

Summer Training Report

By

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ABBREVIATONS

ANOVA	Analysis of Variance
CMMND	Communicable, Neonatal and Nutritional diseases
CTQ	Critical to Quality Test
CVD	Cardiovascular Diseases
DALY	Disability Adjusted Life Years
DMAIC	Define, Measure, Analysis, Improve and Control
ETL	Epidemiological Transition Level
ICMR	Indian Council of Medical Research
IHME	Indian Health Metrics and Evaluation
NCDs	Non-Communicable Diseases
NFHS	National Family Health Survey
NSSO	National Sample Survey Organization
PHFI	Public Health Foundation of India
WHO	World Health Organization

PART-1 REPORT ON WORK FROM HOME

(Assigned by Faculty)

TOPIC-

**Burden and Risk Factors of Non-Communicable
Diseases in Kerala- A Systemic Review**

BURDEN AND RISK FACTORS OF NON-COMMUNICABLE DISEASES IN KERALA- A SYSTEMIC REVIEW

1.Abstract

Background –Due to epidemiological transition, Chronic non communicable (NCD) diseases came into the disease burden, instead of communicable diseases. In low- and middle-income countries, NCDs are contributing to the highest morbidity and mortality. The state of Kerala is also facing the same pattern of disease burden with higher prevalence of NCDs, when compared to other Indian states.

Objective-The study was conducted to identify the major risk factors of NCDs in Kerala and to aware the population to follow a better life style to reduce their disease burden. Kerala can be a harbinger for other states in India, as the epidemiological transaction possess major health issues and economic issues.

Methods-Different surveillance systems such as PubMed, Google scholar were used to access previous studies for the systemic review. Of the total search results, 22 published papers were assessed for eligibility. National and state level representative data on major NCDs and its risk factors, which had proper data of Kerala state was selected.

Data from World Health Organization's (WHO) website and relevant central and state government department websites, national and state level surveys and programs were used to retrieve relevant policy and program documents.

Results- In India, the state of Kerala faces one of the highest morbidity rates among other states. The prevalence rate of Asthma and Diabetes in Kerala is alarmingly higher than the national value. Kerala has the highest diabetic disease burden in the country. The percentage of alcohol consumption in Kerala by both sexes are higher than the national rate. Kerala men and women consume more non vegetarian food than the national rate. The random glucose level (high & very high) in Kerala men and women is more than the national value. The Kerala women have more prevalence of obesity in India. Private hospitals are the main provider of inpatient healthcare system in Kerala.

Conclusion-The NCD prevalence and its risk factor creates economic burden, as in Kerala people use private healthcare system more than public healthcare system which causes out of pocket expenditure. The Kerala government should intervene into the alarming situation in order to reduce risk factors and stop NCDs in Kerala. Kerala state has the highest life expectancy but the highest morbidity also, it leads to a paradoxical situation.

Keywords- NCDs burden in Kerala, Risk factors, Non communicable diseases Kerala

2.Objective

General- To find and compare the major risk factors and the burden of NCDs, in Kerala with the national value.

Specific- 1. The four major non communicable diseases were Diabetes, Cardiovascular diseases, Cancer and Chronic Respiratory diseases.

2.To identify the major causes of death in Kerala.

3.To identify the sex group which is affected more with the NCD burden.

3.Introduction

“Noncommunicable diseases (NCDs), also known as chronic diseases, are the result of a combination of genetic, physiological, environmental and behaviour risk factors and tend to be of long duration. Out of the total 56.9 million global deaths in 2016, 40.5 million (71%), were due to the NCDs. 31.5 million deaths occurred in low- and middle-income countries in 2016 in which 46 % of deaths occurring before the age of 70 in these countries” (1- WHO Facts Sheet). “Globally the major behavioral and biological risk factors are use of tobacco and alcohol, physical inactivity, over weight and obesity, increased fat and sodium intake, low fruit and vegetable consumption, high blood pressure (BP), higher blood glucose and cholesterol. NCDs contribute to around 5.87(60%) million deaths in India” (2, WHO).

The WHO reports show that the major four NCDs (cardiovascular diseases, cancer, chronic respiratory diseases and diabetes) were responsible for 82% of deaths globally. Yearly, NCDs contributes to 15 million deaths globally between the ages 30 and 69 years. The risk factors begin from early life while the morbidity and mortality mainly occur in adulthood only (3, WHO). India is also experiencing a rapid health transition.

The prevalence of hypertension, diabetes and tobacco use are among uneducated populations in India because of lack of awareness and leads to premature death (4).

In the year 2016 the deaths due to NCDs was 63 % and the proportional mortality rate of major NCDs in India were, Cardiovascular diseases (27%), Cancers (9%), Chronic respiratory diseases (11%) and Diabetes (3%) (5- WHO). Over two-thirds (67%) of the measured total disability adjusted life years “(DALY, it is a measure overall disease burden expressed as the number of years lost due to ill-health, disability or early deaths)” of disease burden in India is attributable to NCDs and injuries. The Indian state-level disease burden estimates suggest significant differences among states in the composition of disease burden (6).

