Chapter-III

Methodology

The foremost activity in any research is designing the research plan with the relevant research methods and processes to be carried out towards active set objectives that will potentially give solutions to the problem chosen for the study. The methodology elected for the study mainly depends on the selected modifiable variables and their impact, investigation for solutions on dependable variables are carried out. The methodology adopted for the research on “The Effect of Selected Modifiable Maternal Risk Factors During Pregnancy on Early Childhood Obesity” is discussed under the following headings:

RESEARCH DESIGN:

The entire study was carried out in four phases as mentioned below.

1. PHASE I – CONDUCT STUDY ON SELECTED MATERNAL RISK FACTORS WHICH LEAD TO CHILDHOOD OBESITY.
   
   1.1. Selection of Research Site - WIC Program at a Glance
   1.2. Sources to Data or Data Linkage
   1.3. Statistical Analysis on Study Population such as Maternal Smokers, Children of Maternal Smokers, WIC program mothers based on BMI classification, Gestational Diabetes, Nutrition, Physical Activity and Screen Time Overweight Mothers and Children, Overweight Children for Observational Study.

   1.3.1. Sampling Design
   1.3.2. Tools of analysis
   1.3.3. Classification of Data

2. PHASE II — DEVELOP WHOLESOME PREVENTIVE MEASURES FOR CHILDHOOD OBESITY
2.1. Preparation of Nutrition Education about the Underlying Causes of Childhood Obesity due to Maternal Links

2.2. Development and Training on Medical Documentation

2.3. Assessment of Knowledge of WIC Nutritionists regarding Maternal Links which lead to Childhood Obesity and their Selection for Observational Study for Enhanced Nutrition Counseling Strategy.

3. PHASE III - EVALUATE THE IMPACT OF ENHANCED NUTRITION COUNSELING STRATEGY BY THE SAME NUTRITIONISTS ON THE BMI OF SELECTED OVERWEIGHT AND OBESE CHILDREN

3.1. Selection and Sampling of Overweight Children

3.2. Building Slots for Appointments of the Observational Group

3.3. Assessment of BMI of Overweight Children

4. PHASE IV - DEVELOP A PROFESSIONAL COMPETENCY ASSESSMENT TOOL WITH CURRENT KNOWLEDGE FOR PRACTICING CLINICAL NUTRITIONISTS IN PUBLIC HEALTH:

4.1. Preparation of Module 1 - Infant Growth and Development

4.2. Preparation of Module 2 - Motivational counseling.

4.3. Preparation of Module 3 - Pregnancy and Breastfeeding

4.4. Preparation of Module 4 - Childhood Obesity.

1. PHASE I — CONDUCT STUDY ON MATERNAL LINKS WHICH LEAD TO CHILDHOOD OBESITY

1.1. Selection of Research Site - WIC Program at a Glance.
This study was conducted in United States of America. All subjects were selected from Special Supplemental Nutrition Program for Women, Infants and Children (WIC) for this retrospective study. Asian population was included throughout the selection of study population. WIC is a Special Supplemental Nutrition Program for Women, Infants and Children. Georgia’s WIC is the nation’s fifth largest Special Supplemental Nutrition Program. The Food and Nutrition Service administers the program at the federal level and provides funds to state agencies for implementation. At the state level, the Department of Community Health, Georgia Department of Public Health, Maternal and Child Health Program, Office of Nutrition and WIC administers the program. WIC has provided nutrition education and supplemental foods to low income families for over thirty years. In federal fiscal Year (FFY) of 2010, Georgia’s WIC provided benefits to approximately 303,000 participants. WIC contributes approximately $3.3 billion to the state's economy. Georgia’s WIC services are provided through 18 health districts and two contract agencies. Services are provided at over 220 locations including: 172 health departments, 28 community health centers, 13 hospitals, 5 military bases, and 2 Division of Family and Children Services (DFACS) offices. Of these locations, 99 sites provide WIC and other services during a WIC visit, 98 provide other services by referral within the same location, and 26 provide other services by referral to another location. Most locations have extended hours. There are approximately 1,600 authorized vendors that are participating in the WIC food delivery system who were redeeming approximately one million vouchers each month.

**Eligibility:** WIC serves women, infants, and children in families with income at or below 185 percent of the federal poverty level or enrolled in Medicaid, and for those who are at risk of nutritional deficiencies. Participant categories consist of pregnant, postpartum, and breastfeeding women; infants and children up to their fifth birthday.

**Services:** Participants receive a nutrition assessment, health screening, medical history, body measurements (weight and height), hemoglobin check, nutrition education, breast feeding support, referrals to other health and social services, and vouchers for healthy foods.

**Program Objectives:**

- Increase entry into care for prenataals, infants and children
Increase infant breastfeeding initiation and duration
Decrease number of children who are overweight or obese
Increase nutrition education of participants
Utilize technology to maximize efficiency

Non-discrimination Statement

In accordance with Federal Law and U.S. Department of Agriculture policy, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age, or disability (Georgia Department of Public Health 2012).

1.2. Sources to Data or Data Linkage:

Secondary sources of data available with WIC program was used for this study. WIC program data, along with Head Start and maternal and child health data, are reported to the Centers for Disease Control and Prevention (CDC) by the states and stored as 2 data sets, the Pregnancy Nutrition Surveillance System (PNSS) and the Pediatric Nutrition Surveillance System (PedNSS). In Georgia, (PedNSS) data are collected by local WIC clinics, amalgamated, and submitted monthly to the CDC. Information on child growth, nutrition, and general health is included. This public health (PNSS) data set contains information on maternal factors related to gestational and postnatal health (Alexandra K Adams et al 2005). PNSS data is collected on pregnant women during an initial prenatal visit (usually entry into the WIC program) and during a postpartum visit. PedNSS data is collected on children, twice a year on average; height and weight are measured each time (Andrea, et. al., 2008). To link records, identified PNSS records of births occurring in 2007 were utilized. Duplicate records were excluded. PedNSS records were identified for infants during the year 2008. Mother, infant and child’s family group number, and date of birth were used to link PedNSS and PNSS records (Andrea, J et. al., 2008 and Alexandra K. Adams et. al., 2005). The data for this study was collected from one of the metro Atlanta WIC clinics with its district director permission. These records included demographic and birth data for both the mother and infants and children.

