A PROJECT REPORT

ON

Assessment of modern contraceptive method, its prevalence and association with various factors among women aged 15-49 in different states of India, using NFHS-V data.

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT

FOR THE AWARD OF THE DEGREE OF

BACHELOR OF SCIENCE

IN

STATISTICS

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UNDER THE JOINT SUPERVISION OF

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DEPARTMENT OF SATATISTICS AND OPERATIONS RESEARCH

ALIGARH MUSLIM UNIVERSITY, ALIGARH (INDIA)

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CERTIFICATE

This is to certify that the project entitled: "*Assessment of modern contraceptive method, its prevalence and association with various factors among women aged 15-49 in different states of India, using NFHS-V data*", has been carried out by the following group of students of **Bachelor of Science (Statistics), Final Year, 2022-23,** under our joint supervision for the course **"STB6S1-Project".**

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Chapter I
Introduction

1.1 Introduction:

Back **in 2015**, all United Nations member states adopted the 2030 Agenda for Sustainable Development, an ambitious plan of action to tackle a variety of global challenges, such as poverty, human rights, and climate change, by 2030.

In that agenda, the 17 Sustainable Development Goals, or SDGs, were laid out, as well as **169 targets** for a better world. Each of the 17 sustainable development goals address one major challenge facing the world, from hunger to inequality. Each goal on the list is interconnected with the others; to solve one, we have to solve them all.

1.2 History:

The 2030 Agenda for sustainable development, adopted by all United Nations member states in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 sustainable development goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.

The SDGs build on decades of work by countries and the UN, including the UN Department of Economic and Social Affairs

The content of this chapter has been prepared with the help of various books and websites whose references are provided at the end in the "Reference section"

In June 1992, at the Earth Summit in Rio de Janeiro, Brazil, more than 178 countries adopted Agenda 21, a comprehensive plan of action to build a global partnership for sustainable development to improve human lives and protect the environment.

Member States unanimously adopted the Millennium Declaration at the Millennium Summit in September 2000 at UN Headquarters in New York. The summit led to the elaboration of eight Millennium Development Goals (MDGs) to reduce extreme poverty by 2015.

The Johannesburg Declaration on Sustainable Development and the Plan of Implementation, adopted at the World Summit on Sustainable Development in South Africa in 2002, reaffirmed the global community's commitments to poverty eradication and the environment, and built on Agenda 21 and the Millennium Declaration by including more emphasis on multilateral partnerships.

At the United Nations Conference on Sustainable Development (Rio+20) in Rio de Janeiro, Brazil, in June 2012, Member States adopted the outcome document "The Future We Want" in which they decided, inter alia, to launch a process to develop a set of SDGs to build upon the MDGs and to establish the UN High-level Political Forum on Sustainable Development. The Rio +20 outcome also contained other measures for implementing sustainable development, including mandates for future programmes of work in development financing, small island developing states and more.

In 2013, the General Assembly set up a 30-member Open Working Group to develop a proposal on the SDGs.

In January 2015, the General Assembly began the negotiation process on the post-2015 development agenda. The process culminated in the subsequent adoption of the 2030 Agenda for Sustainable Development, with 17 SDGs at its core, at the UN Sustainable Development Summit in September 2015.

2015 was a landmark year for multilateralism and international policy shaping, with the adoption of several major agreements:

- Sendai Framework for Disaster Risk Reduction (March 2015): The Sendai Framework for Disaster Risk Reduction (2015–2030) is an international document that was adopted by the United Nations (UN) member states between 14 and 18 March 2015 at the World Conference on Disaster Risk Reduction held in Sendai, Japan, and endorsed by the UN General Assembly in June 2015.
- Addis Ababa Action Agenda on Financing for Development (July 2015): The Addis Ababa Action Agenda was the outcome of the 2015 Third International Conference on Financing for Development, held in Addis Ababa, Ethiopia. It was adopted by heads of state and government on 15 July 2015. 174 United Nations member states sent delegations; 28 heads of State, vice presidents and heads of government attended. Governments were joined by the heads of the United Nations, the International Monetary Fund (IMF), the World Bank and the World Trade Organization (WTO), prominent business and civil society leaders, and other stakeholders. The agreement is

a follow-up to the 2002 Monterrey Consensus and the 2008 Doha Declaration on Financing for Development.

- Transforming our world: This Agenda is a plan of action for people, planet and prosperity. It also seeks to strengthen universal peace in larger freedom. We recognise that eradicating poverty in all its forms and dimensions, including extreme poverty, is the greatest global challenge and an indispensable requirement for sustainable development. All countries and all stakeholders, acting in collaborative partnership, will implement this plan. We are resolved to free the human race from the tyranny of poverty and want and to heal and secure our planet. We are determined to take the bold and transformative steps which are urgently needed to shift the world onto a sustainable and resilient path. As we embark on this collective journey, we pledge that no one will be left behind. The 2030 Agenda for Sustainable Development with its 17 SDGs was adopted at the UN Sustainable Development Summit in New York in September 2015.