“Kerala was categorized in the group with highest epidemiological transition level (ETL) group. ETL was defined as the ratio of all-age DALY due to communicable, maternal, neonatal and nutritional diseases (CMNND) versus those due to NCDs and injuries together”. The ETL of Kerala was 0.16, which was lowest value among all other Indian states. “The smallest ETL value shows that Kerala has advanced epidemiological transition (that is higher burden of NCDs and injuries than CMNNDs)” (6). A study by Thankappan K. R et al says that the higher NCDs will be an indication in the future for other states who all are going through the epidemiological transition. Kerala has the lowest infant mortality rates, maternal mortality rates, fertility rate and highest life expectancy among all other states in India. But the state is facing higher prevalence of NCDs such as cardiac diseases, diabetes, cancer and respiratory diseases. (7). The Kerala state have achieved the all the better health indicators before many decades (8).

The NCDs risk factors such as high blood pressure, obesity and alcohol consumption are paradoxically high which leads to high morbidity of major NCDs in Kerala (10). The NHP Kerala shows that the NCDs such diabetes, hypertension, CVDs and Cancer is high in the communities across most of the societies (11). The state’s adolescent aged population also witness high risk factors for NCDs, especially the student’s community (12). Hypertension, obesity and diabetes are significantly high among gulf migrants of the Kerala. A study shows that the prevalence of chronic NCDs are higher among the people with a history of migration than those without any history of migration in Kerala (13). The Kani tribes, which is the most literate and progressive tribal population in Kerala is also having higher prevalence of NCDs (14).

The Sustainable Development goals (SDG), includes one target to reduce the premature deaths due to NCDs by 2030 (15). The National Health Policy 2017 also aimed to increase screening and treatment of people with diabetes and to reduce the premature deaths from it by 2025 (16). So, the NCDs burden must be reduced for a better productive population.

Recognizing the importance of NCDs burden, the Government of India launched the National Program for cancer, diabetes, cardiovascular disease and stroke (NPCDCS), by means of behavioral change communication, community participation, opportunistic screening of NCDs, and provision of NCD services through public health facilities. (17).

4.Rationale

This study was done to find the major NCDs burden and the risk factors in Kerala. It was conducted to identify the major risk factors which contribute to the prevalence of NCDs in Kerala and to compare the rates of Kerala state with national values. So, that the chronic diseases and the major risk factors will be identified and give an insight to the normal population in Kerala. This will impart knowledge about their current habits and pave way for lifestyle changes.

5.Materials and Methods

Type of study-Descriptive

Type of Data – Secondary (Review of empirical studies & Review of Policy and other relevant documents)

Method of Data analysis- Narrative analysis

Method of Data collection-

Peer-reviewed Literature- Articles were collected using Google Scholar and PubMed and selected articles which were published on Lancet, BMJ, etc. The articles related to my topic was selected and others were eliminated from the study. Almost 82 published and unpublished articles were found and most relevant 22 articles were included in my study.

Grey literature- Government websites reports, statistical report and analytical reports and fact sheets. Data from some of the periodic national and state level surveys were taken. Few surveys are, Census 2011, National Family Health Survey 2014-2015 (NFHS-4),

National Sample Survey Organization- 71st round 2014(NSSO), The India State-level disease burden initiative by Indian Council of Medical Research (ICMR) , the Public Health Foundation of India(PHFI) and Institute for Health Metrics and Evaluation (IIHME), Report on Medical Certification of cause death 2017- Directorate of Economics & Statistics- Kerala. Data and guidelines were collected from the official website of World Health Organizations (WHO).

The search was restricted to publications in the English language only. Previous studies of almost 20 years were selected starting from the year 2000 to 2020. Studies related to the NCDs like diabetics, CVD, cancers and respiratory diseases were only included and other diseases were excluded. The NFHS-4 2015-2016 & the Indian state level disease burden initiative study provided data on major NCDs and its risk factors.

6.Findings

Chronic respiratory diseases

Chronic respiratory diseases are divided into Chronic obstructive pulmonary diseases (COPD), Asthma, Bronchitis and other lung diseases. COPD and Asthma are the common respiratory diseases in India.

- Kerala has the highest prevalence of Asthma in south India (18).

Diabetes

The number of people with diabetes in India increased from 26.0 million in 1990 to 65.0 million in the year 2016. The diabetes prevalence was highest in Kerala (high ETL group) in the year 2016. The most important risk factor of diabetes was found to be overweight (19).

- High BMI, dietary risks, physical inactivity and alcohol consumption are the major risk factors of diabetes.

The prevalence of diabetes in adults increased over the years from 1990 to 2016. The prevalence of the risk factor, overweight in adults in India doubled from 1990 to 2016 and it was highest in the more developed states such as Kerala (19).

- Kerala is also called the diabetes capital of India (20).

Cancer

Cancer accounted for 8.3% of total deaths in India in the year 2016. The major cancers were stomach cancer, breast cancer, lung cancer, lip cancer, oral cavity cancer, pharynx cancer, colon and rectum cancer, leukemia, cervical cancer, esophageal cancer and brain cancer (21).