1.3. Statistical Analysis:

1.3.1. Sampling Design

The study units were selected from the population by using stratified random
deliberate sampling. A retrospective study was designed to understand maternal links between the independent variables and the outcome of dependent variables. The collection of existing data was recorded in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. Stratified random and deliberate sampling method was adopted for this research descriptive exploratory study (Dhamu K.P and Ramamoorthy K, 2007). In deliberate sampling, the sampling units are selected with a specified reason. This sampling method was adopted in this study because the selected county’s client load had a mixed population of all races including Asian Indian population and ages. In other words this research population reflect the present day American population, instead of totally white or black or Hispanic dominated communities. Another reason is that WIC data is one of the nation’s most dependable, accurate public data, used by the Center for Disease Control (CDC), and because of its easy access of data availability.

Total number of different research population, and number of samples selected are furnished in table I

<table>
<thead>
<tr>
<th>S.No</th>
<th>Description of subjects</th>
<th>Total No of Sample</th>
<th>Selected No of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3.1.1</td>
<td>Smoking Mothers</td>
<td>292</td>
<td>231</td>
</tr>
</tbody>
</table>
1.3.1.2 | Non Smoking Mothers | 2752 | 2382 |
1.3.1.3 | Smokers (matched withinfant birth weight, BMI, age and race). | 231 | 55 |
1.3.1.4 | Non-Smokers(matched withinfant birth weight, BMI, age and race). | 2382 | 55 |
1.3.1.5 | Matched White and BlackSmokers(matched withinfant birth weight, BMI, age and race). | 231 | 54 |
1.3.1.6 | Children of Smoking Mother 0- 5 | 151 | 121 |
1.3.1.7 | WIC Program Mothers | 6723 | 5640 |
1.3.1.7 | Overweight Mothers for diet habits | 1582 | 1001 |
1.3.1.9 | Overweight Children for diet habits | 30 | 25 |
1.3.1.10 | Overweight children for Observational Study | 62 | 60 |

1.3.1. 1. **First Research Population:**

The sample of 296 infants of smokers during the year of 2005 and 2007 was collected from WIC program data. Out of that, about 231 samples of smoking mothers were selected and analyzed. From this sample, data consisting of mother’s age, ethnicity and average birth weights were collected. Unmatched samples of smokers and non-smoker infant birth weights were analyzed for their statistical significance.

1.3.1. 2. **Second Research Population:**

About 2752 infants of nonsmokers were identified from 2007 WIC program data. Out of that, 2381 samples were selected and data was analyzed to test statistical significance of birth outcome.
1.3.1. 3 & 4. Third and Fourth Research Population:

Out of 231 smoking mothers and 2382 non-smoking mothers, 55 samples were selected. Mean birth weights of infants of smokers and non-smokers were matched for age, pregravid BMI: 2.9yrs ± 0.78kg/M² respectively, & race and tested for statistical significance.

1.3.1. 5. Fifth Research Population

From a total sample of 231 smoking mothers, fifty four white and black samples were selected. Mean birth weights of infants of white and black smokers were matched for age, race, pregravid BMI: 1.6yrs±4.1kg/M² respectively and tested for statistical significance.

1.3.1.6. Sixth Research Population:

Out 151, only 131 children of Smoking mothers during their pregnancy, from age group 0 to 4 years, were selected. Collection of data was very difficult. From 2005 WIC smokers certification, the family number was noted and then matched the mother with her child. Their initial birth weight, length/weight during 1st and second years, and BMI of 3rd and 4th years were recorded, and results were analyzed for significant differences.

1.3.1.7. Seventh Research Population:

The 2008 postpartum WIC certification data from the selected metro Atlanta WIC clinic was used for this analysis. In the year 2008, out of 6723 postpartum women participants, 1083 were samples with inadequate information, so 5640 WIC mothers data were retained for the research purpose. From these samples, data on pregravid weight BMI, age, race, infant birth weight, and pregnancy outcome such as incidence of gestational diabetes was collected for analysis.

1.3.1. 8. Eighth Research Population:

The sample of 1582 postpartum overweight women was on selected WIC program during the year 2010. Only 1001 sample were selected after avoiding 581 sample inadequate data. Data from the sample was gathered on pregravid weight BMI, self-reported information on intake of fruits, vegetable, screen time, and daily activity.

1.3.1. 9. Nineth Research Population:
Thirty WIC overweight children were selected. Out 30 only 25 had adequate data and this sample was selected to analyze their BMI, intake of fruits, vegetable, screen time, and daily activity.

1.3.1. Tenth Research Population:

About 62 WIC overweight children were selected to be observed for BMI maintenance during their research period. Data was collected and analyzed.

1.3.2. Tools of the Analysis

The data was analyzed using statistical package, 16.0 version of SPSS (Statistical Package for Social Sciences). The following statistical tools were employed for analyzing the data collected to fulfill the objectives of the study.

1.3.2.1. Percentage Analysis,
1.3.2.2. Average Analysis,
1.3.2.3. Coefficient Variation (CV%)
1.3.2.4. Z-test
1.3.2.5. Chi-square Test,
1.3.2.6. Analysis of Variance (ANOVA)
1.3.2.7. Dunnette test

1.3.2.1. Percentage Analysis:

The frequency table constructed on different variables such as Pregravid BMI, age, race, fruit, vegetable and dairy intake, daily activity, and screen time infant birth weights, gestational diabetes of WIC mothers; and fruit, vegetable and dairy intake, daily activity, and screen time of overweight children; and percentages analysis was done as well.

1.3.2.2. Average Analysis
The mean, standard deviation, and CV% was calculated for different variables such as BMI of overweight children and mothers, and infant birth weight of smokers and non-smokers, and white and black smokers by using by the following formula:

\[
\text{Mean} = \frac{\sum X}{n}
\]

Where \( \sum X \) = Sum of the observation of \( X \)

\( n = \) Total number of observation

\[
\text{Standard Deviation} = \sqrt{\frac{\sum X^2 - (\sum X)^2}{n(n-1)}}
\]

Where \( \sum X^2 \) = Sum of the squares observation

1.3.2.3. **Coefficient Variation (CV%)**:

This test is used to compare the variability of two or more data sets with different units of measurements. Less indicates more consistency when more CV% indicates less consistent. CV% is calculated with the following formula:

Standard Deviation divided by the Mean multiplied by 100.