Paris Agreement on Climate Change (December 2015): The Paris Agreement (French: Accord de Paris), often referred to as the Paris Accords or the Paris Climate Accords, is an international treaty on climate change. Adopted in 2015, the agreement covers climate change mitigation, adaptation, and finance. The Paris Agreement was negotiated by 196 parties at the 2015 United Nations Climate Change Conference near Paris, France. As of February 2023, 195 members of the United Nations Framework Convention on Climate Change (UNFCCC) are parties

to the agreement. Of the four UNFCCC member states which have not ratified the agreement, the only major emitter is Iran. The United States withdrew from the agreement in 2020, but re-joined in 2021.

Now, the annual High-level Political Forum on Sustainable Development serves as the central UN platform for the follow-up and review of the SDGs.

Today, the Division for Sustainable Development Goals (DSDG) in the United Nations Department of Economic and Social Affairs (UNDESA) provides substantive support and capacity-building for the SDGs and their related thematic issues, including water, energy, climate, oceans, urbanization, transport, science and technology, the Global Sustainable Development Report (GSDR), partnerships and Small Island Developing States. DSDG plays a key role in the evaluation of UN systemwide implementation of the 2030 Agenda and on advocacy and outreach activities relating to the SDGs. In order to make the 2030 Agenda a reality, broad ownership of the SDGs must translate into a strong commitment by all stakeholders to implement the global goals. DSDG aims to help facilitate this engagement.

1.3 Sustainable Development Goals (SGDs):

The lists of targets and indicators for each of the 17 SDGs was published in a UN resolution in July 2017. Each goal typically has 8–12 targets, and each target has between one and four indicators used to measure progress toward reaching the targets, with the average of 1.5 indicators per target. The targets are either *outcome*

targets (circumstances to be attained) or *means of implementation* targets. The latter targets were introduced late in the process of negotiating the SDGs to address the concern of some member states about how the SDGs were to be achieved. Goal 17 is wholly about how the SDGs will be achieved.

The numbering system of targets is as follows:

Outcome targets use numbers, whereas means of implementation targets use lower case letters.

The indicators for the targets have varying levels of methodological development and availability of data at the global level. Initially, some indicators (called Tier 3 indicators) had no internationally established methodology or standards. Later, the global indicator framework was adjusted so that Tier 3 indicators were either abandoned, replaced or refined. As of 17 July 2020, there were 231 unique indicators.

- The 17 goals with their targets and indicators are:

I. Goal 1: No poverty

"End poverty in all its forms everywhere"

The goal has seven targets and 13 indicators to measure progress. The five "outcome targets" are: eradication of extreme poverty; reduction of all poverty by half; implementation of social protection systems; ensuring equal rights to ownership, basic services, technology and economic resources; and the building of resilience to environmental, economic and social disasters. The two targets related to "means of achieving" SDG 1 are mobilization of resources to end poverty; and the establishment of poverty eradication policy frameworks at all levels.

II. Goal 2: Zero hunger (No hunger)

"End hunger, achieve food security and improved nutrition, and promote sustainable agriculture"

SDG 2 has eight targets and 14 indicators to measure progress. The five "outcome targets" are: ending hunger and improving access to food; ending all forms of malnutrition; agricultural productivity; sustainable food production systems and resilient agricultural practices; and genetic diversity of seeds, cultivated plants and

farmed and domesticated animals; investments, research and technology. The three "means of achieving" targets include: addressing trade restrictions and distortions in world agricultural markets and food commodity markets and their derivatives.

III. Goal 3: Good health and well-being

"Ensure healthy lives and promote well-being for all at all ages"

SDG 3 has 13 targets and 28 indicators to measure progress toward targets. The first nine targets are "outcome targets". Those are: reduction of maternal mortality; ending all preventable deaths under five years of age; fight communicable diseases; ensure reduction of mortality from non-communicable diseases and promote mental health; prevent and treat substance abuse; reduce road injuries and deaths; grant universal access to sexual and 6 reproductive care, family planning and education; achieve universal health coverage; and reduce illnesses and deaths from hazardous chemicals and pollution. The four "means to achieving" SDG 3 targets are: implement the WHO Framework Convention on Tobacco Control; support research, development and

universal access to affordable vaccines and medicines; increase health financing and support health workforce in developing countries; and improve early warning systems for global health risks.

IV. Goal 4: Quality education

"Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all"

SDG 4 has ten targets which are measured by 10 indicators. The seven "outcome-oriented targets" are: free primary and secondary education; equal access to quality pre-primary education; affordable technical, vocational and higher education; increased number of people with relevant skills for financial success; elimination of all discrimination in education; universal literacy and numeracy; and education for sustainable development and global citizenship. The three "means of achieving targets" are: build and upgrade inclusive and safe schools; expand higher education

scholarships for developing countries; and increase the supply of qualified teachers in developing countries.