- Alcohol consumption, tobacco use and dietary intakes are the major risk factors for cancer disease in India.

Cancer patients in India face the problems like poorer prognosis because of less awareness of the diseases, late diagnosis, and lack of accessibility and affordability of curative services.

- The crude cancer incidence and crude cancer death rate for both sexes combined was highest in Kerala.

The crude DALY rates for breast cancer and lung cancer incidence was highest in Kerala. The crude DALY rates for colon and rectum cancer in males were second highest in Kerala in 2016. The crude incidence rate for prostate and ovarian cancer were highest in Kerala in 2016. The crude incidence rate for larynx cancer and liver cancer in males were highest in Kerala. The crude incidence rate of thyroid cancer was highest in females in Kerala in 2016(21). The delayed childbearing and lower parity were very high in Kerala as it can be considered as the risk factors of breast cancers in females in Kerala (22,23).

Cardiovascular diseases

The high ETL state group witnessed the highest proportion of deaths due to CVDs. (6).

- The major risk factors for CVDs are dietary intakes, high systolic blood pressure, air pollution, high cholesterol level, tobacco use, high plasma glucose and high body-mass index (BMI).

The major CVDs are Ischemic heart disease and stroke. Nationally the prevalence of ischemic disease was significantly higher in men while the prevalence of stroke was similar in both sexes.

- The prevalence of CVDs such as stroke and ischemic heart diseases were highest in Kerala in 2016.

- Kerala has the highest diabetes disease percentage among all other states in India. Men in Kerala has more heart diseases than the national level.
- The percentage of cancer disease among both sexes in Kerala is same as that of the national level while in Kerala women have more cancer diseases than men.
- In Kerala the asthma patients are more among women and is more than the national level [Table 1& 2] (NFHS-4 2015-2016).

Table- 1 -Percentage of Women with the major NCDs

	Diabetes (%)	Any heart diseases (%)	Cancer (%)	Asthma (%)
India	1.7	1.3	0.2	1.9
Kerala	4.3	1.3	0.2	3.1

Table-2- Percentage of Men with major NCDs

	Diabetes (%)	Any heart diseases (%)	Cancer (%)	Asthma (%)
India	1.7	1	0.3	1.2
Kerala	4.3	1.3	0.1	1

Tobacco use

Tobacco use is widely associated with the onset of many NCDs and it is considered as a major risk factor. Tobacco are of smoking and non- smoking types. Apart from the same health risk as men, studies have shown that women who use tobacco experience infertility risk, complications in pregnancy, premature births etc. The high ETL state group witnesses lower DALY rate due to tobacco use.

- Nationally men use more tobacco than women in the age 15-49 [table- 3].

Nationally the common form of tobacco consumption is chewing paan masala, chewing tobacco and pan, smoking cigarettes and bidis (38). Cigarette smoking is more among men in India. Passive smoking is also a major risk factor of NCDs as it is more common with women (32- NFHS-4 2015-2016).

Table-3, Percentage of any forms of tobacco use by women and men in India

Women (%)	Men (%)
7	45

The type of tobacco use by Kerala people were chews paan with tobacco, chewing tobacco only and bidis, cigarettes were most common among men.

- Men uses more Tobacco products than women in age 15-49 in Kerala [Table 4] (31).

Table- 4, Percentage of any forms of tobacco use by women and men in Kerala

Women (%)	Men (%)
.8	25.7

(32- NFHS-4 2015-2016)

Alcohol use

- Men consume more alcohol than women, and the Kerala state level percentage of alcohol consumption by both sexes is higher than national level [Table 5]. Men consumes more alcohol daily in Kerala (NFHS-4 2015-2016).

Table- 5, Percentage of Alcohol consumption by women and men age 15-49 in India and Kerala.

	Women (%)	Men (%)
India	1.2	29.2
Kerala	1.6	37

(32- NFHS-4 2015-2016)

Dietary intakes

- The Kerala women and men consume fish or chicken or meat daily and that's almost ten times more than the national level [table- 6]. Kerala men and women age 15-49, consume more fried foods daily than nationally [table-7].

- Kerala men and women consume less dark green, leafy vegetables daily than the nationally [table-8] (NFHS-4 2015-2016). The salt intake in Kerala was found to be 6.75 gm/day (25).

Table- 6, Percentage of consumption of fish or chicken or meat daily by women & men

	Women (%)	Men (%)
India	6.1	5.7
Kerala	65	49.3

Table-7, Percentage of consumption of fried foods daily in both sexes

	Women (%)	Men (%)
India	9.8	9.8
Kerala	13.4	14.7

Table- 8, Percentage of consumption of dark, green and leafy vegetables daily

	Women (%)	Men (%)
India	47.2	46.6
Kerala	8.7	27.3

(32- NFHS-4 2015-2016)

Random blood glucose level

- The high (141-160 mg/dl) and very high (>160 mg/dl) random blood glucose value of both sexes in Kerala are more than the national value [Table-9& 10].

The high & very high random blood glucose level in both sexes is highest among the age group 45-49 nationally.