This test was applied when multiple comparison of the mean BMI of children of smoking mothers between 0 to 4 years was done.

1.3.2.4. **Z-test**

This test was done to compare the means of infant birth weight of WIC mothers who are underweight, normal, overweight, obese class I, II, and III. The Z-test for two means was done to compare the means of white and black smokers. The means of smokers and non-smokers are using the following formula:

\[
z = \frac{\bar{x}_1 - \bar{x}_2 - \Delta}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}
\]
where \( \bar{x}_1 \) and \( \bar{x}_2 \) are the means of the two samples, \( \Delta \) is the hypothesized difference between the population means (0 if testing for equal means), \( \sigma_1 \) and \( \sigma_2 \) are the standard deviations of the two populations, and \( n_1 \) and \( n_2 \) are the sizes of the two samples.

### 1.3.2.5. Chi-Square Test

The Chi-Square test is utilized to assess the association between different categories of pregravid BMI, race, age of WIC mothers who are underweight, normal, overweight, obese class I. II. III with infant birth weight by using this formula.

The following formula is used for the analysis

\[
\chi^2 = \sum \frac{(O - E)^2}{E}
\]

Where

- \( O \) = Observed frequency
- \( E \) = Expected frequency

### 1.3.2.6. Analysis of variance (ANOVA)

Analysis of Variance is a statistical method in which the total variation is split into different orthogonal variations and the F-test is used to test the statistical significance of anyone of the orthogonal variations. Ex: If four treatments are tested with five replications of each, the total number of observations will be 20. The variation of the 20 observations will be called total variation. Let each observation have two effects such as treatment effect, and experimental error effect. Analysis of variance will split the total variation of 20 observations into two orthogonal variations and experimental error variations. Then the F-test will be used to test the treatment variation in comparison with experimental error.

**F-Test**

F-test is a statistical test based on the F-ratio.

**F-ratio**

F-ratio is the ratio of two variances.

(Note: In any experiment design, primary aim is to test the treatment variation in comparison with experimental error variation. Hence, the F-ratio always has experimental error variation. For example, if 10 is the treatment variance and S is error variance, then \( F = 10/S = 2 \).)
Assumptions made in analysis of variance

ANOVA was used to test the means of BMI of overweight children of initial, 2nd, 3rd, 4th, 5th, 6th clinical visits.

In any design of experiment, the three basic principles validate the application of statistical tests (outlined in principles of Statistical) to the observations; randomness especially ensures that observations are random samples. In addition to the randomness of the observation, additional assumptions are made in the analysis of variation (in principles of Statistics). They include the following:

1. The different components of total variation are additive.
2. The different components if total variation is orthogonal.
3. The error variation is normally distributed with zero mean and constant variance.

The first, second and third assumption are referred shortly as additivity, orthogonality, normality, and respectively.

The above assumptions are to be satisfied in order to apply F-test in analysis of variance (Dhame, K.P & Ramamurthy, K. 2007).

ANOVA was used to test the means of BMI of overweight children of initial, second, third, fourth, fifth, and sixth clinical visits.

1.3.2.7. Dunnett’s Test

Dunnett’s test compares group means. It is specifically designed for situations where all groups are to be pitted against one "Reference" group. This test was done to compare the mean of initial BMI of selected overweight children (Reference group) with that of the BMI of overweight children of 2nd, 4th, 6th, 8th and 10th months clinical visits. The goal is to identify the groups whose means are significantly different from the mean of the initial group BMI (reference group). It tests the null hypothesis that no group has its mean significantly different from the mean of the reference group. For each pair (Reference Group), the Dunnett's test calculates the value of a statistic «observed ». This value is compared to a critical value read in a "Dunnett's table" (Dunette - Aiaccess.net, 2013).
1.3. 3. Classification of data:

Classification of data is discussed under the following headings:

1.3.3.1. For Percentage analysis:

1.3.3.1.1. First Research Population – WIC Smoking mothers.

WIC smoking mothers (231) who smoked during their pregnancy were selected retrospectively. This was done to study the adverse impact of maternal smoking during pregnancy on infant birth weights and BMI of overweight children born to these mothers. For the purpose of this study, independent variables, such as pregravid BMI, age, race of maternal smokers based on their categories, and the (outcome) dependent variable, infant birth weight on different levels were analyzed. In this analysis, the collected data was classified and tabulated by the frequency table method and corresponding percentages were worked out under the following headings.

1.3.3.1.1. Distribution of Smoking Mothers Based on BMI Classification:

This first important independent Pregravid BMI was studied under WIC classification of smoking mothers - Underweight (BMI below \( \leq 18.5 \)) Normal weight (BMI 18.6 -24.9), Overweight (BMI 25.0-29.9), Obese Class I, (BMI 30.0-34.9); and Obese Class II, (BMI 30.0-34.9), Obese Class III (BMI \( \geq 40.0 \)). This classification is based on (World Health Organization - WHO, 1995). This is for a better understanding of these groups of the nutritional status of the mother and the effects on their infants and children population.
1.3.3.1.2. Distributions of Smoking Mothers Based on Age Classification.

This independent variable of smoking mothers was classified as teenagers (≤19 years), young adults (20 – 24 years), older adults (25 – 29 years), and mid-age adults (≥30 years). The frequency was calculated and analyzed by the researcher.

1.3.3.1.3. Distributions of Smoking Mothers Based on Different Race.

This research population was looked into distribution for different race such as white, black, multicultural, Hawaiian, American Indian and unknown. Study of this independent variable is of great benefit to understand the impact of maternal smoking in different races.

1.3.3.1.4. Distribution of WIC Infants based on Birth Weight Classification:

This very important dependable variable was studied in this study under the classification as low birth weight (≤ 5.5 pounds), normal birth weight (5.6 – 7.5 pounds), and High birth weight (≥7-6 pounds).

1.3.3.2. For Average Analyses:

In this analysis, the mean birth weight, BMI, and age were calculated, compared, and tabulated. The method of comparison was worked out under the following headings.

1.3.3.2.1. Second Research Populations – WIC Non-Smokers:

1.3.3.2.1.1. Comparison of Mean Birth Weight, BMI, and Age Of Smoking mothers:

Average analysis was done on BMI, age and infant birth weights of 2382 selected non-smokers and 231 maternal smokers who smoked during their pregnancy. First comparison of mean and standard deviation (SD) of 231 smoking mother’s pregarvid BMI, Age and their infant’s birth weight for statistical significance.

