International Journal of Current Educational Research | Vol. 1 No. 1 January 2021
ISSN: 2710-4982 (Online) 2710-4974 (Print)
Published by: Radix Research Center and Publications | Dhaka, Bangladesh

STATISTICAL STUDY ON THE IMPACT OF IMMUNIZATION PROGRAMME ON SOME PREVALENT CHILDHOOD DISEASES (A case study of Federal Medical Centre Owerri, Nigeria from 1997-2011)

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ABSTRACT

This study attempts to use simple regression analysis, correlation analysis and Analysis of the variance (one-way) to analyse the total number of infants immunized under National Proramme on immunization and total number of infants with the six childhood diseases in NAUTH Nnewi from 1991 – 2001. The statistical software packages known as the MEGASTAT and MINITAB Version 16.0 were used for the analysis. The simple regression analysis showed that the simple regression model is an adequate model for the number of children contracting the disease, (Y) on the number of children immunized (X). The correlation analysis went ahead to show that except for DPT and Tetanus toxoid, other vaccines had an impact on the diseases they are meant to prevent. The one-way ANOVA test showed that making further studies on the effectiveness of vaccines against the mean number of children immunized are in the following order. $\mu_M = \mu_B < \mu_D < \mu_T = \mu_0$ while the most contractible diseases are measles and tetanus, and the least contractible diseases are tuberculosis and poliomyelitis.

Keywords: Immunization Programme, Prevalent Childhood Diseases, Regression analysis, Analysis of variance, correlation model.

INTRODUCTION

1. BACKGROUND OF THE STUDY

The Rural Healthy People 2010 survey found the "immunization and infectious disease" focus areas virtually tided with "injury and violence prevention" before the 13th ranking rural health priority among 28 Healthy people in 2010 focus area (Gamm et al; 2010). It was nominated by an average of 17 percent of the four groups of state and local rural health leaders. Of these four groups, local public health agencies were most likely to select, and state organizations were least likely to select, immunization and infectious disease as a rural priority. There were no significant differences among the four regions of the country with respect to selection of this topic as a rural priority area.

2. HISTORY OF NPI IN NIGERIA

In 1978, WHO and UNICEF introduced the said EPI at Owo Local Government Area in Ondo State and were launched in 1979 as a follow-up to the smallpox eradication campaign. Due to the success achieved by WHO, the federal government of Nigeria then adopted the Owo's System of giving vaccine to children. The implementation however resulted to a small coverage of 5% - 10% and this just had a little impact on the targeted immunizable disease.

A new strategy was developed and tested by WHO and UNICEF in 1983/1984 in the same Owo local government area to address the identified constraints of logistics, supervision, cold chain, vaccine supply and community mobilization. This model was the supplicated in a phased manner in the whole federation.

It was estimated that 200,000 children died due to mal-nutrition and various diseases including the six killer diseases in 1984 when there was virtually no immunization worth speaking of. From this it was estimated that in 1989, some 320,000 children would die of these diseases and malnutrition, if nothing was done. However due to the recorded immunization coverage of about an average of 60% that was achieved in 1989, 100,000 children were saved through immunization alone. Due to the success of the programme, it was launched in all the state of the federation.

3. THE OBJECTIVES OF NPI

WHO set-up EPI which is now known as NPI in Nigeria with the aim of assisting all nations to carry out immunization of their 0 – 2 years infants populations against the six childhood diseases. The NPI therefore has the following objectives.

(i) To reduce morbidity and mortality from the six childhood killer diseases by immunizing all children.
(ii) To vaccinate all women of child bearing ages (15 – 55) for the dual purpose of protecting the unborn baby and the mother.
(iii) To promote national self-reliance in delivering immunization services within comprehensive health services.
(iv) To promote regional self-reliance in vaccines production and quality control.

3. STATEMENT OF THE PROBLEM

Generally, children's health is an important aspect of any government planning because they are leaders of tomorrow. And as such, it is of utmost importance to reduce death rate among children. Hence, the NPI, meant for the protection of children and pregnant mothers against the six deadly diseases. But, unfortunately, mother and children appears to not to have effectively availed themselves of the services provided by this programme hence the prevalent relatively high number of children that contracted the diseases in Imo State.

Also important to consider, the impact of immunization on the mortality and morbidity caused by these six childhood diseases, since recipients are assured protection on the completion of the immunization schedules. The question now is how effective is the protection offered by these immunization.

Another significant problem facing the NPI is the inconsistent funding of the programme by the federal government. This has contributed to inadequate procurement of equipments and non-recruitment of qualified staff for the realization of the aims of NPI.

It is these constraints that this study seeks to statistically identify as well as provide good statistics, using statistical methods for proper evaluation of the NPI in Federal Medical Centre, Owerri.

This paper is aimed at

(i) Checking if there is relationship between the numbers of children immunized and those that contracted the six childhood disease in F.M.C. Owerri.
(ii) Checking if really whether those that contracted the disease depends on those immunized.
(iii) Checking if there is an increase in the number of infants immunized and a decrease in the number of infants with diseases or vice versa.
(iv) Determining which of the vaccine is in higher demand.
(v) Determining the most contracted diseases.

5. SIGNIFICANCE OF THE STUDY

The prime position occupied by the target population (women and children) makes this work of high significance, as government and officials of NPI will find the result of this work an invaluable asset in their future plans in bequeathing this country with healthy future leaders.

Also the effectiveness of the programme so far which will be deduced from this work will better equip government with tools to plan for a better immunization policy.

6. SCOPE OF THE STUDY

The scope of this study is mainly children aged 0 – 2 years and pregnant women who have been immunized and infants that contracted the diseases in F.M.C. Owerri. Groups considered during the course of study include infants that are fully and partially immunized. Data used spanned a period of fifteen years from 1997 to 2011, hence is wide enough to give a fairly good assessment of the impact of the NPI programme.

7. DEFINITION OF TERMS

i. **Measles**: measles is a disease characterized by a high fever, rashes on the body, cough, running nose and red eyes. It is a viral disease and highly infectious. Serious cases of measles cause blindness and death.
- **Symptoms**: high fever, running nose, rashes, redness of the eyes, white spots inside the check and mouth.
- **Transmission**: it is spread by droplet or through direct contract with the secretion from the nose and throat of an infected person.
- **Prevention**: it is prevented by immunization with the vaccine immune serum globulin (ISG) at 9 months of age. Measles vaccine is a live attenuated virus in powered form. This should be diluted with cold dilutes.

ii. **Whooping cough (pertussis)**: Pertussis is a serious disease, which affects young children and last for about 6 weeks. It is caused by a bacteria pertussis bacilli.
- **Cough** followed by characteristic spasmodic whoop or sometimes in younger children vomiting, running rose, loss of appetite, puffiness of the face around the eyelids, and hermia in severe cases. Some of this complications many lead to death.
- **Transmission**: it is a droplet infection and also by direct contact with the discharge from the mucous membrane of an infected person.
- **Prevention**: it is prevented by the vaccine DPT. Pertussis vaccine is the “P” component in DPT. It is given to infants from 6 weeks of age and repeated at intervals of at least 4 weeks for 3 doses.

iii. **Diphtheria**: This is caused by bacterial infections of the skin or respiratory tract (usually the throat). If it is very serious, it kills through suffocation and heart failure.
- **Symptoms**: inflammation of area of respiratory tract, paleness of face, skin infection resembles common skin lesion with pus. Abnormalities of heart and nervous system.

