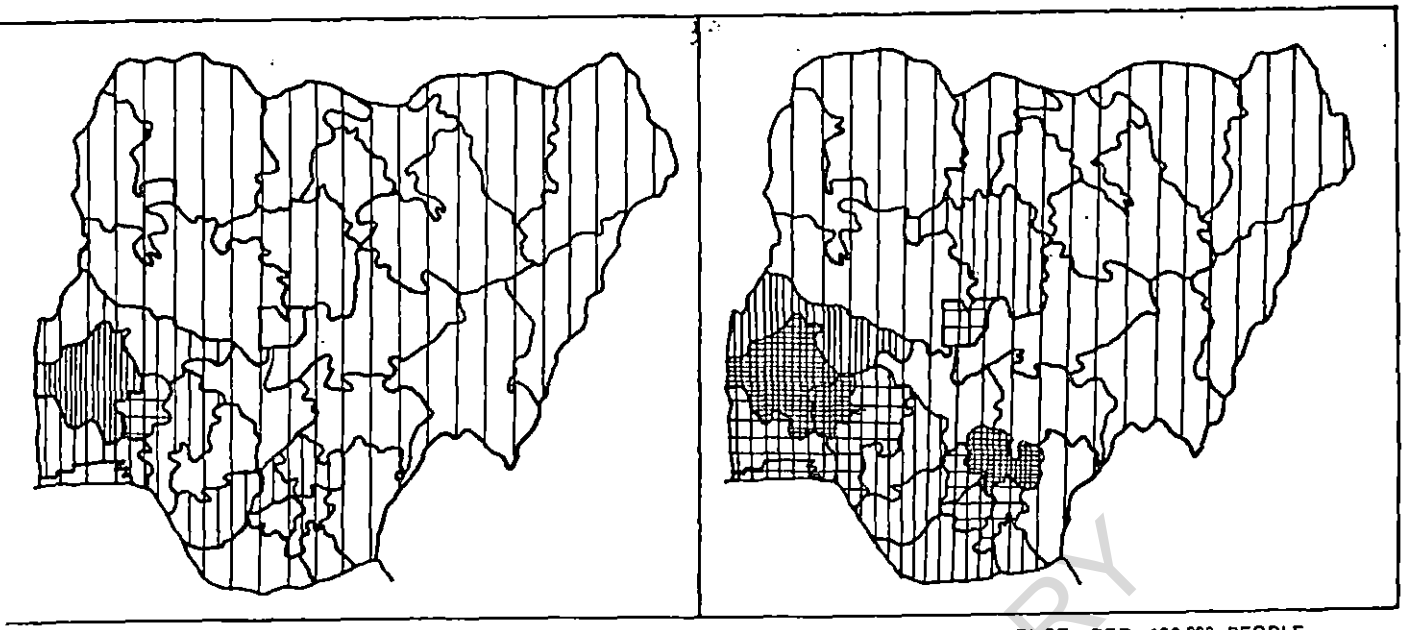
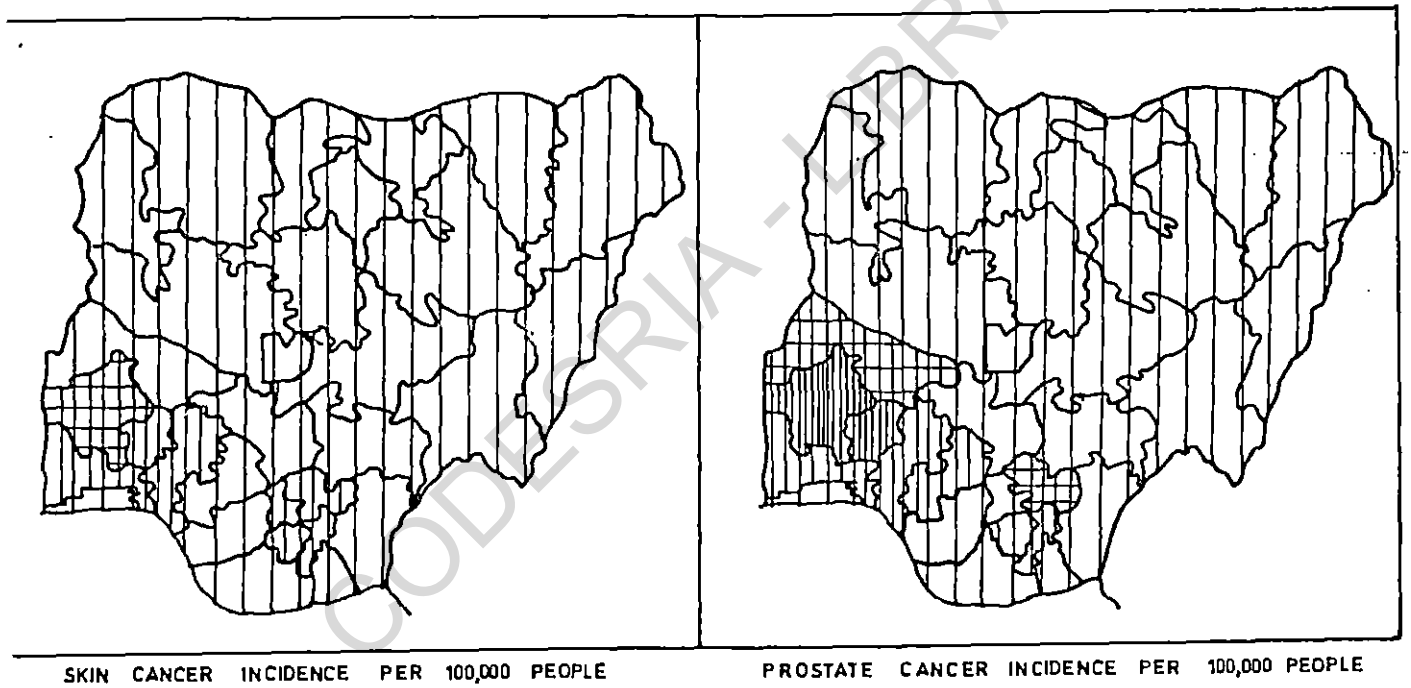


Fig. 5.2a: Spatial Distribution of specific Cancer Incidence.



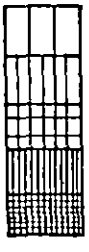
ASTRO-INTESTINAL CANCER INCIDENCE PER 100,000 PEOPLE

BREAST CANCER INCIDENCE PER 100,000 PEOPLE



SKIN CANCER INCIDENCE PER 100,000 PEOPLE

PROSTATE CANCER INCIDENCE PER 100,000 PEOPLE



Below 1.1 Cases Per 100,000 People
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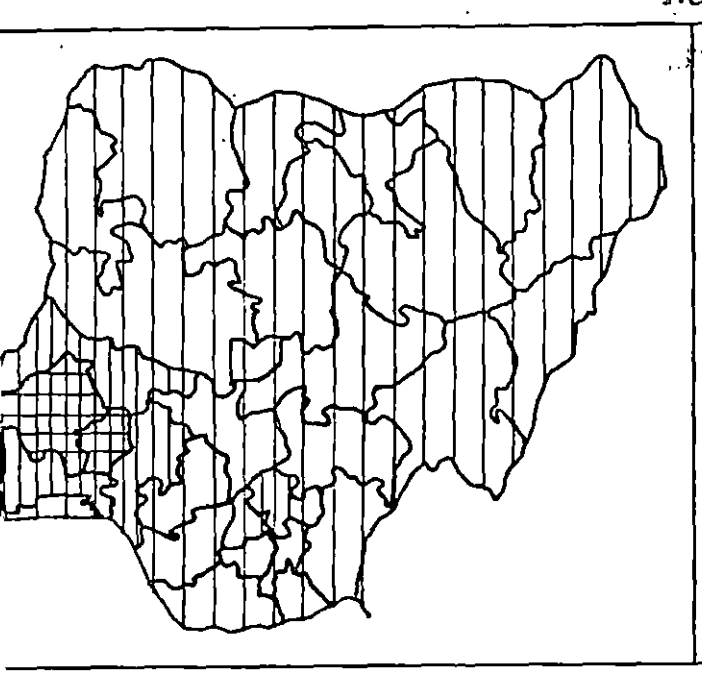
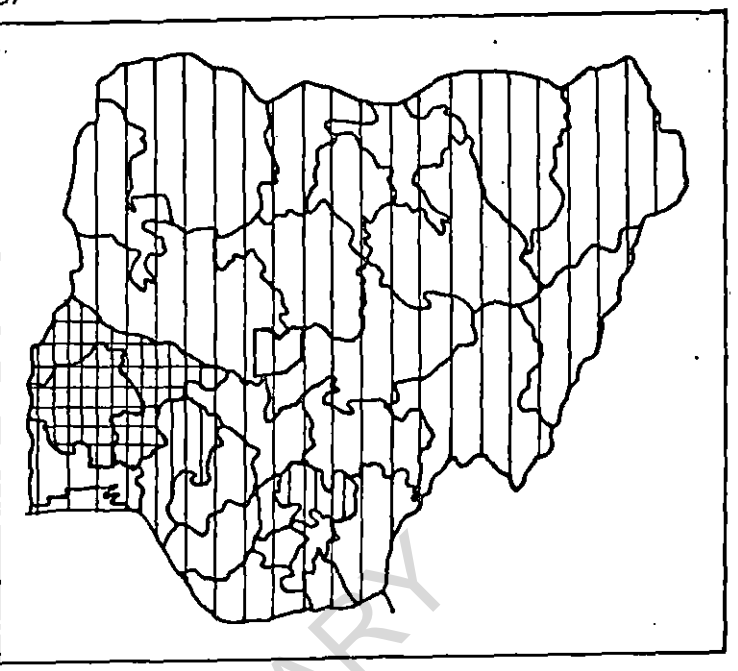
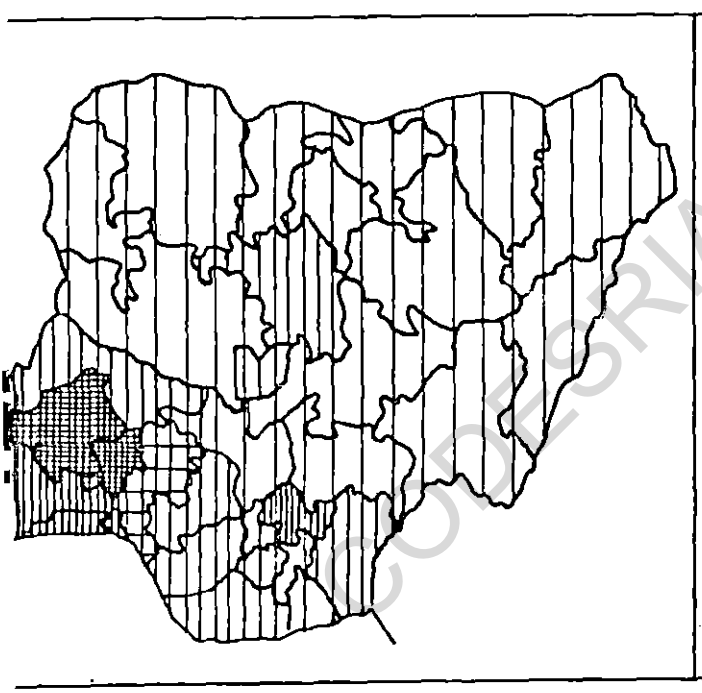
Fig. 5.2b: Spatial Distribution of specific Cancer Incidence.



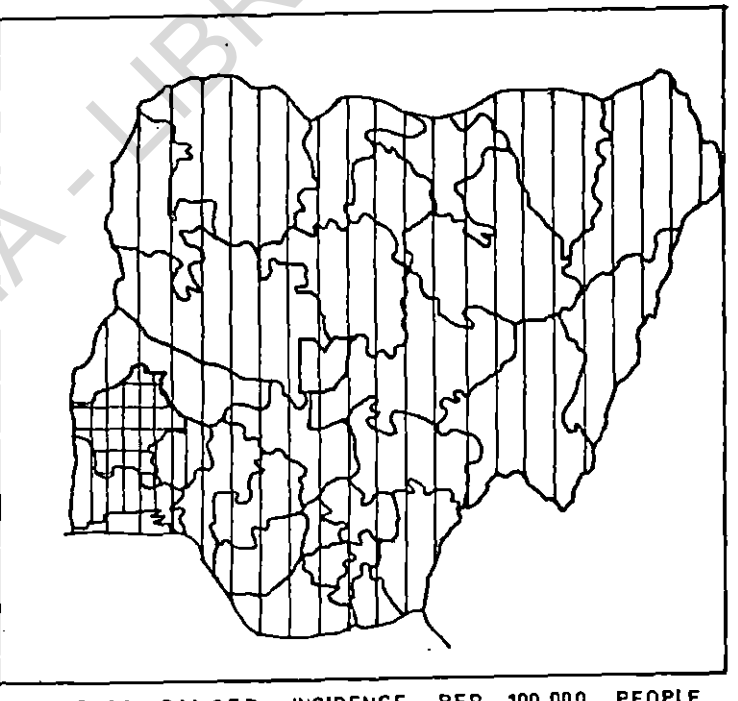
:ER OF THE GLANDS INTERNAL ORGANS INCIDENCE PER 100,000 PEOPLE



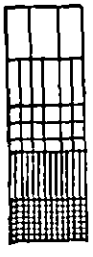
LIVER CANCER INCIDENCE PER 100 000 PEOPLE



CERVICAL CANCER INCIDENCE PER 100,000 PEOPLE



ORAL CANCER INCIDENCE PER 100,000 PEOPLE



Below 1.1 Cases Per 100,000 People
1·1 — 5·0 Cases " " "
5.1 — 10.0 Cases " " "
10.1 — 15.0 Cases " " "
Above 15.0 Cases " " "

Fig. 5.2c : Spatial Distribution of specific Cancer Incidence.

cancer incidence among the northern States, the four cancer groups listed above appear relatively important in the proportion of their incidence rates. These cancers are predominantly those induced by infective agents (viral agents) among societies apart from breast. This analysis shows that cancers identified as "poverty cancer" (Freeman, 1989 and ACS, 1994) appear more prevalent among the northern States more than in any other part of Nigeria.

The spatial pattern of cancer among the states in Nigeria suggests that States, which are socio-economically more developed in the southwest seem to bear the burden of cancers associated with lifestyle practices. These cancers comprise those that are linked to western dietary habit and lifestyles such as breast, prostate and the gastro-intestine system. The other group which consists of cervical cancer associates with unhygienic lifestyle practice. Apparently, the cancers which associate with western consumerism (affluence) decreases in relative importance from the southern States to the northern States. In contrast, the cancers linked to infections tend to increase in relative incidence towards the northern States in Nigeria. This observation may point to the existence of epidemiological transformation in the Nigerian society. Only that a kind of "differential epidemiological transition" is probably taking place in our society as a result of disparity in the level of socio-economic development among the States. The level of socio-economic development of any society (state) will positively influence the level of westernisation and subsequently, the prevalence of western lifestyles. This will likely

increase the risk of cancer groups associated with westernisation and affluence, which generally appear to reduce from the southern states to the northern States.

The impact of physical environmental condition in local areas operate possibly in few instances where cancers such as bone and respiratory system appear relatively outstanding in Enugu State, eye/brain, oral and skin in Ogun state and liver in some northern States.

In the next section, the pattern of cancer incidence is analysed on the basis of the three broad ecological zones in Nigeria. This is undertaken in order to identify possible ecological (physical environmental) factor which may influence the pattern of cancer among the zones. An exercise of this nature assists us to identify the relationship between cancers and some relevant ecological parameters in Nigeria.

5.4 Distribution of Cancer Incidence among Ecological zones

According to Udo (1970), the three broad ecological zones in Nigeria are the (northern) Sudan-Sahel savanna zone, the (middle belt) mixed wooded savanna zone and the (southern) forest zone. These three ecological zones form the basis for analysing cancer incidence among ecological zones so as to identify possible socio-environmental conditions that may influence cancer incidence beyond the boundary of each state. In order to achieve this, cancer cases in each state within the zones were simply aggregated while a similar aggregation of the population figure was employ to calculate the incidence rate per 100,000 people.

Table 5.5 revealed that the incidence of each of the cancers tend to increase generally from the Sudan-Sahel zone through the (middle belt) Wooded Savanna zone to the southern Forest zone. This overall picture is not the same for each of the specific cancer groups in Nigeria. Looking at the "overall" cancer incidence, the Sudan-Sahel zone accounted for 3.1 percent, (mixed) Wooded Savanna zone, 30.8 percent while the forest zone accounted for 66.1 percent of the overall cancer cases between 1987 and 1996.

It is equally noticeable that the incidence of the reproductive cancers (breast, cervical and prostate) was relatively low compared with other cancers in the Sudan-Sahel zone. While the incidence of these reproductive cancers showed no distinct difference compared to other cancers in the Wooded Savanna zone, the latter cancer groups tend to show higher incidence in the (Southern) Forest zone. The cancers that tend to have incidence rates above the overall cancer average (4.3 percent) in Sudan-Sahel Savanna zone were oral (6.8 percent), urinary (6.3), eye (6.1), brain (5.9), skin (5.2), respiratory (5.1), and liver cancer (4.6 percent). Similarly, in the Wooded Savanna zone, leukaemia/lymphomas (39.8), urinary (38.0), breast (36.3) and internal-organs tend to have incidence rates above the 32.2 percent, which is the proportion of the zone in the overall cancer incidence. Furthermore, the (southern) Forest zone had a cancer pattern in which glands, cervical, brain, eye and oral cancer had incidence rates higher than the zone's overall average cancer incidence (69.9 percent).

To examine if the variations observed on the incidence presented on Table 5.5 are statistically significant, the chi-square test was employed. The calculated chi-square value is 30.00, which is significant at 0.000 (100 percent level of confidence). This result

Table 5.5: **Relative Proportion of Specific Cancer Among Ecological Zones**

	Ecological zone					
Cancer Group	Sudan – Sahel Savanna	Percent	Mixed wooden savanna	Percent	Forest	Percent
Breast	25	1.5	586	36.3	1005	62.2
Cervical	28	2.1	288	21.5	1023	76.4
Prostate	18	3.5	139	27.1	355	69.4
Leukaemia/lymphomas	13	3.5	161	39.8	231	57.0
Bone	13	4.0	153	46.9	160	49.1
Gastro-intestine	14	3.9	100	27.1	249	69.1
Liver	15	4.6	131	40.0	182	55.4
Glands	6	2.9	34	16.5	166	80.6
Internal organs	4	3.5	41	36.0	69	60.5
Respiratory	10	5.0	66	33.3	122	61.6
Oral	14	6.8	44	21.4	148	71.8
Skin	9	5.2	55	31.6	110	63.2
Eye	6	6.1	19	19.4	73	74.5
Brain	7	5.9	21	17.8	90	76.3
Urinary	10	6.3	60	38.0	88	55.7
Total	192	3.1	1898	30.8	4071	66.1
Mean	6.66		6.68		6.67	
Standard Deviation	3.55		7.70		7.64	

Source: Fieldwork, 1997.

implies that the relative incidence of specific cancer groups among the ecological regions.

The specific cancers that are relatively important in each ecological zone are identifiable in Table 5.6 based on the cancer profile of the zones. In the Sudan-Sahel Savanna zone, the cancers shown to be relatively important comprise cervical (14.6 percent), liver (7.8 percent), gastro-intestine, oral (7.3 percent), leukaemia/lymphomas and bone (6.8 percent each). The relatively important cancers in the wooded Savanna zone were breast (30.9 percent) leukaemia/lymphomas (8.5 percent), bone (8.1 percent)

and liver (6.9 percent). In the (southern) Forest zone, the relatively important cancers were predominantly the reproductive ones (breast, cervical and prostate) in addition to the gastro-intestine cancer (6.1 percent).

Table 5.6: **Cancer Incidence Among Ecological Zones**

	Ecological zone		
Cancer Group	Sudan – Sahel Savanna	Mixed wooded Savanna	Forest
Breast	13.0	30.9	24.7
Cervical	14.6	15.2	25.1
Prostate	9.4	7.3	8.7
Leukaemia/lymphomas	6.8	8.5	5.7
Bone	6.8	8.1	3.9
Gastro-intestine	7.3	5.3	6.1
Liver	7.8	6.9	4.5
Glands	3.1	1.8	4.1
Internal organs	2.1	2.2	1.7
Respiratory	5.2	3.5	3.0
Oral	7.3	2.3	3.6
Skin	4.6	2.9	2.7
Eye	3.1	1.0	1.8
Brain	3.6	1.1	2.2
Urinary	5.2	3.2	2.2
Total	100.00	100.00	100.00

Source: Fieldwork, 1997.

The aetiology of most cancer groups found to be predominant in the Sudan-Sahel zone points largely to viral infections. With respect to cervical cancer, women in low socio-economic class are at high risk. This has been linked to the prevalence of early and multiple sexual partners coupled with poor personal hygiene among them. This behavioural practices enhance the spreading of the human papilloma viruses 16 and 18 [venerally transmissible agents] (Olweny, 1990). The general practice of early marriage

and low level of education in the northern part of Nigeria, especially among women may explain the outstanding position of cervical cancer in this zone. Similar health problem has been identified to be preponderant among women because of the reason indicated above (Adamu, 1994).

Liver cancer which appeared significant in the Savanna zone is claimed to be initiated by hepatitis B virus (HBV) and promoted by consuming food contaminated by aflatoxin (Olweny, 1990). Aflatoxin which is a promoter commonly grows and contaminates grains especially groundnut in tropical Africa. Since the northern Sudan-Sahel Savanna zone largely depends on grain economy, it provides an environment that is conducive for aflatoxin to thrive. The population in this zone may then be exposed to higher risk of contacting liver cancer. According to Olweny (1990) aetiology of lymphomas which is identified to be endemic in tropical Africa is linked with Epstein-Barr virus (EBV). This virus seems prevalent in the developing countries in the tropics where socio-economic development is low. Even though the whole country is located in the tropics, the accompanying condition of low level of socio-economic development that will make lymphomas to thrive are likely to be more predominant in the Sudan-Sahel Savanna zone.

On the other hand, the incidence of gastro-intestine and oral cancer is usually linked to chemical contamination through consumption habits. While the gastro-intestine is induced by the accumulation in humans of chemical preservatives from manufactured foods and tobacco consumption (Olweny, 1990), especially with 'betel quid' as an

ingredient causes oral cancer. It is not yet known whether or not tobacco consumption is higher in the northern parts, but high consumption (chewing) of kolanut in the northern part of Nigeria may have a role in the aetiology of oral cancers. The outstanding position of the gastro-intestine cancer, may probably point to the fact that the "wave" of western consumption habits are already spreading among the people found in the Sudan-Sahel zone. Such habits include, consumption of refined food (Rowland and Cooper, 1983) and drinking of alcohol (beer) (Enstrom, 1977).

The cancer groups that appeared significant in the Forest zone tend to differ markedly from those found in the Sudan-Sahel Savanna zone. For instance breast, prostate and the gastro-intestine cancers are aetiologically linked to lifestyles that associate with socio-economic development and modernisation. Breast cancer is induced by high consumption of animal fat among women. This is common among women in the high socio-economic status (Remmenick,1998). Similar risk factor has been identified in the causation of prostate cancer among men (Verhasselt, 1977). The risk factors of the gastro-intestine cancers relate to contamination as a result of frequent consumption of manufactured food normally treated with preservatives (Rowland and Cooper, 1983 and Olweny, 1990) and drinking of alcohol (Enstrom, 1977). These habits are common in the southern Forest zone of Nigeria where most breweries are located and most local supermarkets are well stocked with manufactured (canned) foods. As most modernising people appreciate and pursue after this dietary habits, they are exposed to higher risk of contacting the gastro-intestine cancers.

On the contrast, the high relative proportion of cervical cancer points to a co-existence of behaviour habits that may enhance the prevalence of human papilloma virus (HPV) in the Forest (southern) zone. Though cervical cancer is popularly known as a "poverty cancer" (Freeman, 1989), yet its relative proportion was high in the southern Forest zone. This is because both evidences of socio-economic development and poverty co-exist among the population found in the zone. Hence, the preponderance of cervical cancer along side breast, prostate and gastro-intestine cancers.

A close examination of the cancer profile in the mixed wooded Savanna zone reveals that the outstanding cancers of the Sudan-Sahel zone are also found in the former. By and large, the prevalent ecological conditions that favour the thriving of the various initiators and promoters of cancers in the Sudan-Sahel Savanna zone may also be responsible for that of the mixed wooded Savanna zone. The only exception was the predominance of breast cancer in the mixed wooded Savanna. The aetiology of this cancer points almost exclusively to factors of modernisation of consumption habit. From the literature, the generally identified risk factor is the high consumption of animal fat which appear common among women in the high socio-economic status (Rowland and Cooper, 1983 and Remmenick, 1998). By implication, the cancer groups found predominant in the Sudan-Sahel zone (largely associated with infections) and that of the southern Forest zone especially breast cancer is equally outstanding. The mixed wooded Savanna zone, which is a middle zone between the Savanna and Forest zones appear as a

zone of transition. In which case the cancer profile of the Savanna and Forest zones blend together to form the cancer profile of the mixed wooded Savanna zone.

From this analysis, it is noticeable that none of the ecological zones reported exclusively cancers of westernisation or underdevelopment (poverty). Each reported the two broad cancer categories only with unequal relative proportions. This observation may result from the fact that none of the ecological zones consist of homogenous population groups. Moreover, the further the zones are from the southern forest zone, the more the relative proportion of cancers that associate with factors of underdevelopment. In other words, the zones that appear farther from the influence of westernisation and modernisation tend to have low socio-economic status and so higher relative proportion of cancers resulting from infective agents.

Attention is next focused on the impact of the socio-demographic and pathogenic factors in cancer distribution in Nigeria.

5.6 Socio-demographic and Pathogenic correlates of Cancer Pattern

The variables selected to relate cancer incidence to social and pathogenic factors are carried out on states basis. These variables collected from secondary sources include male population, female population, population density and percentage of urbanisation (National Population Commission Report, 1996). Others are number of industries (Directory of the Manufacturers Association of Nigeria, 1996), life expectancy, literacy level (United Nations Development Programme, 1996 Report) and cases of

schistosomiasis (Federal Office of Statistics, 1994 Report) for each of the 30 States in Nigeria (see Appendix 3). Though some of the variables enumerated above are proxy for factors that cannot be measured directly, the established associations of cancer with these factors informed their choice.

For instance, male population may associate with cancers that are male specific (prostate) and likewise those that are exclusively females (breast and cervical) to female population. Population density, number of industries and percentage of urbanisation, which are measures of urbanisation and economic development of the States, have been identified to associate with cancer pattern (Verhasselt, 1977, Harpham and Tanner, 1996). Life expectancy at birth, a measure of population aging is claimed to positively associate with most cancer sites (Remmenick, 1998). The literacy level of each state is chosen as an index of westernisation and modernisation. It is already known that the level of westernisation and modernisation associate with cancers (Verhasselt, 1977) such as breast, prostate and the gastro-intestine cancer (Olweny, 1990). The aetiological role of schistosomiasis is already established in the causation of cancer of the bladder (urinary system) (Olweny, 1990). All these variables were employed to identify the relationship between socio-demographic and pathogenic factors that they represent and incidence of cancer in each State.

The correlation analysis was employed to examine the type of association between cancer incidence and the explanatory variables in each of the States. The results of this correlation analysis are presented in Table 5.7.

Table 5.7 **Correlation Between Cancer Incidence and Explanatory Variables**

Cancer Group	Male Population	Female Population	Life Expectancy	Cases of Schistosomiasis	Number of Industries	Percent of Literacy Level	Percent of Urbanisation
Breast	-.088	.071	.028	-.218	.162	.221	.603**
Cervical	-.051	.135	.021	-.184	.195	.161	.587**
Prostate	-.070	.068	-.009	-.219	.004	.160	.513**
Leukaemia/ lymphomas	-.103	-.021	-.052	-.235	.120	.217	.584**
Gastro-intestine	-.060	.031	.009	-.195	.021	.144	.511**
Liver	-.066	.010	-.064	-.164	-.011	.060	.422*
Glands/Internal organs	-.060	.046	-.054	-.134	.003	.087	.515**
Respiratory	-.017	.099	-.006	-.141	.056	.107	.495**
Oral	-.013	.145	.000	-.094	.059	.096	.471**
Skin	.012	.160	-.087	-.193	.103	.151	.581**
Eye/ Brain	-.008	.087	-.057	-.120	.094	.130	.491**
Urinary	-.187	.171	-.011	-.129	.105	.183	.606**
Overall	-.088	.051	-.010	-.211	.107	.176	.578**

Source: Compilation from computer printout

* Significant at 95% confidence level.

** Significant at 99% confidence level

Generally, the composition of population showed a low association with the incidence of cancer groups in the States. The correlation coefficients of male population were negative with incidence of all cancer groups except skin cancer however the correlations were not significant. With respect to female population, there was low but positive correlation coefficients with the incidence of all cancer groups except leukaemia/ lymphomas. In essence, there appears to be no significant relationship between the sex composition of each State's population and cancer incidence.