V. Goal 5: Gender equality

"Achieve gender equality and empower all women and girls"

SDG 5 has nine targets and 14 indicators. Six of the targets are *outcome targets*: ending all forms of discrimination against all women and girls everywhere; ending violence and exploitation of women and girls; eliminating harmful practices such as child, early and forced marriage and female genital mutilation; increasing value of unpaid care and promoting shared domestic responsibilities; ensuring full participation of women in leadership and decision-making; and ensuring access to universal reproductive rights and health. The three *means of implementation targets* are: fostering equal rights to economic resources, property ownership and financial services for women; promoting empowerment of women through technology; and adopting, strengthening policies and enforcing legislation for gender equality.

VI. Goal 6: Clean water and sanitation

"Ensure availability and sustainable management of water and sanitation for all"

The six *outcome targets* include: Safe and affordable drinking water; end open defecation and provide access to sanitation, and hygiene, improve water quality, wastewater treatment and safe reuse, increase water-use efficiency and ensure freshwater supplies, implement IWRM, protect and restore water-related ecosystems. The two *means of implementation targets* are to expand water and sanitation support to developing countries, and to support local engagement in water and sanitation management.

VII. Goal 7: Affordable and clean energy

"Ensure access to affordable, reliable, sustainable and modern energy for all"

The goal has five targets to be achieved by 2030. Progress towards the targets is measured by six indicators. These targets include access to affordable and reliable energy while increasing the share of renewable energy in the global energy mix. They also focus on improving energy efficiency, international cooperation and investment in clean energy infrastructure.

VIII. Goal 8: Decent work and economic growth

"Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"

SDG 8 has twelve targets in total to be achieved by 2030. Some targets are for 2030; others are for 2020. The first ten are *outcome targets*. These are; "sustainable economic growth; diversify, innovate and upgrade for economic productivity", "promote policies to support job creation and growing enterprises", "improve resource efficiency in consumption and production", 'full employment and decent work with equal pay', 'promote youth employment, education and training', 'end modern slavery, trafficking, and child labour', 'protect labour rights and promote safe working environments', 'promote beneficial and sustainable tourism', universal access to banking, insurance and financial services. In addition, there are also two targets for *means of implementation*, which are: Increase aid for trade support; develop a global youth employment strategy.

IX. Goal 9: Industry, Innovation and Infrastructure

"Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation"

SDG 9 has eight targets, and progress is measured by twelve indicators. The first five targets are *outcome targets*: develop sustainable, resilient and inclusive infrastructures; promote inclusive and sustainable industrialization; increase access to financial services and markets; upgrade all industries and infrastructures for sustainability; enhance research and upgrade industrial technologies. The remaining three targets are *means of implementation targets*: Facilitate sustainable infrastructure development for developing countries; support domestic technology development and industrial diversification; universal access to information and communications technology.

X. Goal 10: Reduced inequality

"Reduce income inequality within and among countries"

The Goal has ten targets to be achieved by 2030. Progress towards targets will be measured by indicators. The first seven targets are *outcome targets*: Reduce income inequalities; promote universal social, economic and political inclusion; ensure equal

opportunities and end discrimination; adopt fiscal and social policies that promotes equality; improved regulation of global financial markets and institutions; enhanced representation for developing countries in financial institutions; responsible and well-managed migration policies. The other three targets are *means of implementation targets*: Special and differential treatment for developing countries; encourage development assistance and investment in least developed countries; reduce transaction costs for migrant remittances.

XI. Goal 11: Sustainable cities and communities

"Make cities and human settlements inclusive, safe, resilient, and sustainable"

SDG 11 has 10 targets to be achieved, and this is being measured with 15 indicators. The seven *outcome targets* include safe and affordable housing, affordable and sustainable transport systems, inclusive and sustainable urbanization, protection of the world's cultural and natural heritage, reduction of the adverse effects of natural disasters, reduction of the environmental impacts of cities and to provide access to

safe and inclusive green and public spaces. The three *means of implementation targets* include strong national and regional development planning, implementing policies for inclusion, resource efficiency, and disaster risk reduction in supporting the least developed countries in sustainable and resilient building.