- **Transmission**: it is an air born disease.
- **Prevention**: it is prevented by immunization with DPT vaccine. Diphtheria vaccine is the "D" component in DPT. It is given from 6 weeks of age and repeated of at least 4 weeks for 3 doses.

iv. **Neonatal Tetanus**: This is caused by a bacterial organism, which enters the body through open wounds and punctures, affects the new born baby through the umbilicus at circumcision. It has a high mortality rate.

- **Symptoms**: muscle spasurs, lock jaw, the baby stops sucking the breast, high temperature and stiff neck.
- **Prevention**: it is prevented by immunization of pregnant women at and infants by tetanus toxoid (TT). TT is given to pregnant women at 10 weeks of and second dose at a minimum of interval of 4 weeks. This protects the mother for 3 years and the baby for 6 weeks after birth, before DPT is given to the baby. DPT contains the antigen vaccine against tetanus. The "T" component in DPT stands for tetanus vaccine.

v. **Poliomyelitis**: polio is a disease characterized by muscle weakness or paralysis, especially of legs. It can effect the muscle of respiration thereby causing death.

- **Symptoms**: fever, the limb maybe weak or paralysed, flaccid paralysis of one leg or both legs.
- **Transmission**: facial oral spread is the major route of transmission when sanitation is poor.
- **Prevention**: it is prevented with either oral or injectable polio vaccine. The oral vaccine is given to infants from 6 weeks of age, along with DTP for 3 doses at 4 weeks interval. It is given in form of mouth drips.

vi. **Tuberculosis**: Tuberculosis is an infectious disease caused by Tubercle bacillus and is contacted mainly through droplets from cough of an infected person and also by drinking raw and unpasteurised milk.

- **Symptoms**: Low grade fever, marked loss of weight, profuse sweating at night, dry-unproductive cough. It is an ninfectous contagious milk.
- **Transmission**: it is spread by droplet and direct contact with saliva coughed out from the throat of the infected person (sputum).
- **Prevention**: BCG (Bacilli Calmette Guerine) vaccine should be given as soon as possible after birth. Proper disposal of the sputum of an infected person and isolation from the new born baby. Only one dose of BCG gives life immunity.

vii. **Vaccine failure**: when a vaccine lose its potency, expires and the mother's antibodies acquired by the child may neutralize the vaccine. When any of these three conditions takes place we say that the vaccine has failed to protect the child.

viii. **Booster Dose**: additional dose of a vaccine given to an individual when he has already been given the recommended dose by EPI for the continued protection of the individual against any of the immunizable disease is called a booster dose.

ix. **Cold Chain**: this is a procedure that ensures that the potency of vaccine are secured by seeing that they are kept at the correct low temperature from the time they leave the producer until they reach the people to be vaccinated.

8. LITERATURE REVIEW

Etuk(2001), in a study carried out in UCTH Calabar, showed that there was an increase in the incidence, morbidity and mortality ratios from measles infection in the year 1997 to 1999 compared to year 1992 of 1996. 1997 to 1999 recorded a total of 72 cases of measles while 1992 to 1996 recorded a total of 36 cases of measles. They attributed the upsurge to changes in the methods vaccine procurement and distribution in the country.

Collis(1971), from his epidemiological findings about communicable diseases, concluded that polio was known to be responsible for at least 100,000 cripples in Nigeria.

Madubuike (1995), in a seminar on the "incidence of Tetanus in Nigeria" recorded that the percentage of children immunized and that of pregnant women immunized against tetanus in Nigeria in 1993 was 31.06 and that of 1995 was 44.26 showing a 13.2% increase in the programme in 1995.

Adeyemi (1999), in a seminar on the "control of tuberculosis" on World Tuberculosis Day, showed that world wide, that there are about 10 million new cases of tuberculosis with 3 to 4 million deaths. He revealed that without treatment after 5 years that 5% of pulmonary tuberculosis patients will be "some-where" while 25% will remain ill with chronic infectious diseases.

Uzor(1987), studying immunization against tuberculosis, diphtheria, pertussis, tetanus and polio in Nsukka local government area, found that the immunization status of children in this area was slow. Using five towns in Nsukka Local government area, namely Opi, Isienu, Edem, Nsukka and Ehandiagu, he discovered that only 512 or 4.7% of the 10,851 one year old children surveyed has received the BCG vaccine, 609 or 5.6% received the triple antigen vaccine, and 120 or 1.1% were immunized with polio vaccines. He concluded that low immunization status was due to lack of vaccines in Health centres within the local government, lack of refrigeration for preservation and poor responses by illiterate parents.

Fatunde and Familusi (2001), in a study carried out on 94 cases of post-neonatal tetanus patients in University College Hospital, Ibadan between 1988 to 1999 shows that 82 (87%) case of the 94 cases were aged 5 years and above. 43, 8 and 15 patients received doses of DPT immunization of 0, 1 – 2 and 3 doses respectively. No patient had tetanus toxoid (TT) administered after infancy. The findings indicates that the current EPI recommended doses of DPT vaccine given during infancy without provision for booster doses is inadequate for tetanus prevention during childhood. It suggested two extra doses of TT between ages four-six and 11 to 12 years be given to all children.

WHO (1995), in its annual report estimated that more than 75% of infants born in 1993 were fully immunized and 45% of pregnant women were immunized to protect their babies against neonatal tetanus. With the current levels of immunization, EPI prevent an estimated 2,900,000 deaths from measles, neonatal tetanus and pertussis and 560,000 cases of poliomyelitis each year. It also, estimated that each year 110,000 children are still being crippled by polio, 500,000 babies die of neonatal tetanus, and 1,200,000 children die from measles.

Morley (19965), in his literature on the virulence of infectious disease in developing countries, observed that disease which are largely preventable, constitute major health problems in developing countries.

In the course of this study, in did not come across any research that attempts to statistically analyse the National programme on Immunization in NAUTH Nnewi at present. This study is therefore, an effort to fill the gap.

Childhood vaccination rates are considered a marker of the general quality of pediatric care given the high correlation between immunizations and other measures of preventive care (Rodewald, et al; 1995). Thus, disparities in immunization coverage rates may reflect problems in the quality of pediatric health care for these subgroups. High immunization rates have resulted in low rates of vaccine-preventable disease (VPD) and subsequently, insulated the U.S. from many of the consequences of such diseases. Without vaccines, children under age 18 are estimated to be 22 times more likely to acquire measles and six times more likely to acquire pertussis (whooping cough). Children in day care facilities would be 60 times more likely to acquire measles and 16 times more likely to acquire pertussis (Edwards, 2000).