The high & very high blood glucose level of women and the very high random blood glucose level of men is highest among the age group 45-49 in Kerala. While the high random blood glucose level of men is highest among the age group 40-45 in Kerala (NFHS-4 2015-2016).

Table-9, Random blood glucose level of women

	Normal (≤ 140 md/dl)	high (141-160 mg/dl)	very high (>160 mg/dl)
India	94.2	3	2.8
Kerala	91.3	3.9	4.8

Table- 10, Random blood glucose level of men

	Normal (≤ 140 md/dl) md/dl)	high (141-160mg/dl)	very high (>160 mg/dl)
India	92	4.1	3.9
Kerala	86.9	6.8	6.3

Blood pressure

The blood pressure is divided into three levels, normal (SBP <120 mmHg & DBP <80 mmHg), Prehypertensive (SBP 120-139 mmHg or DBP 90-89 mmHg) and Hypertensive (SBP ≥ 140 mmHg or DBP ≥ 90 mmHg).

- Nationally and in Kerala state also, the prevalence of hypertension among men age 15-49 is somewhat higher than women [Table-11].

13 % of women and 43% of men age 15-49 are pre hypertensive in India. The prevalence of hypertension in Kerala is more among the age group 45-49 in both sexes (NFHS-4 2015-2016).

The Pre-hypertensive value is more among the age 40-44 and the hypertensive value is more among the age 35-49 of women in Kerala. While the Pre-hypertensive and hypertensive is more among the age 40-44 (except the stage 1 of pre-hypertensive) of men in Kerala.

Table-11, Percentage of prevalence of hypertension in both sexes

	Women (%)	Men (%)
India	11	14.8
Kerala	9.2	11.5

(32- NFHS-4 2015-2016)

Body mass index

The percentage of women and men of age group 40-49 has the highest value of body mass index (BMI) ≥ 25 (overweight) and body mass index (BMI) ≥ 30 (obese), i.e. 50.5 % and 44.6%.

- Kerala men and women are more obese, as the rate is higher than the national value [table-12]. The age group 40-49 has highest percentage of body mass index (BMI) ≥ 25 (overweight or obese) in both sexes in Kerala (32- NFHS-4 2015-2016).
- Physical inactivity can be one major risk factor for NCDs (WHO Report). The physically inactive people have 20%-30% of increased risk of mortality. Overweight and obesity can lead to adverse metabolic effects (WHO Report).

Table-12, Percentage of BMI ≥ 25 (overweight or obese) of both sexes

	Women (%)	Men (%)
India	20.7	18.9
Kerala	32.4	28.5

(32- NFHS-4 2015-2016)

- Kerala experience demographic burden, as the state has more percentage of elderly people (60 years and above) than the national level [Table-14].

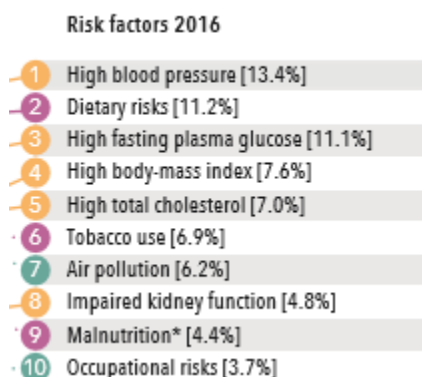
Table- 14- Population of elderly people in India and Kerala

	Elderly people(lakhs)	Elderly people- (Percentage)
India	1038	8.6
Kerala	41.93	12.55

(Census-2011)

The risk factors which driven the most death in 2016 are High blood pressure and Dietary risks in Kerala [Figure-1].

Figure-1, Risk factors driving the most death in the year 2016 Kerala



(34- India State level disease burden initiative- ICMR, PHFI)

- In Kerala, private institutions remained the main provider of inpatient healthcare in both rural and urban areas.

Compare to the national scenario, in Kerala there is not much difference between urban-rural public-private hospital dependency.

Per thousand distribution of hospitalised cases (EC) over levels of care for Kerala and India

Sector	Kerala		India	
	Public	Private	Public	Private
Rural	374	626	419	581
Urban	342	658	320	680

(33- National Sample Survey -71st Round 2014)