XII. Goal 12: Responsible consumption and production

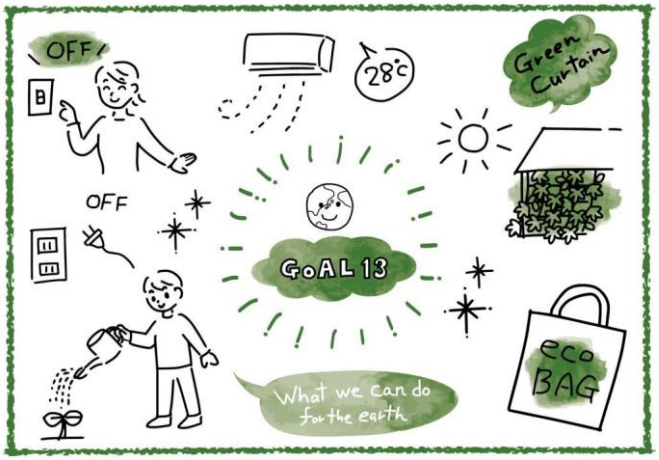
"Ensure sustainable consumption and production patterns"

Sustainable Development Goal 12 has 11 targets. The first 8 are *outcome targets*, which are: implement the 10-Year Framework of Programs on Sustainable Consumption and Production Patterns; achieve the sustainable management and efficient use of natural resources; reducing by half the per capita global food waste at the retail and consumer levels and the reduction of food losses along production and supply chains, including post-harvest losses; achieving the environmentally sound management of chemicals and all wastes throughout their life cycle; reducing waste generation through prevention, reduction, recycling and reuse;

encourage companies to adopt sustainable practices; promote public procurement practices that are sustainable; and ensure that people everywhere have the relevant information and awareness for sustainable development. The three *means of implementation targets* are: support developing countries to strengthen their scientific and technological capacity; develop and implement tools to monitor sustainable development impacts; and remove market distortions, like fossil fuel subsidies, that encourage wasteful consumption.

XIII. Goal 13: Climate action

"Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy"



SDG 13 has five targets which are to be achieved by 2030. They cover a wide range of issues surrounding climate action. The first three targets are *outcome targets*: Strengthen resilience and adaptive capacity to climate-related disasters; integrate climate change measures into policies and planning; build knowledge and capacity to

meet climate change. The remaining two targets are *means of implementation targets*: To implement the UN Framework Convention on Climate Change (UNFCCC), and to promote mechanisms to raise capacity for planning and management. Along with each target, there are indicators that provide a method to review the overall progress of each target. The UNFCCC is the primary international, intergovernmental forum for negotiating the global response to climate change.

XIV. Goal 14: Life below water

"Conserve and sustainably use the oceans, seas and marine resources for sustainable development"

The first seven targets are *outcome targets*: Reduce marine pollution; protect and restore ecosystems; reduce ocean acidification; sustainable fishing; conserve coastal and marine areas; end subsidies contributing to overfishing; increase the economic benefits from sustainable use of marine resources. The last three targets are *means of implementation targets*: To increase scientific knowledge, research and technology

for ocean health; support small scale fishers; implement and enforce international sea law.[75] One indicator (14.1.1b) under Goal 14 specifically relates to reducing impacts from marine plastic pollution.

XV. Goal 15: Life on land

"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"

The nine "outcome targets" include: Conserve and restore terrestrial and freshwater ecosystems; end deforestation and restore degraded forests; end desertification and restore degraded land; ensure conservation of mountain ecosystems, protect biodiversity and natural habitats; protect access to genetic resources and fair sharing of the benefits; eliminate poaching and trafficking of protected species; prevent invasive alien species on land and in water ecosystems; and integrate ecosystem and biodiversity in governmental planning. The three "means of achieving targets"

include: Increase financial resources to conserve and sustainably use ecosystem and biodiversity; finance and incentivize sustainable forest management; combat global poaching and trafficking.

XVI. Goal 16: Peace, justice and strong institutions

"Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels"

The goal has ten "outcome targets": Reduce violence; protect children from abuse, exploitation, trafficking and violence; promote the rule of law and ensure equal access to justice; combat organized crime and illicit financial and arms flows, substantially reduce corruption and bribery; develop effective, accountable and transparent institutions; ensure responsive, inclusive and representative decision-making; strengthen the participation 11 in global governance; provide universal legal identity; ensure public access to information and protect fundamental freedoms. There are also

two "means of achieving targets": Strengthen national institutions to prevent violence and combat crime and terrorism; promote and enforce non-discriminatory laws and policies.

XVII. Goal 17: Partnership for the goals

"Strengthen the means of implementation and revitalize the global partnership for sustainable development"

This goal has 19 outcome targets and 24 indicators. Increasing international cooperation is seen as vital to achieving each of the 16 previous goals. Goal 17 is included to assure that countries and organizations cooperate instead of compete. Developing multi-stakeholder partnerships to share knowledge, expertise, technology, and financial support is seen as critical to overall success of the SDGs. The goal encompasses improving north–south and south-south cooperation, and public-private partnerships which involve civil societies are specifically mentioned.

1.4 Sustainable Development Goal 3 (SDG 3)

SDG 3 is to: ***"Ensure healthy lives and promote well-being for all at all ages"***

This SDG has **13 targets** and **28 indicators** to measure progress toward targets. The first nine targets are outcome targets.

The four means of implementation targets are:

- Implement the WHO Framework Convention on Tobacco Control
- Support research, development and universal access to affordable vaccines and medicines
- Increase health financing and support health workforce in developing countries
- Improve early warning systems for global health risks

Target 3.1: By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births.