1.3.3.2.3&4. Third and Fourth Research Population: Non-Smoking Mothers:
1.3.3.2.3 & 4.1.1 Comparison of Mean Infant Birth Weight of Smokers and Non-Smokers. (Matched Sample for Age, Pregravid BMI & Race).

Out of total 2382 non-smokers and 231 maternal smokers during pregnancy, 55 samples were selected by matching their pregravid BMI, age race. The second comparison of mean and SD was analysed for statistical significance with matched age, pregravid BMI: 2.9yrs ± 0.78kg/M² respectively, & race.

1.3.3.2.3 & 4.1.2. Comparison of Mean Infant Birth Weight of Smokers’ Stopped Smoking 3rd Trimester and Non- Smokers - Matched Sample:

Comparison of mean infant birth weight of smoking mothers during their first and second trimester of their pregnancy but stopped smoking in their third trimester to that of non-smokers. Samples were matched with their age, BMI and age.

1.3.3.2.5. Fifth Research Population: Matched Sample of Smokers and Non Smokers

1.3.3.2.5.1. Comparison of Mean Birth Weight, BMI, Age of White and Black Smoking Mothers:

Out of total 231 smoking mothers during pregnancy, 54 white and black smoking mothers during pregnancy were selected and comparison of their mean infant birth weights was done as well. Analysis was done by matching the samples of age and Pregravid BMI. 6yrs±4.1kg/M² respectively and tested for statistical significance.

1.3.3.3. FORZ- TEST:

The Z- test for two mean was conducted to compare the average infant birth weights of smokers, non-smokers, white, and black smokers, formulated in tables, and presented under following headings:

1.3.3.3.1. Z-Test of Infant Birth Weights of Smokers and Non-Smokers:
The mean and SD of infant birth weight of maternal smokers and non-smokers were analyzed for Z value and tested for statistical significance.

1.3.3.2. Z-Test of Infant Birth Weights of White and Black Smokers:

The mean and SD of infant birth weight of maternal white smokers and black smokers were analyzed for Z value and tested for statistical significance.

1.3.3.4. For Coefficient Variation (CV%)

Four sets of data with different units were analyzed and compared for its variability and noted for less or more consistency of CV% and formulated on a table and the results were provided under following heading.

1.3.3.4.1. Sixth Research Population: WIC Children of Smoking

Mother 0.4 years:

WIC data of smoking mothers was derived and using their family number, with that smoking mother and their children were matched. Out 151 samples, only 131 samples were used for research purpose. 0-4 years birth weight, 1st and second year length/weight and 3rd and 4th BMI was from WIC certification data was recorded. Mean and SD of smoker’s overweight children of BMI from infant birth weight, 1st, 2nd, 3rd, 4th was analyzed for statistical significance.

1.3.3.4.1.1. Comparison of mean, SD and CV% of Smoker’s

Children of age 0-4 years:

Four sets of mean, SD, and CV% of smoker’s children of age 0-4 years with different units such as mean infant birth weight in pounds, 1st and 2nd year body weight in length/ Weight (lg/wt) percentile, and 3rd and 4th year BMI in kg/M² was analyzed. The results were compared for its variability, noted for its less or more consistency of CV%, formulated on a table, and provided.

1.3.3.5. FOR CHI-SQUARE ANALYSIS:
The retrospective studies is to understand the association between Pregravid body mass index (BMI), age, race, of postpartum smoking women was classified into five categories: underweight, normal weight, overweight, and Obese Class I, Obese Class II, Obese Class III, and (outcome) dependent variable, infant birth weight was analyzed for this study. The association between different categories of BMI, Age, and Race of smoking mothers with different levels of infant gestational birth weight has been found by using chi-square analysis. The categories which were used to associate these variables were same as the above and Chi-Square analysis is furnished in the following manner:

1.3.3.5.1. Associations between BMI and Levels of Infant Birth Weights of Smoking Mothers.

1.3.3.5.2. Associations between Age, and Levels of Infant Birth Weights of Smoking Mothers.

1.3.3.5.3. Associations between Race and Levels of Infant Birth Weight of Smoking Mothers

1.3.3.6. For Percentage Analysis:

1.3.3.6.1. Seventh Research Population: WIC Mothers

With intention of this retrospective studies is to understand the maternal links between Pregravid body mass index (BMI), age, race and gestational diabetes of 5640 WIC mothers of selected county with infant birth weight. This is to understand the level of adverse birth out in terms of infant birth weight.

1.3.3.6.1.1. Distribution of WIC mothers based on BMI Classification.

This helps to understand the effect of first independent variable, Pregravid body mass index (BMI) of postpartum women was classified into five categories: Underweight (BMI below \( \leq 18.5 \)) Normal weight (BMI 18.6 -24.9), Overweight (BMI 25.0-29.9), Obese Class I, (BMI 30.0-34.9); and Obese Class II, (BMI 30.0-34.9) obese Class III (BMI \( \geq 40.0 \)). This classification is based on the World Health Organization (WHO, 1995). This is for a better understanding of this group of mother’s nutritional status.

1.3.3.6.1.2. Distributions of WIC Mothers Based on Age Classification.
This was done with WIC mothers, classified as teenagers (≤19 years), young adults (20 – 24 years), older adults (25 – 29 years), mid-age adults (≥30 years). The frequency was calculated.

1.3.3.6.1.3. Distributions of WIC Mothers Based on different Race:
This research population was looked into distribution for different races such as white, black, multicultural, Hawaiian, American Indian and unknown.

1.3.3.6.1.4. Distributions of WIC Mothers Based on Category of with and without Gestational Diabetes (GD) during Pregnancy:
This main research was to know the incidence gestational diabetes.

1.3.3.6.1.5. Distribution of WIC infants of WIC mothers based on WIC Birth Weight Classification:
This was done based on classification as low birth weight (≤5.5 pounds), normal birth weight (5.6 – 7.5 pounds), and High birth weight (≥7-6 pounds).

1.3.3.7. For Average Analyses:
1.3.3.7.1. Comparison of Mean, SD of BMI, age, race and Infant Birth Weight of WIC Mothers and infants were looked analyzed.