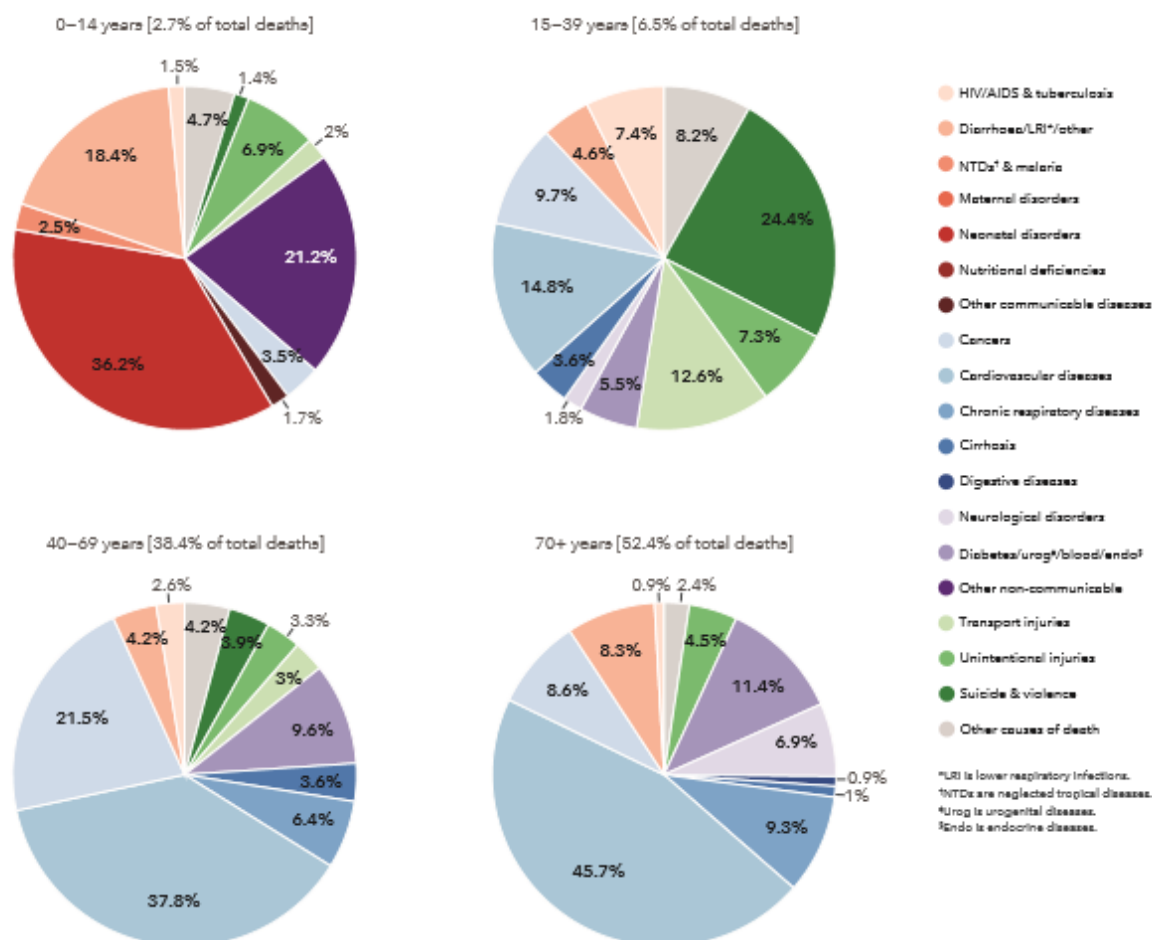
- NCDs contributed as the major cause of deaths in the age groups 40-69 and 70+ years in both sexes in the year 2016 in Kerala.

Cardiovascular diseases contributed to the highest deaths in the age groups 40-69 and 70+ in Kerala[figure-2]. Ischemic heart disease was the major disease burden in both the sexes in the year 2016 in Kerala. Non communicable disease burden contributed 74.6 % of disease burden in the year 2016 in Kerala.

Figure-2- Causes of most deaths in different age groups in 2016 in Kerala (34).

What caused the most deaths in different age groups in 2016?

Percent contribution of top 10 causes of death by age group, both sexes, 2016

**India: Health of the Nation's States – The India State-Level Disease Burden Initiative.**

New Delhi: ICMR, PHFI, and IHME; 2017. ISBN 978-0-9976462-1-4.

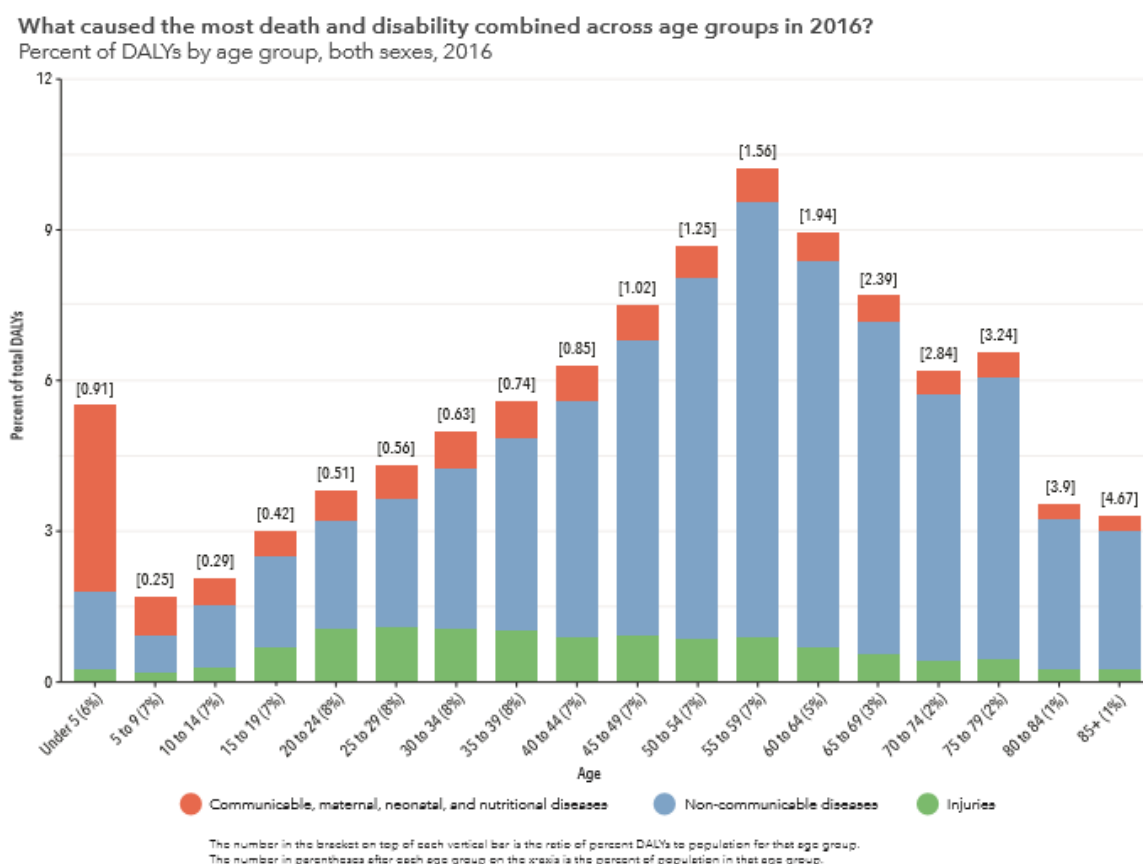
- During the year 2017 in Kerala, the leading cause-groups of deaths according to medically certified deaths are Diseases of circulatory system and Neoplasm[table-13].