Indicators:

3.1.1 Maternal mortality ratio.

3.1.2 Proportion of births attended by skilled health personnel.

Target 3.2: By 2030, end preventable deaths of new-borns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per

1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births.

Indicators:

3.2.1 Under-five mortality rate.

3.2.2 Neonatal mortality rate.

Target 3.3: By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.

Indicators:

3.1.1 Number of new HIV infections per 1,000 uninfected population, by sex, age and key populations.

3.1.2 Tuberculosis incidence per 100,000 population.

3.1.3 Malaria incidence per 1,000 population.

3.1.4 Hepatitis B incidence per 100,000 population.

3.1.5 Number of people requiring interventions against neglected tropical diseases.

Target 3.4: By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.

Indicators:

3.4.1 Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease.

3.4.2 Suicide mortality rate.

Target 3.5: Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol.

Indicators:

3.5.1 Coverage of treatment interventions (pharmacological, psychosocial and rehabilitation and aftercare services) for substance use disorders.

3.5.2 Alcohol per capita consumption (aged 15 years and older) within a calendar year in litres of pure alcohol.

Target 3.6: By 2020, halve the number of global deaths and injuries from road traffic accidents.

Indicators:

3.6.1 Death rate due to road traffic injuries.

Target 3.7: By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes.

Indicators:

3.7.1 Proportion of women of reproductive age (aged 15-49 years) who have their need for family planning satisfied with modern methods.

3.7.2 Adolescent birth rate (aged 10-14 years; aged 15-19 years) per 1,000 women in that age group.

Target 3.8: Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all. **Indicators:**

3.8.1 Coverage of essential health services.

3.8.2 3.8.2 Proportion of population with large household expenditures on health as a share of total household expenditure or income.

Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination. **Indicators:**

3.9.1 Mortality rate attributed to household and ambient air pollution.

3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services).

3.9.3 Mortality rate attributed to unintentional poisoning.

Target 3.a: Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate.

3.a.1 Age-standardized prevalence of current tobacco use among persons aged 15 years and older.

Target 3.b: Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all.

Indicators:

3.b.1 Proportion of the target population covered by all vaccines included in their national program.

3.b.2 Total net official development assistance to medical research and basic heal sectors.

3.b.3 Proportion of health facilities that have a core set of relevant essential medicines available and affordable on a sustainable basis.

Target 3.c : Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States.

Indicators:

3.c.1: Health worker density and distribution.

Target 3.d: Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.

Indicators:

3.d.1 International Health Regulations (IHR) capacity and health emergency preparedness.

3.d.2 Percentage of bloodstream infections due to selected antimicrobial- resistant organisms.

1.5 Modern Contraceptive Prevalence Rate (mCPR)

The contraceptive prevalence rate is defined as the percentage of women of reproductive age (15-49) who use (or whose partners use) a contraceptive method at a given point in time. Increased contraceptive prevalence is also an important proximate determinant of inter-country as well as inter-state differences in fertility and of ongoing fertility

declines in developing countries. Contraceptive prevalence is influenced by people's fertility desires, availability of high-quality products and services; social norms and values; levels of education; and other factors, such as marriage patterns and traditional birth-spacing practices. It is an indicator of population and health, particularly women's access to reproductive health services. The formula for calculating mCPR is given below:

$$mCPR = \frac{\text{Women of reproductive age who are married or in union and who are currently using any method of contraception}}{\text{Total number of women of reproductive age who are married or in union}} X\ 100$$

For analytical purposes, contraceptive methods are often classified as either modern or traditional.

I. **Modern methods of contraception:** These methods include female and male sterilization, the intra-uterine device (IUD), the implant, injectables, oral contraceptive pills, male and female condoms, vaginal barrier methods (including the diaphragm, cervical cap and spermicidal foam, jelly, cream and sponge), the lactational amenorrhea method (LAM), emergency contraception and other modern methods not reported separately (e.g., the contraceptive patch or vaginal ring).

II. **Traditional methods of contraception:** These methods include rhythm (e.g., fertility awareness-based methods, periodic abstinence), withdrawal and other traditional methods not reported separately.

1.5.1 Purpose:

The CPR provides a measure of population coverage of contraceptive use, considering all sources of supply and all contraceptive methods; it is the most widely reported measure of outcome for family planning programs at the population level.

Technically speaking, CPR is a ratio, not a rate. (Prevalence is measured by a ratio and incidence by a rate.) For a given year, contraceptive prevalence measures the percentage of women of childbearing age in union who use a form of contraception. To obtain a true contraceptive use rate, the denominator should reflect the population at risk (of pregnancy), i.e., sexually active women who are not infecund, pregnant, or amenhorreic. The numerator should reflect the number of contraceptive users from that population. The international population community uses the term “contraceptive prevalence rate” as defined above.