The correlation coefficients between life expectancy and the incidence of most cancer groups were negative and insignificant. Exceptions to this were the associations with breast, cervical, gastro-intestine, skin, urinary and overall cancer. Even prostate and urinary cancers that appear predominant among age groups 60-75 years and above do not show any significant positive relationship with life expectancy at birth. In essence, States that have higher life expectancy do not appear to record higher incidence of either the overall or specific cancers in Nigeria. Therefore, aging is not a significant factor in the variation of cancer incidence in our society. This result disagrees with the observations of Verhasselt (1977) and Remmenick (1998) in the developed countries of the world that malignant neoplasms associate with high expectation of life. The peculiar scenario in which most cancer groups concentrate in the middle age in Nigeria like most developing countries may explain the disagreement between the present finding and observations in the developed countries.

Similarly, the magnitude of schistosomiasis cases showed negative correlations with the incidence of each cancer group. One peculiarity in the correlations between schistosomiasis cases and cancer groups is the insignificant negative associations which exist among them. While the negative association between schistosomiasis cases and incidence of other cancer groups may be expected, that of urinary cancer (-0.029) worth mentioning. This is because schistosomiasis infection has been identified to induce cancer of the bladder (urinary cancer) in human communities (Learmonth, 1983 and Olweny, 1990, 1992). By implication the variation in the incidence of urinary cancer may be attributed to other aetiological factors other than the role of schistosomiasis infection in the Nigerian society. Factors that generally have significant positive associations with cancer patterns are number of industrial establishments and percentage of urbanisation in each State. The only case of negative correlation co-efficient between number of industries and incidence of cancer groups was with liver cancer (-.011). While the percentage literacy positively associated with all cancer groups without exception, the correlation co-efficients were not significant. They were generally below 0.25. It was only the percentage of urbanisation that had significant positive association with the incidence of each cancer group. The correlation co-efficient of percentage of urbanisation appeared more significant with urinary (.6064), breast (.603), cervical (.587), leukaemia/ lymphomas (.584), skin (.581), prostate (.511) and overall cancer (.578). The co-efficient of association with liver cancer (.422) appears to be the least.

In addition to the correlation analysis, the regression of cancer incidence on the selected explanatory variables was carried out so as to determine the extent to which the variables explain the regional pattern of cancer groups. The regression equation is of the form:

$$Y = a + bX \quad \text{(model 1)}$$

$$Y = a + b1X1 + b2X2 + b3X3 \text{ ---------- } + bnXn \quad \text{(model 2)}$$

Where a is the intercept of the regression line

b is the regression co-efficient of Y on X

X represents independent (explanatory) variables

Y represents dependent (cancer incidence) variables

So as to avoid using variables that are collinear, the multi-collinearity test was conducted on the explanatory (predictor) variables. Multi-collinearity is a problem that ensues when two or more variables in a correlation analysis have identical distribution (Burt and Barber, 1996). In other words, the variables that are collinear offer the same explanation about the criterion variables in correlation analysis. Multicollinearity is identified in a set of variables if the coefficient of their inter-correlation is higher than 0.9 (near 1.0). The results of inter-correlation among the predictor variables are shown in Table5.8.

Table 5.8 reveals that the predictor variables, which have high inter-correlation co-efficients, are population density and number of industries (0.93). The remaining predictor (explanatory) variables generally have coefficients that are below 0.80. In other words, population density and number of industries are collinear. The implication of this diagnosed multi-collinearity is that either population density or number of industries

Table 5.8: **Inter - Correlation Matrix of the Explanatory Variables**

	Male Population	Female Population	Life Expectancy	Population Density	Cases of Schistosomiasis	Number of Industries	Percent of Literacy Level	Percent of Urbanisation
Male Population	1.000	0.244	-0.232	0.024	-0.046	0.093	-0.028	-0.026
Female Population		1.000	0.134	0.343*	-0.053	0.414*	0.066	0.248
Life Expectancy			1.000	0.370*	0.180	0.226	0.301*	0.017
Population Density				1.000	-0.181	0.932**	0.413*	0.680**
Cases of Schitosomiasis					1.000	0.127	0.394*	0.277
Number of Industries						1.00	0.309*	0.732**
Percent of Literacy Level							1.000	0.377*
Percent of Urbanisation								1.000

Source: Compilation from computer printout

* Significant at 95% confidence level.

** Significant at 99% confidence level

should be used in the regression analysis. Hence, population density is excluded from the regression analysis that follows while number of industries is chosen along with other variables to account for cancer pattern among the States.

From the result of the regression analysis (stepwise) presented in Appendix 8, each cancer group regressed on the explanatory variables indicate that the percentage of urbanisation explained the pattern of all cancer groups. Another variable that provided additional explanation is the number of industries in each State. In the regression of overall cancer on the explanatory variables (model 1), only the percentage of urbanisation was significant enough for selection. The regression co-efficient was .577. This implies that 33.3 percent of the incidence pattern of the overall cancer was explained by the

percentage of urbanisation of the States. Model 2, which selected percentage of urbanisation and number of industries, explained 55.1 percent (R = .742) of the incidence pattern of overall cancer.

In case of the specific cancer groups, the regression result shows that only one variable, percentage of urbanisation was significant enough (95 percent confidence level) to be selected in each of the first step (model 1). The variable singly explained more than 30 percent of the factors responsible for incidence pattern of urinary cancer (36.9%), breast (36.5%), cervical (34.5%), leukaemia/lymphomas (34.0%), and skin cancer (33.7%). For other remaining cancer groups, the contribution of percentage urbanisation to their incidence pattern ranged between 22.1 percent and 26.2 percent, except in the case of liver cancer (17.6).

In model 2, additional variable (number of industries) is selected with percentage of urbanisation to explain the incidence pattern of cancer groups. For the incidence pattern of each cancer group, only these two variables are adjudged significant. They explained between 40 percent and 61.5 percent of the incidence pattern of the cancer groups. While they accounted for more than 50 percent in the explanation of urinary cancer (61.5%), prostate (57.4%), glands/internal organs (56.8%), skin (56.1%), leukaemia/ lymphomas (54.7%), breast (53.3%) and overall (55.1%). The explanation of percentage of urbanisation and number of industries in the incidence of other remaining cancer groups were less than 50 percent.

The other variables shown to be insignificant in the explanation of cancer incidence were automatically removed by the computer, from the regression models (models 1 and 2). Generally, the regression analysis shows that the regional pattern of cancer incidence is attributable to indices of socio-economic development more than anything else. This portrayed by the interacting factors of urbanisation and industrialisation.

By implication all cancer groups in Nigeria are appear to be positively related to the level of urbanisation and industrialisation of each State. Though the urban location of cancer registries might influence the pattern of cancer reporting, yet all cancer groups appear to concentrate in the states where urbanisation level is highest. This result agrees with the observation of Verhasselt (1977), who claimed that "a good correlation exist between cancer mortality and degree of urbanisation, even on a world scale". Also, Clemmesen and Nielsen (1951) admitted the high incidence of malignant neoplasm in towns.

Urbanisation with its accompanying complex of interacting factors such as way of life, stress, diet, air pollution, occupation hazards and perhaps, cigarette smoking has lots of implications for cancer incidence (Verhasselt, 1977 and Remmenick, 1998). In actual fact, urbanisation itself does not breed cancer in any society but the associated lifestyle practices do. Furthermore, the positive association of all cancer groups with urbanisation implies that both the cancers which associate with low socio-economic status (cervical, lymphomas and liver cancers) and those that associate with high socio-economic status

(breast, gastro-intestine, and prostate cancers) co-exist in our urban centres. This is not far-fetched as cities in Nigeria generally consist of elements of socio-economic development (modernisation) and under-development. The "dual" nature of the Nigerian society is already known, as evidences of affluence and poverty co-exist within states and cities (Mabogunje, 1958).

CHAPTER SIX

TEMPORAL PATTERN OF CANCER IN NIGERIA

6.1 Introduction

This chapter focuses on the temporal pattern of cancer so as to determine its relative position within the broad epidemiological profile of Nigeria. Cancer variation over time is of paramount interest because it reflects the temporal characteristics of its epidemiology. Moreover, the knowledge derived from this kind of exercise has the potential for the control of cancer risk factors, the prioritisation of intervention programmes and the projection of health care needs in Nigeria.

Meades and his associates (1988) have observed that the disease experience of any community is not static but dynamic. Hence, the cancer profile of some study societies has shown remarkable temporal variations. According to Davis, Hoel, Fox and Lopez (1990), cancers of the stomach, colon and rectum show some decline in their temporal pattern in England and Wales. On the contrast, lung, pancreas, prostate and breast cancer increased.

The data utilised for temporal analysis were collected from the five national cancer registries in Nigeria from 1960 to 1996. 1960 is the base year since the foremost registry at Ibadan commenced cancer documentation at that particular year. For a meaningful analysis, the cancer data from Ibadan registry (1960 – 1996) was handled separately from the others from 1986 to 1996. This became imperative owing to the wrong impression which lumping of data that have different histories of documentation

gives. Furthermore, time series analysis and cancer projection are based on Ibadan registry data. This is dictated by the need to work with cancer data collected over a long period of time. Only the Ibadan registry sited at the University College Hospital satisfies this condition.

6.2 Cancer Occurrence from 1960 to 1996

Table 6.1a and 6.1b show that Ibadan cancer registry alone recorded cancer cases from 1960 to 1985 (21,263 cases) in Nigeria. These cases accounted for 53.1 percent of the total cancer cases reported from 1960 to 1996. Between 1986 and 1996, the Ibadan registry recorded 31.6 percent of all reported cancer cases within the study period. Considering the total cancer cases recorded from 1986 to 1996 (12,668 cases), the Ibadan registry data accounted for 67.5 percent. Enugu cancer data followed with 13.5 percent while the other three registries at Ile-Ife, Ilorin and Zaria recorded 10.8 percent, 6.1 percent and 2.2 percent, respectively.

Table 6.1a: **Reported Cancer Cases at the Five Registries (1960-1996)**

Registry	Period Covered	Number of Cases	Percent
Ibadan	1960 – 1985	21263	53.1
Ibadan	1986 – 1996	12668	31.6
Enugu	1986 – 1996	2526	6.3
Ile-Ife	1989 – 1996	2027	5.1
Ilorin	1987 – 1996	1140	2.8
Zaria	1989 – 1996	414	1.1
Total		40,038	100.0

Source: Fieldwork, 1997.

Table 6.1b: **Reported Cancer Cases at the Five Registries (1986-1996)**

Registry	Period Covered	Number of Cases	Percent
Ibadan	1986 – 1996	12668	67.5
Enugu	1986 – 1996	2526	13.5
Ile-Ife	1989 – 1996	2027	10.8
Ilorin	1987 – 1996	1140	6.1
Zaria	1989 – 1996	414	2.2
Total		18,775	100.0

Source: Fieldwork, 1997

The Ibadan registry data therefore, far exceeded the other registries data whether from 1960 to 1996 or between 1986 and 1996. In other words, the Ibadan registry data dominated the national cancer profile and provided a complete data for Nigeria. In the section that follows, we shall consider the distribution of specific cancer groups among the registries. The distribution of specific cancer groups in the Ibadan registry and the other four registries is presented in Table 6.2. Between 1960 and 1985, only the registry at University College Hospital (Ibadan) recorded cancer cases. Leukaemia/lymphomas was the most frequently reported cancer group (19.3 percent), followed by cervical cancer (18.7 percent). These two cancer groups jointly accounted for 38 percent of all reported cancer cases during this period. Generally, each of the other cancer groups accounted for less than 10 percent of the overall cancer cases between 1960 and 1985. The cancer groups that accounted for 5 percent and above include gastro-intestine (8.5 percent), liver (7.8 percent), breast (7.3 percent), bone (7.2 percent), oral (5.3 percent) and skin

Table 6.2 Distribution of Reported Cancer Groups According to Registry (1960 – 1996)

Cancer Group	Ibadan Registry (1960 – 1985)	%	Ibadan Registry (1986 – 1996)	%	Other Registries (1986 – 1990)	%	All Registries (1986 – 1996)	%
Cervical	3974	18.7	2414	13.8	195	3.5	2609	11.3
Breast	1549	7.3	2267	12.9	475	8.6	2742	11.9
Leukaemia/ Lymphomas	4102	19.3	2201	12.6	528	9.5	2729	11.8
Gastro-intestine	1807	8.5	1709	9.5	773	13.9	2482	10.8
Liver	1659	7.8	1229	7.0	409	7.4	1638	7.1
Bone	1538	7.2	859	4.9	165	3.0	1024	4.4
Oral	1133	5.3	859	4.9	209	3.8	1068	4.6
Prostate	905	4.3	837	4.8	69	1.2	906	3.9
Respiratory	962	4.5	610	3.5	25	0.5	635	2.8
Skin	1059	5.0	806	4.6	345	6.2	1151	5.0
Urinary	738	3.5	826	4.7	486	8.8	1312	5.7
Glands	571	2.7	538	3.1	224	4.0	762	3.3
Brain	424	2.0	773	4.4	475	8.5	1248	5.4
Internal Organs	443	2.1	1252	7.1	1043	18.8	2295	9.9
Eye	386	1.8	356	2.0	124	2.2	480	2.1
Total	21,263	100.0	17,536	100.0	5,544	100.0	23,081	100.0

Source: Fieldwork, 1997.

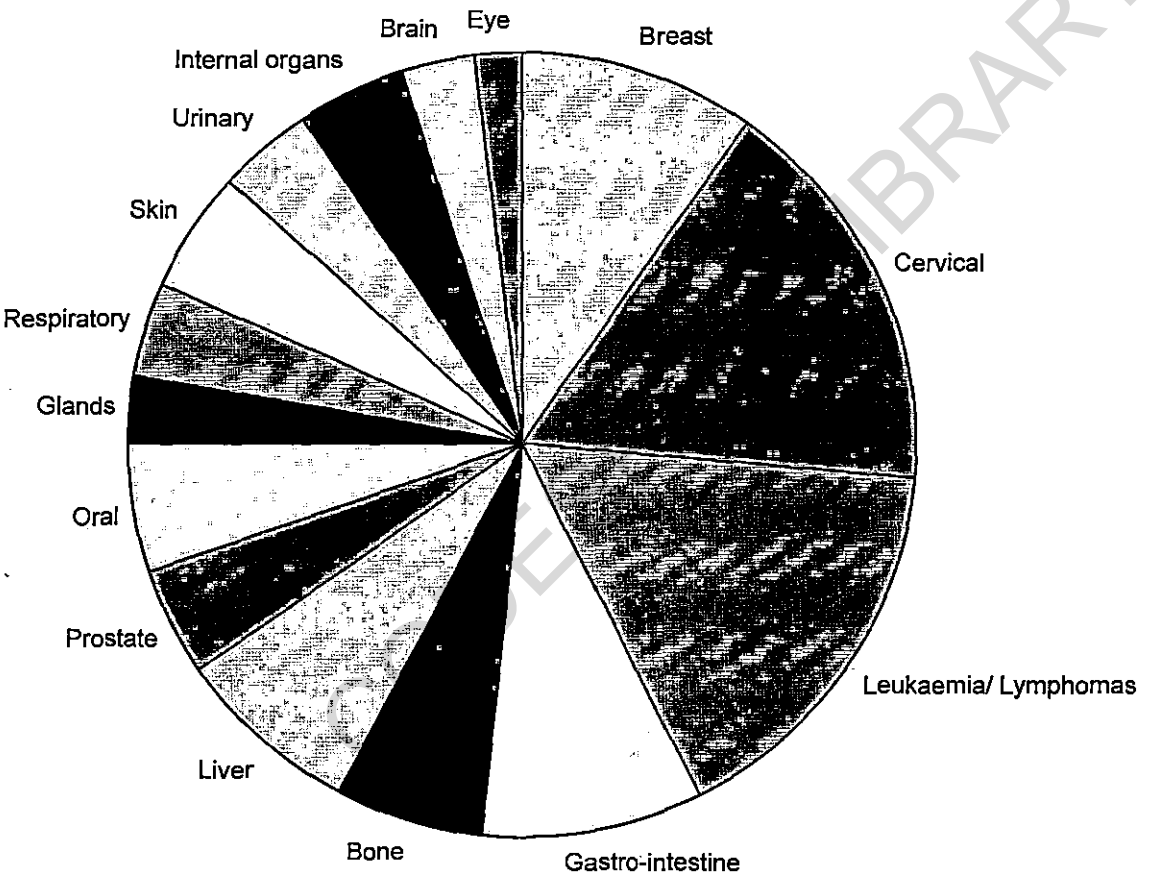


Fig. 6.1 Nigeria Cancer Profile (1960-1996) : Ibadan case study

cancer (5.0 percent). The overview of the cancer profile of 1960-1985 shows that the leading cancers were those related to infections.

The reported cancer cases from 1986 to 1996 at the Ibadan registry portray some differences from the 1960 – 1985 profile. One notable difference is the emerging importance of breast cancer. Breast cancer rose from its sixth position in the 1960 – 1985 profile to a second position in the 1986 – 1996 profile. On the contrast, leukaemia/lymphomas which was the leading cancer group between 1960 – 1985 has declined to the third position after cervical and breast cancer. Between 1986 and 1996, cervical, breast and leukaemia/lymphomas were the leading cancer groups that accounted for about 40 percent of all cancer cases. Moreover, cancer of the internal organs which had the least percentage in the 1960 – 1985 profile rose in proportion to the fifth position (7.1 percent) in the 1986 – 1996 profile. By implication, the position of specific cancer groups at the Ibadan registry did not remain static over the years.

The cancer profile of the other four registries (1986 – 1996) shows that cancer of the internal organs and the gastro-intestine were the most important cancer groups. They accounted for 32.7 percent (18.8 percent and 13.9 percent) of all reported cancer cases in these centres. Other cancer groups that appear reported often were leukaemia/lymphomas (9.5 percent), urinary (8.8 percent), breast (8.6 percent), brain (8.5 percent), liver (7.4 percent) and skin cancer (6.2 percent). While there is similarity in the cancer groups that appear significant in the Ibadan and the four other registries, the leading cancers in the two were different. Between 1986 and 1996, cervical, breast and leukaemia/lymphomas

accounted for 39.3 percent at the Ibadan registry whereas internal organs and gastro-intestine cancers alone accounted for 32.7 percent in the other four registries. The risk factors of these cancers are quite different. Furthermore, the increasing magnitude of internal organs cancer is noticeable in all the centres in 1986 – 1996. At the Ibadan registry, it has increased in proportion in 1986 – 1996, and its occurrence far exceeded any other cancer group in the profile of the four remaining registries. From this analysis, the changing trends of the specific cancer groups may indicate concomitant changes in their epidemiology, that is, shifting risk factors.

Combining the cancer profile of the Ibadan registry and that of the four other registries at Enugu, Ile-Ife, Ilorin and Zaria (1986-1996), leukaemia/lymphomas, cervical, gastro-intestine, internal organs and liver were the most important cancer groups in Nigeria. These cancer groups jointly accounted for 62.8 percent of all reported cancer cases. On the other hand, the cancer groups that tend to record small number of cases are prostate (3.9 percent), glands (3.3 percent), respiratory (2.8 percent) and eye cancer (2.1 percent). This cancer scenario reveals the predominance of cancers that associate with low socio-economic development and infections (leukaemia/lymphomas, cervical and liver) in Nigeria. The exceptions are gastro-intestine and internal organs cancers. Comparing this cancer experience with the profile in the United States, respiratory cancer which ranks among the lowest in Nigeria is the leading cancer for both males and females in the USA (Last, 1998).

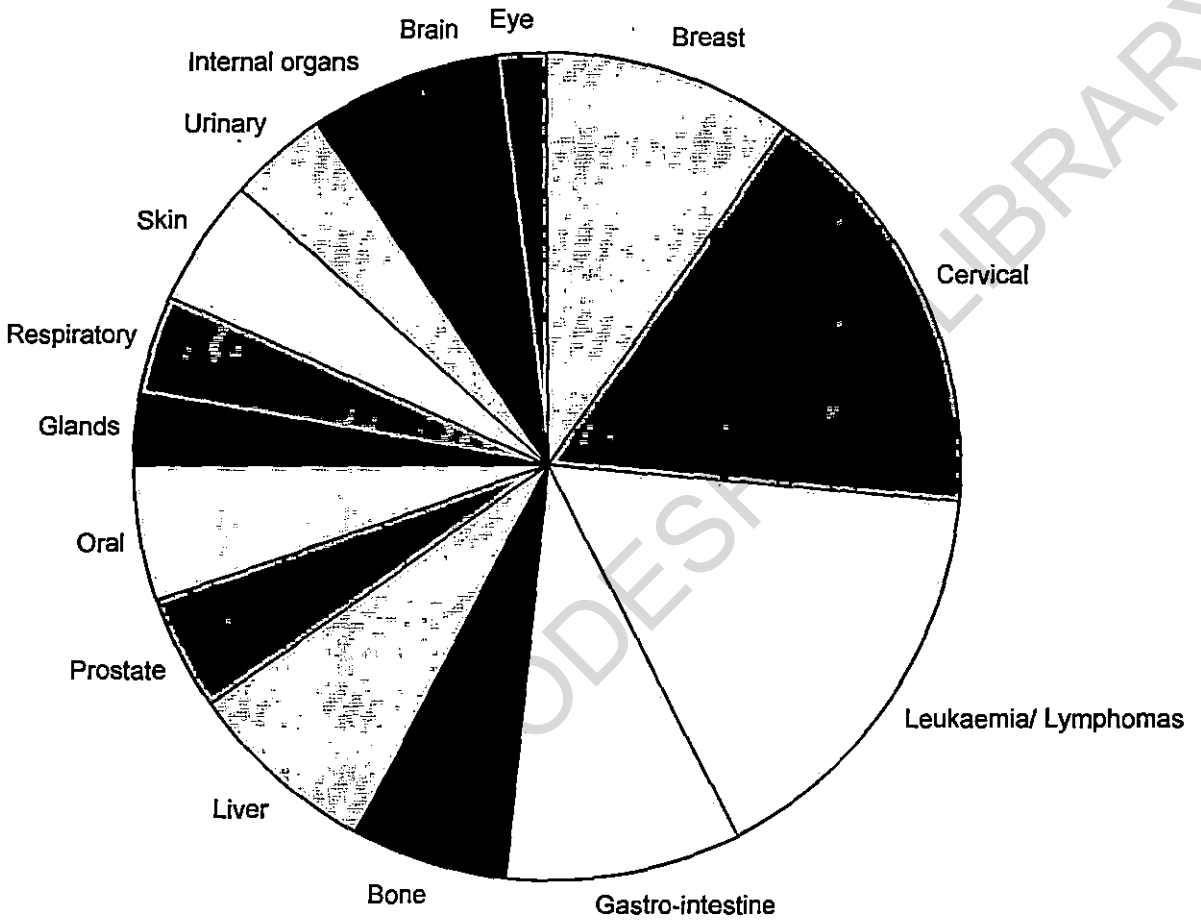


Fig. 6.2: Nigeria Cancer Profile (1987-1996) : All Registries

Generally, the temporal pattern of the overall cancer depicts two broad peaks (Fig. 6.2), though the first peak is higher than the second. This pattern indicates an increase over the years in spite of the decline in-between the two identifiable peaks. It is worth mentioning that the small number of cancer cases sandwiched between the years when large number of cases was reported is not likely to be actual decline in cancer morbidity but in reporting. Reduced rates of reporting may have resulted from the incessant labour crises of 1993 and 1994. It is generally known that the "work-to-rule" and "total strike" even among the medical practitioners in public hospital almost paralysed health services in those years. In essence, patients who would have visited the registries at this time may have used alternative health centres, especially some "reliable" private hospitals.

Besides the apparent under-reporting in 1993 and 1994, there is likely to be a general under-reporting of cancer cases in the 1990s. This may be due to the severe effects of the Structural Adjustment Programme (SAP) introduced in the second-half of 1980s. According to Iyun (1991), SAP in Nigeria has priced health care services out of the reach of most people. Because of the reduction in public expenditure on social services which characterises SAP, the cost of health care services has become unbearably high. Hence, cancer cases reported by patients who utilise alternative (private) health services may remain undocumented at the national cancer registries. Coupled with the high cost of health care services in the government hospitals is the poor quality of services rendered. As a result, there is a general distrust for the public health sector, such that most people prefer using alternative health care services. Cancer cases reported by

some of these people to private health centres will mean under-reporting at the cancer registries.

Be that as it may, the upward trend of the overall cancer implies that epidemiological transition is on course in Nigeria. Iyun (1991), reached similar conclusion was when she discovered that cancer mortality topped the list of ten major causes of death at the University College Hospital, Ibadan. In addition, Verhasselt (1993) indicated that epidemiological transition is in progress in the developing countries of the world. According to her, "these countries still carry a double burden of both the infectious-parasitic diseases and those of degeneration.

In order to identify the stage which the Nigerian health profile occupies in the course of epidemiological transition, we consider the temporal characteristics of the specific cancer groups. This is pertinent so that variations in the temporal pattern of cancers caused by infective agents and those induced by westernisation of lifestyles may be highlighted. Such information is essential for planning and policy formulation in specific cancer control.

The national cancer profile (all registries) reveals the predominance of both the cancer cases found to be prevalent in the less developed countries (liver, leukaemia/lymphomas and cervical) and in the developed countries (breast and gastro-intestine) according to Olweny (1990). This cancer spectrum, which is peculiar to the Newly Industrializing Countries (NICs) of the world (Korea, Philippine among others)

has become a reality in Nigeria. In essence, the Nigeria cancer experience confirms the speculation of Verhasselt (1993), that "the developing countries carry a double burden of health hazard of both the less developed and the economically advanced societies of the world.

6.3 Temporal Pattern of Cancer Occurrence (1960-1996)

Cancer occurrence in Ibadan registry from 1960 to 1996 totals 33,931 cases (Table 6.3a). A close observation of the annual occurrence shows that the highest number was recorded in 1990 (1483 cases). This is followed closely by 1411 cases in 1988, 1409 cases in 1991 and 1307 cases in 1992. The years with the smallest cases are 1961 (652 cases), 1962 (610 cases), 1978 (646 cases), and 1982 (657 cases). While 1961 and 1962 mark the initial years of cancer documentation, the other years with small number of cases may be due to under-reporting at the registries.

Two things are noteworthy in the annual pattern of cancer occurrence. One is that high number of cancer cases was recorded in the late 1980s (1987) through 1990s, with the exception of 1993 and 1994. Generally, fewer number of cases were reported in years that preceded 1987. In other words, there appear to be an increase in the occurrence of the overall cancer from 1987 to 1996 in Nigeria. Secondly, there is no sequence in the annual pattern of cancer occurrence as years of high number of cases are intertwined with those of fewer cases. This implies that the pattern does not follow a straight line (curve).

Table 6.3a **Annual Occurrence of Overall Cancer at Ibadan Registry (1960-1996)**

Year	Number of cases	Year	Number of cases
1960	722	1979	699
1961	652	1980	761
1962	610	1981	885
1963	708	1982	657
1964	884	1983	809
1965	838	1984	982
1966	949	1985	974
1967	808	1986	982
1968	772	1987	1197
1969	829	1988	1411
1970	924	1989	1292
1971	938	1990	1483
1972	1002	1991	1409
1973	882	1992	1307
1974	845	1993	718
1975	855	1994	737
1976	835	1995	1069
1977	797	1996	1063
1978	646	Total	33,931

Source: Fieldwork, 1997

Obviously, the description of a temporal pattern with high and low cases intertwined is often faced with difficulty. In order to minimise this problem, the annual occurrence data have been aggregated on 5 years interval. The 5-year aggregation of the annual data is preferred to any other because the 8 points it produces are adequate for graphical presentation of the data in Table 6.3a. In short, Fig 6.3a portrays the temporal pattern of overall cancer shown in Table 6.3a.

Table 6.3b presents the number of cancer cases reported for each of the periods. A close examination of Table 6.3b and Figure 6.3b shows that a general increase in cancer occurrence from 1960/61 to 1992-1996. The highest occurrence was reported between 1987-1991 with 6992 cases (20.0 percent) followed by 1972-76 (13.1 percent) and 1982-86 (13.0 percent). In contrast, 1977-81 and 1962-66 recorded the least number of cancer cases (11.2 percent and 11.8 percent respectively).

Table 6.3b **Occurrence of Overall Cancers (5-Year Grouping) at Ibadan Registry (1960-1996)**

Period	Number of cases	Percent
1960/61	1374	4.0
1962-66	3989	11.8
1967-71	4271	12.6
1972-76	4419	13.0
1977-81	3788	11.2
1982-86	4404	13.0
1987-91	6792	20.0
1992-96	4894	14.4
Total	33,931	100.0
Mean	4241.4	
Standard Deviation	1487.2	

Source: Fieldwork, 1997.

From the mean value (4241.4) calculated for Table 6.2b, the numbers of cases reported in 1962 to 1966 and 1977 to 1981 were less than the mean. While the cases reported between 1967 and 1971 had small variation from the mean value, other periods 1982 to 1986, 1972 to1976, 1987 to 1991 and 1992 to 1996 had larger variations. In

Fig 6.3a: Annual Cancer Occurrence at Ibadan Registry

Fig. 6.3 5-Yearly Aggregation of Cancer Occurrence at Ibadan Registry

fact, the number of cases reported in 1987 to 1991 has the largest variation from the mean value.