Childhood morbidity and mortality have been dramatically reduced in the past 50 years with routine vaccinations (Hinman, and Orenstein 1999). The public health practice of routine vaccine use among all U.S. children has resulted in the eradication of smallpox, the elimination of poliomyelitis from the Western Hemisphere, and the control of other infectious disease such as measles, rubella, tetanus, diphtheria, and haemophilus influenzae type b (Centres for Disease Control and Prevention (CDC); 1999). As of 1998, the annual number of cases for nine vaccine-preventable diseases (smallpox, diphtheria, pertussis, tetanus, poliomyelitis, measles, mumps, rubella and haemophilus influenza type b) decreased between 95 percent and 100 percent since 1900 (Centres for Disease Control and Prevention (CDC); 1999).

Children are currently recommended to receive vaccinations for 10 childhood diseases including diphtheria, tetanus, whooping cough, bacterial meningitis, poplio, hepatitis B, chicken pox, measles, mumps, and rubella (Abbot, and Olness, 2001). A total of 16 to 20 doses of seven different vaccines are recommended by 18 months of age (Recommended childhood immunization schedule; 2001). In 2000, the national childhood immunization coverage for the combined 4:3:1:3:3 series (four or more doses of diphtheria and tetanus toxoids and pertussis vaccine [DTP]; three or more doses of oral poliovirus vaccine; one or more doses of measles, mumps, and rubella vaccine (MMR); three or more doses of Haemophilus influenzae type b [Hib]; and three or more doses of hepatitis B) was 73 percent, well below the target of greater than 90 percent set by Healthy people 2010 (U.S. Department of Health and Human Services; 2000 and National, State and Urban are vaccination coverage levels among children age 19-35; 2001). The vericella vaccine for chickenpox had the lowest coverage of all vaccines at 68 percent (National, State and Urban are vaccination coverage levels among children age 19-35; 2001). The pneumococcal conjugate vaccine was added to the schedule of recommended vaccine in 2001 by the Centre for Disease Control (CDC) Advisory Committee on Immunization practices, the American Academy of family Physicians, and the American Academy of Pediatrics (Recommended childhood immunization schedule; 2001).

DTP, polio and MMR vaccination coverage levels for school-aged children (five to six years old) have state-mandated completion of the immunization series by the time of school entry (Orenstein, et al.; 1990). Coverage levels for infants and toddlers, however, have been much lower and are in need of improvement (National, State and Urban are vaccination coverage levels among children age 19-35; 2001).

Studies evaluation immunization coverage in infants and toddlers has revealed poor rates in both rural and urban areas. Data from the 1991 National Maternal and Infant Health Survey (NMIHS) and the 1993 National Health Interview Survey (NHIS) were evaluated to compare urban and rural immunization rates for the basic 4:3:1 series before 36 months of age, (Lowery, et al; 1998 and Steiner, et al; 1996). No differences in immunization rates were detected between metropolitan urban and nonmetroplitan areas, though rates failed to exceed 70 percent for either area. CDC data from 1994 reveal 66 percent of rural children (19 – 35 months) were immunized for the basic 4:3:1 series compared to 71 percent of suburban and 62 percent of urban children (Vaccination coverage among two-year-old children; 1994). Thus, roughly one-third of urban and rural children under three years of age could be characterized as under-immunized in 1993 and 1994.

According to 1995 county-level immunization data from 11 state public health agencies, non-metropolitan countries had higher immunization coverage for the 4:3:1 series for two-year-old children in the public sector (by 2.5 percentage points) than metropolitan countries (Slifkin, et al; 1997). However, in a cross-sectional survey of two-and three-year-old children visiting selected private pediatric practices, Taylor et al reported that children seen in practices located in small towns with a population less than 50,000 were less likely to be fully immunized than those visiting practices in large (> 250,000) or mid-sized cities (50,000 – 250,000) (Taylor et al; 1997).

More recently, the vaccination coverage rates of preschool-aged children were compared among urban, suburban, and rural children aged 19 to 35 months who participated in the 1999 National Immunization survey (Stokley et al; 2001). In this study, urban, suburban and rural residence was defined by using residence, which were then assigned one of five metropolitan statistical area (MSA) categories as described by the Office of Management and Budget. Urban was defined as those living within the central city of an MSA, and rural included those living outside MSAs. Suburban included all others (those living outside the central city of an MSA but within the country containing the central city, in the MSA but not in the central city country, or in an MSA that does mot contain a central city). Coverage levels for the basic 4:3:1:3 series (for does of DTP, three does of poliovirus vaccine, one dose of MMR vaccine, and three doses of Hib vaccine) were slightly higher for rural children (79.6 percent) compared to urban children (76.7 percent) and no different than suburban children (79.1 percent), but all remained well below the Healthy People 2010 goal of 90 percent (U.S. Department of Health and Human Services; 2000).

ISSN: 2710-4982 (Online) 2710-4974 (Print)
Published by: Radix Research Center and Publications | Dhaka, Bangladesh

According to CDC National immunization Survey (NIS) data from 2002, children ages 19 to 35 months residing in a non-central city metropolitan statistical areas reported the highest immunization rates for the basic 4:3:1 series, 4:3:1:3 series, and vericella vccine compared to children in MSAs with a central city and nonMSA areas ([CDC] National Immunization Programe; 2003), including all 50 state and 25 immunization action plan areas. Four or more doses of DTP, three or more doses of poliovirus vaccine, one or more doses of any measles-containing vaccine (MCV), three or more doses of Hib. For or more doses of DTP, three or more doses of poliovirus vaccine, or more doses of any MVC, three or more doses of Hib, and three or more doses of Hep B.

Stokey, 2001, found when vaccination coverage for individual vaccines was evaluated, significantly lower levels of varicella coverage were observed among rural children (47.2 percent) compared to urban (58.9 percent) and suburban (60.5 percent) children (Stokley et al; 2001). Rates for pneumococcal conjugate immunization (three or more doses) among children ages 19 – 35 months were also lower in nonMSAs than MSAs with and without a central city (32 percent, versus 41 percent and 45 percent, respectively); however, immunization rates among nonMSAs and MSAs with and without central cities were comparable for three or more doses of hepatitis B vaccines (90 percent, versus 89 percent and 91 percent, respectively), (CDC, National Immunization Programme; 2003).

Vaccination coverage levels were also found to differ by rural, urban, and suburban residence when evaluated by various subgroups defined by race, ethnicity, education, and income. Counter-intuitively, socially advantaged rural children faired worse than disadvantaged rural children when compared to their urban and rural counterparts. Rural children living above the poverty level with households incomes exceeding $75,000 had lower coverage levels (76.2 percent) than similar urban (84.9 percent) and suburban (83.4 percent) children (Stokley et al; 2001). Conversely, rural children who were non-Hispanic blacks, those whose mother had less than a high school education, and those who received their vaccinations from public facilities each had better coverage levels than their urban and suburban counterparts (Stokley et al; 2001).