1.5.2 Issue(s)

The convention in reporting contraceptive prevalence is to base this calculation on women married or in sexual union (even though most DHS-type surveys ask questions of contraceptive use to women of reproductive age, regardless of their marital status). In countries with relatively little sexual activity outside marriage for women, basing prevalence estimates on women in sexual union captures the population at risk of pregnancy. However, in countries with the widespread practice of sexual activity outside of marriage or stable sexual unions, a prevalence estimate based on women in

union *only* would ignore a considerable percentage of current users. Thus, researchers and program evaluators generally report percentage of sexually active unmarried women using contraception, if appropriate, in addition to contraceptive prevalence, because method mix is very different for those married versus unmarried (in/not in a stable union).

Whereas evaluators may theoretically derive the CPR from service statistics on numbers of current users and estimates of the population at risk, current practice is to rely upon population-based sample surveys in order to minimize the problems associated with maintaining a running count of current users and with obtaining accurate population estimates. (The problems include incomplete data, double-counting of users who enter the service delivery system at more than one point, purposeful inflation of service statistics, and poor quality of data due to other activities competing for the attention of those recording the information, to name the primary ones.)

Chapter II
Research Methodology

2.1 Topic

Assessment of modern contraceptive method its prevalence and association with various factors among women aged 15-49 in India using NFHS-V

2.2 Objective

Use of modern contraceptive methods provides opportunities for women and couples to achieve optimal child spacing, achieve desired family size and reduce unsafe abortions. This project aims to explore the current state of modern contraceptive method and its prevalence rate with a focus on trends and factors in different states of India in 2019-2021 in the light of NFHS-V data set.

2.3 Data

There are two types of statistical data based on their source. They are primary and secondary sources.

1. **Primary Data:** Data that is being generated by the researcher themselves, surveys, interviews, experiments, specially designed for understanding and solving the research problem at hand.
2. **Secondary Data:** Secondary data is the data that have been already collected for another purpose but has some relevance to your current research needs. In other

words, it has already been collected in the past by someone else, not you. And now, you can use the data. Secondary data is second-hand information. It is not used for the first time. That is why it is called secondary. Typically, secondary data is found in resources like the Internet, libraries, or reports. Web information, business reports, mass media products, encyclopaedias, and government statistics are among the most popular examples of secondary data.

In this study we are using a secondary data known as NFHS-V data set. The data is collected from the website of **Demographic and Health Survey (DHS).** The letter for the same is attached at the end.

2.3.1 National Family Health Survey (NFHS)

The National Family Health Survey (NFHS) is a large-scale, multi-round survey conducted by International Institute for Population Sciences (IIPS), Mumbai, India; ORC Macro, Calverton, Maryland, USA and the East-West Center, Honolulu, Hawaii, USA. The Ministry of Health and Family Welfare (MOHFW), Government of India, designated IIPS as the nodal agency, responsible for providing coordination and technical guidance for the NFHS. NFHS was funded by the United States Agency for International Development (USAID) with supplementary support from United Nations Children's Fund (UNICEF). IIPS collaborated with a number of Field Organizations (FO) for survey implementation. Each FO was responsible for conducting survey activities in one or more states covered by the NFHS. Technical assistance for the NFHS was provided by ORC Macro and the East-West centre.

The first National Family Health Survey (NFHS-1) was conducted in 1992-93. The survey collected extensive information on population, health, and nutrition, with an emphasis on women and young children. Eighteen Population Research Centres (PRCs), located in universities and institutes of national repute, assisted IIPS in all stages of conducting NFHS-1. All the state-level and national-level reports for the survey have already been published (48 reports in all).

The second National Family Health Survey (NFHS-2) was conducted in 1998-99 in all 26 states of India with added features on the quality of health and family planning services, domestic violence, reproductive health, anaemia, the nutrition of women, and the status of women. The results of the survey are currently being published.

The third National Family Health Survey (NFHS-3) was conducted in december 2005 – august 2006. It provides information on several new and emerging issues, including family life education, safe injections, perinatal mortality, adolescent reproductive health, high-risk sexual behaviour, tuberculosis, and malaria. Further, unlike the earlier surveys in which only ever-married women age 15-49 were eligible for individual interviews, NFHS-3 interviewed all women age 15-49 and all men age 15- 54. Information on nutritional status, including the prevalence of anaemia, is provided in NFHS-3 for women age 15-49, men age 15-54, and young children.

The fourth National Family Health Survey (NFHS-4) was conducted in 2015-16. NFHS-4 is a nationally representative survey that provides essential information on various aspects of population, health, and nutrition in India. The survey covers a wide range of topics, including fertility, maternal and child health, family planning, nutrition, water

and sanitation, HIV/AIDS, and domestic violence. NFHS-4 aims to provide policymakers, researchers, and other stakeholders with reliable and up-to-date data to make informed decisions and develop effective strategies to improve health outcomes and the quality of life for the people of India.