1.3.3.8. Chi-Square Analysis:
The retrospective studies is to understand the association between pregravid body mass index (BMI), age, race, gestational diabetes of postpartum women was classified into five categories: underweight, normal weight, overweight, and Obese Class I, Obese Class II, Obese Class III, and (outcome) dependent variable, infant birth weight was analyzed for this study. In addition, association between age and pregravid BMI of WIC mothers also was calculated. The categories which were used to associate these variables were same as the above mentioned and Chi-Square analysis are furnished in the following manner:
1.3.3.8.1. Associations between BMI and Levels of Infant Birth Weight of WIC Program Mothers.

1.3.3.8.2. Associations between Age and Levels of Infant Birth Weight of WIC Program Mothers

1.3.3.8.3. Associations between Race and Levels of Infant Birth Weight of WIC
1.3.3.8.4. Associations between Race and BMI Classification of WIC Program Mothers.

1.3.3.8.5. Associations Between Gestational Diabetes (GD) and Birth weight of Infants of WIC Program Mothers

1.3.3.9. For Z–Test:

This test was done to compare the mean of normal gestational birth weight, with the means of underweight, overweight, obese class I, II, III. WIC mothers. The Z–score is to know whether there is any significant difference between the following means. Their analyzed data was presented as follows:

1.3.3.9.1. Z-Test – Infant Birth weight of Normal Vs Underweight Mothers:

The mean and SD of infant birth weight of WIC mothers with underweight BMI was compared for that of Normal WIC mothers. Z - Value was found out for statistical significance between the two means.

1.3.3.9.2. Z-Test – Infant Birth weight of Normal Vs Over weight Mothers:

The mean and SD of infant birth weight of WIC mothers with overweight BMI was compared for that of Normal WIC mothers. Z - Value was found out for statistical significance between the two means.

1.3.3.9.3. Z-Test – Infant Birth Weight of Normal Vs Mothers with Obesity Class I:

The mean and SD of infant birth weight of WIC mothers with mothers with Obesity Class I BMI was compared for that of Normal WIC mothers. Z - Value was found out for statistical significance between the two means.

1.3.3.9.4. Z-Test – Infant Birth weight of Normal Vs Mothers with Obesity
Class II:

The mean and SD of infant birth weight of WIC mothers with mothers with Obesity Class II BMI was compared for that of Normal WIC mothers. Z - Value was found out for statistical significance between the two means.

1.3.3.9.5. Z-Test- Infant Birth weight of Normal Vs Mothers with Obesity

Class III:

The mean and SD of infant birth weight of WIC mothers with mothers with Obesity Class III BMI was compared for that of Normal WIC mothers. Z - Value was found out for statistical significance between the two means.

1.3.3.10.1. For Percentage Analysis:

1.3.3.10.1. Eighth Study Population was 1001 Overweight WIC Mother from the Year 2010.

These mothers were specially studied for their fruit, vegetable, dairy intake and daily activity, screen time and frequency distribution. This is to know whether there is similarity of food habits between mothers and overweight children. The same research was done on selected overweight children also. A nutrition questionnaire for dietary food frequency checklist (Appendix: I) was used to assess by the WIC nutritionist, the intake of fruits, vegetables, and dairy. Research has found that replacing foods of high-energy density (high calories per weight of food) with foods of lower energy density, such as fruits and vegetables, can be an important part of a weight management strategy (Tohill, BC. et.al., 2004 and Rolls, BJ. et. al., 2004). Additionally, fruits and vegetables are good sources of many important nutrients including potassium, vitamin C, foliate, fiber, and numerous phytochemicals. In addition, the USDA Food Guide, represented by MyPyramid, recommends eating 2 to 6 ½ cups of fruits and vegetables per day depending on age, sex, and activity level (CDC Fruits and vegetables guide, 2010). Fruits, vegetables and dairy intakes were assessed in two groups, as S (some intake / week), D (daily intake). The data was collected and assessed for statistical significance.
Self-reported survey (Appendix: I) during the WIC certification process to record the screen time and daily activity is also done procedure. Screentime is noted as number hours spent daily on television viewing or working on computergames. Daily activity level was assessed by grouping the children with N (not active), S (some active), and V (very active). The observation that obesity results from an energy imbalance, whereby energy intake is greater than energy expenditure, has led to the widely held assumption that an increase in physical activity is inversely related to weight and fatness change and that inactivity is directly related to these changes (Aviva Must et.al., 2007). Statistical analysis was done to study this population under these following headings.

1.3.3.10.1.1. Distribution of Overweight WIC Mothers was Done Based on their Fruit, Intake Classification:
This WIC classification is ‘Daily Intake’ (D), Some Intake during week’ (S), ‘Do Not Take’ (N).

1.3.3.10.1.2. Distribution of Overweight WIC Mothers was done Based on their Vegetable Intake Classification:
This WIC classification is ‘Daily Intake’ (D), Some Intake during week’ (S), ‘Do Not Take’ (N).

1.3.3.10.1.3. Distribution of Overweight WIC Mothers was done Based on their Dairy Products Intake Classification:
This WIC classification is ‘Daily Intake’ (D), Some Intake during week’ (S), ‘Do Not Take’ (N).

1.3.3.10.1.4. Distribution of Overweight WIC Mothers was done Based on Daily Activity Classification.
This WIC classification is ‘Very Active (V), Some activity (S), Not Active (N).

1.3.3.10.1.5. Distribution of Overweight WIC Mothers was done Based on Screen Time Classification:
The mothers were classified for their screen time as mothers who spend 0-2 hours, 3-5 hours, and 6 and above hours of screen time spent per day.

1.3.3.11. For Chi Square Analysis

This was used to see the association between BMI category of overweight mothers and intake of fruit, vegetable, dairy, daily activity, and screen time.

1.3.3.11.1. Association between BMI category of overweight mothers and their levels of weekly fruit intake.

1.3.3.11.2. Associations between BMI category of overweight mothers and their levels of weekly vegetable intake.

1.3.3.11.3 Association between BMI category of overweight mothers and their levels of weekly dairy intake.

1.3.3.11.4. Associations between BMI category of overweight mothers and their levels of daily activity.

1.3.3.11.5. Association between BMI category of overweight mothers and their levels of screen time.

1.3.3.12. For Average Analysis:
1.3.3.12.1. Ninth Study Population: Overweight children:

1.3.3.12.1.1. Distribution of Overweight Children was done Based on their Fruits intake Classification:
This WIC classification is ‘Daily Intake’ (D), Some Intake during week’ (S), ‘Do Not Take’ (N).