Death Causes	Percentage
Diseases of Circulatory System	27.36
Neoplasm (Cancer)	16.44
Endocrine, Nutritional& Metabolic diseases	11.00
Diseases of Respiratory System	10.21

(35- Report on Medical Certification of cause of death 2017- Directorate of Economics & Statistics-Kerala)

- The Non communicable diseases contributed to the most death and disability across all age groups in Kerala in 2016 [Figure-3].

Figure-3, Causes of most death and disability combined across age groups in 2016 in Kerala



(34-India State level disease burden initiative- ICMR, PHFI)

The findings are aligning with the objectives. As, Kerala is witnessing higher prevalence of four major NCDs such as diabetes, CVD, Cancer and Chronic Respiratory diseases. These NCDs are only the major causes of deaths and disabilities in the State. The prevalence of diabetes in both sexes is the highest in India among all other states. The major risk factors in Kerala were found to be alcohol consumption, dietary risk, higher blood glucose level, high body-mass index, higher elderly population while the tobacco use in both sexes in Kerala is lesser than the national level.

The risk factors dietary intake, high body-mass index is more associated with women in Kerala. NCDs caused the most death and disability among most of the age groups except under 5.

6.Discussion

The rate of use of alcohol and tobacco were low in women in Kerala. The abdominal obesity/ overweight was higher in women than men in Kerala was found to be comparable with the study by P S Sarma et al (25). The alcohol use and tobacco use were more in men and the values were found to be almost same to the study P S Sarma et al (25). A study conducted by Jishnu Sathees Lalu et al had found that the prevalence of asthma among the higher secondary school students from Ernakulam district in Kerala was estimated to be 9.9% (26). A study conducted by S. Sivasankaran et al had found that lifestyle changes such as the adoption of unhealthy diet and physical inactivity are the major factors attributed to the rise in the noncommunicable diseases burden in Kerala (27). A study conducted by Meena Daivadanam et al had found that Prevalence of risk factors for diabetes is very high and increasing in Kerala, which is almost same with my current study results (28). The prevalence of all NCD risk factors increases with age were found to be almost same to the study by K.R. Thankappan et al (7). A cross sectional study conducted in rural Kerala in 2016 showed that the physical activity among the rural population of Kerala was alarmingly low and was more with the female population in the study (30). A study in northern part of Kerala by N Shamim Begam et al reported that the prevalent of NCDs and its risks factors are high among male gulf migrants compare to non-migrants as Kerala has large number of expatriates working in gulf countries (31).

7.Recommendations

The NCDs and its prevalence must be controlled in Kerala through government interventional programs. Government should implement programs based on proper nutritional diet, more on sports education, hike taxes on food items which contains trans-fat and limit the availability of alcohol and cigarettes to the population. Proper knowledge and awareness about the required dietary intake and identifying the risk factors must be imparted to the population of the state.

8. Conclusion

The findings provide support for more studies into the interventions for controlling NCDs in Kerala. The prevalence of NCDs in Kerala is high when compared to National figures. Timely diagnosis and Management are the most possible way to control NCDs. Even though the Kerala has the highest life expectancy but the state has one of the highest morbidity rates in India and this leads to paradox. The literacy level of the state is high but a large population is unaware about their medical conditions and the changing life patterns. Kerala people are spending more on healthcare treatments in private hospitals which leads to out of pocket expenditure. All these issues lead to severe health and economic burden in Kerala, which on future can also occur in other developing states in India.