One barrier to high immunization rates is the problem of record scatter, which occurs when patients visit multiple providers to receive immunizations. A number of studies have evaluated the impact of referral patterns and providers type on immunization rates. Heuston, et al. tracked the immunization status of all children born within one year (mid 1988 to mid 1989) in two rural countries and four urban census tracts in Kentucky (Hueston, et al. 1994). This study found rural children utilized public health clinics more often for immunization services than urban children. Furthermore, children seeing public providers were less likely to have up-to-date immunization records compared to those seeing private providers (44 percent versus 66 percent) (Hueston, et al.1994). A statewide survey of children born in Kentucky in 1990 – 1991, however, showed different results. Rural children served by the public health sector had higher rates of adequate immunization coverage (4:3:1 basic series) by age two than rural children served by the private sector and urban children served by public health departments or private providers (Kentucky Department of Health; 1994). Immunization coverage in this study ranged from 56 percent (children served by urban health department) to 68 percent (rural children served by health departments).

A national study conducted in 1994 of the 36,000 members of the American Academy of Pediatrics further examined the referral practices of pediatricians in an attempt to understand low immunization rates during the early 1990s. Researchers found immunization referrals to public health clinics were more common among pediatricians in nonmetropolitan areas (63.9 percent than pediatricians in large (44.7 percent) and small (52.5 percent) metro areas (Ruch and O'Connor, 1994). This same study found that in states with programs providing free or reduced cost vaccines to providers, pediatricians were less likely to refer patients for immunizations.

Note: during this 1994 study, only 16 states had vaccines programs in place that provided some or all vaccines free or at reduced cost to providers. More recent studies have found that since the implementation of the Vaccines for Children Program, providers participating in VFC may be less likely to refer uninsured children to public clinics for their vaccinations than those who do not participate in the program (44 percent

versus 90 percent), although this study did not include comparisons of rural versus urban (Zimmerman et al. 1997). A study of rural Colorado physicians found that 40 percent of patients are referred for immunizations for insurance reason (Deutchman, et al. 2000). Referral patterns also vary by specialty type. In a 1997 Texas study (Roche et al. 2000), rural pediatricians and family practitioners were more likely than general practitioners to offer immunizations to children (80 percent, 76 percent and 54 percent respectively). In the same study, rural pediatricians were significantly more likely than family pediatricians and general practitioners to participate in the VFC program (52.9 percent, 40.8 percent and 33.3 percent, respectively). Forty percent of pediatricians participated in VFC, accepted Medicaid, and did not refer the uninsured for immunizations compared to 31.5 percent of family practitioners (FPs) and 25.5 percent of general practitioners (GPs) (Roche et al. 2000). While this study suggests pediatricians are less likely to refer children for immunizations (even in rural areas), there are fewer pediatricians in rural areas (Gamm, et al. 2003) and children may be referred more often to public health providers in rural areas, compounding the problem of record scatter. Overall, a study of 1999 National Immunization Survey data found that rural children are more frequently vaccinated at public clinics than suburban and urban children (Stokley, et al. 2001).

A component of full immunization coverage is also timely coverage. Williams, 1994 reported considerable delays in vaccine administration before school entry for urban, suburban, and rural children in Maryland (Williams et al.; 1994). By the age of two, children in rural areas experienced delayed immunization more often than suburban children but less frequently than urban children (Williams et al.; 1994).

Disparities in infectious disease prevalence also exist among ethnic and special populations. Latino children, representing the largest minority group of children (11.6 million) are 13 times more likely to be infected with tuberculosis than white children (Flores, et al.; 2002). Children of farm laborers, predominantly of Latino descent (94 percent), also have higher rates of tuberculosis, parasites, and sexually transmitted disease (Flores, et al.; 2002). In a Florida study, migrant farm worker children ages six to 11 years were found to have a higher seroprevalence of hepatitis A than the same age group in the general U.S. population (57 percent versus 10 percent) (Dentinger, et al.; 2001). One study found that the prevalence of hepatitis A in children residing in rural Texas Colonias areas was 37 percent compared to 17 percent in the urban border area of McAllen, Texas and 6 percent in the San Antonio, Texas, metro area. However, the prevalence of hepatitis B and C in these Colonias studied was comparable to U.S. rates (Leach, et al.; 1999). Cryptosporidium parvum, a parasite, was also high in Colonias areas than urban border and urban nonborder communities (Leach, et al.; 2000).

Note: Colonias are unincorporated and impoverished rural areas along the United States/Mexico border. These areas are home to 350,000 residents in 1,450 Colonias in Texas alone. Over half of the residents do not have access to adequate water supplies and waste water system (Colonias in Texas, 2003). These substandard conditions make residents particularly vulnerable to hepatitis A, which is transmitted person to person through unsanitary conditions, such as poor hand-washing practices and contaminated cooking utensils and overcrowding (Hepatitis A Transmission, 2003). Otitis media (OM), also known middle ear infection, is the most common childhood bacterial infection –accounting for an estimated 24 million cases annually. Amoxicillin is the recommended first line antibiotic treatment for otitis media. Appropriate use of first line antibiotics slows antibiotic resistance. One Healthy People 2010 objective is to decrease the number of courses of antibiotics for ear infections. In a study analyzing the antibiotic prescribing patterns of rural and urban physicians in a Midwestern health plan, researchers, found urban physicians more likely to prescribe amoxicillin for OM than rural physicians (31 percent versus 28 percent), although the differences were modest (McEwen, et al.; 2003). The same study found the prescribed duration of antibiotic treatment for children over two years old was longer than the recommended duration of five to seven days for acute infections; however, for individuals of all ages with recurrent infection, the prescribed duration was less than recommended (10 versus ≥ 14 days).

Having reviewed other people's work, we shall use Regression analysis and Analysis of variance techniques to investigate the records of infants immunized by specific vaccines for the years 1997-2011 and the number of infants that contracted the six childhood diseases for the years 1997-2011, using Federal Medical Centre, Owerri.

9. DATA COLLECTION AND METHOD OF ANALYSIS

In this chapter, we shall discuss the technique adopted in data collection, limitations and method of analysis.

10. DATA COLLECTION

The data collected for this study, are secondary data. These data collected are on the number of infants immunized by specific vaccines for the years 1997 – 2011 and the number of infants that contracted the six childhood diseases for the years 1997 – 2011, from the department of medical records F.M.C. Owerri.