1.3.3.12.1.2. Distribution of Overweight Children was done Based on their Vegetable Intake Classification:
This WIC classification is ‘Daily Intake’ (D), Some Intake during week’ (S), ‘Do Not Take’ (N).
1.3.3.12.1.3. Distribution of Overweight Children was done Based on their Dairy Products Intake Classification:

This WIC classification is ‘Daily Intake’ (D), Some Intake during week’ (S), ‘Do Not Take’ (N).

1.3.3.12.1.4. Distribution of Overweight Children was done Based on Daily Activity classification.

This WIC classification is ‘Very Active (V), Some activity (S), Not Active (N).

1.3.3.12.1.3. Distribution of Overweight Children was done Based on Daily Screen Time Classification:

The classification of screen time is overweight children with 1 hour, 2 hours, 3 hours and 4 hours screen time per day.

1.3.3.13. For Chi-Square analysis

Chi-Square analysis was used to see the association between BMI of overweight children and intake of fruit, vegetable, dairy, daily activity, screen time. The following Chi-Square analysis was done for statistical significance.

1.3.3.13.1. Associations Between BMI category of Overweight Children and their Levels of Weekly Fruit Intake.

1.3.3.13.2. Associations Between BMI category of Overweight Children and their Levels of Weekly Vegetable intake.

1.3.3.13.3. Association Between BMI Category of Overweight Children and their Levels of Weekly Dairy Products intake.

1.3.3.13.4. Associations Between BMI Category of overweight children and their Levels of Daily Activity.

1.3.3.13.5. Association between BMI Category of Overweight Children and their Levels of Screen Time.
1.3.3.14. ANOVA Test

1.3.3.14.1. Tenth Study Population: Overweight Children for Observational Study:

Statistical Analysis of Variance (ANOVA) is used to test the statistical significance means of BMI of sixty overweight children of initial, 2\textsuperscript{nd}, 3\textsuperscript{rd}, 4\textsuperscript{th}, 5\textsuperscript{th}, 6\textsuperscript{th} clinical visits

1.3.3.15. Dunnette test

1.3.3.15.1. Tenth Study Population: Overweight Children for Observational Study:

Dunnette test was used to test the statistical significance of the referral mean of initial BMI of sixty overweight children compared with means of BMI of sixty overweight children of 2\textsuperscript{nd}, 3\textsuperscript{rd}, 4\textsuperscript{th}, 5\textsuperscript{th}, 6\textsuperscript{th} clinical visits.

2. PHASE II — DEVELOP WHOLESOME PREVENTIVE MEASURES FOR CHILDHOOD OBESITY.

After studying the needs of the research population, based on that various research oriented nutrition education materials on power point presentations, and pamphlets, were developed to impart education to all the nutrition staff of Nutrition Services. Nutrition education sessions were conducted using power point presentation on various aspects of nutrition on to the nutrition staff on continual basis to enhance their nutritional knowledge. The power point presentations were presented under following headings.

2.1.1. Power Point Presentation on Pregnancy. (Appendix: II)

- Maternal smoking and Neonatal Birth weight outcomes in Cobb County WIC Participants
- Preeclampsia - Investigating Issues Associated with Pregnancy.
 Weight Loss: The Risks during Pregnancy and Ways to Prevent during Pregnancy.
 The Relevance Of Foliate & Neural Tube  Fetal alcohol syndrome
 Teenage Pregnancy and Iron Intake
 Gestational Diabetes
 High-Quality Protein Diet on a Limited Budget during Pregnancy
 Pregnancy Among End-Stage Renal Disease Patients On Dialysis

2.1.2. Powerpoint presentations on Infants and children of 1-5 years (Appendix: II)

 Nutrition Needs of the Preterm Infant
 Childhood overweight and obesity
 Childhood Obesity and Short Sleep Duration
 Vitamin D & Children
 Inflammatory Bowel Disease: Cohn’s Disease & Ulcerative Colitis

2.2.3. PowerPoint presentation topics which are common in obesity children and women. (Appendix: II)

 Diabetes mellitus(DM)
 Hypertension
 Eating to Lower Hypertension and Blood Sugar Emotional Eating.
 The Low Down on the Sugar High
 Hemoglobin/Iron Deficiency Anemia
 Hypertension

2.2.4. Power point Presentations for healthy families. (Appendix: II)

 Healthy Living for Families
 Exercise Recommendations for WIC participants
 Functional Foods.
 Food Safety: The Importance to Pregnant Women, Infants, and Children, for RDs.
 Food Safety: The Importance to Pregnant Women and Small Children. (For clients).
 Water Contamination and Malnutrition, What We Can Do and Why It Isn’t Being Done.’

2.2.5. Power point presentation on Medial Documentation and motivational interviewing. (Appendix: II)

 Nutrition Documentation (SOAP Note with Case Studies) For Vulnerable Population
 A Look at Motivational Interviewing
2.2.6. Pamphlets used for the power point presentation: (Appendix: II)

Many pamphlets were referred and developed to use as tool for nutrition education. The names of the pamphlets are listed below.

- Are you an emotional eater?
- Following the DASH Eating Plan - for 2000 calories per day –
- What Color is your Urine?
- Healthy Restraint Eating.
- Heme Iron Sources.
- Making Exercise Work for You!
- A Look at Motivational Interviewing
- Prochaska and DiClemente’s Stages of Change Model
- Ways to Add Low Calorie Flavor to Water
- Unwanted Holiday Pounds, “Avoiding the Gain”