6.3.1 Temporal Pattern of Specific Cancer Occurrence: Ibadan Registry (1960-1996)

From Table 6.4, the temporal pattern of the 15 cancer groups is presented based on the Ibadan registry data. A close observation of the cancer groups indicates some differences among them and between them and the pattern depicted by overall cancer. There is a close similarity between the overall cancer and the temporal pattern of gastro-intestine, liver, glands, bone, prostate, cervical, breast, oral and respiratory cancer. They generally have two peaks whereby the initial peak is remarkably lower than the second peak. This pattern implies an upward trend. Conversely, leukaemia/lymphomas and skin cancer portray a decline, which appears different from the pattern of the overall cancer.

More specifically, there are three patterns that can be identified among the various cancer groups. The first pattern consists of cancers that showed one conspicuous peak at the tail end of their trend lines. That is, they had significant high occurrence towards the end of the study period. Such cancers include breast, prostate respiratory and liver cancer. With the exception of liver cancer, other cancers in this category of pattern are cancers that show strong association with dietary habit and western lifestyles (Vigneron, 1989). By implication, the cancers that are prevalent in the

Table 6.4: **Occurrence of Specific Cancer group at Ibadan Registry (1960 – 1996)**

	Period								
Cancer Group	1960/61	1962-66	1967-71	1972-76	1977-81	1982-86	1987-91	1992-96	Total
Bone	128	355	303	312	255	237	400	242	2232
Brain	11	63	73	80	85	138	146	128	724
Breast	83	207	253	275	322	453	1019	729	3341
Cervical	245	728	892	913	628	719	1177	891	6193
Eye	7	62	85	86	73	87	120	98	618
Gastro-intestine	117	327	383	386	312	422	453	342	2743
Glands	23	85	136	126	106	114	212	83	885
Internal Organs	30	76	74	100	78	108	99	87	652
Leukaemia/ lymphomas	312	895	849	805	785	668	810	651	5775
Liver	83	318	262	288	353	404	468	303	2479
Oral	81	239	202	266	224	192	312	267	1783
Prostate	52	111	160	189	184	266	395	316	1673
Respiratory	71	153	192	192	186	197	328	228	1547
Skin	72	250	251	208	149	175	228	187	1520
Urinary	59	120	156	144	121	155	179	144	1520
Overall Cancer	1374	3989	4271	4370	3861	4335	6346	4697	33243
Percent	4.2	12.2	13.1	13.4	11.8	13.3	19.14	12.6	100.0

Source: Fieldwork, 1997.

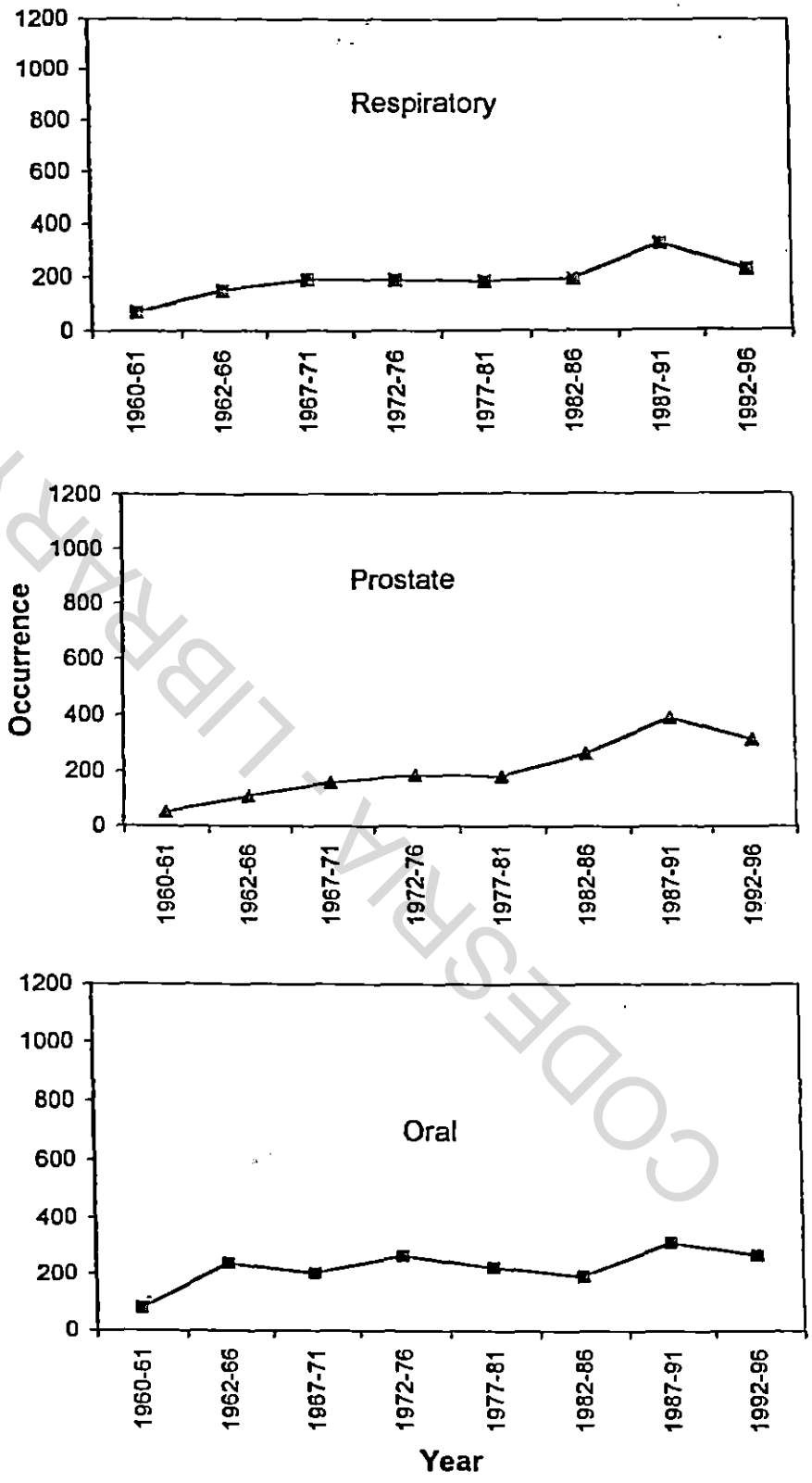


Fig. 6.4a Temporal Pattern of Specific Cancer Occurrence (1960-1996)

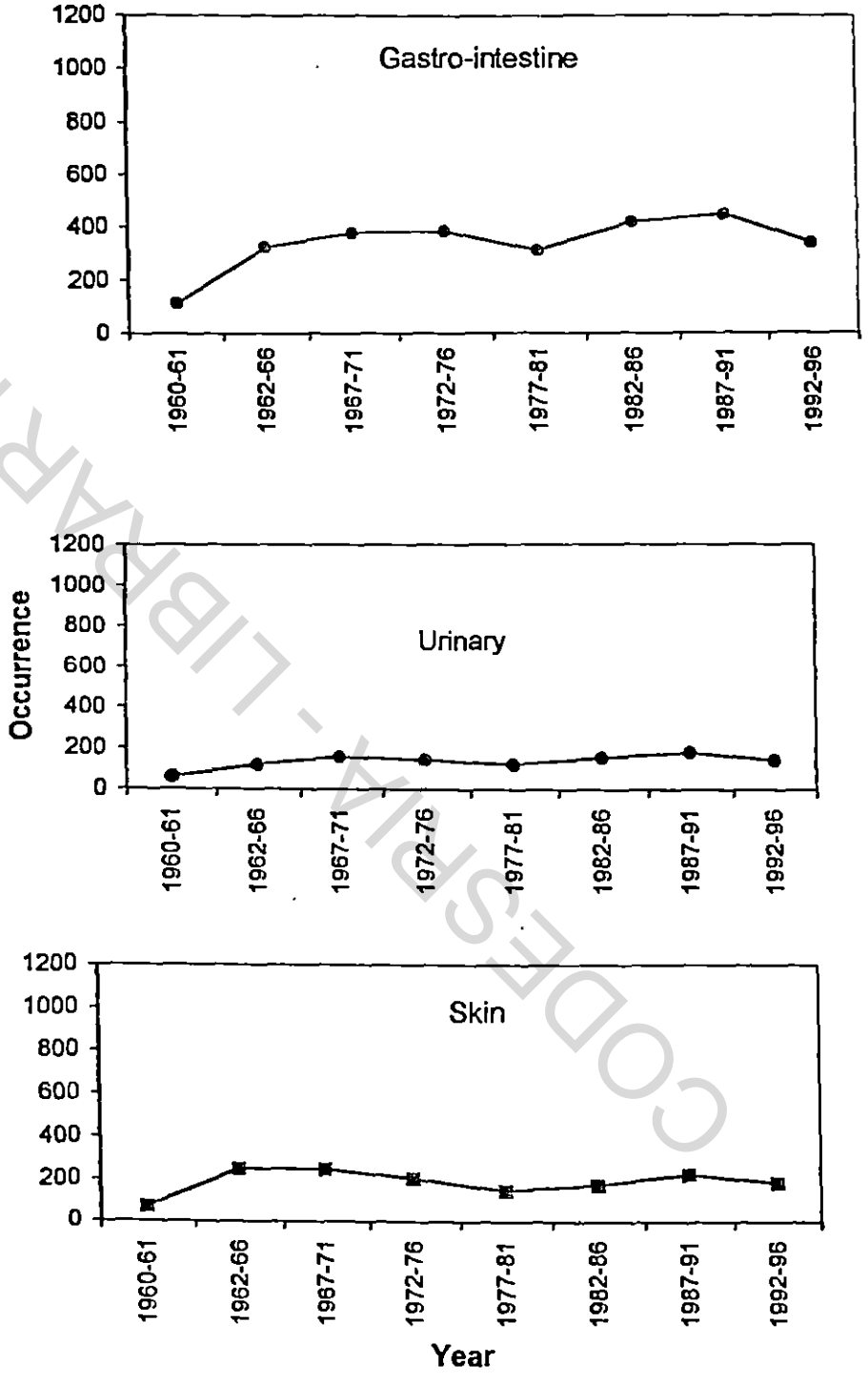


Fig. 6.4b Temporal Pattern of Specific Cancer Occurrence (1960-1996)

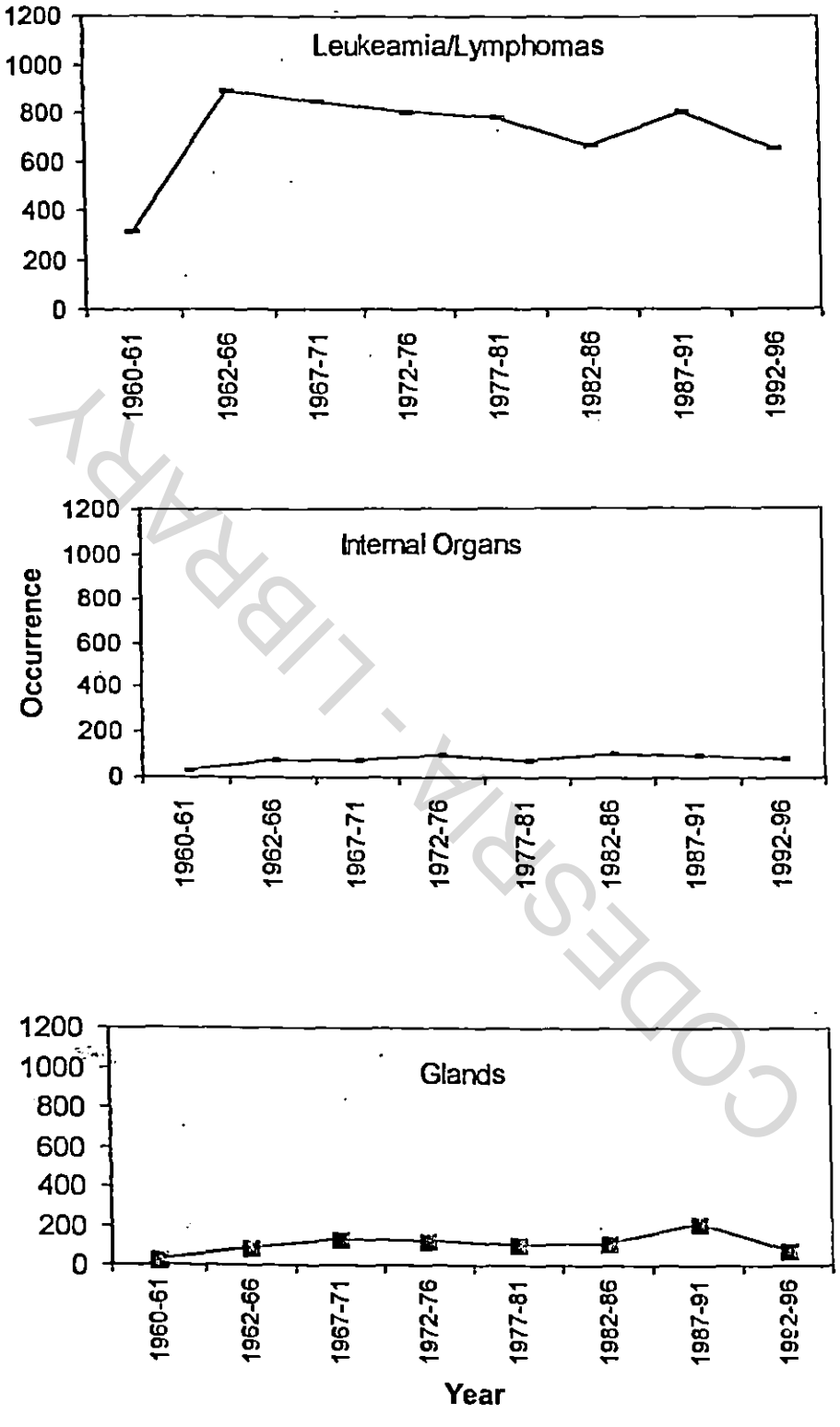


Fig. 6.4c Temporal Pattern of Specific Cancer Occurrence (1960-1996)

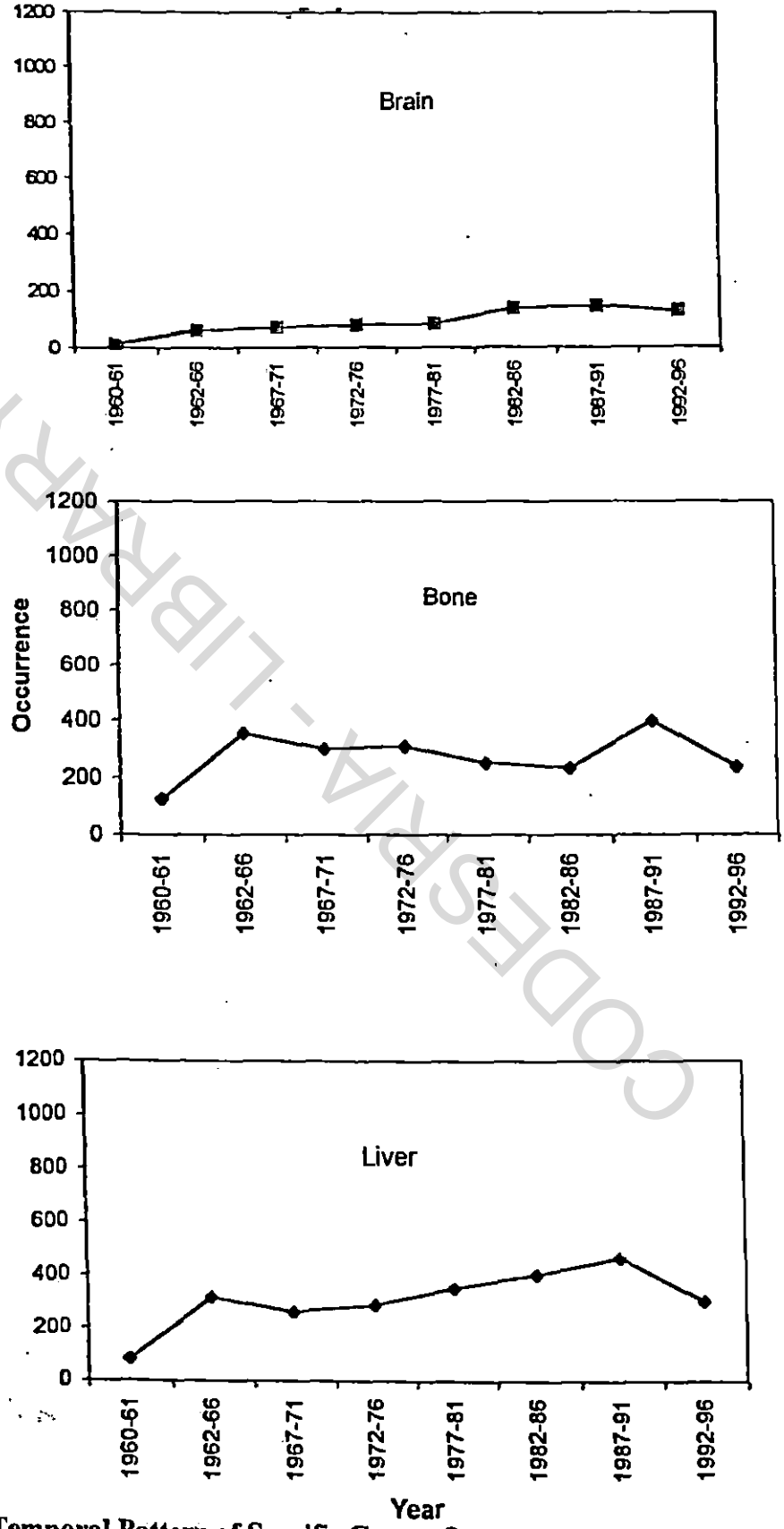


Fig. 6.4d Temporal Pattern of Specific Cancer Occurrence (1960-1996)

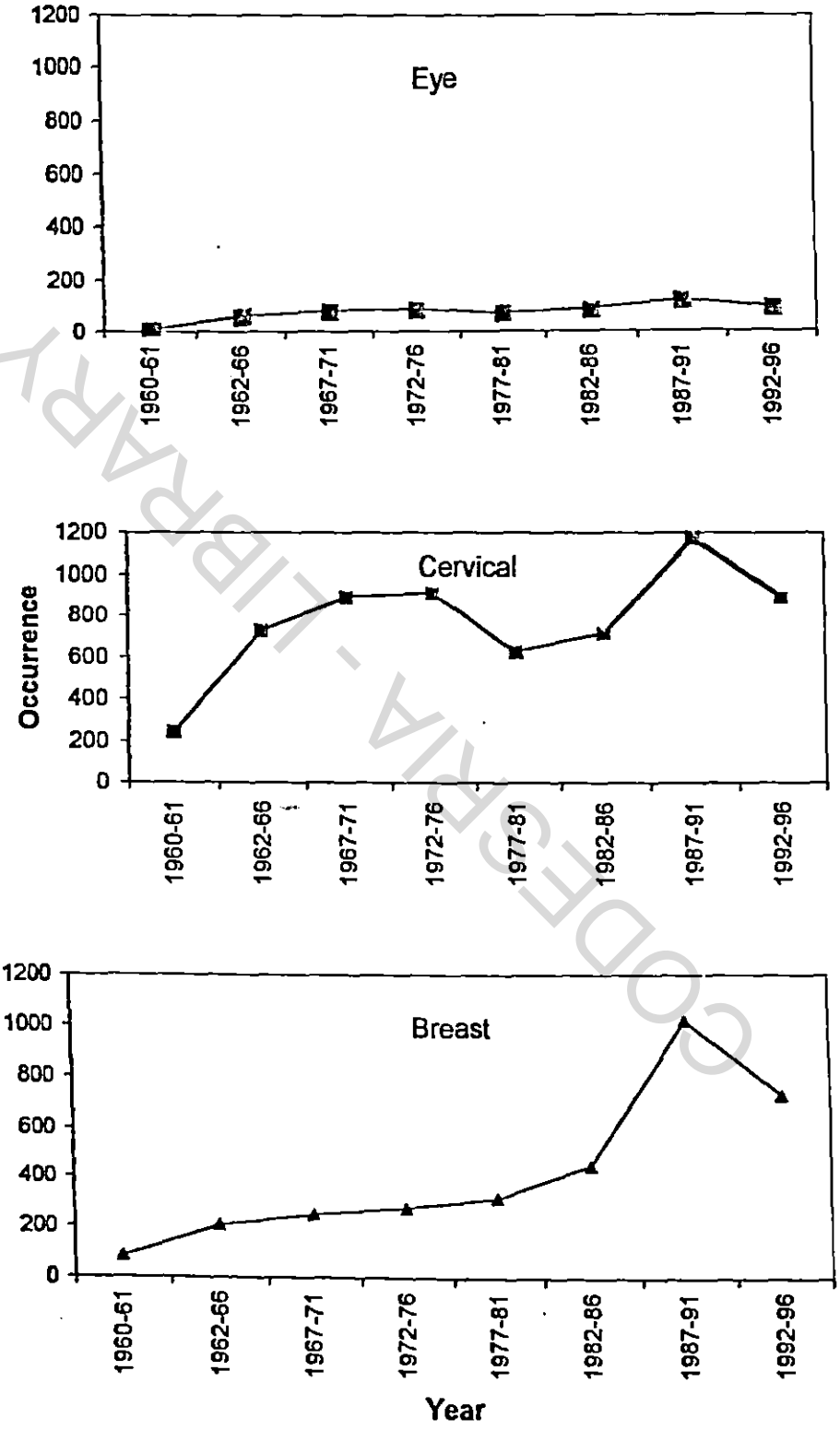


Fig. 6.4e Temporal Pattern of Specific Cancer Occurrence (1960-1996)

developed countries are equally found to be rapidly increasing in occurrence more than other cancers.

Secondly, there are cancers that had two distinct peaks but their latter peaks are higher than the initial one. This pattern implies a "moderate" upward trend. Cancer groups in the second pattern are cervical, gastro-intestine, bone, glands, oral and brain cancer. The increasing occurrence of these cancers may equally point to the preponderance or outstanding increase in their risk factors in our society.

The third pattern comprises leukaemia/lymphomas and skin cancer. These cancers also possess two peaks but the first peak is higher than the second. This pattern indicates a decline or downward trend in their occurrence over the study period. In a more practical way, the apparent decline in the occurrence of leukaemia/lymphomas may imply a decrease in the prevalence of the viral agents that initiate them in our society.

6.3.2 Temporal Pattern of Specific Cancer Occurrence: All Registries (1986-1996)

Next, we examine the temporal pattern of the 15 cancer groups based on the data collected from all registries from 1986 – 1996. A two-year interval has been chosen for the information presented in Table 6.5 so as to produce an adequate number of points for analysing the small number of years (periods) involved. We have also included Ibadan registry data in order to identify differences between them and the other registries data.

Table 6.5a reveals that the Ibadan registry data accounted for more than 50 percent (67.5 percent) of all reported cancer cases between 1986 and 1996. Considering the other four registries, with the exception of Ibadan registry (Table 6.5b), Enugu registry data accounted for 41.2 percent of reported cancer cases. The Ile-Ife registry followed with 33.2 percent and the remaining 26.6 percent were reported in Ilorin and Zaria centres. The overall cancer cases in all the registries tend to show an upward trend similar to the picture in Ibadan registry. Again, peak in the trend of the overall cancer is seen in 1989/90 period. On specific note, only Ibadan and Enugu registries recorded their highest cancer occurrence in 1989/90. The peak in Ilorin, Ile-Ife and Zaria registries are found in 1987/88, 1995/96 and 1995/96 periods respectively.

The temporal pattern of each of the 15 cancer groups as reported in Enugu, Ilorin, Ile-Ife and Zaria is presented in Table 6.6. Table 6.6 clearly shows two broad patterns of cancer occurrence over time (1986-1996). The first group which consists of oral, glands, prostate, leukaemia/lymphomas, liver, bone, eye and cervical reached their climax in 1988/89. Afterwards, it declined till 1995/96. The second pattern depicts an upward (temporal) trend. The cancer groups showing this pattern include brain, breast, skin, internal organs and gastro-intestine cancer.

Table 6.5a: **Occurrence of Overall Cancer At the Five Registries (1986 – 1996)**

	Registries						
Period	Ibadan	Ilorin	Enugu	Ile-Ife	Zaria	Total	%
1986	982	53	40	-	-	1075	5.7
1987/88	2608	258	499	-	-	3365	17.9
1989/90	2775	208	961	352	33	4329	23.1
1991/92	2716	231	485	423	98	3953	21.1
1993/94	1455	168	246	609	134	2612	13.9
1995/96	2132	222	295	643	149	3441	18.3
Total	12668	1140	2526	2027	414	18775	100.0
Percent	67.5	6.1	13.5	10.8	2.2	100.0	

Source: Fieldwork, 1997.

Although the patterns discussed so far are limited to the more recent times (1986-1996), certain cancers showed similar patterns to those of Ibadan registry (1960-1996). For instance, cancers of the breast, brain and gastro-intestine showed upward trend in the Ibadan registry data and also at the other four registries. Moreover, leukaemia/ lymphomas, which depicted a downward trend going by the data from the four other registries, also showed a decrease in Ibadan registry data. The four cancer groups which appear to portray identical patterns in Ibadan registry data on one hand and the four other registries on another, confirm the fact that breast, brain and gastro-intestine are

Table 6.5b: **Occurrence of Overall Cancers at the Registries (excluding Ibadan)**

1986-1996

Period	Enugu	Ile-Ife	Zaria	Total	Percent	Cum. Percent
1986	40	-	52	92	1.5	1.5
1987/88	499	-	258	757	12.4	13.9
1989/90	961	352	208	1554	25.4	39.3
1991/92	485	423	231	1237	20.3	59.6
1993/94	246	609	168	1157	18.9	78.5
1995/96	295	643	222	1309	21.5	100.0
Total	2526	2027	1140	6107	100.0	
Percent	41.2	33.2	18.7	100.0		

Source: Fieldwork, 1997.

most probably on the increase while leukaemia/lymphomas are decreasing in Nigeria.

Differences exist in the temporal patterns of skin, liver, oral and glands as portrayed by the data from Ibadan registry and the four other registries. In the case of skin cancer, its downward trend in the Ibadan registry data showed an increase in the data at Ile-Ife, Ilorin, Enugu and Zaria registries combined. Again, liver, oral and glands, with downward trends in the data of the four other registries, tend to portray an increasing pattern in the Ibadan registry data. Be that as it may, the patterns shown by the cancer groups reported at the Ibadan registry take precedence over those of other registries in

Table 6.6: **Occurrence of Specific Cancer Group at Ilorin, Enugu, Ile-Ife and Zaria Registries (1986-96)**

Cancer Group	Period						
	1986	1987/88	1989/90	1991/92	1993/94	1995/96	Total
Bone	1	18	61	24	28	33	165
Brain	1	60	112	79	105	117	474
Breast	1	40	102	118	135	79	475
Cervical	1	12	46	53	41	42	195
Eye	-	27	34	21	20	22	124
Gastro-intestine	4	61	152	162	185	209	773
Glands	2	42	86	42	21	31	224
Internal Organs	19	95	254	189	237	249	1043
Leukaemia/ lymphomas	2	92	174	101	56	103	528
Liver	4	37	127	80	72	89	409
Oral	2	28	64	32	35	49	209
Prostate	-	7	19	14	19	10	69
Respiratory	1	4	6	9	3	1	24
Skin	1	11	99	88	58	89	346
Urinary	1	78	97	159	76	75	486
Overall Cancer	40	613	1433	1171	1091	1197	5545
Percent	0.7	11.1	25.8	21.1	19.7	21.6	100.0

Source: Fieldwork, 1997.

showing the national cancer situation. This is because the Ibadan registry provides complete data from 1960 to 1996 that represent the temporal pattern of cancer in Nigeria.

According to the available literature, there is a level of conformity in the temporal trend of certain cancers in Nigeria and other countries. For instance, the upward trend of respiratory, breast and prostate cancers found in Nigeria agrees with that of Eastern Europe and East Asia countries (Hoel, et al; 1992). In addition, Davis and his associates (1990) have indicated that stomach cancer has been on the increase in Japan just as the gastro-intestine cancer has shown an upward trend in Nigeria. On the contrast, there is a line of difference in the cancer experience of England and Wales vis-à-vis Nigeria's. Specifically, cancer of the gastro-intestine tract, which shows an upward trend, has been declining in England and Wales. In a similar way, prostate and breast cancers, that are increasing in Nigeria, have downward trends in East Asia (Hoel, et al; 1992). The basis of this dissimilarity may be due to the marked socio-economic difference in the two countries, while Nigeria belongs to the under-developed countries, England and Wales are developed countries.

It is well known also that health education is already embarked upon by the industrialised nation to increase their consumption of fresh foods while reducing the manufactured ones. The health education equally identifies simple tumour "markers" for most women specific cancers. This effort will enhance early detection, diagnosis and treatment among the western countries. With respect to the east Asians, their adherence to traditional diet which features less manufactured food (normally treated with chemical preservatives) has been shown to act as protection against breast and prostate cancers (Rowland and Cooper, 1983; Norie, 1992). Ironically, some of the traditional substances

which act as protection against a category of cancer groups in a population may predispose them to the risk of others. Findings on the cancer situation that are indicated here stand as reference point for other less developed countries, particularly in the West Africa sub-region.