At this point, it would be interesting to explain how these figures were obtained. For the data on the number of infants immunized in the hospital, nurses that carry out the immunization, records the number of infants immunized every week of the month in a register, Which is transferred to the medical records department at the end of every month-while for the data on the number of infants that contracted the six childhood diseases, the nurses at the pediatrics department records the number of infants that were brought to the hospital with the diseases in a register on a daily basis. In the pediatrics section, there are two kinds of registers used for the recording of these cases of infants with these diseases; namely

i. In-patients registers and
ii. Out-patients register

11. DATA PRESENTATION

The collected data are hereby presented below:

Table 1: Total number of infants immunized from 1997 – 2011 by type of vaccine

Year	BCG	DPT	OPV	Measles	Tetanus toxoid	Total
1997	645	723	1347	765	1987	5467
1998	754	1678	1897	898	2356	7583
1999	764	1657	2345	987	2345	8098
2000	700	2374	2367	996	2456	8893
2001	823	2355	1987	1201	3245	9611
2002	985	2456	2456	1543	3211	10651
2003	896	2357	3467	1654	2543	10917
2004	1200	2346	4509	1563	3654	13272
2005	1368	2478	2590	1534	4102	12072
2006	1654	3109	2356	798	2987	10904
2007	1674	2765	2367	989	4321	12116
2008	2013	3089	3256	1308	2673	12339
2009	1879	3243	2675	1988	3425	13210
2010	1764	3456	3908	1277	2342	12747
2011	1874	3987	4190	1877	4324	16252
Total						164132

TABLE 2: TOTAL NUMBER OF INFANTS THAT CONTRACTED THE SIX CHILDHOOD DISEASES FROM 1997 – 2011

YEAR	MEASLES	PERTUSSIS	TUBERCULOSIS	POLIOMYELITIS	TETANUS	DIPHTHERIA	TOTAL
1997	69	46	24	41	49	58	287
1998	89	65	34	32	59	49	328
1999	46	68	23	29	45	47	258
2000	67	46	16	32	49	52	262
2001	98	57	8	29	87	42	321
2002	87	37	12	26	34	39	235

YEAR	MEASLES	PERTUSSIS	TUBERCULOSIS	POLIOMYELITIS	TETANUS	DIPHTHERIA	TOTAL
2003	67	46	6	17	39	23	198
2004	50	45	9	32	25	17	178
2005	69	23	5	23	31	19	170
2006	94	14	9	18	23	24	182
2007	56	6	6	12	19	14	113
2008	87	5	5	4	14	9	124
2009	67	4	5	6	21	3	106
2010	45	7	6	7	13	7	85
2011	39	5	5	4	10	2	65
TOTAL							2912

TABLE 3: Percentages of the Total Number of Infants Immunized and Total Number of Infants with Disease Each Year

Year	Total No. of infants immunized each year	Percentage	Total No. of infants with disease each year	Percentage
1997	5467	3.33	287	9.86
1998	7583	4.62	328	11.26
1999	8098	4.93	258	8.86
2000	8893	5.42	262	9.00
2001	9611	5.86	321	11.02
2002	10651	6.49	235	8.07
2003	10917	6.65	198	6.80
2004	13272	8.09	178	6.11
2005	12072	7.36	170	5.84
2006	10904	6.64	182	6.25
2007	12116	7.38	113	3.88
2008	12339	7.52	124	4.26
2009	13210	8.05	106	3.64
2010	12747	7.77	85	2.92
2011	16252	9.90	65	2.23
Total	164132	100	2912	100

12 METHOD OF ANALYSIS

The method of analysis we shall use in this research work is as follows;

(i) Regression analysis.

(ii) Analysis of variance

12.1 REGRESSION ANALYSIS

Regression analysis is a statistical technique that express mathematically the relationship between two or more quantitative variables such that one variable (the dependent variable) can be predicted from the other or others (independent variables). Regression analysis is very useful in predicting or forecasting (Inyama and Iheagwam, 2006). It can also be used to examine the effects that some variables exert on others. However, regression analysis may be simple linear, multiple linear or non linear.

12.2 SIMPLE LINEAR REGRESSION

This is a regression line involving only two variables as it is applicable in this research work. A widely used procedure for obtaining the regression line of y and x is the least square method developed by Carl Fredrick Gauss (1777 – 1855), a great German mathematician.

The linear regression line of y on x is

$$y = \beta_0 + \beta_1 x + \varepsilon_I \quad \ldots \quad (1)$$

Suppose we have n pairs of sample observations $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$, then applying (3.1), we have

$$y_i = \beta_0 + \beta_1 x_i + \varepsilon_I, \; i = 1, 2, \ldots, n \quad \ldots \quad (2)$$

We now seek the estimators $\hat{\beta}_0$ and $\hat{\beta}_1$ of β_0 and β_1 respectively such that L is minimum.

Let $L = \sum_{i=1}^{n} e_i^2 = \sum_{i=1}^{n} (y_i - \beta_0 - \beta_1 x_i)^2 \quad \ldots \quad (3)$

Differentiating (3.3) partially with respect to β_0 and β_1, we have

$$\frac{\partial L}{\partial \beta_0} = -2\sum_{i=1}^{n} (y_i - \beta_0 - \beta_1 x_i) = 0$$

$$\Rightarrow \quad \sum y_i - n\beta_0 - \beta_1 \sum x_i = 0 \quad \ldots \quad (4)$$

$$\frac{\partial L}{\partial \beta_0} = -2\sum_{i=1}^{n} x_i (y_i - \beta_0 - \beta_1 x_i) = 0$$

$$\Rightarrow \quad \sum_{i=1}^{n} x_i y_i - \beta_0 \sum_{i=1}^{n} x_i - \beta_i \sum_{i=1}^{n} x_i^2 \quad \ldots \quad (5)$$

Solving (4) and (5) simultaneously, we have

$(4) \times \sum x_i \Rightarrow \sum x_i \sum y_i - n\beta_0 \sum x_i - \beta_1 (\sum x)^2 = 0 \ldots \quad (6)$

$(5) \times n \Rightarrow n\sum x_i y_i - n\beta_0 \sum x_i - n\beta_1 \sum x_i^2 = 0 \quad \ldots \quad (7)$

(7) – (6): $n\sum x_i y_i - \sum x_i \sum y_i$

$$- n\beta_1 \sum x_i^2 + \beta_1 (\sum x_i)^2 = 0$$

$$\Rightarrow \quad n\sum x_i y_i - \sum x_i \sum y_i = n\beta_1 \sum x_i^2 - \beta_1 (\sum x_i)^2$$

$$\Rightarrow \quad \beta_1 \left(n\sum x_i^2 - (\sum x_i)^2\right) = n\sum x_i y_i - \sum x_i y_i$$

$$\therefore \quad \hat{\beta}_1 = \frac{n\sum x_i y_i - \sum x_i y_i}{n\sum x_i^2 - (\sum x_i)^2} \quad \ldots \quad (8)$$

From (3.4), we have

$$\frac{\sum y_i}{n} - \frac{n\beta_0}{n} - \frac{\beta_1 \sum x_i}{n} = 0$$

$$\bar{y} - \hat{\beta}_0 - \beta_1 \bar{x} = 0$$

$$\therefore \quad \hat{\beta}_0 = \bar{y} - \beta \bar{x} \quad \ldots \quad (9)$$

Alternatively, we can substitute (8) into (5) to obtain

$$\hat{\beta}_0 = \frac{\sum x_i^2 \sum y_i - \sum x \sum xy}{n\sum x_i^2 - (\sum x)^2} \quad \ldots \quad (10)$$

12.3 PROPERTIES OF LEAST SQUARES ESTIMATORS

Some of the properties of least square estimators are

(a) $\hat{\beta}_0$ and $\hat{\beta}_1$ are biased estimators of β_0 and β_1 respectively:

$E(\varepsilon_i) = 0$, var. $(\varepsilon_i) = \delta^2$, $E(\varepsilon_I, \varepsilon_j) = 0$, $\quad i \neq j$