2.2. Development and Training of Medical Documentation:

SOAP notes (Subjective, Objective, Assessment, Plan), ADIME – (assessment, diagnosis, intervention, monitoring, evaluation) are two type of medical documentation approve by American dietetic association for RDs to practice for nutrition assessment. Training on both types medical documentation was very essential for effective MNT provision for the RDs. ADIME processing is new method of medical documentation, which enables every RD to practice MNT and bill their client’s insurance companies, Medicaid, Medicare (government insurance companies) directly. The ADA is washing its hands of SOAP notes and implementing a more standardized, evidence-based nutrition care process. The PESS statement and nutrition diagnosis are part of the ADA Nutrition Care Process model adopted in 2003. This process is a “systematic problem-solving method that dietetics professionals use to think critically and make decisions to address nutrition-related problems and provide safe, effective, high-quality nutrition care.” The Nutrition Care Process consists of several steps: nutrition assessment, nutrition diagnosis, nutrition intervention, and nutrition monitoring and evaluation (Carol M. Meerschaert, 2007).
As a result, the researcher developed the ADIME forms for the nutrition public health services. Because of these developments, three district training and audits were conducted to ensure efficient MNT provision. The summary of district audits, ADIME training for the nutrition district staff was presented as powerpoint presentations nutrition district meetings. The following ADIME forms were developed for, pregnant, breast feeding and non-breast feeding mother and children 0-5 years

- High Risk Form: Pregnancy
- High Risk Form: Postpartum
- High Risk Form: Child 1-5 years
- High Risk Monitoring and Evaluation Form
- Nutrition Care Process Audit Form

ADIME training and Three WIC nutrition care audits with periodic change nutrition risk criteria for the research population were as follows.

- WICNutrition Risk Criteria Changes 08/2010 & Nutritioncare Process audit results - June 2010
- Nutrition Care Process Audit Results Sep 2010
- Nutrition Care Process Audit Results Feb 2011 & ADIME District Plan Feb 2011

2.3. Assessment of Knowledge of WIC Nutritionists Regarding Maternal Links which lead to Childhood Obesity and their Selection for Observational Study for Enhanced Nutrition Counseling Strategy:

Research related topics were selected from the presented topics such as childhood obesity, maternal smoking, etc. The attendance of RDs was noted. The RDs who had highest attendance were selected. Their knowledge was tested on selected research topics. Then RDs who highest posttest scores were selected. Among them two Clinical nutritionist who had highest education level was chosen to be the nutrionist who provide effective counseling for observational children. The criteria for selection of clinical nutritionist were attendance, 90 and above percent attendance andposttest score, and Master’s degree with RD, LD certification.
3. PHASE III - EVALUATE THE IMPACT OF ENHANCED NUTRITION COUNSELING STRATEGY BY THE SAME NUTRITIONISTS ON THE BMI OF SELECTED OVERWEIGHT AND OBESE CHILDREN

3.1. Selection and Sampling of Overweight Children

A quality improvement study was designed for the research to assess the effectiveness of nutrition counseling provided to overweight children by the WIC same selected clinical nutritionists (RD). This study was to enhance the quality of nutrition counseling. This research project, which was conducted by the approval of the director of the Nutrition Services. This study also was designed, and evaluates, the above mentioned one of the objectives of the WIC program. That is to decrease number of children who are overweight or obese. The existing WIC nutritionists counseling section were aimed to change lifestyle behaviors, including increase intake of fruits, vegetable and dairy and decrease screen time and increase daily activity. Secondly, it was also to assess the effect of this counseling section by RDs on BMI of selected overweight children. It was observed that the present effort of the nutritionist was still not sufficient to meet the program’s goal. This large WIC clinic still had 30 percent of overweight children with an increasing trend of childhood obesity. Therefore, this study was sought to assess different ways to improve the efforts of nutrition counseling section by the RDs. This is in turn to decrease the number of overweight children of the program by improving the current knowledge of the nutritionists, and increase greater impact through nutritional counseling by the same nutritionist services on same client.

Sixty overweight children (>BMI 95th %ile) were identified, from the WIC program. These selected group overweight children were assigned bimonthly clinical visits with same nutritionist. They received nutrition counseling by the same nutritionists to build trust and rapport through motivational skill technique. This helped to monitor the efficacy of nutritional counseling aimed at changing lifestyle behaviors on continuous basis.

3.2. Building Slots for Appointments of the Observational Group:
Appointment slots were built for the selected nutritionist and appointments for the observational group were given to the same nutritional professional. Clients were called and reminded about the appointments and if there are any changes needs to be done, it was taken care at the front desk. This procedure was done on every visit for certification of eligibility.

3.3. Assessment of BMI of Overweight Children:

Anthropometry is the single most portable invasive method of assessing body composition reflecting health and nutrition and predicting performance, health and survival (WHO Expert Committee, 1995). While height is used to assess past nutritional status, weight helps to assess the present (Novotny et al., 2004). Body mass index (BMI) is a measure used to determine childhood overweight and obesity. It is calculated using a child's weight and height. BMI does not measure body fat directly, but it is a reasonable indicator of body fatness for most children and teens. A child's weight status is determined using an age- and sex-specific percentile for BMI rather than the BMI categories used for adults because children's body composition varies as they age and varies between boys and girls.

CDC (Central Disease Control) Growth Charts (Appendix: III) are used to determine the corresponding BMI-for-age and sex percentile. For children and adolescents (aged 2—19 years):

- Overweight is defined as a BMI at or above the 85th percentile and lower than the 95th percentile for children of the same age and sex.
- Obesity is defined as a BMI at or above the 95th percentile for children of the same age and sex. (CDC, 2013)

Heights and weights of all the overweight children were measured using the standard procedure outlined by WIC program.

3.3.1. Height

Height is generally a controlled characteristic, which is also influenced by the food intake. Therefore, the measurement of height deficit for age gives a picture of the subjects past nutritional status. Height was measured by making the children two (2) years of age and older,
stand barefoot with the heels against the upright bar of the scale, standing erect, looking straight and the height was recorded to the nearest of 1/8th of an inch. The measuring board with a moveable headboard at least six (6) inches wide was used. However, if a child is 24-36 months and measures <30 inches, they were measured lying down (recumbent length). The equipment was installed according to manufacturer’s instructions and routinely monitored to verify compliance (WIC Anthropometrics Module, 2007).

3.3.2. Weight

Body weight indicates the body mass and gives a rough estimate of body volume. It has been observed to be a sensitive indicator of growth failure and current nutritional status of individual. Weight was measured using a linear balance. The subjects were in light clothing, without shoes and the weight was measured to the nearest of 0.1 pound.

A beam balance scale with a platform and free-sliding weights (non-detachable) was used. The scale was marked in increments of four ounces (4 oz) or 100 grams (g) or ¼ pound. The scale had a large enough platform to support the person being weighed. The scale was calibrated yearly and the calibration was documented (WIC Anthropometrics Module, 2007).