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PART- 2 ONLINE COURSE-
Data Analytics for Lean Six Sigma

1.Name of the Course-

Data analytics for lean six sigma

2.Course Description

- Data analytics technique that are typically useful within Lean Six Sigma projects for the belt.
- To analyze and interpret data gathered within such a project.
- Use of statistics for data analysis.
- Learnt to use data analytics tools and interpretation of the outcome to find the relationship between different variables.
- Training on Statistical power tool software Minitab.

Minitab is a statistical software package. It is used in many organizations by Belts executing Lean Six Sigma projects. It is the industry-wide standard. We use Minitab for applying statistical tools to data while excel is used for storing data and simple operations.

3.Objective

- To learn data analytics and its techniques used within Lean Six Sigma improvement projects.
- To learn how to play with data and operate the software Minitab to find the relationship between variables.

4.Learning Methodology

Video Lectures, Cases, Assignments, Quizzes and Reading Materials

5.Key Learnings

- Statistics
- Lean Six Sigma method
- Data Analysis
- Minitab Software
- Hypothesis Testing

6. Website/ Organization

Coursera, <https://www.coursera.org/learn/data-analytics-for-lean-six-sigma/home>

7. Course Contents

- WEEK-1 (9 videos, 1 Practice quiz, 1 Graded Quiz)

Data and Lean Six Sigma- Introduction about Lean Six Sigma and the software Minitab which is used for data analytics.

1. Introduction to Lean Six Sigma- It is a methodology for process improvement, and it makes use of data and data analytics. Lean Six Sigma is a data-driven approach to process improvement.

2. DMAIC- The acronym stands for 1. Define, 2. Measure, 3. Analyze, 4. Improve, 5. Control. It is a step wise procedure in Lean Six Sigma for process improvement. Someone leading the Lean Six Sigma project is called a Belt.

3. Selecting Critical to Quality Test (CTQ)- In Lean Six Sigma, the CTQ is the metric which is used to change. It is often called Y-variable or dependent variable or outcome variable.

4. Units and Measurement definition- Units are things which we collect data on. Example - Objects, People. Units are always stored in the rows of the data set.

5. Sampling- Collecting a representative sampling and Minitab is used to make a random sample population.

6. Organizing data- Data can be organized in a structured way using units and variables. Variables are properties we measure and It is always stored on the column.

- WEEK-2(8 Videos, 1 Practice Quiz, 1 Graded Quiz)

Understanding and visualizing data – Differentiating numerical and categorical variables. Visualizing data of both single variables and two variables using appropriate graphs.

1. Numerical & Categorical data- Numerical data known as quantitative data has been divided into discrete and continues.

Categorical data known as qualitative has been divided into ordinal, nominal and binary data. Numerical data contains more information than categorical data

2. Descriptive analysis- Descriptive statistics are only available for numerical data. It summarizes features from a collection of information such as mean, median, Range, Standard deviation, Variance, Interquartile range etc.

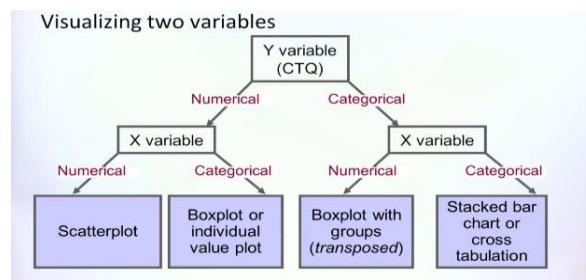
3. Visualizing numerical data- The histogram and boxplot are the graphs for the numerical data. The histogram shows the variable and gives information about the data distribution. A box plot gives information about the spread in our data and outliers.

4. Visualizing categorical data- Pie chart, Bar chart and Tally table are used for visualizing categorical data. A pie chart shows us how often each category occurs. A bar chart also gives the same information, but it is easy to identify which category occurs most often. A Tally Table gives the exact numbers.

5. Pareto Analysis- It is a chart in which Pareto principle can be seen and it counts how often each cause on the x-axis occurs. It can be helpful to differentiate the major and minor causes of the problems.

6. Visualizing two variables-

The graph to visualize two variables depends on the type of data.



- **WEEK-3(7 Videos, 1 Explanation Quiz, 1 Practice Quiz, 1 Graded Quiz)**

Using Probability Distributions- Usage of probability distributions and Quantifying uncertainty.

1. Population versus Sampling- The population is a collection of all units of interest, example all customers of a company. The sample is a subset of the population, example all male customers of a company.

2. Estimation and Confidence Interval- Estimates the unknown population parameters and uses confidence interval to quantify the uncertainty. Confidence Interval gives the boundaries where the population mean will lie in between with a certain level of confidence.

3. Probability distribution- The normal distribution is the most often seen probability distribution while in Lean Six Sigma projects, both Weibull distribution and Lognormal distribution are also relevant.

4. Probability Plot- It is a tool used to determine which distribution to be used for modelling the population. It can be used to spot data anomalies. Depends upon the data which lies on the straight line, it can be classified into good fit and poor fit.