(b) $$\sum_{i=1}^{\infty} e_i = 0$$

(c) $$\sum_{i=1}^{n} y_i = \sum_{i=1}^{n} \hat{y}_i$$

(d) $$\sum_{i=1}^{n} x_i e_i = 0 \Rightarrow \sum_{i=1}^{n} x_i y_i = \sum_{i=1}^{n} x_i \hat{y}_i$$

(e) $\sum_{i=1}^{n} \hat{y}_i e_i = 0$

(f) $\sum_{i=1}^{n} e_i^2$ is a minimum

12.4 HYPOTHESIS TEST ABOUT β

Another way of evaluating the sample regression equation is to use b, the slope of the sample line, as a basis for testing the null hypothesis of no regression. When the assumptions of linear regression are met, it can be shown that b is a point estimator of β. Under the stated assumptions, the sampling distribution of β is normal with mean $\mu_0 = \beta$ and variance

$$\sigma_b^2 = \frac{\sigma^2}{(n-1)S_x^2} \qquad \ldots. (11)$$

where σ^2 is the variance about the population regression line. If σ^2 is known, the test statistic is

$$Z = \frac{(b-\beta_0)S_x\sqrt{n-1}}{\sigma} \qquad \ldots (12)$$

However, if σ^2 is unknown, we estimate it by S^2, where;

$$S^2 = \frac{n-1}{n-2}\left(S_y^2 - b^2 S_x^2\right), \qquad \ldots (13)$$

$S_y^2 = \frac{\Sigma Y^2}{n} - \overline{Y}^2$ is the sample variance for Y

and $S_2^2 = \frac{\Sigma X^2}{n} - \overline{X}^2$ is the sample variance for X

The test statistic then becomes

$$t = \frac{(b-\beta_0)S_x\sqrt{n-1}}{S} \qquad \ldots (14)$$

which has a t distribution with n – 2 degrees of freedom.

12.5 ASSUMPTIONS OF LINEAR REGRESSION MODEL

According to Nwachukwu (2003), the following assumptions of linear regression model are;

(i) The magnitude of the measurement error in X is negligible.
(ii) The values of X may be either "fixed" or "random".
(iii) For each value of X, there is a subpopulation of Y values. These subpopulations must be normally distributed for most of the inferential procedures of estimation and hypothesis testing to be valid.
(iv) The variances of the subpopulations of Y are all equal.
(v) The means of the subpopulations of Y all lie on the same straight line.
(vi) The Y values are statistically independent. This means that in drawing the sample, the values of Y chosen at one value of X in no way depend on the values of Y chosen at another value of X.

12.6 THE CORRELATION MODEL

If our interest is to obtain a measure of the strength of the relationship between two variables X and Y, then the correlation model requires X and Y to be both random. Unlike the regression model, the correlation model takes the two variables on equal status. It does not distinguish between them on the basis of dependence. In which case, we may find the regression line of X on Y or Y on X; given two different regression lines. However, if the only objective is to obtain a measure of the strength of the relationship

between the two variables, it does not matter which line is fitted, since the computed measure of correlation will be some in each case.

On the other hand, if the investigator wishes to use the equation describing the relationship between the two variables for estimating and predicting purposes which line is fitted makes a difference. In this situation, the variable for which we wish to estimate or make predictions about should be regarded as the dependent variable (Nwachukwu, 2003).

The measure of the strength of the linear relationship or association between two variables X and Y is called the correlation coefficient. The population correlation coefficient is denoted by ρ, and is usually estimated by r; the sample correlation coefficient.

13 ANALYSIS OF VARIANCE (ANOVA)

The one way classification shall be discussed in this section. Analysis of variance (ANOVA) is a statistical method for determining the existence of differences among several population means (Nwachukwu; 2006).

The aim of ANOVA: according to Nwachukwu (2006) is to detect differences among several population means, and the technique requires the analysis of different forms of variances associated with the random samples.

13.1 TESTING PROCEDURE

Suppose we have r population or treatments, under study, and wish to test the hypotheses:

$H_0 : \mu_1 = \mu_2 = \mu_3 = \cdots = \mu_r$

H_1 : Not all the μ_i's are equal, i = 1, 2, 3, ···, r.

We then draw an independent random sample of size n_i from each of the r populations. The total sample size is

$$n = n_1 + n_2 + n_3 + \cdots + n_r$$

Table 4: Data layout for one way ANOVA

SAMPLE				
1	2	3	...	r
X_{11}	X_{12}	X_{13}	...	X_{1r}
X_{21}	X_{22}	X_{23}	...	X_{2r}
X_{31}	X_{32}	X_{33}	...	X_{3r}
⋮	⋮	⋮	...	⋮
$X_{n_1 1}$	$X_{n_2 2}$	$X_{n_3 3}$	···	$X_{n_r r}$

13.2 ASSUMPTIONS

The following assumptions must be satisfied for the ANOVA test to be valid according to Nwachukwu (2006):

(i) Sampling from each of the r populations must be independent and random.

(ii) The r populations must be normally distributed, with means μ_i (not necessarily equal), and equal variances, δ^2.

13.3 SOURCES OF VARIATION

An ANOVA is based on a comparison of the amount of variation in each of the treatments. If the variation from one treatment to the next is significantly high, it can be concluded that the treatments have

dissimilar effects on the population (Nwachukwu; 2006). We can identify three sources of variation which are;

(i) Total variation, which is variation among the total number of all n observations.
(ii) Between sample variation, which is variation between the different treatments (samples).
(iii) Within sample variation, which is variation within any one given treatment (sample).

13.4 THE SUMS OF SQUARES AND MEAN SQUARES

The test the equality of population means, we use the sums of squares of the three sources of variation, namely, the

(i) Total sum of squares (TSS)
(ii) Treatment sum of squares (TRSS) and
(iii) Error sum of squares (ESS)

where

$$TSS = TRSS + ESS \quad \ldots \quad (15)$$

The formulae for the various sum of squares are as follows:

$$TSS = \sum_{i=1}^{n_j} \sum_{j=1}^{r} \left(X_{ij} - \overline{\overline{X}}\right)^2 \ldots \quad (16)$$

$$= \sum_{i=1}^{n_j} \sum_{j=1}^{r} X_{ij}^2 - \frac{\left(\sum_{i=1}^{n_j} \sum_{j=1}^{r} X_{ij}\right)^2}{n} \quad \ldots \quad (17)$$

where $\overline{\overline{X}} = \frac{\sum_{i=1}^{n_j} \sum_{j=1}^{r} X_{ij}}{n}$ is the grand mean of all the n observations. The total sum of squares has (n – 1) degrees of freedom.

$$TSS = \sum_{j=1}^{r} n_j \left(X_j - \overline{\overline{X}}\right)^2 \quad \ldots \quad (18)$$

where $\overline{X}_j = \frac{\sum_{i=1}^{n_j} X_{ij}}{n}$ is the mean for the jth treatment

$$\sum_{j=1}^{r} n_j \overline{X}_j - n\overline{\overline{X}}^2 \quad \ldots \quad (19)$$

If $n_1 = n_2 = \cdots = n_r = m$, say, then the formula reduces to

$$TRSS = m\sum_{j=1}^{r} X_j^2 - n\overline{\overline{X}}^2 \quad \ldots \quad (20)$$

The treatment sum of squares has (r – 1) degrees of freedom.

$$ESS = \sum_{i=1}^{n_j} \sum_{j=1}^{r} (X_{ij} - \overline{X}_j)^2 \quad \ldots \quad (21)$$

Table 5: ANOVA table

Source of variation	SS	df	MS	F-ratio
Between Samples (Treatment)	TRSS	r – 1	$\frac{TRSS}{r-1}$	$\frac{TRMS}{EMS}$
Within samples (errors)	ESS	n – r	$\frac{ESS}{n-r}$	

Total	TSS	n - 1		

14. DATA ANALYSIS

Using all the statistical techniques discussed in Chapter three, we now proceed with the analysis of the observed data.