3.3.3. Body Mass Index (BMI)

Body Mass Index (BMI) is a simple computation derived from weight in kilograms and height in meters using the formula weight (kg) / height (m²). It is valuable and appropriate since these anthropometric measurements are considered together and not in isolation. The subcommittee of International Dietary Energy Consultative Group (IDECG) suggested that Body Mass Index could be a good parameter to assess the nutritional status and to grade Chronic Energy Deficiency (CED).

Therefore using height and weight measurements, body mass index of all overweight children was computed. The measurements are then compared with a reference population of healthy people by using a growth chart. This activity is part of the WIC Program certification procedures. Much can be learned about the nutritional status and general health of WIC applicants and participants when these measurements are used along with dietary data and blood values. Height / length and weight measurements are required to help determine WIC eligibility (WIC Anthropometrics Module 2007). Initial and second, fourth, sixth, eighth, final BMI of
overweight children during the study period were recorded, and analyzed for statistical significance using dunette’s test, and analysis of variances.

4. **PHASE IV- DEVELOP A PROFESSIONAL COMPETENCY ASSESSMENT TOOL WITH CURRENT KNOWLEDGE FOR PRACTICING CLINICAL NUTRITIONISTS IN PUBLIC HEALTH:**

Modules containing various current prenatal, postnatal, breastfeeding, infant and childhood nutrition sound articles were collected. Questions and answers were set for each module. The topics for each module are as follows.

**4.1. Preparation of Module 1 Infant Growth and Development:** (Appendix: IV) In this module, the following articles were put together, and questions are prepared for each topic.

4.1.1. Infant Growth and Development birth to one year

4.1.2. Nutrition Practice Care Guidelines for Pre Term Infants
4.1.3. Failure to Thrive as a manifestation of Child Neglect. in the Community – 2006.
4.1.4. AAP- Vitamin D deficiency clinical report.

**4.2. Preparation of Module 2 - Motivational Counseling.** (Appendix: IV)

This modules focus was on motivational in interviewing techniques

4.2.1. Motivational counseling and interviewing skills
4.2.2. Anthropometrical Biochemical and physical Assessment
4.2.3. Food and Drug interactions

**4.3. Preparation of Module 3 – Pregnancy and Breastfeeding** (Appendix: IV)

This module includes various articles on normal, adolescent, obese pregnancy and Breast feeding.

4.3.1. Normal pregnancy
4.3.2. Adolescent pregnancy
4.3.3. Gestational Diabetes
4.3.4. Obesity and Gestational Diabetes Mellitus (GDM)

4.3.5. Breastfeeding

4.3.6. Non – Breastfeeding

4.4. Preparation of Module 4 - Childhood Obesity. (Appendix: IV)

Dietitians were advised to use these articles for their district presentations of Nutrition Services.

4.4.1. Childhood obesity

4.4.2. Maternal smoking and childhood obesity

4.4.3. Maternal risk factors and Childhood obesity

The descriptive exploratory research design, the location of the study is depicted in the figure. 1
DESCRIPTIVE EXPLORATORY RESEARCH DESIGN
PHASE I – CONDUCT OF STUDY ON MATERNAL LINKS WHICH LEADS TO CHILDHOOD OBESITY

Research site - Cobb and Douglas Public Health Nutrition Department – Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

Smoking (S) and Non Smoking (NS) Pregnant Mothers (S = 231, NS = 2481)
- Percentage analysis of smoking mothers of Pregravid BMI, age, race
- Average analysis of mean infant birth weight of smokers non smokers, white and black smokers, with and without (matched sample with Pregravid BMI, age, Race)
- Chi Square analysis to know the association of Smoker's Pregravid BMI, Age, and race with infant birth weight
- Comparison of mean, standard deviation and CV% of smoking children of 0 to 4 years.

Maternal Overweight And Obese Pregravid Weight, agerace and infants Birth weights (5640)
- Percentage Analysis of WIC Pregravid BMI, Age, Race, GD, Infant birth weight
- Average analysis on Mean and SD of WIC mothers Pregravid BMI - underweight, norma, overweight, obese class I, II, III and infant birth weight
- Chi Square analysis to know the association between Pregravid BMI, age, race, and GD, with Infant birth weight
- Z-test for comparison of mean of infant birth weight WIC mothers - underweight, norma, overweight, obese class I, II, III

Gestational Diabetic mothers (196) and infants birthweights

Study On Nutritional Status of overweight mothers (1001) and children (25)
- Average analysis of intake fruit, vegetable, dairy, daily activity and screen time
- Association between intake of fruit, vegetables, dairy, daily physical activity and screen time

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PHASE II – WHOLESALE PREVENTIVE MEASURES OF CHILDHOOD OBESITY

Preparation of Power Point Presentation and Handouts on Selected Modifiable Maternal Risks Factors Which are Underlying Causes of Childhood Obesity

Selection Subject Population - Overweight and Obese Children for Observation Study

Assessment of Knowledge Of WIC Nutritionists on Maternal links which leads to Childhood Obesity

Development and Training of Medical Documentation for Registered Dietitians and Nutrition Care Process Audits

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PHASE III – IMPACT ON BMI OF SELECTED OVERWEIGHT AND OBESE CHILDREN DUE TO ENHANCED NUTRITION COUNSELING STRATEGY.

NUTRITION COUNSELING BY SAME NUTRITIONISTS

Monitored Anthropometric Profile - BMI, on first Clinical Visit

Monitored Anthropometric Profile - BMI, on Second Clinical Visit

Monitored Anthropometric Profile - BMI, on 3rd Clinical Visit

Monitored Anthropometric Profile - BMI, on 4th Clinical Visit

Monitored Anthropometric Profile - BMI, on 5th Clinical Visit

Dunette's Test - Reduction in Childhood Obesity
PHASE IV – DEVELOPMENT OF PROFESSIONAL COMPETENCY ASSESSMENT TOOL WITH CURRENT KNOWLEDGE FOR PRACTICING CLINICAL NUTRITIONISTS IN PUBLIC HEALTH.

Module 1 - Infants Growth and Development

Module 2 - Motivational counseling

Module 3 - Maternal pregnancy, breastfeeding, Non-breastfeeding

Module 4 - ChildMaternal risk factors and Childhood obesity

DEVELOPMENT OF PROFESSIONAL COMPETENCY ASSESSMENT TOOL
LOCATION OF THE STUDY