6.4 Trends of Specific Cancer group

The time series procedure performs basically two functions. According to Burt and Barber (1996), it is employed to analyse and plot the temporal trend of a phenomenon. It equally attempts the prediction of data collected over substantial period (year, month, week). Considering the fact that cancer data collected are on frequency basis, the time series method can be used to plot trend line of cancer occurrence and attempt a simple projection of each cancer group into the future. To plot the trend line for each cancer group, the "line of best fit" or least square (regression) was chosen as an option in the EXCEL computer programme for time series analysis. The equation for plotting each trend line is indicated as a simple regression equation of the form:

$Y = a + bX$

where Y and X are variables (say cancer occurrence and time)

a is the intersect of the regression line

b is the regression co-efficient of Y on X.

Although the time series procedure is not the most rigorous method for data prediction, yet it remains the best alternative compatible with the frequency data involved in this study. A notable weakness of the time series procedure in data prediction is its assumption that all conditions remain the same over time. In other words, it does not consider changes in the pattern of risks that may impact on the temporal pattern of cancers. Regardless of the limitations associated with this procedure of data projection, a general impression of the future trend of cancer is usually obtained. More specifically, the trend line which is a product of time series analysis indicates the linear direction and gradient of the temporal pattern of the cancer groups.

Cancers groups that show outstanding temporal pattern in Figure 6.4a, b, c, d, and e are selected for trend line analysis. Nine of these cancers were chosen: breast, prostate, liver, cervical, respiratory, skin, gastro-intestine, brain and leukaemia/lymphomas. The trend lines plotted using the least square method for the cancer groups are presented in Figure 6.4a, b and c. Based on the gradient of each trend line; three major patterns are identified. These are the "rapidly" increasing cancer groups, the "gradually" increasing cancer groups and the "gradually" decreasing cancer groups.

The rapidly increasing cancer groups comprise breast, prostate and liver. Cancer of the breast appears to be the most rapid of the three cancers, followed by prostate and then liver. The projection of these cancers into the future indicates rapid upward trend. This is based on the assumption that all risk factors inducing these cancers will remain the same. Cancers of the gastro-intestine, respiratory, brain and cervix (cervical) belong

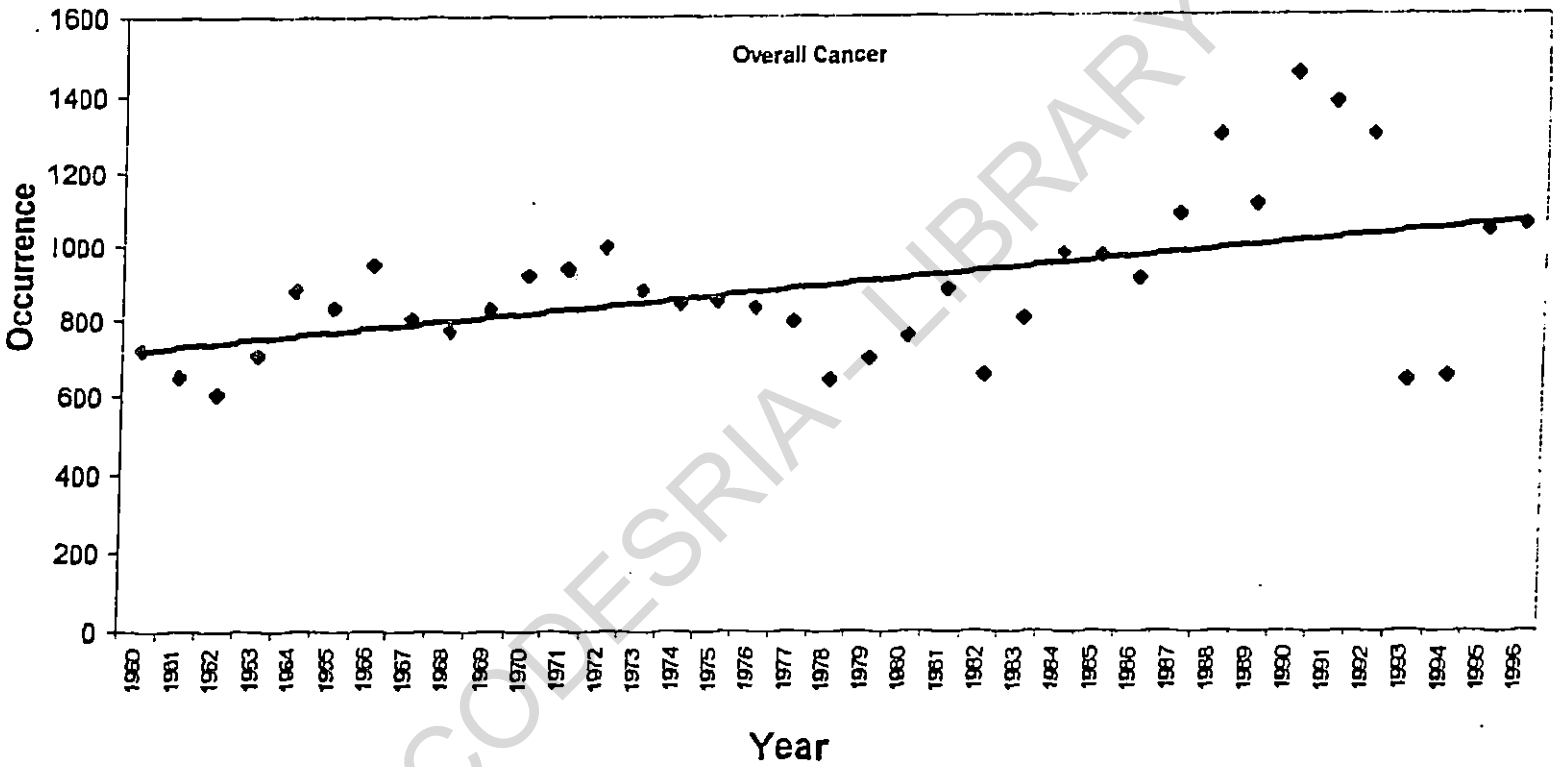


Fig. 6.5 Trend of Overall Cancer (1960-1996)

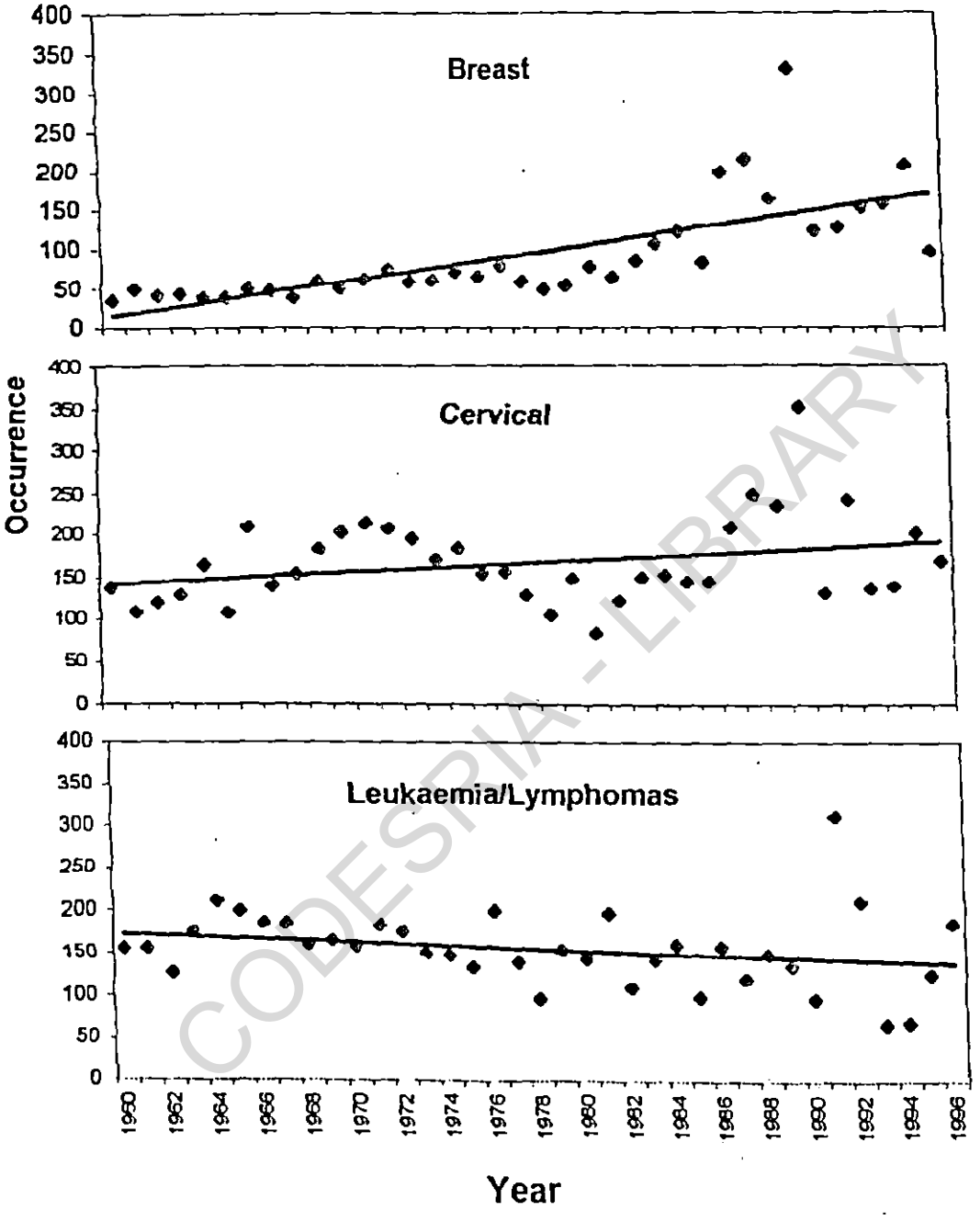


Fig. 6.5a Trend of Specific Cancer Groups

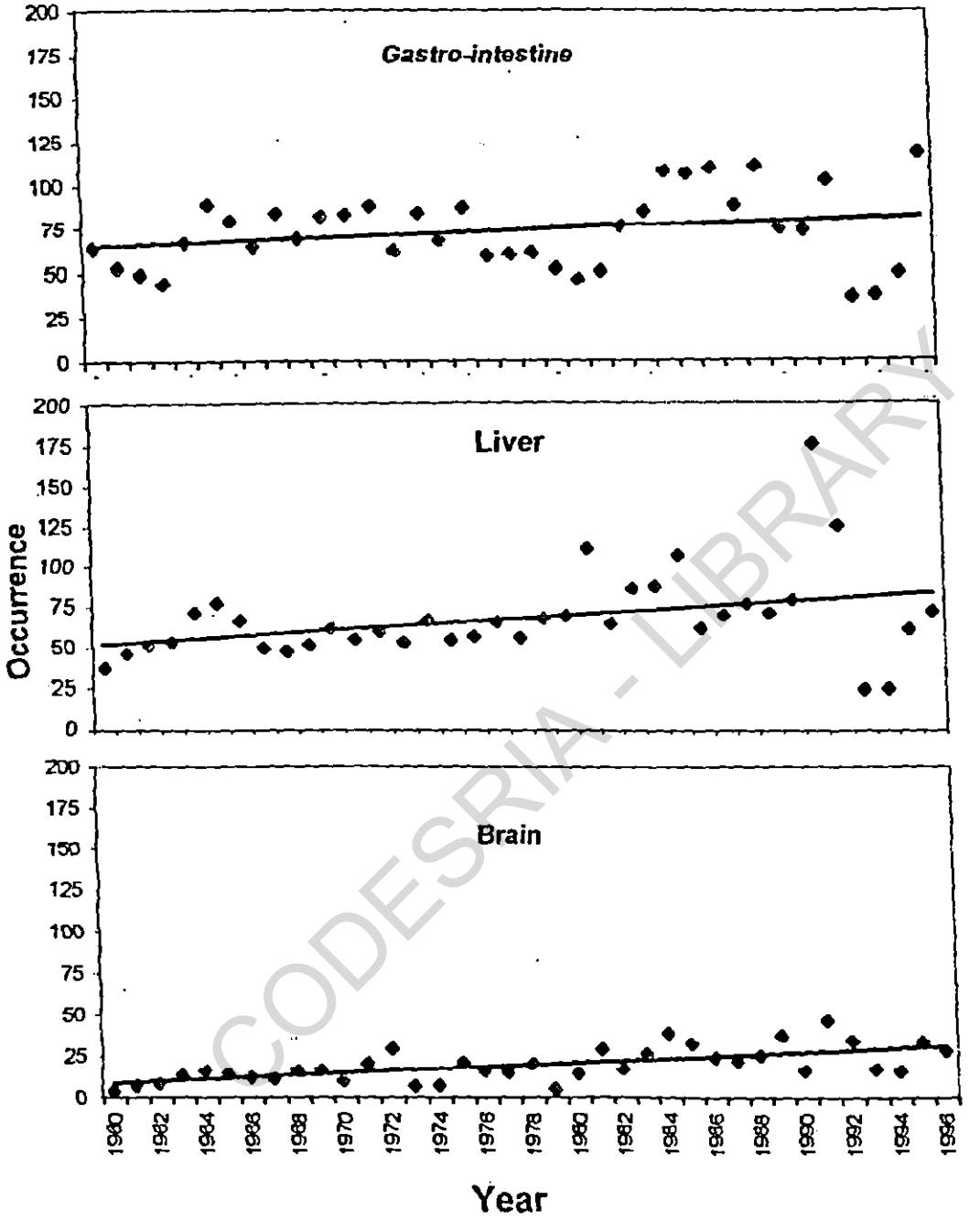


Fig. 6. 5b Trend of Specific Cancer Groups

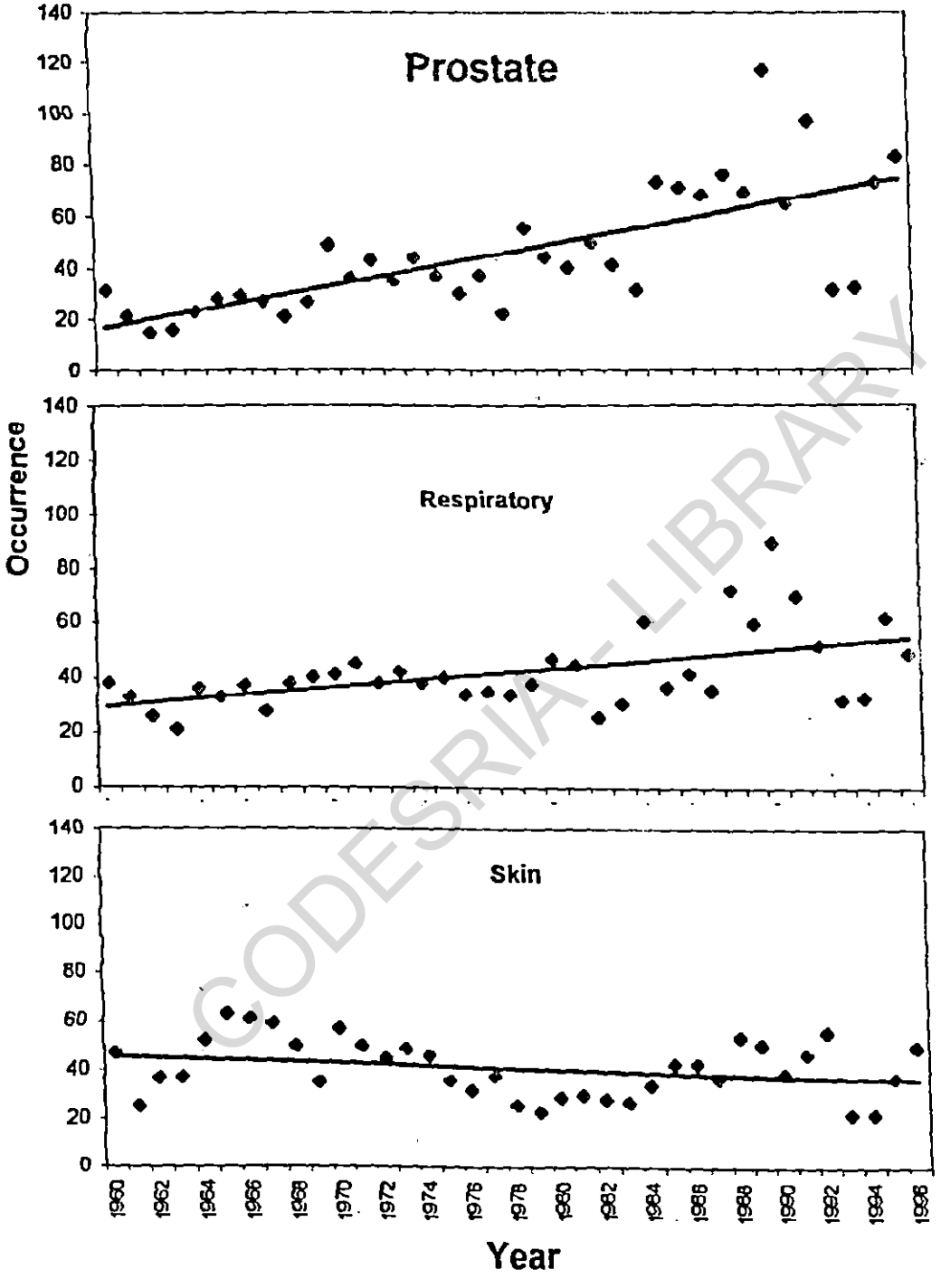


Fig. 6.5c Trend of Specific Cancer Groups

to the gradually increasing group. The gradient of their trend lines tends to be less steep compared with those of breast, prostate and liver. Projections of the trend lines of these four cancer categories also show an upward trend into the future. The last trend line pattern features two cancer groups, leukaemia/lymphomas and skin cancer. These cancer groups show "gradually" declining trend lines over time. A projection of the trend line of leukaemia/lymphomas indicates a continued decline into the future. It is appreciated from this analysis that cancer groups have varying trends; increase or decrease. Even those with an increasing pattern still show differential levels of increase, that is, rapid and gradual. This type of information implies that intervention programme for cancer control should be prioritised based on the different rates of cancer temporal behaviour in our society.

In order examine the variability of each cancer group, the mean and standard deviation is considered. From Table 6.8 (calculated from Table 6.4), cancer groups that recorded higher number of cases than their mean values in the early years of the study period include bone, skin, leukaemia/lymphomas, liver and oral cancers. Bone cancer recorded number of cases higher than the mean value (279 cases) in 1962-96 and 1987-91. Skin cancer shows the similar pattern of occurrence to bone with cases above its mean value (190) occurring at the same period. Leukaemia/lymphomas was higher than the mean value (721 cases) from 1962 to 1986 and in 1987-91. In the case of liver and oral cancers, their reported cases rose above the mean values of 310 and 223 cases in 1962-66. While liver cancer cases recorded higher number than the mean again from 1977 to 1991, oral cancer shows a similar pattern with the exception of 1982-86.

Table 6.7 **Measures of Variability in the Temporal Pattern of Cancer Groups**

Cancer Group	Mean	Standard Deviation	Mean/Standard Deviation (%)
Bone	279.0	83.3	29.9
Brain	90.5	45.1	50.0
Breast	417.6	310.0	74.2
Cervical	774.1	271.4	35.1
Eye	77.3	33.1	42.9
Gastro-intestine	342.8	102.9	30.0
Glands	110.6	53.8	49.0
Internal Organs	81.5	24.3	29.8
Leukaemia/lymphomas	721.9	185.4	25.7
Liver	309.9	113.4	36.6
Oral	222.9	69.2	31.1
Prostate	209.1	111.5	53.3
Respiration	193.4	71.7	37.1
Skin	190.0	59.7	31.4
Urinary	134.8	36.1	26.8
Overall	4155.4	1364.6	32.8

Source: Computed from Table 6.4.

Cervical cancer recorded cases higher than the mean value of 774 cases from 1982 to 1996. Similarly, gastro-intestine, glands and cancer of the brain recorded cases higher than their mean values of 243, 111 and 91cases over the same period.

Moreover, the cancer groups that have large variation in the pattern of occurrence over the study period have standard deviation above 100.0. These include breast (± 310), cervical (± 271), leukaemia/lymphomas (± 185), liver (± 113), prostate (± 111) and gastro-intestine (± 103). The remaining nine cancer groups have small standard deviation value, which implies that their occurrences are more homogenous over the study period.

Comparing the percentage of standard deviation to the mean of each cancer group, a clearer picture of those that are actually heterogeneous is portrayed. From Table 6.8, cancer groups that truly showed high variability have standard deviation/mean percentage of about 50.0. The cancer groups that fall within this percentage are breast (74.2%), prostate (53.3%), brain (50.0%) and glands (49.0%). Succinctly put, the occurrences of these four cancer groups have large variation over the study period (1960 to 1996).

The temporal analysis of the cancer groups in Nigeria shows the co-existence of high occurrence (upward trend) of cervical cancer vis-à-vis breast, gastro-intestine and prostate cancers. This cancer scenario has implication for the dimension of epidemiological transition in the country. Whereas the former associates with poverty and under-development, breast and prostate cancers associate with lifestyles of socio-economic development (affluence). Hence, Nigeria is portrayed here as carrying a double-burden of the two epidemiological experiences that usually characterise less developed and economically advanced societies. This finding confirms the propositions of Verhasselt, (1989) and Akinkugbe (1997) for some developing countries and Nigeria respectively, that they carry a double-burden of health experiences. The Nigerian health profile therefore, can be located in the second stage of the epidemiological transition model of Omran (1971). The second stage in epidemiological transition witnesses the high occurrence of the diseases of westernisation and those of infectious-parasitic agents, though the first group tend to be higher in occurrence.

CHAPTER SEVEN

INTRA-URBAN PATTERN OF CANCER INCIDENCE

7.1 Introduction

In this chapter the intra-urban pattern of cancer is analysed. This becomes a necessary follow-up to the regional analysis, so as to pinpoint specific socio-environmental factors that tend to explain cancer pattern. An appropriate framework for considering this aspect of the study is the environmental risk-cells concept.

The concept of environmental risk-cells indicates that human beings are influenced by artificial rather than natural factors in the occurrence of ill-health. In other words, indicators of ill-health are interpreted by considering different living conditions and lifestyles. Here credence is given to the increasing ecological dominance of human beings in man-environment relationship. In health determination therefore, the predominant role of the social environment is largely considered.

Based on this premise, it is expected that differences in the socio-economic and environmental qualities among wards and residential areas will explain variations in their predominant cancer groups. Emphasis is hereby placed on the characteristics of the residents and the physical conditions of each area within the city that may predispose the inhabitants to risks of specific cancer.

According to Learmonth (1988) and Iyun (1995), it is the urban "elites" in the third world cities that suffer most from the degenerative diseases such as cancer and cardiac problems. This observation implies that, the distribution of such diseases especially cancer, is far from being

uniform within cities. This results from the peculiarities of most urban centres in the developing countries, where there is a co-existence of modern and traditional (indigenous) areas (Mabogunje, 1958), and also slums (Onibokun, 1986). Each of these areas tends to be inhabited by people with recognisable socio-economic and lifestyle characteristics.

7.2 Cancer Profile in Ile-Ife city

Out of 2027 cancer cases documented at the Ile-Ife registry from 1989 to 1996, only 543 cases were from Ile-Ife city. A thorough screening of these records showed that only 380 cases were recorded with the appropriate residential addresses of the patients. Therefore, the analysis presented in this section is based on the 380 cases, which have detailed information including the patients' addresses within the community.

Table 7.1 reveals that the Ile-Ife residents reported all cancer groups found in the national (Nigeria) cancer profile. Breast cancer appears to be the leading cancer group in Ile-Ife city. It contributed 17.4 percent of all cancer cases in the city. The next cancer groups in order of magnitude are bone (16.3 percent) and glands (15.3 percent). Other cancers that accounted for more than 5 percent are prostate (10.8 percent), gastro-intestine (10.3 percent), cervical (9.7 percent) and liver (7.9 percent). These seven cancer groups jointly accounted for 87.7 percent of the total cancer cases reported by Ile-Ife residents. Each of the remaining 8 cancer groups shown in Table 7.2 accounted for less than 5 percent of the overall cancer cases.

Generally speaking, the predominant cancer groups in Ile-Ife city were breast, bone, glands, gastro-intestine, cervical and liver (in descending order). This observation is similar to that of Ojo (1992), who identified cancers of the breast, cervical, prostate and liver to be predominant in Ile-Ife community.

Again, the cancer profile in Ile-Ife tends to show some similarities with the national (Nigeria) cancer profile. Instances where there are similarities include the proportion of breast,

Table 7.1: **Composition of Cancer Cases in Ile-Ife**

Cancer Group	Number of Cases	Percent
Breast	66	17.4
Bone	62	16.3
Glands	58	15.3
Prostate	41	10.8
Gastro-intestine	39	10.3
Cervical	37	9.7
Liver	30	7.9
Urinary	12	3.2
Skin	11	2.9
Oral	6	1.6
Internal Organs	5	1.3
Eye	5	1.3
Respiratory	5	1.3
Leukaemia/Lymphomas	2	0.5
Brain	1	0.2
Total	380	100.0

Source: Fieldwork, 1997

gastro-intestine, liver, internal organs and brain. The contradistinctions which exist between the two profiles comprise the proportion of leukaemia/lymphomas, glands, and cervical cancers. Cervical cancer which as always assumed the first or second position in the Nigeria cancer profile over the years, ranked sixth in the Ile-Ife profile. In the same vein, leukaemia/lymphomas

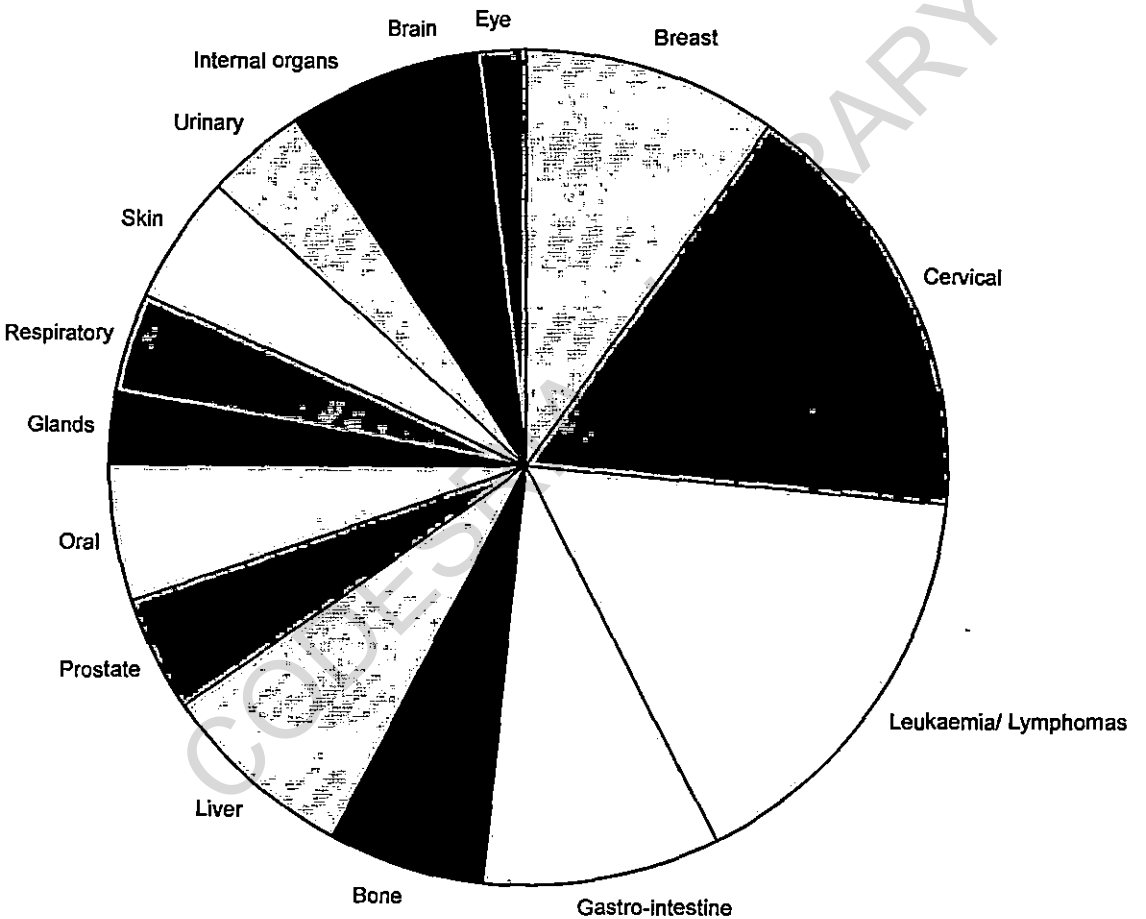


Fig. 7.1: Ile-Ife Cancer Profile

which ranked third in the national cancer profile takes the fourteenth position in Ile-Ife. On the other hand, cancer of the glands that ranked ninth in the Nigeria profile is the third most reported cancer group in Ile-Ife.

Going by the record presented above, the aetiology of the predominant cancer groups in the city of Ile-Ife relates to lifestyle and behavioural factors than factors in the physical environment. This informed the investigation of mostly socio-behavioural risk factors in the Ile-Ife household survey for the explanation of cancer pattern in the city. In order to achieve the holistic perspective of cancer pattern in the community, the chemical parameters of both surface and ground water are used as indicators of the physical environment.