14.1 FITTING A REGRESSION MODEL TO THE NUMBER OF INFANTS IMMUNIZED (X) AND THE NUMBER OF INFANTS WHO CONTRACTED THE DISEASES (Y)

Let X_i = Total number of infants immunized each year

Y_i = Total number of infants with diseases each year

The null and alternative hypotheses are:

$H_0 : \beta = 0$ (the regression model is not significant)

$H_1 : \beta \neq 0$ (the regression model is significant)

From the MINITAB output in Appendix I, we have the following:

The regression model is

$$\hat{Y}_t = 494 - 0.0274X_i$$

The $F_{cal} = 39.91$ and the F_{tab} at 5% level of significance is $F_{tab} = F_{1,13} = 10.13$

Since the F-calculated value is greater than the F-tabulated value, we reject the null hypothesis and conclude that the regression model for the number of infant immunized and the number of infants with diseases are significant. This also, simply means that Y_i is dependent on X_i, which shows that the model is adequate for the data.

15. FINDING THE TYPE AND STRENGTH OF THE LINEAR RELATIONSHIP BETWEEN THE NUMBER OF CHILDREN IMMUNIZED BY A PARTICULAR VACCINE AND THE NUMBER OF CHILDREN THAT CONTRACTGED THE DISEASES

For clarity, the vaccines and the diseases they prevent are shown below:

Table 1: Vaccines and the diseases they prevent

s/n	Vaccines	Disease it prevent
1	B.C.G	Tuberculosis
2	D.P.T	Diphtheria, pertussis and Tetanus
3	O.P.V	Poliomyelitis
4	Tetanus Toxoid	Tetanus
5	Measles vaccine	Measles

15.1 CORRELATION CO-EFFICIENT BETWEEN BCG VACCINE AND TUBERCULOSIS

Let BCG vaccine be X_i

Tuberculosis be Y_i

Testing the hypothesis that the population correlation co-efficient is significantly different from zero, that is to test;

$H_0 : \rho = 0$

$H_1 : \rho \neq 0$

Table 2: BCG Vaccine (X_i) and Tuberculosis (Y_i)

X_i	Y_i
645	24
754	34
764	23
700	16

823	8
985	12
896	6
1200	9
1368	5
1654	9
1674	6
2013	5
1879	5
1764	6
1874	5

Using a statistical package known as megastat, we have the output presented in Appendix II.
$r = -0.698$; $|t_{cal}| = 3.51$
but from the table $t_{0.025,13} = 2.16$

Conclusion

Since $t_{cal} > t_{tab}$, we reject H_0 and conclude that $r = -0.698$ is significantly different from zero. In order words, the number of children who received BCG immunization is negatively correlated with the number of children who contracted tuberculosis. Thus, we can say with 95% confidence that as the number of BCG vaccines administered increases, the number of infants contracting tuberculosis decreases.

Using the same procedure, and the same statistical software package the value of r, together with the corresponding values of the test statistic, t, and decisions for the other vaccine and diseases are shown in table 4.3, see Appendix III to VIII for the output.

Table 3

s/n	Vaccine and Disease	r	t	Decisions
1	DPT & Diphtheria	-0.852	5.86	Reject H_0 and conclude that 'r' is significantly different from zero
2	DPT & Pertussis	-0.793	4.70	Reject H_0 and conclude that 'r' is significantly different from zero
3	DPT & Tetanus	-0.655	3.13	Reject H_0 and conclude that 'r' is significantly different from zero
4	OPV & Polio	-0.528	2.24	Reject H_0 and conclude that 'r' is significantly different from zero
5	Measles vaccine & measles	-0.300	1.13	Accept
6	Tetanus toxoid and Tetanus	-0.368	1.43	Accept

16. TESTING FOR THE SIGNIFICANCE DIFFERENCE OF THE MEAN NUMBER OF INFANTS IMMUNIZED FOR THE VARIOUS VACCINES

One way ANOVA shall be used to determine which of the vaccine(s) is (are) in higher demand. Using the MINITAB software package to run the data in Table 3.1, we have the result below (see Appendix IX).

ISSN: 2710-4982 (Online) 2710-4974 (Print)
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Table 4: ANOVA table

Source	df	SS	MS	F
Treatment	4	43438167	10859542	22.20
Error	70	34247159	489245	
Total	74	77685326		

The null and alternative hypothesis are
H_0 : All vaccine means are equal
H_1 : Atleast one vaccine mean differs

$F_{tab} = F_{4,70} = 2.52$ at 5% level of significance
f-calculated = 22.20
since the f-calculated is greater than the f-tabulated, we reject H_0 and conclude that at least one of the mean number of children immunized for different vaccine differs.
To determine the order of demand for the different vaccines, we use the pairwise comparison.
Let μ_B = mean of BCG
μ_O = mean of OPV
μ_T = mean of Tetanus toxoid
μ_D = mena of DPT
μ_M = mean of measles
The number of pairwise comparisms for the five means is given by ordering the means in an ascending order. The ordering is as follows;
$\mu_B < \mu_D < \mu_O < \mu_T < \mu_M$, which gives rise to 4 pairwise comparism test.
To test, the null and alternative hypotheses are
$H_0 : \mu_i = \mu_j$
$H_1 : \mu_i \neq \mu_j$
The test statistic is;

$$t = \frac{|X_{i.} - X_{.j}|}{\sqrt{\frac{MSe}{2r}}}$$

To test the hypothesis;
$H_0 : \mu_D = \mu_O$
$H_1 : \mu_D \neq \mu_O$
The test statistic is

$$t = \frac{2530.2 \quad 2701.1}{\sqrt{\frac{489248}{30}}} = 1.90$$

But from the t-table, at $\alpha = 0.05$, $t_{70,0.05} = 1.67$

CONCLUSION

Since 1.90 > 1.67, we reject H_0 and conclude that DPT and OPV have different mean number of infants immunized.

Using the same test statistic, the values of the test statistic, together with the corresponding decisions for the remaining 3 comparisms are shown in table 4.5 (See Appendix X for the detail workings).