2.3.2 Demographic and Health Survey (DHS)

The Demographic and Health Surveys (DHS) Program is responsible for collecting and disseminating accurate, nationally representative data on health and population in developing countries. The project is implemented by ICF International and is funded by the United States Agency for International Development (USAID) with contributions from other donors such as United Nations Children's Fund (UNICEF), United Nations Population Fund (UNFPA), World Health Organization (WHO), and Joint United Nations Programme on HIV/AIDS (UNAIDS).

The DHS is highly comparable to the Multiple Indicator Cluster Surveys and the technical teams developing and supporting the surveys are in close collaboration.

Since 1984, The Demographic and Health Surveys (DHS) Program has provided technical assistance to more than 300 demographic and health surveys in over 90 countries. DHS surveys collect information on fertility and total fertility rate (TFR), reproductive health, maternal health, child health, immunization and survival, HIV/AIDS; maternal mortality, child mortality, malaria, and nutrition among women and children stunted. The strategic objective of The DHS Program is to improve and institutionalize the collection and use of data by host countries for program monitoring and evaluation and for policy development decisions.

2.4 Some data analysis tools:

2.4.1 Graphical Representation

- **Bar chart:**

A bar chart (a.k.a. bar graph, column chart) plots numeric values for levels of a categorical feature as bars. Levels are plotted on one chart axis, and values are plotted on the other axis. Each categorical value claims one bar, and the length of each bar corresponds to the bar's value. Bars are plotted on a common baseline to allow for easy comparison of values. From a bar chart, we can see which groups are highest or most common, and how other groups compare against the others. Since this is a fairly common task, bar charts are a fairly ubiquitous chart type.

- **Histogram:**

A histogram is a graphical representation of the distribution of a continuous variable. The variable is divided into intervals, or "bins," and the frequency of observations falling within each bin is represented by the height of a bar. A histogram can be used to check the normality of a distribution, as a normal distribution will have a symmetrical and bell-shaped histogram.

To check for normality, a histogram of the data is plotted and visually inspected for symmetry and a bell-shaped curve. If the histogram is skewed, has multiple peaks, or is not bell-shaped, the data may not be normally distributed. In addition to the histogram, statistical tests such as the Shapiro-Wilk test can be used to formally test for normality.

Histograms are commonly used in exploratory data analysis to visualize the distribution of a variable and to identify potential outliers or unusual patterns in the data. They are also useful in selecting appropriate statistical models and in assessing the assumptions of statistical tests.

- **QQ - Plot:**

A quantile-quantile (QQ) plot is a graphical tool used to assess the normality of a distribution. It is a plot of the quantiles of a sample distribution against the corresponding quantiles of a theoretical normal distribution. If the data are normally distributed, the points on the QQ plot will fall approximately along a straight line.

To construct a QQ plot, the ordered values of the sample are plotted on the y-axis and the expected quantiles of a normal distribution are plotted on the x-axis. If the points on the plot fall close to a straight line, then the data are approximately normally distributed. If the points deviate from the line, then the data are not normally distributed.

QQ plots are commonly used in exploratory data analysis and in the assessment of the assumptions of statistical tests. They are useful for identifying departures from normality and can help to guide the selection of appropriate statistical models.

2.4.2 Crosstabs

Cross tabulation (crosstab) is a useful analysis tool commonly used to compare the results for one or more variables with the results of another variable. It is used with data on a nominal scale, where variables are named or labelled with no specific order. They

are basically data tables that present the results from a full group of survey respondents as well as subgroups. They allow you to examine relationships within the data that might not be obvious when simply looking at total survey responses.

2.4.3 Odds Ratio

An odds ratio (OR) is a statistic that quantifies the strength of the association between two events, A and B. The odds ratio is defined as the ratio of the odds of A in the presence of B and the odds of A in the absence of B, or equivalently (due to symmetry), the ratio of the odds of B in the presence of A and the odds of B in the absence of A. Two events are independent if and only if the OR equals 1, i.e., the odds of one event are the same in either the presence or absence of the other event. If the OR is greater than 1, then A and B are associated (correlated) in the sense that, compared to the absence of B, the presence of B raises the odds of A, and symmetrically the presence of A raises the odds of B. Conversely, if the OR is less than 1, then A and B are negatively correlated, and the presence of one event reduces the odds of the other event.

2.4.4 Linear Regression

Linear regression attempts to model the relationship between various variables by fitting a linear equation to the observed data.

One variable is considered to be a dependent variable, and the other is considered to be explanatory variable. For example, a modeler might want to relate the weights of individuals to their heights using a linear regression model.