7.3 Pattern of Cancer Incidence among wards

Until 1996, only one local government area (LGA) and seven wards existed in Ile-Ife. The 1997 local government creation exercise divided the city into two LGAs and twenty-one wards. These are Ife Central LGA, which has eleven wards and Ife East LGA with ten wards, namely Ilare 1, 2, 3 and 4; Iremo 1, 2, 3, 4 and 5; Akarabata and Moore-Ojaja. In Ife East LGA, three of the ten wards are located in rural area while the remaining seven in urban areas comprise Moore, Okerewe 1, 2, 3 and Modakeke 1, 2, 3.

Besides the fact that these newly created LGAs and wards, have generated serious communal clashes between the two predominant communities in the area (Modakekes and Ifes), no map is available in the area to show boundaries of the new wards. Another problem that makes the new wards' spatial framework unsuitable for the intra-urban analysis of cancer

incidence is the small number of cancer cases reported within the study period. In this regard, many of the twenty-one wards that were ignored would record empty cells if adopted for this analysis. Hence, only seven wards were adopted for the spatial analysis of cancer incidence in the city (see Fig. 1.3).

Due to the unavailability of the 1991 population figures needed for the calculation of cancer incidence in each ward, estimations were made based on the 1963 census figure. Using 2.5 growth rate per annum, the total population figures estimated for the city from 1963 census figures of 130,050 is 221,287 (Appendix 6). In spite of the discrepancy that may exist between the estimated population and 1991 census figure, a more realistic picture of cancer pattern is portrayed compared to using absolute number of cases in each ward without considering their population figures.

Cancer Incidence Rate (CIR) on ward basis is of the form $CIR = n_{ij}/p_{ij} . k)$

Where n_{ij} - is the number of cancer cases in all age groups $_{(i)}$ in the wards $_{(j)}$

p_{ij} - is the population age groups $_{(i)}$ in the wards $_{(j)}$

k - is a constant (10,000)

The incidence rate has been calculated for every 10,000 persons rather than 100,000 persons commonly used for the calculation of the incidence rate. This is done so as to reflect the population figure of the wards, which are in tens of thousands as against the states' population which runs into hundreds of thousands. The cancer incidence rate for each ward is presented in Table 7.2.

Table 7.2 **Cancer Incidence Within the Wards in Ile-Ife**

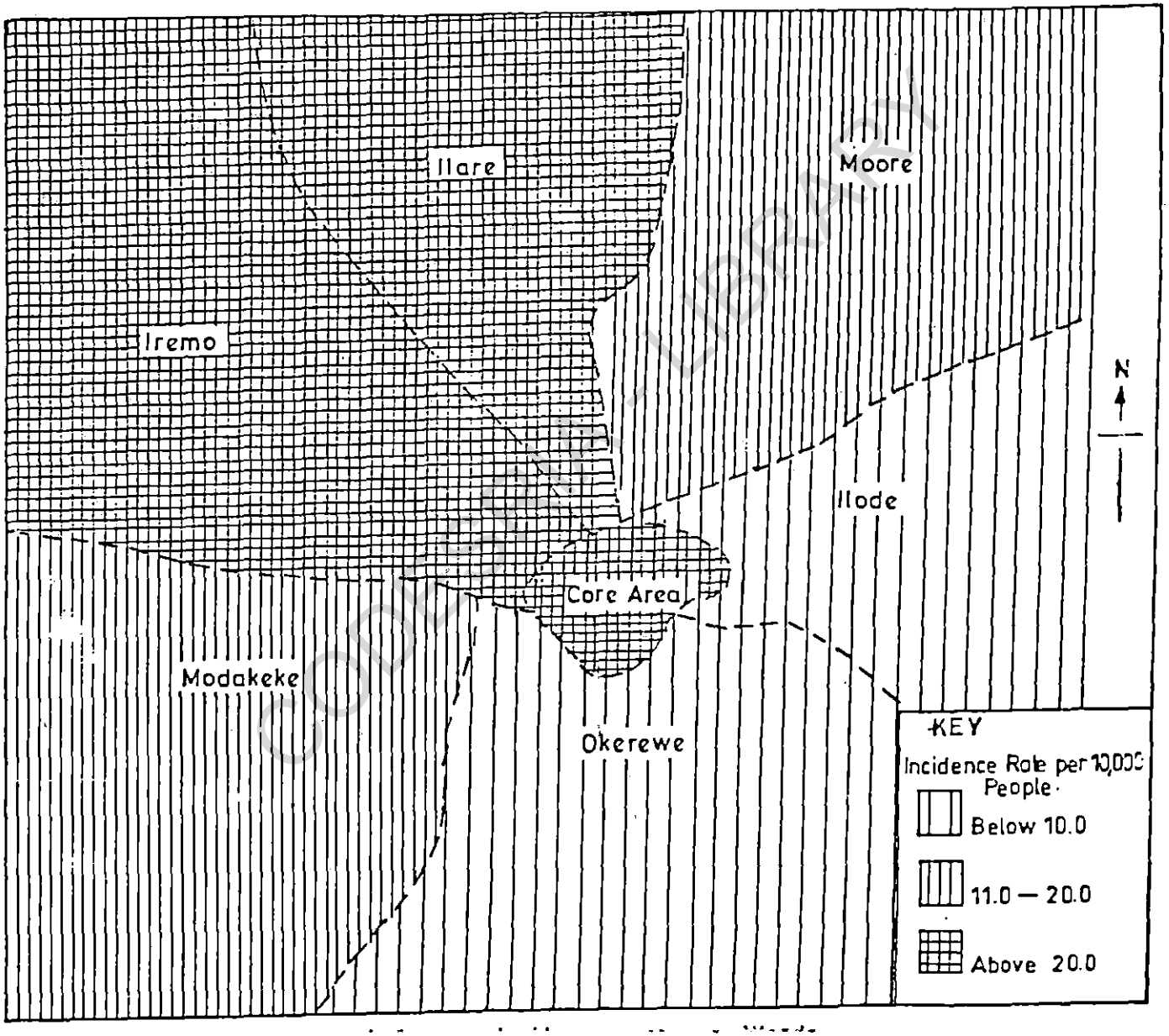
Ward	Number of Cases	1991 Population (Estimated)	Incidence Rate (per 10,000 persons)	Rank
Iremo	109	51,339	21.2	3
Modakeke	95	52,445	18.1	4
Ilare	61	14,605	41.8	1
Okerewe	34	46,249	7.4	6
Moore	32	18,367	17.4	5
City Centre	29	7,966	36.4	2
Ilode	20	30,316	6.6	7
Total	380	221,287	17.2	

Source: Fieldwork, 1997

As shown in Table 7.2, Ilare ward had the highest cancer incidence rate of 42 cases per 10,000 persons in the city. The city centre followed this ward with 36 cases per 10,000 persons, thereafter Iremo ward with 21 cases. Modakeke ward (18 cases per 10,000 persons) and Moore (17 cases per 10,000 persons) wards recorded about the mean cancer incidence rate for the city (17 cases per 10,000 persons).

Generally, Ilare, City Centre and Iremo wards recorded higher incidence rates than the city mean incidence rates. On the other hand, Okerewe and Ilode wards tend to have lower cancer incidence rates. This pattern of cancer incidence discussed above is portrayed in Fig. 7.2. Here wards having cancer incidence rate below 15.0 cases per 10,000 persons were classified as low incidence wards. Whereas wards which have cancer incidence rates between 15.0 and 20.0 cases per 10,000 persons are tagged medium incidence wards, those with higher incidence rates (20.1 cases and above per 10,000 persons) are simply referred to as high incidence wards.

There appear to be variation in the distribution of cancer (overall) incidence among wards in Ile-Ife. This finding is supported by a similar study conducted by White (1972) on leukaemia. According to him there is a concentration of leukaemia cases in areas with residential congestion within Buffalo City.


Ilare
Moore
Iremo
N
Ilode
Core Area
Modakeke
Okerewe
KEY
Incidence Rate per 10,000 People
Below 10.0
11.0 — 20.0
Above 20.0

In order to examine if there is any significant variation in the pattern of cancer incidence among the wards, the Tress Score test was used to analyse the data presented in Table 7.2. The Tress Score test essentially dichotomises a set of data, thereby examining whether it is homogenous or heterogeneous. The calculation procedure is shown in Appendix 5, while the result is presented below:

Upper numerical limit (n x 100) = 700

Lower numerical limit (100 x (n-1)/2) = 300

Mid-class value (700 - 300) = 500

Calculated Tress Score (T_i) value is 513.0

Since the Tress Score value of 513.0 is higher than the mid-class value of 500, there is a significant variation (heterogeneity) in the ward distribution of cancer incidence in Ile-Ife city.

An attempt to explain the disparity in the incidence of all cancer groups among the wards faced certain difficulties. In the first instance, the composition of the specific cancer groups, which are often linked with different and sometimes contrasting aetiological factors are not uniformly distributed among the wards. Again, the tendency to give all attention to the ward which has the highest incidence of the overall cancer groups without considering the relative importance of each cancer in its profile may conceal vital aetiological information.

For instance, a critical observation of Table 7.3 reveals that though Ilare, City Centre and Iremo wards are "high" incidence wards, they differ in their composition of specific cancer groups. In Ilare ward, the predominant (relative proportion) cancer groups are bone, gastro-intestine, cervical and glands cancers. These cancer groups except the gastro-intestine cancers are aetiologically linked to infective agents and indices of under-development rather than risks associated with modern lifestyles. Similarly, the cancer groups which appeared frequently

reported in the city centre ward are bone, breast, glands and cervical. Generally, these cancer groups (with the exception of breast) may point to the prevalence of traditional and unhygienic lifestyle practices in these two wards which are predominantly indigenous and old migrants residential areas.

In the third "high" incidence ward, that is Iremo ward, contrasting profile of predominant cancer groups is exhibited. These are breast, liver and prostrate cancers that are induced largely by risks associated with the consumption of food containing high animal fat and alcohol consumption. At this juncture, it is important to note that Iremo ward encloses the Obafemi Awolowo University campus. Hence, the prevalence of dietary habits and lifestyles common to modern societies are likely to be more prevalent in this ward than in others.

The composition of the predominant cancer groups among the wards in the "medium" cancer incidence areas appears not to be too distinctive. Considering the two wards which have low cancer incidence rates, there is a marked difference between them. Ilode ward which is more indigenous (traditional) features the predominance of glands, cervical and gastro-intestine cancers. Apart from the gastro-intestine cancers which are often linked to contamination of manufactured food (among other things), the others are infective agent related. On the other hand, Okerewe that consists of relatively newer residential areas has breast, prostate and gastro-intestine cancers. These cancer groups often associate with socio-economic development (affluence) and lifestyle of consuming high animal fat and food treated with preservatives.

Studies that analyse multiple cancer sites at a micro-scale are rare. Nevertheless, White (1972) found spatial variation in the distribution of leukaemia incidence in Buffalo City. The

Table 7.3: **Occurrence of Specific Cancer groups in each Ward**

Ward	Breast	Bone	Glands	Prostate	Gastro-intestine	Cervical	Liver	Urinary	Skin	Oral	Internal Organs	Eye	Respiratory	Leukaemia/lymphomas	Brain	Overall
Core Area	5 (7.6)	5 (8.1)	4 (6.9)	2 (4.9)	1 (2.6)	3 (8.1)	3 (10.0)	2 (16.7)	-	1 (16.7)	2 (40.0)	1 (20.0)	-	-	-	29
Ilare	4 (6.1)	10 (16.2)	8 (13.8)	8 (19.5)	9 (23.1)	8 (21.6)	5 (16.7)	4 (33.3)	2 (20.0)	-	-	1 (20.0)	2 (40.0)	-	-	61
Ilode	3 (4.5)	2 (32.3)	6 (10.3)	2 (4.9)	2 (5.2)	3 (8.1)	-	1 (8.3)	-	-	-	-	-	1 (50.0)	-	20
Iremo	26 (39.4)	16 (25.8)	9 (15.5)	10 (24.4)	10 (25.6)	9 (24.3)	15 (50.0)	3 (25.0)	5 (50.0)	2 (33.3)	1 (20.0)	1 (20.0)	1 (20.0)	-	1 (100.0)	109
Modakeke	16 (24.2)	15 (24.2)	21 (36.2)	9 (22.0)	10 (25.6)	11 (29.7)	4 (13.3)	1 (8.3)	2 (20.0)	2 (33.3)	1 (20.0)	2 (40.0)	1 (20.0)	-	-	95
Moore	4 (6.1)	8 (9.8)	5 (8.6)	5 (12.2)	3 (7.7)	1 (2.7)	1 (3.3)	1 (8.3)	1 (10.0)	-	1 (20.0)	-	1 (20.0)	1 (50.0)	-	32
Okerewe	8 (12.2)	6 (9.8)	5 (8.6)	5 (12.2)	4 (10.3)	2 (5.4)	2 (6.7)	-	1 (10.0)	1 (16.7)	-	-	-	-	-	34
Total	66	62	58	41	39	37	30	12	10	6	5	5	5	2	1	380

Source: Fieldwork, 1997.
Note: Figures in parentheses are percentages

most important factor that explained the pattern of leukaemia distribution in the city was the level of crowdedness, that is, housing congestion. In actual fact, housing congestion is largely an evidence of poor socio-economic status of most residential areas. In a comprehensive compilation put up by Verhasselt (1977), she remarked that the distribution pattern of different cancer sites within cities could be explained by socio-economic status. Hence, there is an association between high socio-economic status and cancers of the breast, colon, bladder, prostate and leukaemia, while carcinoma of the cervix, stomach, oesophagus, and lung seem to correlate with low socio-economic status.

The ward distribution of specific cancer incidence agrees in part with Verhasselt's observation. Specifically, the incidence of breast cancer is most predominant in Iremo ward which is the most modern among the seven wards in Ile-Ife City. Also, the fact that cervical cancer appears more predominant in the indigenous wards corroborates Verhasselt's observation. Exceptions to the rule are cancers of the liver and gastro-intestine, which are found in almost all wards. Furthermore, the incidence of leukaemia/lymphomas that appear concentrated in the indigenous areas disagrees with Verhasselt's claim that this cancer group is associated with high socio-economic status. In Ile-Ife City, indigenous areas are equally areas of low socio-economic status, while the newer (modern) areas house residents with high living standard. Just as Verhasselt noted, it is the socio-economic factor that tend to explain the ward distribution of specific cancer groups in Ile-Ife City.

A thorough explanation of the ward pattern of cancer incidence in Ile-Ife is limited in some ways because most of the wards do not contain residential areas with homogenous socio-economic groups. Therefore, the exact role of the socio-economic factors cannot be indicated in the above analysis. Practically, almost all the wards except the city centre is a mix of both the high-density (old migrants and indigenous) and low-density (new migrants) areas.

Since our interest goes beyond describing the pattern of cancer groups in the study area, this study would attempt identifying the specific socio-economic and environmental factors that explain variations in cancer pattern in Ile-Ife City. Results of the factor analysis of data obtained from household survey conducted in Ile-Ife and groundwater quality were employed to explain the pattern of predominant cancer groups in randomly selected areas within the city.

7.4 Ecological Risk-cells of Cancer in Ile-Ife

The identification of the risk cells or areas of specific cancer group in the city would enable us to assess the status (socio-environmental characteristics) of each sampled area vis-à-vis their predominant cancer groups. To achieve this, information was collated on the socio-economic and environmental characteristics of each sampled area. Data so sourced were used to explain the predominance of specific cancer in these areas.

Generally, the predominant cancer groups in Ile-Ife are breast, bone, glands, prostate and gastro-intestine cancers, which accounted for 62 percent of all reported cancer cases (Table 7.2). Others which jointly accounted for 23.7 percent of all reported cases of cancer are cervical, liver, urinary and skin cancers. The risk factors associated with these ten cancer groups which

accounted for 95.4 percent of all cancer cases within the city informed the variables used in the analysis that follows. Hence, the variables that derive from the risk factors were reflected in the questionnaire administered on household basis in Ile-Ife. Questionnaire method coupled with personal observation was employed to elicit information on the social and environmental characteristics of each sampled area.

From the review of literature, dietary habit of consuming high calorie of animal fat and low fibre is related in the aetiology of colorectal (gastro-intestine) cancers (Norie, 1992), breast and prostate cancers (Verhasselt, 1977). Rowland and Cooper (1981) have identified the frequent consumption of refined food normally preserved with nitrate as being responsible for the incidence of gastro-intestine cancers. Liver cancer has been linked with the consumption of alcohol polluted by nitrosamine (McGlashan, 1972) and Hepatitis B virus infection (Olweny, 1990). The latter risk factor has been identified by Ojo (1992) to be responsible for the predominance of liver cancer in Ile-Ife and Ijesha communities. Another cancer whose aetiology has been linked to viral infection is cervical cancer. The Human Pappiloma Virus which induces cervical cancer is identified to be common among women in the low socio-economic status. Poor personal hygiene and poverty which characterise these women encourage the prevalence of the Human Pappiloma virus. In the case of skin cancer, the practice of using chemicals to bleach skin for beautification purpose has been implicated. Similarly, frequent contact between the skin and hazardous chemicals in the course of occupation also induces skin cancer. Another risk factor of skin cancer which is rare among the Nigerian population but often practised by the "whites" is sunbathing. Among the Ile-Ife community the practice of skin bleaching that seems

appealing to many 'socialising' people especially women, may be an important risk factor of skin cancer in Ile-Ife City.

Be that as it may, few micro-studies conducted on cancer investigated generally factors that range from demographic characteristics, housing qualities, socio-economic status, lifestyle practices and general environmental condition (Schonland and Bradshaw, 1969; White, 1972; Armstrong, 1976; McGlashan, 1982, 1984; Whitelegg and Gorst, 1987). White (1972) identified indices of over-crowdedness (housing congestion) in the pattern of leukaemia occurrence, in Buffalo. McGlashan (1972) showed that drinking of contaminated local-gin (alcohol) was responsible for variation in the pattern of liver and oesophagus cancers in Malawi. In the explanation for the incidence of lung cancer in South Africa, McGlashan and Harington (1985) pinpointed smoking of locally manufactured cigarette and the use of unclean pipes for tobacco smoking. While the study of Whilelegg and Gorst (1987) was essentially exploratory, they have observed that housing congestion closely relates to leukaemia cluster in England. Dever (1972) showed that contamination of the source of drinking water explains the variation in the occurrence of digestive (gastro-intestine) cancers among the communities sited on the Ohio river (U.S.A). Some of the variables employed by these researchers are direct while others are indices of the direct factors which appear difficult to measure on a micro-scale. In the study conducted by McGlashan in South and Central Africa, specific factors were investigated after oesophagus and liver cancer clusters have been identified. Variations in the frequency and type of alcohol consumed among a community in Malawi were investigated so as to explain liver cancer cluster. Similar study was conducted on the smoking habit (frequency and type of tobacco smoked)

between two ethnic groups in South Africa. This was done to probe the observed cluster of oesophageal cancer in one of the communities (tribes).

In the analysis that follows, this study attempts to explain the predominance of specific cancer groups with reference to the social and environmental qualities of the sampled areas.

7.4.1 Choice of Variables for Ile-Ife Risk-cell Analysis

As shown in Appendix 4b, fourteen (14) variables were used in analysing the risk factors associated with the intra-urban pattern of cancer in Ile-Ife. The data matrix include variables on housing quality, domestic environment, neighbourhood sanitary condition, duration of urban residency, economic status, educational level, possession of modern household facilities, sources of drinking water and chemical parameters of groundwater in each selected cell (area). Generally, these variables largely indicate the social and environmental qualities of the sampled cells. The socio-behavioural variables are more than those of the physical environment because the predominant cancers types in Ile-Ife City are linked to risks deriving from behavioural practices. Moreover, the available information from the initial analysis of cancer pattern among wards has shown that behavioural factors are the most possible determinant of cancer variation in the community.

7.4.2 Socio-Economic Characteristics of the Selected Areas

This section presents the socio-economic characteristics of respondents that were interviewed during the household survey of some selected areas. Variables that were considered include income level, educational status, housing qualities, sanitary condition, household

facilities and sources of drinking water. As shown in Table 7.4, majority of the respondents 54.0%) had monthly income ranging from #1,000 to #5,000. About 18.0 percent earned less than #1,000 per month, 14.5 percent earned between #5,001 and #10,000 while 13.8 percent earned above #10,000. This implies that those who belong to high income level (#10,000 and above) are about 14.0 percent of the sampled population.

The education level of the respondents shows that a high percentage (46.3%) of had tertiary education, followed by secondary education (23.1%). In other words, only 30.6 percent of the respondents had less than secondary education while about 70.0 percent had above primary school education (see Table 7.4).

Housing characteristics in Ile-Ife community show that traditional buildings accounted for 16.0 percent of the various house types, storey buildings show the highest percentage (49.3%) while bungalows/duplexes account for 34.7 percent. Toilet facilities that were available in the buildings showed that a small proportion of the respondents used dunghill (7.1%), 48.8 percent used pit-latrine while almost the same percentage (44.1%) used water closet.

Other housing facilities that were investigated include possession of radio, television, electric iron, fan, gas cooker, kerosene stove and fire clay. Items owned by a high percentage of the respondents are radio (94.0%), electric fan (84.0%), electric iron (82.7%), and television (67.3%). Though kerosene stove was possessed by a large of the respondents (80.0%), it indicates high level of domestic pollution in low and middle income areas where such were used within the living apartment (room). Only a small number of the respondents possessed gas cooker (28.7%).

Similarly, only a few people in the community used local method of cooking (fire-clay 14.7%) which is known to generate lots of air pollution within the living environment.

Table 7.4 **Socio-economic and Housing characteristics of the Respondents in Ile-Ife**

Selected Characteristics	Frequency	Percentage	Cumulative Percentage
1.Income (n = 124)			
i. Less than #1000	22	17.7	17.7
ii. #1000 - #5000	67	54.0	71.7
iii #5001 - #10000	18	14.5	86.2
iv Above #10000	17	13.8	100.0
Total	124	100.0	
2. Educational Status (n = 127)			
i. No formal education	20	13.6	13.6
ii. Primary education	25	17.0	30.6
iii. Secondary education	34	23.1	53.7
iv. Tertiary education	68	46.3	100.0
Total	147	100.0	
3. Building Type (n = 150)			
i Traditional Building	24	16.0	16.0
ii Story Building	74	49.3	65.3
iii Bungalows/Duplexes	52	34.7	100.0
Total	150	100.0	
4. Toilet Type (n = 127)			
i Dunghill	9	7.1	7.1
ii Pit Latrine	62	48.8	55.9
iii Water Closet	56	44.1	100.0
Total	127	100.0	
5. Household Facilities			
i Radio	141	94.0	94.0
ii Television	101	67.3	67.3
iii Electric Iron	124	82.7	82.7
iv Electric Fan	126	84.0	84.0
v Gas Cooker	43	28.7	28.7
vi Kerosene Stove	120	80.0	80.0
vii Fire Clay	22	14.7	14.7
6. Water Sources (n = 149)			
i Stream	1	0.7	0.7
ii Well/Borehole	47	31.5	32.2
iii Pipe Borne	101	67.8	100.0
Total	149	100.0	
7. Duration of Residency (n = 136)			
i 1 to 10 years	36	26.5	26.5
ii 11 to 20 years	30	22.1	48.6
iii Above 20 years	32	23.5	73.1
iv From Birth	38	27.9	100.0
Total	136	100.0	

Source: Fieldwork, 1999.

Table 7.4 shows that a negligible percentage of the respondents sourced water from Streams for drinking purposes (0.7 %) in the study area. 32.5percent of the respondents use water from wells/boreholes while 67.8 percent sourced their drinking water from publicly supplied water. In other words, the generality of the people depend on pipe borne water which is often irregular in supply. This unreliability of the public water supply makes those who have no dependable alternatives to use untreated (unhygienic) water sources in the community.

Summarily, the socio-economic characteristics of the respondents show that a good percentage of the population that possessed modern household facilities, hence 'modernised'. Modernisation is generally known to associate with lifestyles that favour the consumption of high animal fat, canned food treated with chemical preservatives, reduced vitamin intake, less exercise and stressful living. The modernisation and urbanisation may have contributed to high cases of breast (17.4%), prostate (10.8%) and gastro-intestine cancer (10.3%) in Ile-Ife community.

The fact that the remaining percentage of the respondents belongs to the low socio-economic cadre implies that cancers that associate with underdevelopment and poverty will also be reported. It is not surprising that cervical and liver cancer cases account for 17.6 percent in the cancer profile of the community. Indeed, the urban poor are likely exposed to infections which predisposes them to cancer such as liver among others. The laboratory analysis conducted by Ojo (1992) supports this conclusion in that he found most liver cancer cases were caused by Hepatitis B virus infection in Ile-Ife and Ijesha communities rather than the implicative role of aflatoxin.

7.4.3 Bio-Chemical Qualities of Water in the Selected Areas

From Table 7.5 the trace elements that are of concern are nitrate, iron, chloride, alkaline and organic matter in drinking water. The rationale behind this selection is because they have been shown to induce cancers of the gastro-intestine, liver and oesophagus when in excess in human body. On the positive side, calcium, magnesium and total hardness provide protection against the initiation of breast, gastro-intestine (colon and pancreas) and oesophagus cancers.

Nitrate which has been shown to induce cancer in the gastro –intestinal tract appear low in both ground and surface water sources found in Ile-Ife community. The mean nitrate level for groundwater, 4.45ppm (± 0.0 – 14.25) was lower than the WHO Standard (25ppm). Similarly, surface water has mean nitrate level of 0.53ppm (0.05 – 2.45), which was lower than that of groundwater and the recommended minimum level by WHO.

Chloride level in ground and surface water (0.0 – 10.62ppm and 0.0 – 13.1ppm) is lower than 200ppm that is recommended by WHO. Indeed, no sample point had chloride level that is near in value to the minimum stipulated for drinking water.

On the contrast, iron level in both ground and surface water (0.41 and 1.41ppm) was higher than the WHO Standard (0.30 and 1.0ppm). Though there is no specific guide level for total alkalinity and organic matter content in water, their degree of variability between the sampled points is noteworthy. Total alkalinity in the ground and surface water ranges between 5.5 to 239ppm and 51.0 to 538ppm. In other words, while some points had low level of alkalinity (less than 50.0ppm) others had values above 500.0ppm. Likewise organic matter content in

TABLE 7.5: **Quality of Ground and Surface water in Ile-Ife Area**

Parameter	Groundwater (n = 51)*		Surface water (n = 64)**		W.H.O Standard (1971)***	
	Range	Mean	Range	Mean	Guide Level	Maximum Permissible
Hydrogen ion (pH)	5.8 –8.4	6.89	6.7 – 7.8	7.32	7.8-8.5	6.5-9.5
Total hardness (ppm)	6.4–286.5	98.7	4.0-156.0	58.73	100	500
Calcium (ppm)	0.83-112.8	30.27	1.6-43.2	15.0	75	200
Magnessium (ppm)	0.0-34.45	5.62	0.5-117	5.17	50	150
Potassium (ppm)	0.35-143.8	35.89	2.0-36.92	16.2	10	12
Sodium (ppm)	0.85-86.2	21.61	0.0-13.9	7.68	20	150
Chloride (ppm)	0.0-10.62	1.41	0.0-13.13	4.00	200	600
Sulphate (ppm)	3.94-170.3	30.14	0.9-21.2	7.3	200	400
Total Alkalinity (ppm)	5.5-239.0	91.3	51.0-538	94.47	Variable	Variable
Silicate (ppm)	1.76-14.4	5.23	7.7-34.0	14.67	Variable	Variable
Phosphate (ppm)	0.0-0.61	0.06	0.05-10.7	2.01	35	61
Nitrate (ppm)	0.0-14.25	4.45	0.05-2.45	0.53	25	50
Iron (ppm)	0.0-6.22	0.41	0.0-14.65	1.41	0.30	1.0
Organic matter (ppm)	0.0-14.40	1.22	1.0-5.4	2.62	Variable	Variable

Sources: * Ako,B.D; Adeniyi, F.I and Adepoju, J. F (1990). Journal of Africa Earth Sciences Vol.10 No. 4 pp 603 – 613.

** Ekpenyong, E. (1982). Unpublished M.Sc Dissertation, Dept. of Zoology, University of Ife

*** W.H.O Standard (cited by Oke, 1980) In the Proceedings of the First National Conference on Water Pollution and Pesticides Residues in Foods. Ed.s Akinyele, I.O; Omueti, J.A.I and Imevbore, A.M.A. University of Ibadan.

ground and surface water vary. While some sample points have a desirable level of 0.0ppm, some ground water samples have as high as 10.0ppm.

The level of calcium, magnesium and total hardness in both the ground and surface water were generally lower than the WHO guide level. Mean calcium level in ground and surface water (30.3ppm and 15.0ppm) was lower than the WHO Standard of 75ppm. In the case of magnesium, the mean level of 5.6ppm and 5.2ppm for ground and surface water were lower than the guide level of 50.0ppm

In other words, while some points had low level of alkalinity (below 50.0ppm), others had values above 500.0ppm. Likewise, organic matter content with mean levels of 5.6ppm and 5.2ppm for ground and surface water was lower than the guide level of 50.0ppm. The mean level of total hardness was lower in the surface water (58.7ppm) of Ile-Ife compared with the level in ground water (98.7ppm) which approximates the WHO recommended level (100ppm).