Table 5

	Comparisms	t	decisions
1	μ_B and μ_D	0.20	Accept H_0
2	μ_T and μ_M	2.22	Reject H_0

3	μ_O and μ_T	1.90	Accept H_0

Thus, we can say with 95% confidence, that the mean number of children immunized by the different vaccines is in the following order;

$\mu_B = \mu_D < \mu_O < \mu_T < \mu_M$

17. TESTING FOR THE SIGNIFICANCE DIFFERENCE BETWEEN THE MEAN NUMBER OF INFANTS WITH DISEASE FOR THE VARIOUS DISEASES

Using the same One Way ANOVA and the statistical software applied in section 4.3, the ANOVA table for infants with diseases is shown below in Table 4.6 (see Appendix xi)

Table 6: One-Way ANOVA Table for Number of Infants with the Disease

Source	df	SS	MS	F
Treatment (Diseases)	5	28794	5759	17.86
Error	84	27091	323	
Total	89	55885		

The null and alternative hypothesis are
H_0 : All diseases means are equal
H_1 : At least one disease mean differs
From the F-table, $F_{5,84} = 2.39$ at 5% level of significant.

CONCLUSION

Since the F-calculated = 17.86 > F-table = 2.39, we reject H_0 and conclude that at least one of the mean of the number of children that contracted the disease differs.

Using the same test statistic applied in section 4.3 for the pairwise comparison, we would try to determine the disease that is mostly contracted by infants. The values of the test statistic, together with the corresponding decisions for the five (5) pairwise comparisons are shown in Table 4.7. See Appendix XII for the detail workings.

Let μ_M = mean of measles
μ_P = mean of Pertussis
μ_{TU} = mean of Tuberculosis
μ_{PO} = mean of Poliomyelitis
μ_T = mean of Tetanus
μ_D = mean of Diphtheria

Table 7

	Comparisms	t	decisions
1	μ_{TU} and μ_{PO}	2.83	Reject H_0
2	μ_{PO} and μ_D	1.89	Reject H_0
3	μ_D and μ_P	1.40	Accept H_0
4	μ_P and μ_T	0.89	Accept H_0
5	μ_{DT} and μ_M	10.40	Reject H_0

Thus, we can say with 95% confidence that the mean number of children who contracted the diseases are in the following order.

$\mu_{TU} = \mu_{PO} < \mu_D < \mu_P < \mu_{UT} < \mu_M$

From the above, it can be seen that measles is the most easily contracted disease followed by Tetabnus, Pertussis and Diphtheria. It is with joy that we observe that the two deadly diseases, tuberculosis and poliomyelitis are the least contractable infant diseases now.

ISSN: 2710-4982 (Online) 2710-4974 (Print)
Published by: Radix Research Center and Publications | Dhaka, Bangladesh

18. SUMMARY, CONCLUSION AND RECOMMENDATIONS

18.1 SUMMARY

With reference to the findings made from the analysis, we hereby make the following summaries:

i. From the percentage analysis, in table 3.3, it can be observed that there is continuous increase in the number of infants immunized a continuous decline in the number of infants contracting the six childhood diseases for the period under review. This observation is supported by the confirmed regression model which has a decreasing trend.
ii. The regression analysis shows that there exist a significant linear relationship between the number of infants immunized and the number of infants with the diseases.
iii. There is an inverse linear relationship between all the vaccines and the diseases they are meant to prevent, except for the vaccines against measles vaccine and Tetanus toxoid, where $\rho = 0$.
iv. The one-way ANOVA for infants immunized shows that Meales has the highest number of infants immunized while BCG and DPT have the least number of infants immunized. Also the one-way ANOVA for infants with diseases shows that measles has the highest number of infants with disease while Tuberculosis has the least number of infants with diseases.

18.2 CONCLUSION

Based on the findings from our analysis, we hereby make the following conclusions:

i. The number of infants responding to the immunization programme in FMC Owerri is increasing over the years, while the numbers of infants that are contracting the six childhood diseases are also decreasing over the years. These findings indicate the effectiveness of the immunization programme.
ii. The number of infants with the six childhood diseases depends on the number of infants immunized.
iii. Except for Measles vaccine and Tetanus toxoid which didn't have a significant impact on Measles and Tetanus respectively, other vaccines had a significant impact on the diseases they are meant to prevent. This development would explain for the high number of infants with measles and tetanus.
iv. The high number of infants with Measles can be attributed to the low number of infants immunized under measles vaccine.

18.3 RECOMMENDATION

As a result of findings from the analysis, we make the following recommendations:

(i) Government should continue on enlightenment programme to educate mothers on the importance of taking their children for immunization and also the need of completing their immunization schedule.
(ii) There is the need to look for means of improving the effectiveness of the tetanus toxoid vaccine and the measles vaccine. This may be by increasing the number of doses or the composition of vaccine to make them more effective.
(iii) Government should allocate more funds to the programme, in order to help in the procurement and distribution of equipments and vaccines.
(iv) Government should recruit more qualified staff, so that more centres of immunization may be created in the rural areas for enhanced coverage.
(v) Mothers should be enlightened on the need to take their children back for tetanus toxoid vaccines, any time they have an open wound, even after the completion of the immunization schedule as the effectiveness of the vaccine in the body is short lived.

REFERENCES

Adeyemi, O. (1999): "T.B. a global program". National Light Press Limited Awka, April 21.

Collis, U.S. (1971): "Epidemiology on Communicable Disease" Tropical Doctor – Journal of modern medical practice vol. 3, No. 3.

Etuk, I.S. (2001): "Incidence of measles in UCTH Calabar: Nigerian Journal of Pediatrics. Vol. 28 No. 3.

Fatunde, O.J. and Familusi (2001): "Post-neonatal Tetanus in Nigerian: A need for Booster doses of tetanus toxoid." Nigerian journal of Pediatrics. Vol. 28. No. 2.

Hathaway, W.E. (1989): "Current pediatric, diagnosis and treatment". 10th ed. McGraw – Hill Book Company, New York.

Klein, A. and Ramington, C. (1982): "Infectious diseases of the fetus and new born infant. Hafner publishing Co. Inc. New York.

Madubuike, I. (1995): "Incidence of Tetanus in Nigerian". Health Magazine Federal Ministry of Health Publication Lagos.

Morley, B.C. (1965): "Virulence of infectious Diseases in Developing Countries". American journal of Public Health. Vol. 78 no. 5.

Nwachukwu V.O. (2008): Principle of Statistician Inference. 3rd edition, Zelon enterprises, Port-Harcourt Rivers State Nig.

Oyeka, I.C.A. (1991): Applied Statistical method in the Sciences. Nobern Avocation Publishing Co., Enugu.

Salami, M.V. (1975): "Urban measles control". Health magazine. Federal Ministry of Health Publication Lagos.

WHO (1995): "WHO's New Vaccines Programme." World Health Journal vol. 48 No. 1.

Uzor, L.A. (1087): "Immunization of T.B, D.P.T and Polio in Nsukka Local Government Area". A seminar paper presented on state's Immunization day on October 9, 1987.