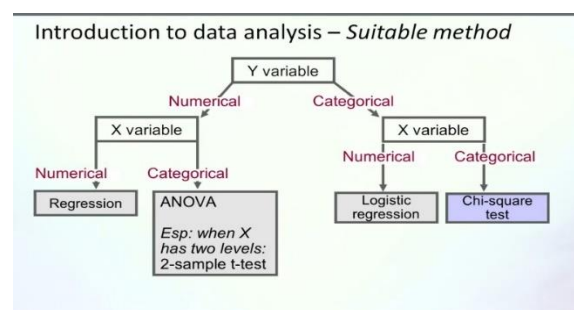
5. Empirical CDF- It is used in the analyze phase of the project and it is used to calculate percentages.

6. Properties of Normal distribution- It is symmetrical looks like a bell shaped. It is even called Gauss curve. The shape of the distribution is determined by the parameters location parameter (μ) and dispersion parameter (σ).

- **WEEK- 4(9 Videos, 2 Explanation Quiz, 2 Practice Quiz, 1 Graded Quiz)**

Introduction to Testing -Modeling CTQ and influence factors and selecting appropriate tool for data-based testing of the models.

1. Introduction to data analysis – In the Lean Six Sigma project, the main intension is to know whether CTQ is related to the influence factor or not. The suitable method depends on the type of data that is the CTQ and the influence factor is categorical or numerical variable.



2. Hypothesis Testing – This is done to find the effect between the variables. The null hypothesis and alternate hypothesis stated have to be checked in accordance with the P-value. If the P- value is smaller than 0.05, reject null hypothesis. If P-value is larger than 0.05, do not reject null- hypothesis.

3.Causality- It is about the cause & effect of relationships, example if x variable changes y variable also changes. So, the relationships should be interpreted judiciously in order to avoid mistakes.

Testing numerical Y and categorical X- Establishing relationship between numerical Y variable (CTQ) and categorical influence factors (X variables).

4.Introduction to ANOVA- It stands for analysis of variance. It is used to study the relationships between numerical Y and categorical X variable. It consists of 3 steps, 1. Organize data, 2. ANOVA and 3. Residuals. The two assumptions of ANOVA are, the distribution should be normal and there won't be any outliers.

5.ANOVA analysis – The hypothesis test using p-value is done to find the significant relationship between the variables. The R-square value gives the relevancy of the influence factor.

6.ANOVA residual analysis- This is done to validate the assumptions underlying ANOVA. To validate the assumptions, it must be checked that the residuals are normally distributed and there are any outliers or other irregularities present.

7.Kruskal-Wallis Test- This is a non-parametric test used as an alternative to ANOVA when the assumptions are not met.

8.Two sample t-test – This is used to analyze the difference between the means of two groups. The P-value obtained can be used to calculate whether the mean difference is coincidental or truly significant.

9.Test for equality of variances-This is used to test the variability across groups as variation shows the consistency of the variables. The hypothesis test shows the consistency of the variance.

- **WEEK-5(8Videos, 3 Explanation Quiz, 2 Practice Quiz, 1 Graded Quiz)**

Testing: numerical Y and numerical X- Statistical tests to relate a numerical Y variable (CTQ) and numerical X variable (influence factor).

1.Correlation- It shows the strength of relationship between two numerical variables. It is always between the value -1 and +1. A negative correlation shows that the variables are correlated in the opposite direction. Correlation of 0 means there is no relation between the variables.

2.Regression- This is a statistical method to test whether two numerical variables are related or not by calculating the best fitting line. Regression analysis is about finding the values of a and b from the formula $y = a + bX$. Regression analysis consists of 4 steps which are, 1. Make a fitted line plot to visualize the data, 2. Perform main Regression analysis, 3. Perform residual analysis, 4. Calculating the prediction interval.

3.Reggression Analysis- The hypothesis shows the significant relation using P-value and the R square shows the strength of the relationship.

4.Reggression Residual analysis- If the residuals are normally distributed and shows no outliers or irregularities then the assumptions can be proved. If not, then the quadratic regression model can be used.

5.Reggression prediction interval- This can be used to determine the level of influence factor, which ensures a certain CTQ performance.

6.Quadratic Equation-This is used when the linear regression analysis is not meeting the assumption. A curved line fits to the data instead of a straight line.

Testing categorical Y- Testing relationship between a Y and a X variable, when Y variable (CTQ) is categorical.

7.Chi- Square analysis- It is used to find the relation between a categorical Y and categorical X variables. This has two steps, 1. Cross tabulation of data, 2. Chi-square analysis and p-value. The p-value shows the significance of relationship between the variables.

8.Logistic Regression- It is used to find the relation between a categorical Y and numerical X variables. This consists of 3 steps,1. Enter data in event/trial format, 2. Make fitted line plot, 3.P-value. The p-value shows the significance of relationship between the variables.

8.Course Completion



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Ajil Rajasekharan, congratulations!

Completing an online course is no simple endeavor. It requires time, dedication, and commitment, so when we say "Congratulations" - we mean it! Take a moment to reflect on your hard work and enjoy your completion of [Data Analytics for Lean Six Sigma](#). You've earned it.