An overview of the level of calcium, magnesium and total hardness in ground and surface water in Ile-Ife community shows a lower value compared with the WHO Standard. Although calcium in surface water and magnesium in ground water were higher than the guide level at some sample locations, the general low status may not provide sufficient protection against cancer initiation in the community. On the other hand, the high level of iron in the two water sources in the study area coupled with the high level of total alkalinity and organic matter content at some sampled points possibly act as promoters in the initiation of breast, gastro-intestine and liver cancer. The aetiological roles of these trace elements may be implicated in or explain the reported high cases of breast (17.4%), gastro-intestine (10.3%) and liver cancer (7.9%) in the community.

7.5 Factors that Associate with Cancer Pattern in Ile-Ife

Considering the multi-causal nature of cancer, the various variables collated from the responses indicated in the household survey were used to identify the factors that associate with cancer pattern in the sampled areas within the city. These areas (cells) were selected randomly from a uniform 500 metres by 500 metres grid network of the settled area of the city. The areas (cells) picked by the random number selection are cell 45 (Mayfair), cells 68 and 85 (Akarabata), cells 92 and 93 (Eleyele), cell 110 (Olonade), cell 123 (O.A.U staff quarters), cell 130 (Idi-Obi/Gate way), cell 135 (Iremo), cell 158 (Aderemi), cell 161 (Oduduwa college area), cell 168 (Fajuyi), cell 188 (Ajamopo/Oke-Atan), cell 198 (Moore) and cell 213 (Ode-Atan/Odi Olowo).

To identify the socio-environmental factors that tend to predispose the various inhabitants of the sampled areas to risks of certain cancer groups ranking method could be used. Here, we simply rank each sampled area on the basis of each of the variables collated and then compared with the predominant cancer groups in it. But this method suffers a setback in that ranking does not "reduce" the numerous variables to few dimensions so as to concisely explain the result of the analysis. Hence, factor analysis is a more reliable multivariate statistical technique for the present exercise.

Factor analysis "recognises that all measurements (variables) are not of equal weight but that many of them may overlap and tell us the same story about the ways in which a set of areas may vary" (Haggett, 1965). As a multivariate statistical technique, factor analysis (F.A.) is used to collapse a set of variables (X_1, X_2, X_3 ... X_n) to a few set of factors (Y_1, Y_2, Y_3... Y_m), which account for much of the possible variation among the original variables. Parsimony of

description is achieved by reducing the original set of variable to a smaller (Y < X) number of basic variables or factors.

Factor analysis assumes that when several measurements show basically the same pattern of variation, some factors are usually redundant while a more basic pattern lies beneath. This is revealed by the principal factor which depicts an approximation of the basic pattern (Haggett, 1965). Thus, the relative differences of the areas with respect to their level of reported diseasedness is retained. This method more than anyone else, solves best the multiple component-mapping problem by providing a simple index (or few indices), that is, the principal factors (Mather, 1976).

7.5.1 Principal "Associative or Explanatory" Factors

The characteristic roots or eigenvalues indicate the amount of total variance explained by the "general associative or explanatory" factors which the application of factor analysis tries to reveal. Thus, the factors do not equally affect the different variables selected for this study. Most often, components having eigenvalues greater than or equal to 1.0 indicate factors accounting for at least the amount of average variance of a variable. Therefore, components with less than 1.0 are taken as being insignificant. In this analysis, the same practice is followed. Moreover, the factors and factor scores are orthogonal since varimax rotation was used. This method tries to maximize the high loadings of the significant variables on the factors and minimize the near-zero loadings.

From the fourteen variables selected for the factor analysis, four principal factors (components) were generated. To arrive at these, the varimax rotation method was adopted so as

to maximize the between variance among the factors. The criterion used for selecting the factors was the eigenvalue. Generally, factors that have eigenvalues above 1.0 are normally considered significant enough to explain the spatial variation in the socio-environmental characteristics of the areas sampled.

The result of Factor Analysis shown in Table7.6 indicates the four principal factors accounted for about 84.0 percent of the explanation provided by the initial fourteen variables. Reliable explanation can then be made from the four factors so identified. Factor I alone explained 43.1 percent of the total variance in the original data. Factor II followed with 18.8 percent. Other factors (III and IV) accounted for 22.1 percent of the variation in the socio-environmental qualities of the sampled areas/cells. It can be observed that factor I and II provided a substantial explanation (61.9 percent) of the variation found in the original data. Similarly, the variables that have high positive score (loading) under factor III, have low and negative score under factor IV.

In naming the dimensions of the principal factors in Factor Analysis, analysts always recourse to the variables which have high factor loading on the specific factors. Table 7.6 shows the variables that have high factor score under each factor.

Factor 1 has the largest eigenvalue of 6.034 and also accounted for the highest percentage of variance (43.1 percent). Variables that have high factor score under this factor are use of water closet, high and medium income status (#5000 and above), high education status, percentage drinking well/borehole water, mean nitrate, iron, magnesium and calcium present in ground water. These variables have positive factor scores ranging from 0.840 to 0.706 (Table 7.6).

This factor reflects high socio-economic status of the sampled areas. It appears that this factor influences to a large extent the potential cancer risk of the areas in Ile-Ife city.

The second factor (Factor II) that explained 18.8 percent of the variation in the characteristics of the sampled areas consists of mean nitrate (0.755) and mean magnesium level (0.720) in the ground water. This factor is named drinking water quality.

In Factor III that accounted for 13.2 percent of the variance among the original variables, the factor score are generally low. The variables that records high factor loading in the component are percentage born in the city (0.478), percentage with #5000 and above income level, (0.460), percentage drinking well/borehole water (0.414) and percentage with secondary school education and above (0.457). This factor has been named indigenous (traditionalism) status. This becomes logical since the percentage with #5000 and above income level and percentage with secondary school education and above have higher factor scores under factor I.

Furthermore, Factor IV which accounted for about 8.9 percentage of the variance characteristics of the areas consist of percentage using gas cookers and percentage living in bungalows/duplexes. This factor is labelled modernisation and hygiene status.

Succinctly put, the principal factors that largely explain variations in the socio-environmental characteristics of the various areas randomly selected in Ile-Ife are modernisation and high socio-economic status, water quality index, indigenous status and modernisation level. Though the result of Factor Analysis identified these four factors, the level of modernisation and socio-economic status appears to be the most outstanding principal factor that explains the variation in cancer pattern. In other words, whether an area is modern or traditional (indigenous) and whether

Table 7.6: **Result of Factor Analysis (Variables)**

Communalities

	Initial	Extraction
%bung/duplx	1.000	.845
%w/c	1.000	.831
1roomden	1.000	.728
%cityborn	1.000	.824
%incom>#5000	1.000	.962
%usinggas	1.000	.864
%usingfireclay	1.000	.804
%drink.BH	1.000	.751
1meanNitrate	1.000	.872
1meanIron	1.000	.839
1meanCal	1.000	.928
1meanMagn	1.000	.862
1No.educ	1.000	.741
1Secschl+	1.000	.906

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.034	43.104	43.104	6.034	43.104	43.104
2	2.629	18.777	61.880	2.629	18.777	61.880
3	1.850	13.215	75.096	1.850	13.215	75.096
4	1.243	8.881	83.977	1.243	8.881	83.977
5	.944	6.744	90.721			
6	.556	3.969	94.690			
7	.318	2.273	96.963			
8	.181	1.294	98.257			
9	.160	1.146	99.402			
10	5.188E-02	.371	99.773			
11	2.172E-02	.155	99.928			
12	7.377E-03	5.269E-02	99.981			
13	2.695E-03	1.925E-02	100.000			
14	-2.20E-16	-1.572E-15	100.000			

Extraction Method: Principal Component Analysis.

Table 7.6: **Result of Factor Analysis (Continues)**

Component Matrix[a]

	Component			
	1	2	3	4
%bung/duplx	.701	-.337	.144	.468
%w/c	.840	-.295	-.174	9.278E-02
1roomden	-.189	-.595	-.566	-.132
%cityborn	-.359	-.661	.478	-.175
%incom>#5000	.818	-.281	.460	-3.88E-02
%usinggas	.591	5.373E-02	.139	.702
%usingfireclay	-.694	.403	.144	.372
%drink.BH	.514	.190	.414	-.529
1meanNitrate	.528	.755	.119	-9.07E-02
1meanIron	.706	-1.35E-02	-.583	-3.88E-02
1meanCal	.801	.256	-.465	-6.60E-02
1meanMagn	.565	.720	.101	-.116
1No.educ	-.765	.306	.195	.158
1Secschl+	.766	-.329	.457	-4.04E-02

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

Table 7.7: **Dimensions of the Principal Factors**

Factor	Dimension	Factor Loadings of the Significant Variables
I	Socio-economic status	Percentage using water closet (0.840), percentage with #5000 and above monthly income (0.818), mean calcium level (0.801), percentage with secondary education (0.766) and mean iron level.
II	Drinking water quality.	Mean nitrate level (0.755) and mean magnesium level (0.720).
III	Indigenous status (level of traditionalism).	Percentage born in the city (0.478), percentage drinking well/borehole water (0.414).
IV	Modernisation status.	Percentage using gas cooker (.702) and percentage residing in bungalows/duplexes (0.468).

Source: Extracted from computer print-out

it has high or low socio-economic status will determine the cancer groups which are likely to be reported most often by its residents.

A necessary caution at this junction is that traditional areas with low socio-economic status do not breed a specific cancer group directly but that the lifestyles and living conditions common among their inhabitants predispose them to the risk of contracting certain cancer groups.

Since our goal is to identify principal factors that explain the cancer pattern of the sampled areas (cells), the basis for discussing the performance of each area must be established. In order to avoid unnecessary repetition of areas that have identical characteristics, factor analysis is applied on the areas. This affords the opportunity of arriving at concise grouping of areas with similar socio-economic and environmental qualities. The factor analysis result of the characteristics of the fourteen areas is shown in Table 7.8. The Table shows that three principal factors have eigenvalue above 1.0 (8.359 to 1.212). The remaining factors (components) that are not selected have eigenvalue below 1.0 and they accounted for 16.7 percent of the variance between the characteristics of the areas (cells). In other words, the three principal factors are the most outstanding since they jointly accounted for a high percent of the variance.

Factor I which accounted for 59.7 percent of the variance between the areas equally has the highest eigenvalue of 8.359. There are eight (8) areas that have high factor score ranging from 0.943 to 0.794, under Factor I. Idi-obi/Gateway has the highest score of 0.943, followed by Oduduwa College area (0.927), Olonade, Mayfair, Fajuyi, Moore, and O.A.U Staff quarters have

factor scores ranging from 0.862 to 0.809. It is only Eleyele that has the lowest factor score of 0.794. This component is named modern and high socio-economic residential areas because it consists of newer residential areas with high proportion of bungalows, good housing qualities, medium to high income and educated people.

Areas that appear significant under factor II are Akarabata I with the highest factor score (0.87) followed by Iremo (0.86), Akarabata II (0.69) and Aderemi (0.68). The name that depicts the areas selected into this component is the transitional (mixed) residential area. They consist of residential areas with elements of modernisation and traditionalism.

Factor III consist of only two areas: Ajamopo (0.86) and Ode-Atan/Odi-Olowo (0.75). These are typical traditional (indigenous) core area of the city. Houses are largely unflustered with brown roof and general squalid condition is evident.

From the results of factor analysis presented above, high socio-economic factor (factor I) account for 43.1 percent of the variation in the socio-environmental characteristics of the city.

On area basis, modern and high socio-economic residential factor also accounted for an overwhelming percentage (59.7 %) of the residential status of the areas. The double pointer to the factor of modernisation and high socio-economic status implies that a high proportion of the cancers reported in Ile-Ife community are attributable to lifestyles that associate with modernisation and socio-economic development. The predominance of breast, prostate and gastro-intestine cancers (about 40.0%) in the community supports the results of the factor analysis.

Table 7.8: **Result of Factor Analysis (Area)**

Communalities

	Initial
VAR001	1.000
VAR002	1.000
VAR003	1.000
VAR004	1.000
VAR005	1.000
VAR006	1.000
VAR007	1.000
VAR008	1.000
VAR009	1.000
VAR010	1.000
VAR011	1.000
VAR012	1.000
VAR013	1.000
VAR014	1.000

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.359	59.709	59.709	6.313	45.091	45.091
2	2.085	14.893	74.602	3.192	22.798	67.889
3	1.212	8.657	83.260	2.152	15.371	83.260
4	.870	6.213	89.473			
5	.654	4.670	94.144			
6	.470	3.359	97.503			
7	.155	1.107	98.609			
8	.128	.914	99.524			
9	5.350E-02	.382	99.906			
10	1.188E-02	8.488E-02	99.991			
11	1.195E-03	8.537E-03	99.999			
12	1.085E-04	7.747E-04	100.000			
13	8.958E-06	6.399E-05	100.000			
14	1.405E-16	1.004E-15	100.000			

Extraction Method: Principal Component Analysis.

Table 7.8: **Result of Factor Analysis (Areas Continues)**

Rotated Component Matrix[a]

	Component		
	1	2	3
VAR007	.943	.184	6.431E-02
VAR010	.927	7.984E-02	.151
VAR005	.862	.280	.140
VAR001	.853	.251	.286
VAR011	.810	.293	.365
VAR013	.809	7.507E-02	.517
VAR006	.809	.260	-7.51E-02
VAR004	.794	.418	-3.61E-02
VAR003	.357	.871	5.231E-02
VAR008	.227	.861	.117
VAR002	.434	.693	.345
VAR009	9.743E-02	.677	.397
VAR012	.335	.126	.870
VAR014	-7.09E-02	.471	.751

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

On the contrast, traditional and indigenous factor (factor III), which explained 15.4 percent of the variance in the socio-environmental characteristics of the areas may account for the pattern of cervical and liver cancers. The identification of the water quality as a factor that accounted for 18.8 percent of the variance in the socio-environmental characteristics of the areas, possibly operate as a confounding factor in the initiation of specific cancers in the community. We then consider the areas (cells) one after the other. Firstly, the areas under the modern and high socio-economic factor thereafter, we consider those under traditional and low socio-economic factor followed by transitional (semi-modern) status.

Among areas that have high factor scores under modern and high socio-economic factor, Fajuyi (0.96), Moore (0.90), and O.A.U Staff quarters (0.83) appear to have sufficient cancer cases to enable us to identify the predominant ones. Be that as it may, the cancer cases that tend

to be predominant in Fajuyi area are prostate, bone and breast cancers. In Moore area, the cancers that appeared predominant are bone and glands cancers while breast, gastro-intestine, liver and bone are reported more frequently in O.A.U Staff quarters. From the cancer groups that appear predominant in the high socio-economic residential areas, it is possible to identify bone, breast, prostate, gastro-intestine and liver cancers. The predominance of breast, gastro-intestine and prostate cancers among people in the high socio-economic areas is in accordance with the observations of Olweny (1990) and Remmenick (1998). These authors have observed positive relationship between socio-economic status and the incidence of breast, prostate and gastro-intestine cancers. Meanwhile, the predominance of liver cancer in high and low socio-economic areas appears contrary to the finding of Remmenick (1998).

From Table 7.9, areas that have high factor score and sufficient number of cancer cases to allow an ecological (comparative) analysis of their socio-environmental condition and predominant cancers are O.A.U Staff quarters, Moore, Fajuyi and Eleyele. O.A.U Staff quarters showed about the highest socio-economic status in Ile-Ife community. It has a high percentage of residents earning above #5000 per month, using gas cooker and high housing quality. There was no respondent without formal education while the percentage born in the city (indigenes) was one of the least in the city. Similarly, Moore and Eleyele also had evidences of high socio-economic status as 50% and 8% earned above #5000 and 42% and 67% resided in houses with modern facilities. In essence, the areas represent high socio-economic residential areas where lifestyle practices of consuming high animal fat, canned food and meat treated with chemical preservatives are likely to be more rampant. These characteristics may predispose the residents to high cases of breast (7 cases), gastro-intestine (3 cases) and probably bone cancer.

Table 7.9: **Explanatory Factor and Predominant Cancer Groups in each Area/ Cell**

Factor	Factor Loading of the Area/Cells (i)	Predominant Cancer Group in the selected Areas/Cells (ii)
Factor I – Modern and high socio-economic status	* Fajuyi – Cell 168 (0.81)	Prostate (4), Bone (4) and Breast (3)
	* Moore – Cell 198 (0.81)	Bone (4) and Glands (3)
	* OAU Staff quarters – Cell 123 (0.81)	Breast (7), Gastro-intestine (3), Liver (3), Bone (3) and Skin (2)
	* Eleyele – Cell 92 (0.94)	Cervical (4) Bone (3|), Breast (2) Prostate (2) Urinary (1)
	* Gateway – Cell 130 (0.96)	Cervical (1)
	* Olonade – Cell 110 (0.86)	
	* Oduduwa Col – Cell 161 (0.93)	Respiratory (1) and Bone (1)
	* Mayyfair – Cell 45 (0.85)	
Factor II -- Transitional (mixed) residential status	* Akarabata I – Cell 85 (0.87)	Cervical (2) Bone (2), Glands (2) and Breast (2)
		Cervical (2), Liver (2) and Skin (1)
	* Iremo – Cell 135 (0.86)	Cervical (1), Breast (1), Liver (1)
	* Akarabata II – Cell 68 (0.69)	Gastro-intestine (2), Oral (1), Skin (1)
	* Aderemi – Cell 158 (0.68)	
Factor III – Traditional and low socio- economic status	* Ode-Atan – Cell 213 (0.87)	Gastro-intestine (2), Urinary (1), Liver (1)
		Cervical (2) Leukaemia/lymphomas (1), Bone (1)
	* Ajamopo – Cell 188 (0.75)	

Note
* Figures in Parentheses are factor scores (i) and number of cases (ii)
Source: Fieldwork, 1997 and 1999

O.A.U Staff quarters, Eleyele and Fajuyi are located on bedrock of Undifferentiated Schist. The chemical parameters of groundwater derived from this geological formation (Appendix 7) show nitrate level ranged between 0.03-14.05ppm (5.12), iron 0.00-3.34ppm (0.36), alkalinity 5.50-239.0ppm (106.11), chloride 0.50-5.93ppm (1.50) and organic matter 0.00-2.92ppm (0.84). Of the parameters that impact negatively on health (induce cancer) when in excess, only iron level is higher than the guide level (0.30ppm). In some sample sites iron level was as high as 3.34ppm. Though the levels of alkalinity and organic matter are not specified, there are locations on this bedrock that recorded values as high as 239.0ppm and 2.92ppm whereas others had values less than 10.0ppm and 0.01ppm. These high levels of iron, alkalinity and organic matter may contribute to the predominance of gastro-intestine cancers in the area. The environmental situation is further worsened as the levels of chemical parameters that inhibit cancer initiation (calcium 2.68-11.8ppm, magnesium 0.00-34.5ppm and total hardness 10.0-286.05ppm) were too low to protect the residents from the accumulation of carcinogens in their body. The only exception is total hardness that recorded values higher than the guide level (100.0ppm) at some locations.

Fajuyi area equally manifested characteristics of high socio-economic status with about 70.0 percent that used water closet, 50.0 percent used gas cooker, 30.0 percent earned above #5000 and none of the residents without formal education. All these imply high income, education, housing quality and good general living condition. Hence, the predominance of prostate (4 cases) and breast cancer (3 cases) may be attributed to the high socio-economic status of residents in the area.

With respect to the chemical quality of groundwater in the area, Fajuyi is underlain by Pegmatite Schist having nitrate level ranging from 0.35-14.25ppm, chloride values 0.00-10.62ppm, iron 0.00-0.54ppm, alkalinity 31.5-234.0ppm, and organic matter content 0.0-2.39ppm. The only parameter that appeared higher than the guide level at some locations within this area is iron. While chloride level is within the guide level the values are above the community average. Although alkalinity level is not specified, it was very high at some sample sites where values were in excess of 200.0ppm. These parameters may be implicated in the reported high cases of the gastro-intestine cancer. Parameters that are expected to provide protection against cancer initiation such as calcium (0.83-88.0ppm), magnesium (0.09-20.2ppm) and total hardness (10.0-286.5ppm) were rather too low. Although calcium and magnesium were comparable to the guide level at some locations within the area, the value of total hardness was too low to provide any protection against breast and gastro-intestine cancer.

Considering Ode-Atan which has high factor score under indigenous and low socio-economic residential status, none of the respondents earned #5000and above monthly, none used gas cooker and 45.0 percent used fireclay, an evidence of indoor air pollution. 36.0 percent had no formal education, over 80.0 percent used pit latrine and dunghill for excretal disposal, and 45.0 percent were born in the city (indigenes). Similarly, the socio-economic characteristics of Ajamopo area show that 80.0 percent lived in traditional houses which were largely unflustered, 20.0 percent had no formal education, less than 10.0 percent possessed modern household facilities and 73.0 percent were born in the city. This typical indigenous area had low education

status, poor housing condition, poor general sanitary condition, in-door air pollution and indiscriminate use of open spaces as dumpsites. Hence cancer groups that associate with ignorance, under-development and viral infections are more predominant in these two areas. Table 7.9 shows that the common cancer cases are cervical, gastro-intestine and leukaemia/lymphomas. Indeed, the few cases of lymphomas are traceable to these areas. The observed predominance of cervical and liver cancers in the traditional and low socio-economic areas agrees with the observations of Verhasselt (1977), Rowland and Cooper (1987) and Olweny (1990). These cancer cases are linked to infections that are prevalent among people in the low socio-economic status.

Geologically, Ode-Atan is located on Pegmatite bedrock while Undifferentiated Schist underlies Ajamopo. The chemical parameters of groundwater of Ode-Atan area showed nitrate level ranging from 0.00-0.22ppm, chloride 0.18-2.74ppm, iron 0.00-13.70ppm, alkalinity 18.0-520.0ppm and organic matter 0.97-4.86ppm. Besides iron level that was higher than the guide level at some sample points in the area (13.0ppm as against 0.3-1.0ppm), other parameters were less than the maximum permissible.

With regard to Ajamopo area that is underlie by a bedrock of Undifferentiated Schist, nitrate level ranged between 0.03-14.05ppm (5.12), iron 0.00-3.34ppm (0.36), alkalinity 5.50-239.0ppm (106.11), chloride 0.50-5.93ppm (1.50) and organic matter 0.00-2.92ppm (0.84). Of the parameters that have been shown to induce cancer when in excess, only iron level is higher than the guide level (0.30ppm). In some sample sites iron level was as high as 3.34ppm. Though the levels of alkalinity and organic matter are not specified, there were locations on this bedrock that recorded values as high as 239.0ppm and 2.92ppm whereas others had values less than 10.0ppm and 0.01ppm. The high level of iron at some locations within the area has implication

for high cases of gastro-intestine cancers reported by its residents. Though the predominance of gastro-intestine cancer is not expected going by its low socio-economic status, high iron content of groundwater in the area may be predisposing the residents to this cancer group. Moreover, the levels of parameters that are to inhibit cancer initiation in human body are generally too low to provide any protection against cancer. Calcium level was 5.28-57.44ppm, magnesium 0.19-10.30ppm while total hardness is 16.0-185.8ppm.

Iremo, Aderemi and Akarabata I, II are the four areas that have high factor score under transitional (mixed modern and traditional) residential status. Their socio-economic characteristics portray both elements of high and low status. 15 percent of respondents in Iremo were residing in modern buildings, 23 percent used water closet and 15 percent gas cooker. Evidences of traditional status include 8 percent without formal education, 31 percent used fireclay, no respondent earned #5000 and above. A similar combination of features of high socio-economic status and those of poor socio-economic level are seen in Aderemi, Akarabata I and II. The predominant cancer groups reported from these areas are cervical, liver, glands, bone breast and gastro-intestine cancers. A close look at the profile of the predominant cancers shows a combination of the predominant cancers under high socio-economic residential areas and those of traditional low socio-economic status.

Moreover, the basic geological compositions of the two contrasting areas are found in this transitional residential area: Pegmatite Schist (Iremo and Aderemi) and Undifferentiated Schist (Akarabata I and II). In essence, the implications of iron that appears high at some

locations on gastro–intestine cancers and low level of chemical parameters that are known to inhibit cancer initiation in the ground water of these areas.

Summarily, as the socio-economic characteristics of the residents in each of the sampled areas appear to predispose them to the predominant cancer groups, certain chemical parameters that are in excess of the guide level appear to further the course of the various cancers while providing little or no recognisable protection.

The result above implies that the socio-economic level attained by each residential area tend to influence its stage in the course of epidemiological transition as revealed by the most common cancers suffered by its residents. This assertion agrees with the concept of "many transition" proposed by Zuanna (1996) and supported by Coelho (1997). According to them "transition occurred differently according to time and place due to difference in socio-demographic development". They indicated that the process of epidemiologic and demographic transition is not the same for all ethnic groups both within and between regions and at different times. Therefore, residential areas manifesting varying socio-economic status tend to portray different cancer patterns within Ile-Ife city. This finding has implication for the planning of intervention programme for specific cancers and population at-risk in similar communities.

CHAPTER EIGHT

SUMMARY AND CONCLUSION

8.1 Summary of major Findings

This study has examined the spatial-epidemiology of cancer morbidity in Nigeria with particular emphasis on the spatial - temporal patterns and risk factors associated with the health problem. Cancer data collected over the period of 37 years (1960 - 1996) were employed for the temporal pattern, while the spatial analysis of cancer incidence was based on data from 1987 - 1996. A comprehensive cancer categorisation method adopted grouped all the reported 65 cancer sites into 15 groups such that no specific site was excluded, except the ill-defined sites.

The pattern of cancer occurrence over the years (1960 - 1996) showed that the leading cancers in Nigeria were cervical, leukaemia/lymphomas, breast, gastro-intestine, liver, bone, oral, and prostate. These seven cancer groups jointly accounted for 80 percent of all reported cancer cases in the country. Hence, Nigeria showed a cancer experience that combines the predominant cancers in the economically advanced societies and the under-developed countries.

Socio-demographic characteristics of cancer occurrence revealed that certain cancer groups are more common among specific age, sex and occupation groups. Generally, age - cohort 46 - 60 recorded the highest cancer cases (30.0 percent), followed by 31 - 45 years (26.0 percent). In essence, most cancer cases were reported by patients aged 31years to 60years in Nigeria. The exceptions to this general pattern include leukaemia/lymphomas, eye and urinary cancers which were reported substantially among children (0-15 years). The sex composition of

cancer cases showed that females generally had more cancer cases (61.9 percent) than males in Nigeria. Further analysis indicates that besides cancers that are exclusive to male and female physiology (prostate, breast, and cervical), males had higher occurrence of the other remaining cancer cases (54.4 percent) compared to females.

Regional pattern of cancer incidence showed that Oyo, Osun, Enugu, Kwara, Ogun, Ondo, Abia and Lagos States reported substantial proportion of cancers in Nigeria. On individual State basis, Oyo appears to lead all other States in the incidence of virtually all cancer groups except in the case of glands cancer. The contribution of Oyo State in the incidence of breast, cervical, prostate and leukaemia/lymphomas almost double that of any other State. Generally, cancer incidence showed the highest concentration of cases in south-western part of the Country, followed by the south-eastern part while the least cancer incidence was found among States in the northern part.

A further aggregation of cancer incidence on the basis of the 3 broad ecological zones identifies the relative predominance of breast, cervical, prostate, gastro-intestine and glands cancers in the Forest zone. In the Sudan-Sahel Savanna zone, the cancers that appeared relatively predominant were liver, gastro-intestine, oral, leukaemia/lymphomas and bone. The predominant cancers in the mixed wooded Savanna zone apparently comprise those of the Sudan-Sahel Savanna and Forest zones (breast, leukaemia/lymphomas, bone and liver cancer). Apart from the incidence of liver and leukaemia/lymphomas which relatively concentrate in the drier middle belt and Sudan-Sahel ecological zones, other cancers do not appear to concentrate in this ecological zones in Nigeria.

Associative analysis of the regional cancer incidence with the selected socio-demographic and pathogenic variables indicates the highest level of cancer association with the percentage of urbanisation. Specifically, the co-efficient of association between the regional incidence of each cancer group and the percent of urbanisation are as follows: prostate (.51), eye/brain (.49), urinary (.61), gastro-intestine (.51), oral (0.60), respiratory (.59), breast (.58), cervical (.84) and leukaemia/lymphomas (.87) which are significant at 99 percent confidence level. The analysis of the regional cancer incidence showed an interesting pattern as indices of urbanisation have significant positive association with all cancer groups. In short, cancer groups generally associate with the level of socio-economic development of the States in Nigeria.

Moreover, the regression of the explanatory variables on cancer incidence showed that percentage of urbanisation (model 1) explained more than 30.0 percent in the incidence of cancer pattern in the States. The addition of a second variable, number of industries showed that the two variables provide the highest explanation of cancer pattern among the States in Nigeria. They accounted for 40.0 to 61.5 percent of the incidence of most cancer groups.

Results of the temporal analysis of cancer occurrence showed that cancer has assumed an outstanding dimension over the years, though there are variations according to specific cancer groups. The trend lines of breast, prostrate and liver cancers show rapid increase while gastro-intestine, eye, brain and cervical cancers portrayed gradual increase. Apart from the remaining cancers that did not show any distinct temporal pattern, leukaemia/lymphomas largely showed a downward trend over the study period. A projection of these trend lines will show a continuation

of the present trend into the future, all other things being equal. The rapid rate of urbanisation and general socio-economic development which tends to favour high consumption of animal fat and canned food treated with chemical preservatives, may explain the increasing pattern of breast, prostate, gastro-intestine and oral cancers. On the contrast, the decline of leukaemia/lymphomas may not be unconnected with the general socio-economic development, which may have reduced the prevalence of some viral-parasitic diseases in the society.

This study has shown that the spatial variation of cancer pattern was not limited to the regional level but vary also within an urban centre. There was a significant variation in the distribution of cancer occurrence among wards in Ile-Ife city. More specifically, the intra-urban distribution of cancers among the residential zones within the city appeared to reflect disparity in their socio-economic status. Specifically, the cancers that were predominant in the core area include liver, gastro-intestine, cervical and glands cancer. The occurrence of breast and glands cancers was quite outstanding in the modern (newer) residential area of the city. Interestingly, the predominant cancers in the transitional area tend to feature partly those of the core area and some of the predominant cancers in the modern (newer) residential area.

The seemingly peculiar cancer pattern among the residential areas relates to the distribution of socio-economic status and modernisation on one hand and the chemical quality of water within the city on the other. O.A.U Staff quarters, Moore, Fajuyi and Eleyele that showed evidence of high socio-economic status reported largely cases of breast, gastro-intestine and bone cancers. The fact that a good percentage of the residents earned above #5000 monthly, had education beyond secondary school, resided in high quality houses and possessed modern household facilities imply their ability to afford things associated with affluence. Such include the consumption of food rich in animal fat, canned food treated with chemical preservatives, less

vitamins and absence of physical exercise normally encourage the initiation of cancer in the gastro-intestine tract, breast and prostate. While the content of calcium, magnesium and total hardness of groundwater of the area appeared too low to offer any significant protection against cancer initiation, the high level of iron at some sample sites within these four areas could further the course of gastro-intestine cancer.

On the contrast, Ode-Atan and Ajamopo that manifested evidences of low socio-economic residential status reported largely cases of cervical, gastro-intestine and leukaemia/lymphomas. The high proportion of residents in these two areas that had no formal education, low income, poor housing condition and general indoor pollution may be conducive for the infective activities of viral agents. Hence, the predominance of cervical cancer and lymphomas may not be far-fetched in a poor living environment coupled with ignorance and poverty. While the reported cases of gastro-intestine cancer may not be explained by the poor socio-economic status of the areas, the high level of iron in Ajamopo is noteworthy. The high iron content found in the groundwater of some sample sites in the area may be responsible for the predominance of gastro-intestine cancer cases. By and large, both the socio-economic and environmental parameters of the selected areas appear to be implicated in the specific cancers that are reported more frequently in them.

8.2 Implication of Research Findings

The findings of this study have implications for theoretical formulation and health planning purposes. In the first instance, the age and sex selectivity of some cancers implies that intervention programme to control cancer should target the at- risk population group in the appropriate regions. No doubt, this will enhance the optimal allocation of the available health

care resources in Nigeria. Similarly, the identification of disparity in the trend pattern of each cancer shows that health policy makers need to prioritise the attention required for each cancer. This attention should vary depending on how rapid cancer trend is in the specific communities in the Country. Specifically, breast cancer that portrayed the most rapid upward trend should top health policy agenda for cancer management in Nigeria.

The identification of socio-behavioural factors as the major determinant of cancer incidence among State in Nigeria provides clues to the risk factors that are crucial in cancer control/intervention programme in our society. Intervention programme for cancer control should incorporate health education so as to reduce the prevalence of lifestyle practises that associate with cancer initiation in most cities. Such programme will enhance the planning of cancer intervention programme for other sub-Saharan African countries that have similar cancer patterns.

Moreover, the peculiar cancer scenario that shows a co-existence of high incidence of cancers that are predominant among economically advanced societies and those induced by viral-parasitic infections in the under-developed countries implies a rethinking of the framework for cancer investigation. The popular conceptualisation of disease pattern using either the natural foci of disease or environmental risk cell will prove inadequate for the analysis of cancer in this part of the world. Hence, an Integrated Ecological Model (IEM) that incorporates the natural foci of disease and environmental risk cell provides a holistic perspective of cancer analysis in Nigeria.

Finally, the variations in cancer patterns among States and residential areas within Ile-Ife city have implication for the relevance to the concept of "many transitions". Though, Goger and Nelson (1997) had argued than "many transitions" take place within a country rather than one, the current study has further shown that "many transitions" equally operate on a micro-scale. The cancer pattern and consequently, the transition within the traditional (core) residential area tend to contrast with that of the modern (newer) residential area while a combination of the two patterns is found in the transitional area.

8.3 Recommendation

The spatial locations of the National Cancer Registries in Nigeria need continuous assessment and currently, the number should be increased so as to afford wider coverage of the population in the various geo-political zones. In other words, the seeming concentration of registries in the south-western part of the Country should be reflected in the other parts (south-east, middle belt, north-east and north-west). Increased number of registries will enhance higher reporting of cancer cases and documentation of cases that otherwise will be missing. Hence, the identification of cancer clusters in the various parts of the Country becomes possible. This submission is predicated on the fact that service availability enhances utilisation and consequently, cases reporting.

Towards enhancing better result on the treatment methods administered on cancer patients in Nigeria, the present over-dependence on chemotherapy and surgery should be

supplemented with palliative care. Experiences of most developed and other developing countries underscore the indispensable role of family/community participation in the recovery of cancer patients. In societies where strong and intimate relationship exists between cancer patients and the community in terms communication cum traditional care provision, the rate of recovery is tremendous. Recently, the tremendous result of a good combination of palliative care and biomedical treatment in India is being publicised.

Health education and public awareness should be provided in Nigeria especially, in the urban centres in order to reduce the prevalence of lifestyle practices that positively associate with cancers. In the same direction, environmentalists should be more concerned with the negative impacts of imported foods, chemicals and 'fairly' used materials (clothing and shoes) on human health. Constant monitoring of imported materials and appropriate policy formulation should be submitted to concerned Agencies so as to influence decision making on cancer control.

Finally, the various tiers of Government and other non-governmental organisations should provide adequate funding in order to facilitate monitoring, documentation, public enlightenment, control and management of cancer in Nigeria. Increased facilities provision, information networking, sustained research activities and the transformation of all hospital-based registries to population/community base requires real financial commitment.

8.4 Areas of future Research

Further research on cancer in Nigeria should seek to identify the specific pathways through which the risk factors transform into actual assault. Such knowledge will assist the

identification of the specific risk factors to manipulate in cancer prevention efforts at a community level. This will provide useful information for the planning intervention programme for similar cancers in other West African countries.

Moreover, additional information is required on specific risk factors which associate with intra-urban cancer patterns in the eastern and northern part of the country so as to obtain comprehensive information on the possible variations in cancer risk within Nigeria. Similarly, further research activities should seek to elucidate spatial variation in perception, attitude and health seeking behaviour of cancer patients in Nigeria because of the practical relevance of this information in the control of other non-communicable diseases. This aspect of research is also crucial for the design and utilisation of cancer awareness programmes and medical facilities allocation among the various communities in the country.

REFERENCES

America Cancer Society ACS (1994) Cancer Facts and Figures – 1994 Atlanta, GA: American Cancer Society.

Adamu, Y.M. (1994). Geographical Perspective of Obstetric complications in Kano City. An M.Sc. project submitted to the Department of Geography, University of Ibadan (unpublished).

Adepoju, J.F (1981) Groundwater quality aspects of dug wells in southern Nigeria. Proc. Of int. symposium on "Quality of groundwater" Noordvijikerhout (Amsterdam). March.

Agboola, O. (1992). "Public Education about cancer". In T.F. Solanke et al; Cancer in Nigeria. *Ibadan Tropical Med. Series*. Ibadan University Press.

Ahmed, N. and Cook, P. (1969). The incidence of the Oesophagus cancer in West Kenya. *Brit. J. Cancer* XXIII: 302.

Akhtas, R. (1983). Geography Distribution of Cancer with special reference to stomach cancer. *Int. J. of Environmental Studies.* Vol. 20, No. 3-4 pp. 291-298.

Akinkugbe, O.O. (1995). Lifestyle and Cardiovascular Disease: emerging problem of health development in the 3rd World. In Health of Nations (eds.) B.F. Iyun et al. Ashgate Pub. Ltd. pp. 117-185.

Akinkugbe, O.O. (1997) Mere Consulting Clinics: The Riddles of Health Care in Today's Nigeria. University of Ibadan Alumni Lecture. Spectrum Books Ltd., Ibadan.

Akinkugbe, O.O. and Ojo, O.A. (1969). Arterial pressures in rural and urban populations in Nigeria. *Brit. Med. J.* Vol. 2, pp. 222-224.

Anyanwu, C.H. (1982). "Brocho – Pulmonary and Pleural Carcinoma in Nigeria". In T.F. Solanke et al; Cancer in Nigeria. *Ibadan Tropical Med. Series*. Ibadan University Press.

Armijo, R. and Gonzalez, A. (1981). Epidemiology of gastric cancer in Chile. II – Nitrate exposures and Stomach cancer frequency. *Int. J. of Epidemiology* Vol. 10, No. 1 pp. 57-61.

Armijo, R.; Orellana, M. and Medina, E. (1981). Epidemiology of Gastric Cancer in Chile. *Int. J. of Epid.* Vol. 9, No. 4 pp. 305-315.

Armstrong, B. (1980). The epidemiology of cancer in people's Republic of China. *Int. J. of Epidemio* Vol. 9 No. 4 pp. 305-315.

Armstrong, R.W. (1978) Self-specific environment associated with Nasopharyngeal carcinoma in Malaysia. *Soc. Sci. Med.* 12D pp. 149-156.

Armstrong, R.W. (1996). Population, Health and Environmental health *Environment, Disease and Health Care Planning* Vol. 1 (1) pp. 1 - 7

Ayeni, B. (1989) Concepts and Techniques in Urban Analysis. Croom Helm Ltd. London. pp. 11-32

Beresford, S.A.A. (1981). The relationship between water quality and Health in the London Area. *Int. J. of epidemio*. Vol. 10 No. 2 pp. 103-115.

Boyd, J.T., Doll, S.R. and Guard, C.H. (1973). Cancer incidence in Fiji *Int. J. of Epidemio* Vol. 2 No. 2 pp. 177-187.

Bradshaw, E. and Schonland, M. (1974) *Brit. J. Cancer* 30, 157.

Bradshaw, E.; McGlashan, N.D. and Harington, J.S. (1983). Oesophageal Cancer: Smoking and drinking in Trankei. Occasional paper No. 27. Inst. of Social and Econ. Research, Rhodes Univ. Grahamstown, South Africa.

Burt, E.J. and Barber, M.G. (1996). Elementary Statistics for Geographers 2nd Edit. The Guilford Press Ltd. New York pp. 242-251.

Bury, M. (1991). 'The Sociology of Chronic Illness'. Sociology of Health and Illness 13(4), 451-67.

Calabrese, E.J. (1985). Sex differences in response to toxic substances. In Medical Geography (eds.) Melinda Meades et. al., New York pp. 200.

Campagna, F.A. and Anderson, J. (1960). Asbestos and Carcinoma of Lung: Case report and review of literature. Arch. Env. Health 1 27-32.

Carlo, G.L. and Mettlin, C.J. (1980). Cancer incidence and trihalomethane concentrations in a public drinking water system. *Am. J. of Public Health* 70: pp. 523-525.

Chalkin, A.V. (1962). The geographical distribution of cancer in the Soviet Union. *Sov. Geography*. 3, p. 59.

Clemmensen, J. and Nielsen, A. (1951). The Social distribution of cancer in the Soviet Union. Soviet Geog. 3, 59.

Coelho, P.R.P. (1997). Epidemiology and the demographic transition in the New World. Forum: The Epidemiologic transition Review 7: 237-241.

Cole, P.J. and King, M.A.C. (1970). Quantitative Geography. John Wiley & Sons Ltd. pp. 294-302.

Commission on Health Research for Development (1990). Health Research: Essential Link to Equity in Development New York: Oxford University Press.

Davis, D.L. Hoel, D., Fox, J. and Lopez, A. (1990). Epidemiology International trends in cancer mortality in France, W. Germany, Italy, Japan, England and Wales and the U.S.A *The Lancet* . Aug. 25, 1990.

Dever, G.E.A (1972): Leukemia and housing: an intra-urban analysis. In medical geography (1972) (ed.) N.D. McGlashan. Butler and Tanner Ltd. London pp. 233 - 245.

Doll, R.; Muir, C.S. and Waterhouse, J.A. (1972). Cancer Incidence in five continents. IUCC Report: Spring Vol. 2 Verlag, Berlin.

Dubos, R. (1965) Man Adapting. New Haven CT. Yale University Press. P. 7.

Dzik, A.J. (1991) Leukaemia Mortality Rites of Ohio River Communities in Comparison with other communities. Geographia Medica 21, pp. 63-66

Egunjobi, L. (1993). Spatial distribution of mortality from leading notifiable diseases in Nigeria *Soc. Sci. Med.* Vol. 36, No. 10 pp. 1267-1272.

Ekanem, I.O.A (1995) Is cancer Real? Cancer News Vol. 1 No. 2

Enstrom, J.E. (1977). Colorectal cancer and beer drinking. *Br. J. Cancer* 35, 674.

Feachem, R.G.A.,T. Kjellstrom, C.J.L. Murray, M. Over, and M.A. Phillips, eds. (1992) The Health of Adults in the Developing World. New York: Oxford University Press.

Foster, H.D. (1988a). Reducing Cancer mortality. A geographical perspective. Western Geographical Series, Vol. 23 Victoria: In community, Environment and Health Geographical perspective (1992) (eds.) Hayes, *et al.*, Vol. 27.

Foster, H.D. (1992). Mortality and Soil Geochemistry: Tentative Working Hypotheses. Community, Environment and Health Geographic Perspectives (eds.) Hages M.V.

Freeman, H.P. (1989). 'Cancer in the Economically Disadvantaged'. *Cancer* 64 (suppl.) 324-334.

Ghadirian, P. and Thouez, T.P. (1991). The Possible role of Opium in the aetiology of Oesophageal Cancer: A geographical Interpretation Geographia Medica 21 pp. 49-60.

Giggs, A.J. (1983) Schizophrenia and ecological structure in Nottingham. In Geographical Aspects of Health (Eds.) N.D. McGlashan and J.R. Blunder. Academic Press London pp.

Gile, (1983) "Use of Bracken in the Japanese diet" in Geography of Cancer" Cancer and Environment Session F - 2 p. 36

Glick, B. (1980). The Geographical Analysis of cancer occurrence: Past progress and future directions. In M.S. Meade (Ed.), Conceptual and Methodological issues in Medical geography. Chapel Hill. North Carolina pp. 170-193.

Glick, B.J. (1982) The spatial organisation of cancer mortality. *Annals of the American Geographer*. 77 (4) pp. 471-481.

Greenberg. M.R. (1983). Urbanization and Cancer Mortality: The U.S.A. experience (1950-1975). Oxford University Press, New York.

Grillo, I.A. and Sofowora, O. (1972). Primary tumours of the lung and pleural in Nigeria. *Nat. Med. Assoc.* 63: 166-172.

Grove, A.T. (1992). The dissolved and solid load carried by some West African rivers. In Areola, O. (1991): Ecology of Natural Resources of Nigeria. Avebury Academic Pub., England.

Habib, A. (1975). Le cancer en Iran. Revue les formes frequentes et leuvs particularites epidemiologique *J. cancer* 3 (1).

Haggett, P. (1965).Locational Analysis in Human Geography London. p. 211.

Hazra, J. (1984): Cancer in West Bengal. *Geographia Medica* (14) pp. Vol. 142 - 151.

History of Nigeria's Medical Records and Services 1904-1963

Hoel, D.G., Davis, D.L and Miller, A.B. (1992). Trends in Cancer Mortality in 15 Industrialized countries, 1969-1986. *J. of the Natl. Cancer Inst.* Vol. 84 No. 5. pp. 313-319.

Holden, M.J and Green, J. (1960) The hydrology and plankton of the River Sokoto. J. Anim. Ecol. 29, 65-84

Howe, G.M. (1981): Presence or absence of nitrates, nitrite and trace elements in water supply. In Geography of Cancer: *Cancer and environment* p. 36 Suppl.

Howe, G.M. (1986) Global geocancereology. A world Geography of Human cancers. Churchill Livingstone Edinburgh.

Iversen, O.H. (1987) Cancer risks in relation to other health hazards in a modern society. *Environment International*, 13(2), pp. 155-158.

Iyun, B.F. (1983) The determinants of disease - Risk Areas in Ibadan City - *Geoforum* Vol. 14, No. 2 pp. 211-221.

Iyun, B.F. (1985). Spatial Distribution of Diseases in Ibadan City Geog. Review of India. Vol. 45, No. 1, pp. 17-26.

Iyun B.F. (1987) Ecology and disease in Nigeria *Geographia Medica*, Vol. 17, 85-128.

Iyun, B.F. (1991) "The impact of the structural Adjustment Programme (SAP) on Maternal Child Health Care in Nigeria". In G. Thomas - Emeagwali (ed.) Women pay the Price: Structural Adjustment in Africa and the Caribbean, Africa World Press, pp. 31-37.

Iyun, B.F. (1992) Some Aspects of the Epidemiological transition in Africa: The Nigerian experience (I.G.U) Conference Paper.

Jamison, D.T., Mosley, W.H; Measham, A.R. and Bobadilla (1993) Disease Control priorities in developing countries New York: Oxford University press.

Jensen, O.M. (1982). Nitrate in drinking water and cancer in Northern Jutland, Denmark with reference to stomach cancer. *Ecotoxicology and Environmental safety* 6(3) pp. 255-267.

Johnson, A.O.K. and Williams, C.K.O. (1982). "Childhood Abdominal Tumours in Ibadan: a need of reappraisal". In T.F. Solanke et al; Cancer in Nigeria. *Ibadan Tropical Med. Series*. Ibadan University Press.

Johnston, R.J. (1979). Geography and Geographers. London Arnold) p. 32.

Johnston, R.J. (1983) Philosophy and Human Geography An introduction to contemporary approaches.

Jun-Yao, L.; Be-Qi, L. et. al. (1984). Atlas of Cancer Mortality in t he peoples Rep. of China. An aid for cancer control and Research DHEW Publications No (NIH).

Keay, R.W.J. (1952). An outline of Nigerian vegetation. In Areola, O. (1991): Ecology of Natural Resources in Nigeria. Avebury Academic Pub., England.

King, L.A. and Harris, G.R. (1987). Assessing Cancer Incidence in a small Community. *Environment monitoring and Assessment* 8(2), pp. 151 - 161.

Kogenivas, M. (1992). 'Social Inequalities and Cancers' pp. 5-17. In Remmenick, L.I. The Cancer Problem in the context of Modernity: Sociology, Demography, Politics. *Current Sociology*. Jan. 1998, Vol. 46(1).

Kui, G.S. and Liag, F.W. (1982): An analysis of the geographical environments of typical areas of oesophageal cancer in China. *Geographical Sinica* 2(4) pp. 311 - 318.

Kuzma, R.J., Kuzma. C.M. and Buncher, C.R, (1977). Ohio drinking water source and cancer risk. *American Journal of public Health*, 67: 725 - 729.

Last, J.M. (1998). Public Health and Human Ecology (2nd Edition). McGraw-Hall Medical Publishing Prentice - Hall International Editions. Canada p. 153.

Lawani, J.; Nkoposong, E.O.; Aghadiumo, P.U. and Akute, O. (1982). "Twenty-years Review of Genito-urinary Tract Tumours in Ibadan". In T.F. Solanke et al; Cancer in Nigeria. *Ibadan Tropical Med. Series*. Ibadan University Press.

Learmonth, A. (1988) Disease Ecology: An Introduction. Basil Blackwell Ltd., Oxford, U.K. pp. 367-277.

Loehnert, E.P (1981) Groundwater quality aspects of dug wells in southern Nigeria. Proc. Of int. symposium on "Quality of groundwater" Noordvijikerhout (Amsterdam). March.

Logan, W.P.D. (1982). Cancer Mortality by Occupation and Social Class, 1851-1971 Lyon. In Remmenick, L.I. (1998). The Cancer Problem in the Context of Modernity: Sociology, Demography, Politics. *Current Sociology*. Jan. 1998, Vol. 46(1).

Lowenberg, U. and Kunzel, T. (1992) Investigations on the hydrology of the Lower Cross River , Nigeria. Anim. Res. Dev.: Inst. Sci. Co-op, Tubingen 32, 75-85.

Mabogunje, A.L. 1968. Urbanization in Nigeria. London University Press.

Mabogunje, A.O.; Lawrie, J.H.; Harrison, K. and Edington, G.M. (1982)."Surgical experience with Teratomas in Zaria, Nigeria". In T.F. Solanke et al; Cancer in Nigeria. *Ibadan Tropical Med. Series*. Ibadan University Press.

Makinde, M.A (1974). Ile-Ife: An introduction. Ilesanmi & Son press Ltd., Ibadan pp.10-19.

Mather, P.M. (1976). Computational methods of Multivariate Analysis in Physical Geography. John Wiley and Sons, London pp. 294-295.

Mauskopf, J.A. (1987). Projections of Cancer risks attributable to future exposure to asbestos (U.S.A) *Risk Analysis*, 7(4). pp. 447-456.

May J.M. (1958) The Ecology of Human Disease M.D. Publications Inc. New York (U.S.A.) pp. 1-2

Mayer, J.D. (1958) Challenges to understanding spatial patterns of Disease: Philosophical alternative to logical positivism. Soc. Sci. Med. 35(4), pp. 579-587.

McGlashan, N.D. (1972). Food contaminants and Oesophageal cancer (ed.) N.D. McGlashan. Butler and Tanner Ltd. London pp. 247-259.

McGlashan, N.D. (1982). Environmental detectives probe riddle of cancer. *Geographical Magazine* 5 (5). pp. 263-267.

McGlashan, N.D. (1985). Risk factors in Gastro intestinal cancer. *Geographical Epidemiology*. Vol. 29 No. 1-2 pp. 7-11.

McGlashan, N.D. and Harington, J.S. (1985). Lung Cancer 1978-1981 in the black peoples of South Africa. *Brit. J. Cancer*, 52 pp. 339-346.

Meades, M.; Florin, J. and Wesler, W. (1988). Lung Cancer 1978-1981 in the black peoples of South Africa. *Brit. J. Cancer*, 52 pp. 339-346.

Minder, C.E. and Beer-Porizek, U. (1992). Cancer Morbidity of Swiss men by occupation (1979-82). Scand J. of Work, Environment and Health 18 (supp. 3 pp. 27).

Ministry of Local Government and Information (1977). A publication of the Ministry (unpublished).

Muna, W.F.T. (1993). Cardiovascular disorders in Africa *World Health statistics quarterly* 46. pp. 125-131.

Nash, T.A.M. (1944). A low density of tsetse flies associated with a high incidence of sleeping sickness. Bulletin Entomological Research 35, 51.

National Population Report (1996). A publication of the National Population Commission, Nigeria

Neuberger, J.S. and Hollowell, J.G. (1982). Lung cancer excess in an abandoned lead-zinc mining and swelting area (U.S.). *Science of the total environment*, 25(3), pp. 287-294.

Neuman, W.L. (1994). Social Research Methods: Qualitative and Quantitative Approaches (eds.) Allyn and Bacon. Simon and Schuster Inc.

Norie, I.H. (1992). Water hardness and the digestive cancers. Community, Environment and Health: Geographical perspective (Western Geographical Series) (Eds.) Hayes, M.V. *et al.*, Vol. 27 pp.

Notestein, F.W. (1953). Economic Problems of Population change in the proceedings of the 8th Inter. Conference of Agricultural Economists, London: Oxford Univ. Press pp. 13-31.

Ojo, O.S. (1992). Cancer Registration in Nigeria. In National Cancer Control Programme Report (Ed.) T.F. Solanke.

Okeowo, P.A. and Ajayi, D.O.S. (1982). "Nasopharygeal Carcinoma in Nigeria". In T.F. Solanke et al; Cancer in Nigeria. *Ibadan Tropical Med. Series*. Ibadan University Press.

Olasinde, T.A. (1992). "The role of Radiotherapy in Cancer Management. In T.F. Solanke (ed.) National Cancer Control Programme for Nigeria, 1992 Report pp. 67-73.

Olumide, A.A. and Adeoye, A.O. (1982). Primary Malignant Tumours of the Brain". In T.F. Solanke et al; Cancer in Nigeria. *Ibadan Tropical Med. Series*. Ibadan University Press.

Olweny, C.L.M. (1990) Neoplasms and Malignancies - Tropical and Geographical Medicine (Eds.) Kennett S. Warren/Adel A.F. Mahmoud New York (2nd edition) McGraw-Hill Information Services coy. (Inc.) U.S.A

Olweny, C.L.M. (1992). Risk factors in Nigeria. In N.C.C.P Workshop Report. (Ed.) T.F. Solanke. Lagos, Nigeria.

Omran, A.R. (1971). The Epidemiological Transition: a theory of the epidemiology of population change. Milbank Memorial Fund quarterly 49(4), pp. 509-538.

Onibokun, A.G. (1986). Two Decades of Public Housing in Nigeria NISER, Ibadan.

Oyemade, G.A. and Junaid, T.A. (1982). "Clinical Pathological Features of Osteosarcomas in Ibadan". In T.F. Solanke et al; Cancer in Nigeria. *Ibadan Tropical Med. Series*. Ibadan University Press.

Page, T., Harris, R.H. and Epstein, S.S. (1976). Drinking Water and Cancer mortality in Louisiana. *Science* 193 (424) pp. 55-57.

Park, R.E. and Burges, E.W. (1925). The City. Chicago: University of Chicago Press.

Paulson, M. (1993). The Politics of cancer. Detroit metro Times Nov/Dec. (1993). Utne Reader pp. 81-89.

Phillips, D.R. (1991) Problem and Potential of Researching Epidemiological Transition: Examples from South Asia. *Soc. Sci. Med.* Vol. 33, No. 4, pp. 395-404

Phillips, D.R. (1993) Health and Development: Key issues *Geographia Medica* Vol. 23, No. 2 pp. 132-133.

Phillip, D.R. (1995). IGU Commission on Health, Environment and Development: aims and activities. Health and Place Vol. 1, No. 1, pp. 66-67.

Priestman,T.J. (1977) Cancer Chemotherapy-An Introduction. Montedison Pharmaceuticals Ltd. Barnet, Herts.

Remmenick, L.I. (1998). The Cancer Problem in the context of Modernity. Sociology, Demography, Politics Current Sociology Vol. 46, N0. 1, pp. 10-25.

Roger, J. and Nelson, M.C. (1997). The epidemiologic transition revisited: or what happens if we look beneath the surface? Forum: Health Transition Review 7, 241-255.

Rowland, J.A. and Cooper, P. (1983). Environmental and Health. Edward Aruod Pty. Ltd. pp. 53-67.

Rukang, F. (1986a). Geographical distribution of the high mortality of malignant Tumours (Male) in China with special reference to Shanghai. *Geographia Medica* 16. pp. 11-26.

Sadeghi, A. and Behmar, S. (1978). Cancer of the bladder in Southern Iran. *Cancer 42*, pp. 353-356.

Schell, L.M; Smith, M.L. and Bilsborough, A. (1993) Urban Ecology and Health in the third world. 32nd symposium volume of the society for the study of Human Biology. Cambridge University Press.

Schonland, M. and Bradshaw, E. (1969). Upper alimentary tract cancer in Natal Indians with special reference to the betel-chewing habit. *Br. J. Cancer* 23, 670.

Shannon, G.W and Dever, G.E.A (1974). Health Care Delivery: Spatial perspectives, McGraw-Hill, New York

Shannon, G.W. and Spurlock, C.W. (1975). Urban Ecological Containers, Environmental Risk cell and the use of Medical Services. *Econ. Geography* Vol. 10 pp. 347 - 365.

Smith, K.R. (1990) The Risk Transition *International Affairs* 2 (3) : 227 - 251

Solanke, T.F. (1992). Health of the Nation: Cancer in Focus. In National Cancer Control Programme for Nigeria 1992 Report (Ed.) T.F. Solanke pp. 14-15.

Spinnelli, J.J.; Band, P.R., Gallagher, P.R., Threfall, J. W. and Ng, V . (1992) Cancer mapping in British Columbia. Community environment and health. Geographical Perspective (eds.) Hayes, M.V. *et al.* Vol. 27, pp. 39-52.

Stjensward, J. (1992). "Urgent need of cancer control programme". In T.F. Solanke (ed.) National Cancer control Programme for Nigeria, 1992 report p. 22.

Tawaih, E.O. (1989). Cause of death at Ahmadu Bello University Teaching Hospital, Zaria (1984 - 1987). *Savanna* 10, 2

Tipple, A.G. and Hellen, J. (1986). "Priorities for Public Utilities and Housing Improvement in Kumasi, Ghana: An Empirical Assessment on six variables". seminar Paper No. 44, University of New Castle – Upon-Tyne.

Tuthill, R.W. and Moore, G. (1978). Chlorination of Public Drinking water supplies and subsequent cancer mortality on Ecological Time-lag study. In Community, Environment and Health: Geographical perspective (1992) (Eds.) Hayes *et al.*, Vol. 27 Western Geographical Series.

Tuyns, A.J. and Masse, L.M.F. (1973). Mortality from cancer of the oesophagus in Brittany. *Soc. Sci. Med.* Vol. 2, No. 3. pp. 241-246.

Udo, R.K. (1970). The Geographical Regions of Nigeria, Heinemann, Ibadan.

Uwaifor, A.O. (1995) Cancer: a consequence of cellular breakdown of law and order (Inaugural paper) presented at the University of Ibadan, Ibadan, Nigeria.

Uwaifor, A.O., Bababunmi, E.A. and Emerole, G. (1982). The aetiology of Hepatocrcinoma in Nigeria: the role of plant-based chemicals. In "cancer in Nigeria". (Eds.) T.F. Solanke *et al.,* Ibadan Tropical Medicine Series. pp. 11-18.

Vagero, D. and Persson, G. (1986). 'Occurrence of Cancer in Socio-Economic Groups in Sweden'. Scandinavian *J. of Soc. Med.* 14: 151-160.

Verhasselt, Y. (1990). Environmental Changes and Health in Tropical Africa. In Environment and Health (Ed). Akltar, R. Ashish, New Delhi, 1990.

Verhasselt, Y. (1977). Notes on Geography and Cancer. *Soc. Sci. med.* Vol. 11 pp. 745-749.

Verhasselt, Y. (1992) Problem on cancer epidemiolog *Geographia medica,* Suppl. 8.

Verhasselt, Y. (1993) Geography of health: Some trends and perspectives *Soc. Sci med.* Vol. 36, No. 119-123.

Verhasselt, Y. and Timmermans, A. (1987). World maps of cancer mortality. Geografisch Instituut, Brussel.

Vigneron, E. (1989). The Epidemiological Transition in an overseas Territory: Disease mapping in French Polynesia. *Soc. Sci. Med.* Vol. 29, No. 8 pp. 13-922.

W.H.O. Technical Report (1985) Twenty Years of Political Struggle for Health (Ed) Queenum C.A.A. Afro-Technical Papers No. 20. P. 218 Brazzaville.

Waller, R.E. (1981). Trend in lung cancer in London in relation to exposure to diesel fumes. *Environment International* 5 (4.6). pp. 79-83.

Waterhouse, J., Muir, C., Shanmugaratuam, K and Powell, J. (eds.) (1989) Cancer in five continents. Lyon: IARC Geneva.

White, R.R. (1972): Probability maps of leukemia mortality in England and Wales. In Medical Geography: Techniques and field studies. (ed.) N.D. McGlashan Methuen - London pp. 171-185.

Whitelegg, J. and Gorst, D. (1986). Leukaemia incidence in North England: Some hypothesis. (Int. symposium in Medical Geography).

WHO (1993) The Urban Health Crisis: Strategies for Health for all in the face of Rapid Urbanization: Report of the Technical Discussions at the 44th World Health Assembly Geneva.

World Bank (1993). World Development Report (1993): Investing in Health. New York: Oxford University Press.

Wynder, E.L. and Graham, E.A. (1950). Tobacco smoking as a possible etiologic factor in bronchogenic carcinoma. A study of 684 proved cases. *JAMA* 143: 329-336.

Zimmet and Whitehouse (1981). Killed by the "Good Life" the Chronic disease epidemic – adverse effects of lifestyle change in developing pacific nations. Health Transition (Eds.) Cabelwell, J. et. al. Vol. 1, No. 2.

Zuanna, D.G. (1996). Transition demographique et societies. *Genus* 51 1-2: 216. In Fetter (1997). Forum: The Epidemiologic transition Review 7 pp. 235-237.

Appendix 1
Cancer sites and their code according to WHO 9th Revision

ICD CODE	MALIGNANT NEOPLASM
T140	Malignant Neoplasm of lip
T141	Malignant Neoplasm of tongue
T142	Malignant Neoplasm of salivary gland
T143	Malignant Neoplasm of gum
T144	Malignant Neoplasm of floor of mouth
T145	Malignant Neoplasm of other parts of mouth
T146	Malignant Neoplasm of oropharynx
T147	Malignant Neoplasm of nasopharynx
T148	Malignant Neoplasm of hypopharynx
T149	Malignant Neoplasm of other parts of the oral system
T150	Malignant Neoplasm of oesophagus
T151	Malignant Neoplasm of Stomach
T152	Malignant Neoplasm of Small intestine, duedenum
T153	Malignant Neoplasm of colon
T154	Malignant Neoplasm of rectum, rectosigmoid, anus
T155	Malignant Neoplasm of liver, intrahepatic bile duct
T156	Malignant Neoplasm of gall bladder, extrahepatic bite duct
T157	Malignant Neoplasm of pancreas
T158	Malignant Neoplasm of retroperitoneum, peritoneum
T159	Malignant Neoplasm of ill-define site within (158)
T160	Malignant Neoplasm of the digestive organ, peritoneum nasal cavities, mid ear, of accessory sinuses
T161	Malignant Neoplasm of larynx
T162	Malignant Neoplasm of trachea, bronchus, lung
T163	Malignant Neoplasm of pleura
T164	Malignant Neoplasm of thymus, heart, mediastinum
T165-169	Malignant Neoplasm of ill-defined site within the respiratory system, intra thoracic organ
T170	Malignant Neoplasm of bone and articular cartilage
T171	Malignant Neoplasm of connective, other soft tissue
T172	Malignant Neoplasm of melanoma of skin
T173	Malignant Neoplasm of skin
T174	Malignant Neoplasm of Female breast
T175	Malignant Neoplasm of Male breast

ICD CODE	MALIGNANT NEOPLASM
T179	Malignant Neoplasm of uterus, unspecified part
T180	Malignant Neoplasm of cervix uteri
T181	Malignant Neoplasm of placenta
T182	Malignant Neoplasm of body of uterus
T813	Malignant Neoplasm of ovary, other uterine adnexia
T184	Malignant Neoplasm of other, unspecified female genital organ
T185	Malignant Neoplasm of prostate
T186	Malignant Neoplasm of testi
T187	Malignant Neoplasm of penis, other male genital organs
T188	Malignant Neoplasm of bladder
T189	Malignant Neoplasm of kidney, other and unspecified urinary organs
T190	Malignant Neoplasm of eye
T191	Malignant Neoplasm of brain
T192	Malignant Neoplasm of other and unspecified parts of nervous system
T193	Malignant Neoplasm of thyroid gland
T194	Malignant Neoplasm of other endocrine glands
T195	Malignant Neoplasm of other and ill-defined sites
T196	Malignant Neoplasm of lymph nodes (Secondary, unspecified)
T197	Malignant Neoplasm of respiratory and digestive systems
T198	Malignant Neoplasm of other specified sites
T199	Malignant Neoplasm of other unspecified sites
T200	Lymphosarcoma and reticulo sarcoma
T201	Hodgkins diseases
T202	Others of lymphoid and histiocytic tissue
T203	Multiple myeloma and immuno proliferative neoplasm
T204	lymphoid leukaemia
T205	Myeloid leukaemia
T206	Monocytic leukaemia
T207	Other specified leukaemia
T208	Leukaemia of unspecified cell type.

APPENDIX 2
INDIVIDUAL CANCER CASES

SECTION II

HOSPITAL NAME: _____ MONTH OF _____ 19

No	Sex	Age	Occupation	Ethnic Group	State/LGA of Origin	Diagnosis Code	Condition	Residential Address

Appendix 3

Explanatory/Independent Variables of Cancer Pattern

	1	2	3	4	5	6	7	8
State	Male Population	Female Population	Life Expectance at birth	Popu. Density	Cases of Schistosomiasis	No. of Industries	% of Literacy Level	% of Urbanisation
Oyo	1745720	1743069	51.3	122.61	144	94	27.97	69.32
Osun	1079424	1123592	51.3	239.14	53	12	27.97	55.5
Enugu	1482245	1679050	44.9	246.38	185	56	29.7	41.55
Lagos	2999528	2686253	61.4	1699.79	80	728	44.64	93.69
Ondo	1958928	1925557	49.4	185.14	0	17	34.83	40.38
Kwara	790921	775548	45.9	42.54	0	41	27.67	42.77
Ogun	1144907	1193663	37.4	139.52	70	133	28.8	44.78
Anambra	1374801	1393102	44.9	571.41	25	139	29.7	61.94
Imo	1178031	1307468	60	449.46	1	32	51.67	32.67
Abia	1108357	1189621	60	363.64	17	108	51.67	37.75
Edo	1082718	1077130	53.7	121.33	8	53	45.07	45.44
Delta	1273208	1296973	53.7	145.22	1	46	45.07	33.15
Rivers	2079583	1904274	50.2	182.33	0	67	35.88	31.35
Kaduna	2059382	1909870	36.6	86.19	990	75	21.04	40.77
Benue	1385402	2394996	53.5	81.63	21	5	18.64	16.52
Kano	2838724	2773316	57.1	279.77	1487	143	8.31	39.88
Borno	1327311	1269278	37	36.62	760	4	6.85	35.63
Kogi	1055964	1043082	45.9	70.36	30	1	27.67	35.25
Sokoto	2158111	2234280	49.2	66.82	60	12	1.94	13.54
Cross River	945270	920334	57.8	92.56	26	22	47.36	25.08
Niger	1290728	1191647	54.9	32.51	1269	7	11.01	22.82
Plateau	16445730	1637974	39.59	56.59	383	40	25.19	23.02
FCT	206535	172136		51.77	1	2		28.81
Katsina	1944218	1934126	57.1	160.32	13	5	8.31	30.32
Bauchi	2202962	2091451	36.7	66.47	86	18	27.21	16.01
Adamawa	1084824	1039225	57.8	57.54	5737	8	18.05	22.51
Taraba	754754	725836	57.8	27.18	2144	1	18.05	10.43
Akwa-Ibom	1162430	1197306	57.8	333.25	0	21	47.36	12.11
Jigawa	1419726	1410203	57.1	122.22	821	0	8.31	6.94
Kebbi	1024334	1037892	49.2	56.04	2344	0	1.94	12.37
Yobe	719763	691718	37	31.02	277	1	6.85	24.35

Sources: 1, 2, 3, 4 and 8: National Population Commission Report (1996) Report on 1991 Population Census

5: Federal Office of Statistics, 1994 Annual Report.

6: Directory of the Manufacturers' Association of Nigeria (1991)

7: United Nations Development Programme (UNDP) Report on Human Development Index in Nigeria (1996)

APPENDIX 4a

DEPARTMENT OF GEOGRAPHY
UNIVERSITY OF IBADAN
IBADAN

SOCIO-DEMOGRAPHIC CHARACTERISTICS AND LIFESTYLE PRACTICES OF CITY DWELLERS IN NIGERIA: CASE OF ILE-IFE

SECTION A: BACKGROUND INFORMATION ON THE STUDY AREA

1. Identification Number of Questionnaire .....
2. Residential district/compound/ward .....

SECTION C: GENERAL HOUSEHOLD INDICES
(TO BE COMPLETED BY INTERVIEWER)

3. Indicate the house type: (i) Traditional house (ii) Storey building (iii) Bungalow (iv) Duplex.
4. Indicate the wall materials: (i) Mud unplastered (ii) Plank/Thatch (iii) Brick/Block.
5. Indicate the roof materials: (i) Asbestos (ii) Red Brick/Cement Block (rid) (iii) corrugated iron sheet (iv) Thatch.
6. Indicate presence of refuse dump around the house (i) Yes (ii) No.
7. If yes, approximate distance to the house ..... metres.
8. Type of toilet facility provided (i) Bush/dung hill (ii) Pit latrine (iii) Water Closet (iv) UNICEF VIP Toilet.
9. How many rooms do you and your household occupy? .....
10. Please indicate the total number of people in the household .....

SECTION C: GENERAL HOUSEHOLD INDICES

11. Do you possess any of the following?
    (a) Television (i) Yes (ii) No.
    (b) Radio (i) Yes (ii) No.
    (c) Electric Iron (i) Yes (ii) No.
    (d) Electric Fan (i) Yes (ii) No.
12. What do you use for cooking most of the time? (i) Fire clay (ii) Kerosine stove (iii) Gas cooker (iv) Electric cooker (iv) Others (Specify) .....
13. What utensils do you use mostly for household cooking? (i) Clayed (ii) Metallic (iii) Aluminum (iv) Others (Specify) .....
14. Is there any industrial plant around your house? (i) Yes (ii) No.
15. If yes, which industrial plant(s).....

16. Estimate the distance .....metres.
17. What is your major source of drinking water (i) Stream/River (ii) Well (iii) Borehole/Deep well (iv) Pipe-borne water (v) Rain water (vi) Commercial plastic water.
18. Which is your second best source?.....
19. Do you often boil the water before drinking? (i) Yes (ii) No.
20. How else do you treat your drinking water?.....
21. How do you store your drinking water (i) Metal Container (drum) (ii) Aluminum (iii) Plastic (iv) Clay pot (v) Others (specify).....
22. How long have been residing in Ile-Ife (i) From birth (ii) 1-5 years (iii) 6-10 years (For non-indigene).
23. Did you reside in any other town before coming to Ile-Ife? (i) Yes (ii) No
24. What work do you do during the last (i) 1-10 years..... (ii) 11-15 years..... (iii) 16-20 years..... (iv) 21-40 years.....
25. Name 3 most worrisome environmental problems of your neighbourhood in order of importance (1).....(2)..... (3).....

SECTION D: BEHAVIOURAL LIFESTYLE PRACTICES

26. Please state types of food you consume most (in order of preference 1, 2, 3, etc (i) Yam/Cassava (ii) Rice (iii) Beans (iv) Maize/Sorghum/Millet (v) Plantain (vi) Fruits
27. How often do you eat the following food items?

Food	Regularly	Occasionally	Rarely
(i) Margarine			
(ii) Pork meat			
(iii) Ground nut			
(iv) Smoked fish			
(v) Smoked meat			

28. Do you use tobacco (i) Yes (ii) No
29. Please indicate the modes of tobacco use

(1) Smoking	(i) Yes	(ii) No
(2) Piping	(i) Yes	(ii) No
(3) Chewing	(i) Yes	(ii) No
(4) Chewing with potash	(i) Yes	(ii) No
(5) Snuffing	(i) Yes	ii) No

30. For how long have you used tobacco..... years
31. What type of tobacco do you often use?

(1) Locally grown	(i) Yes	(ii) No
(2) Nigeria made cigarette	(i) Yes	(ii) No
(3) Imported cigarette	(i) Yes	(ii) No
(4) Cigar	(i) Yes	(ii) No

32. Do you drink alcohol (i) Yes (ii) No
33. Which of these drinks do you drink regularly.

(1)	(Locally) made in Nigeria Beer	(i) Yes	(ii) No
(2)	Imported Beer	(i) Yes	(ii) No
(3)	Ogogoro	(i) Yes	(ii) No
(4)	Emu	(i) Yes	(ii) No
(5)	Spirit liquor	(i) Yes	(ii) No

34. Have you ever used any of the medicated body creams (beautification products). (i) Yes (ii) No

35a. If yes, for how long?..... years (b) Name most used products.....

36. Does your household practise female circumcision (i) Yes (ii) No

37. Do you use insecticides (i) Yes (ii) No. What brand?.....
(b) Herbicides (i) Yes (ii) No. What brand?.....
(c) Pesticides (i) Yes (ii) No. What brand?.....

38. If yes, purpose of use

(i)	For killing bugs mosquitoes, cockroaches	(i) Yes	(ii) No
(ii)	Farming activities (weeding, spraying cocoa trees etc)	(i) Yes	(ii) No
(iii)	Industrial (manufacturing/processing)	(i) Yes	(ii) No

SECTION D: KNOWLEDGE AND AWARENESS OF COMMUNITY DISEASES

39. Name the five top diseases that causes high mortality (death) in Ile-Ife
(i) ..... (ii) ..... (iii) ..... (iv) ..... (v) .....

40. Have you heard about cancer before (i) Yes (ii) No.

41. What do you think are the causes of cancer .....

42. What is the best way to treat cancer (i) Orthodox medicine (hospital) (ii) Traditional medicine (herbs) (iii) Faith healing (iv) No treatment yet (v) Others specify .....

43. What is the best method to prevent cancer (i) Regular medical examination (ii) Spiritual exercises (praying/fasting) (iii) Keeping a hygienic lifestyle (iv) Others specify).....

44. Do you know anyone who is currently suffering from cancer in this community (i) Yes (ii) No

45. Do you know anyone who has died of cancer in this community (i)Yes (ii) No

46. Has any member of your husband suffered from cancer (i) Yes (ii) No.

47. Characteristics of victim (i) Age ..... (ii) Sex ..... (iii) Marital Status ..... (iv) Occupation ..... (v) Type/Site .....

SECTION E: GENERAL SOCIO-DEMOGRAPHIC INFORMATION

48. How old are you? ..... years.

49. Sex (i) Male (ii) Female.

50. What is your most regular occupation? .....

51. What is your highest education qualification? .....
(i) No formal schooling (ii) Primary Education (iii) Secondary Education

(iv) Tertiary Education.

52. About how much do you realise per month? .....
53. Marital status (i) Never married (ii) Married monogamy (iii) Married polygamy (iv) Widow (v) Other (Specify) .....
54. If married woman, age at first marriage ..... years.
55. Number of children ever born .....
56. Where did you deliver your last two children I) Clinic/hospital (ii) TBA assisted (iii) Self delivery at home (iv) Others specify .....

Appendix 4b

Socio-Environmental Variables Used for Factor Analysis

Variable	Cell 45	Cell 85	Cell 92/9	Cell110	Cell 123	Cell 130	Cell 135	Cell 158	Cell 161	Cell 168	Cell 188	Cell 198	Cell 213
Percentage of Bungalow	31	0	25	30	100	69	15	10	90	20	9	33	27
Percentage of water closet	31	33	67	80	100	77	23	0	60	70	27	42	18
Percentage born in the city	23	0	0	10	10	15	8	20	30	50	73	50	45
Percentage with #5000+ Monthly	15	0	8	30	40	54	0	10	50	30	9	50	0
Percentage with Formal Educ.	0	22	8	0	0	0	8	40	10	0	18	8	36
Percentageusing Gas cooker	23	33	8	10	100	38	15	50	50	50	9	25	0
Percentage Using Fireclay	0	22	0	0	10	8	31	40	0	10	9	0	45
Percentage Drinking mainly B.H/Well Wat	15	11	17	70	0	69	8	40	50	40	0	50	9
Average Room Density	3.4	1.5	2	1.8	2	1.5	1.3	1.2	1.3	2.2	2.3	1.6	2.4
Mean MagnessiumLevel	5.9	5.9	5.9	5.9	5.9	5.9	6.7	6.7	5.9	5.9	5.9	6.7	3.2
Mean Calcium Level	35.5	35.5	35.5	35.5	35.5	35.5	29.4	29.4	35.5	35.5	24.5	29.4	24.5
Mean Nitrate Level	5.1	5.1	5.1	5.1	5.1	5.1	6.2	6.2	5.1	5.1	2.3	6.2	2.3
Mean Iron Level	0.4	0.4	0.4	0.4	0.4	0.4	0.1	0.1	0.4	0.4	1	1	1

APPENDIX 5

CALCULATION OF TRESS SCORE TEST FOR CANCER INCIDENCE AMONG WARDS IN ILE-IFE

Ward	Incidence Rate	Percent	Percent Ordering	Cumulative Percent
Iremo	21	14.2	28.4	28.4
Modakeke	18	12.2	24.3	52.7
Ilare	42	28.4	14.2	66.9
Okerewe	7	4.7	12.2	79.1
Moore	17	11.5	11.5	90.6
City Centre	36	24.3	4.7	95.3
Ilode	7	4.7	4.7	100.0
Total	148	100.		513.0

Upper Numerical Limit (n x 100) = 700
Lower Numerical Limit (100 x (n – 1)/2) = 300
Mid Class Value (700 300) = 500
Calculated Tress Score Value = 513

APPENDIX 6

1991 POPULATION PROJECTION FOR WARDS IN ILE-IFE

Ward	1963 Population (1963 Census)	Projection with 2.5 Growth Rate for 1989	Projection with 2.5 Growth for 1991
City Centre	4,713	7,723	7,966
Ilare	8,620	14,159	14,605
Ilode	17,785	29,390	30,316
Iremo	30,145	47,770	51,339
Modakeke	30,844	50,843	52,445
Moore	10,733	17,806	18,367
Okerewe	27,210	44,836	46,249
Total	130,050	214,527	221,287

APPENDIX 7

PARAMETER	BEDROCK TYPE				W.H.O Standard (1971)***	
	PEGMATITE	PEGMATITE SCHIIST	GRANITE GNEIS	UNDIFF. SCHIST	Guide Level	Maximum Permissible
Hydrogen ion (pH)	6.55 –8.40 (7.01)	6.05- 8.10 (7.32)	6.00 – 6.85 (6.49)	5.80-7.90 (6.75)	7.8-8.5	6.5-9.5
Total hardness (ppm)	16.0–185.8 (76.8)	6.4-237.7 (100.8)	10.0-203.8 (77.2)	10.0-286.5 (112.8)	100	500
Calcium (ppm)	5.28-57.44 (24.52)	0.83-88.00 (29.36)	2.40- 75.20 (22.06)	2.68 – 11.80 (35.48)	75	200
Magnessium (ppm)	0.19-10.30 (3.19)	0.09 – 20.21 (6.66)	0.58-9.72 (5.36)	0.0- 34.45 (5.88)	50	150
Potassium (ppm)	1.35-102.23 (23.31)	6.55- 143.83 (50.81)	5.51-56.47 (15.47)	1.35- 93.91 (36.63)	10	12
Chloride (ppm)	0.18- 2.74 (1.06)	0.00-10.62 (1.89)	0.11-2.89 (0.75)	0.50-5.93 (1.50)	200	600
Sulphate (ppm)	4.82-170.32 (47.70)	3.94-89.59 (22.40)	3.94-37.57 (20.56)	3.94-95.09 (30.2)	200	400
Total Alkalinity (ppm)	18.00-52.00 (42.06)	31.50-234.0 (117.81)	22.00-114.0 (61.14)	5.50-239.00 (106.11)	Variable	Variable
Silicate (ppm)	2.70-14.40 (7.64)	1.76-4.35 (2.99)	2.70-11.50 (7.51)	1.78- 8.65 (4.83)	Variable	Variable
Phosphate (ppm)	0.00-0.10 (0.05)	0.50- 0.24 0.06)	0.0- 0.56 (0.09)	0.0- 0.61 (0.06)	35	61
Nitrate (ppm)	0.0 0-13.70 (2.30)	0.35-14.25 (6.16)	0.30- 14.00 (2.51)	0.03- 14.05 (5.12)	25	50
Iron (ppm)	0.00-0.22 (0.97)	0.00-0.54 (0.11)	0.09-1.14 (0.37)	0.00-3.34 (0.36)	0.30	1.0
Organic matter (ppm)	0.97-4.86 (2.22)	0.00-2.39 (1.56)	0.00-1.65 (0.61)	0.00-2.92 (0.84)	Variable	Variable

Sources: * Ako,B.D; Adeniyi, F.I and Adepoju, J. F (1990). Journal of Africa Earth Sciences Vol.10

No. 4 pp 603 – 613.

*** W.H.O Standard (cited by Oke, 1980) In the Proceedings of the First National Conference onWater Pollution and Pesticides Residues in Foods. Ed.s Akinyele, I.O; Omueti, J.A.I and Imevbore, A.M.A. University of Ibadan.

Note: Figures in parentheses are mean values.

Appendix 8

Regression

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.577[a]	.333	.309	21.43
2	.742[b]	.551	.517	17.92

Model Summary[c]

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.333	13.980	1	28	.001
2	.218	13.066	1	27	.001

a. Predictors: (Constant), %urban

b. Predictors: (Constant), %urban., 1no.indust

c. Dependent Variable: 1overall

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-12.050	8.118		-1.485	.149
	%urban	.784	.210	.577	3.739	.001
2	(Constant)	-26.754	7.911		-3.382	.002
	%urban	1.464	.257	1.077	5.694	.000
	1no.indust	-.132	.037	-.684	-3.615	.001

a. Dependent Variable: 1overall

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.604[a]	.365	.343	7.57
2	.730[b]	.533	.498	6.62

Model Summary[c]

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.365	16.108	1	28	.000
2	.168	9.692	1	27	.004

a. Predictors: (Constant), %urban

b. Predictors: (Constant), %urban., 1no.indust

c. Dependent Variable: 1breast

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-4.319	2.868		-1.506	.143
	%urban.	.297	.074	.604	4.013	.000
2	(Constant)	-8.992	2.921		-3.079	.005
	%urban	.513	.095	1.043	5.410	.000
	1no.indust.	-4.213E-02	.014	-.600	-3.113	.004

a. Dependent Variable: 1breast

Regression

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.587[a]	.345	.321	7.78
2	.681[b]	.463	.423	7.17

Model Summary[c]

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.345	14.721	1	28	.001
2	.119	5.968	1	27	.021

a. Predictors: (Constant), %urban.

b. Predictors: (Constant), %urban., 1no.indust.

c. Dependent Variable: 1cervical

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.512[a]	.262	.236	3.11
2	.757[b]	.574	.542	2.41

Model Summary[c]

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.262	9.943	1	28	.004
2	.312	19.742	1	27	.000

a. Predictors: (Constant), %urban

b. Predictors: (Constant), %urban., 1no.indust

c. Dependent Variable: 1prostate

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.888	1.178		-.753	.457
	%urban	9.597E-02	.030	.512	3.153	.004
2	(Constant)	-3.314	1.063		-3.119	.004
	%urban	.208	.035	1.110	6.028	.000
	1no.indust	-2.188E-02	.005	-.818	-4.443	.000

a. Dependent Variable: 1prostate

Regression

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.583[a]	.340	.316	3.21
2	.739[b]	.547	.513	2.71

Model Summary[c]

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.340	14.426	1	28	.001
2	.207	12.298	1	27	.002

a. Predictors: (Constant), %urban.

b. Predictors: (Constant), %urban., 1no.indust.

c. Dependent Variable: 1leuk/lymph

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.107	1.214		-.912	.370
	%urban	.119	.031	.583	3.798	.001
2	(Constant)	-3.259	1.195		-2.729	.011
	%urban.	.219	.039	1.070	5.634	.000
	1no.indust	-1.941E-02	.006	-.666	-3.507	.002

a. Dependent Variable: 1leuk/lymph

Regression

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.509[a]	.259	.233	2.08
2	.730[b]	.533	.498	1.68

Model Summary[c]

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.259	9.808	1	28	.004
2	.273	15.788	1	27	.000

a. Predictors: (Constant), %urban.

b. Predictors: (Constant), %urban., 1no.indust.

c. Dependent Variable: 1gastro-int

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	-.357	.786		-.454	.654
	%urban	5.360E-02	.020	.509	3.122	.004
2	(Constant)	-1.870	.741		-2.523	.018
	%urban	.134	.024	1.070	5.546	.000
	1no.indust.	-1.364E-02	.003	-.766	-3.973	.000

a. Dependent Variable: 1gastro-int

Regression

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.420[a]	.176	.147	1.82
2	.642[b]	.412	.368	1.57

Model Summary[c]

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.176	5.993	1	28	.021
2	.235	10.807	1	27	.003

a. Predictors: (Constant), %urban

b. Predictors: (Constant), %urban., 1no.indust.

c. Dependent Variable: 1liver

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	.188	.690		.272	.788
	%urban.	4.362E-02	.018	.420	2.448	.021
2	(Constant)	-.981	.692		-1.418	.168
	%urban.	9.764E-02	.022	.940	4.344	.000
	1no.indust.	-1.054E-02	.003	-.711	-3.287	.003

a. Dependent Variable: 1liver

Regression

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.513[a]	.263	.237	1.73
2	.754[b]	.568	.536	1.35

Model Summary[c]

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	.263	10.017	1	28	.004
2	.305	19.056	1	27	.000

a. Predictors: (Constant), %urban

b. Predictors: (Constant), %urban., 1no.indust

c. Dependent Variable: 1gland/int.org

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	-.212	654		-.325	748
	%urban	5.345E-02	017	513	3.155	004
2	(Constant)	-1.545	594		-2.601	015
	%urban	115	019	1.105	5.961	000
	1no.indust	-1.202E-02	003	-.809	-4.365	000

a. Dependent Variable: 1gland/int.org

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	104	428		242	811
	%urban	3.332E-02	011	.495	3.012	005
2	(Constant)	-.603	434		-1.389	176
	%urban	6.597E-02	014	980	4.679	000
	1no.indust	-6.368E-03	002	-.663	-3.167	004

a. Dependent Variable: 1respiratory

Regression

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.495[a]	245	218	1.13
2	.670[b]	449	409	.98

Model Summary[c]

Model	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
1	245	9.072	1	28	005
2	205	10.031	1	27	004

a. Predictors: (Constant), %urban

b. Predictors: (Constant), %urban, 1no.indust

c. Dependent Variable: 1respiratory