Before attempting to fit a linear model to observed data, a modeler should first determine whether or not there is a relationship between the variables of interest. This does not necessarily imply that one variable causes the other (for example, higher SAT (Scholastic Assessment Test) scores do not cause higher college grades), but that there is some significant association between the two variables. A scatterplot can be a helpful tool in determining the strength of the relationship between two variables. If there appears to be no relationship between the proposed explanatory and dependent variables (i.e., the scatterplot does not indicate any increasing or decreasing trends), then fitting a linear regression model to the data probably make no sense. A valuable numerical measure of linear relationship between two variables is the correlation coefficient, which is a value between -1 and 1 indicating the strength of linear relationship between two variables under consideration.

- **Simple Linear Regression**

In statistics, simple linear regression is a linear regression model with a single explanatory variable. That is, it concerns two-dimensional sample points with one independent variable and one dependent variable (conventionally, the x and y coordinates in a Cartesian coordinate system) and finds a linear function (a

non-vertical straight line) that, as accurately as possible, predicts the dependent variable values as a function of the independent variable. The adjective simple refers to the fact that the outcome variable is related to a single predictor. Mathematically, a simple linear regression model is written as :

$$y = \beta_0 + \beta_1 x + \epsilon$$

Where y is dependent variable, x is independent variable, β_0, β_1 are the regression coefficients and ϵ is the error or disturbance term.

Assumptions:

1. ϵ is a random variable.
2. ϵ has zero mean and constant variance σ_ϵ^2.
3. The error term follows normal distribution with mean 0 and variance σ_ϵ^2 i.e $\epsilon \sim N(0, \sigma_\epsilon^2)$.
4. The independent variable X is fixed and is measured without any error.
5. The disturbance term and dependent variable are independent.
6. Error terms are uncorrelated.

- **Multiple Linear Regression :**

Multiple linear regression (MLR), also known simply as multiple linear regression, is a statistical technique that uses several explanatory variables to predict the outcome of a response variable. The goal of multiple linear regression is to model the linear relationship between the explanatory (independent) variables and response (dependent)

variables. In essence, multiple regression is the extension of ordinary least-squares (OLS) regression because it involves more than one explanatory variable.

Assumptions:

1. ϵ is a random variable.
2. ϵ has zero mean.
3. The disturbance term,ϵ constant variance σ_ϵ^2.This property is known as Homoscedasticity.
4. The error term follows normal distribution with mean 0 and variance σ_ϵ^2 i.e $\epsilon \sim N(0, \sigma_\epsilon^2)$.
5. The dependent variable X is fixed and is measured without any error.
6. The disturbance terms and dependent variables are independent.
7. No autocorrelation: Error terms are uncorrelated.
8. No perfect multicollinearity: The explanatory variables are not perfectly linearly correlated.
9. Data matrix X has full rank i.e., r(x)=K+1, where K is the number of independent variable.

2.4.5 Shapiro-Wilk Test

The Shapiro-Wilk test is a statistical test of the hypothesis that the distribution of the data as a whole does not deviate from a comparable normal distribution. If the test is non-significant (p>. 05) it tells us that the distribution of the sample is not significantly

different from a normal distribution. The Shapiro–Wilk test tests the null hypothesis that a sample x_1, ..., x_n came from a normally distributed population. The test statistic is

$$W = \frac{\left(\sum_{i=1}^{n} a_i x_{(i)}\right)^2}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

The null-hypothesis of this test is that the population is normally distributed.

Thus, if the p value is less than the chosen level of significance(α) , then the null hypothesis is rejected and there is evidence that the data tested are not normally distributed. On the other hand, if the p value is greater than the chosen level of significance(α), then the null hypothesis (that the data came from a normally distributed population) can't be rejected.

2.4.6 Box – Cox Transformation

The Box Cox transformation is a statistical tool that transforms non-normal data into a normal distribution. This transformation can improve the accuracy of predictions made using linear regression. The Box Cox transformation can be used on data that is not normally distributed. This includes data that is skewed or has outliers. The transformation can improve the accuracy of predictions made using linear regression.

$$w_t = \begin{cases} \log(y_t) & if\ \lambda = 0; \\ \dfrac{y_t^{\lambda} - 1}{\lambda} & otherwise. \end{cases}$$

2.4.7 Correlation Matrix

A correlation matrix is a table that shows the correlation coefficients between multiple variables. The matrix provides a visual representation of the strength and direction of the relationships between the variables. Correlation coefficients range from -1 to +1, with values closer to -1 indicating a strong negative correlation, values closer to +1 indicating a strong positive correlation, and values close to 0 indicating no correlation.

Correlation matrices are commonly used in data analysis to investigate the relationships between variables. They can be used to identify patterns in data, to select variables for further analysis, and to test hypotheses about the relationships between variables. Correlation matrices are useful in a variety of fields, including social science, business, health care, and engineering.

2.4.8 Variance Inflation Factor (VIF)

Variance inflation factor (VIF) is a measure of the degree to which the variance of the estimated regression coefficients is increased due to multicollinearity in the data. Multicollinearity is the presence of high correlations among predictor variables in a regression model. VIF values greater than 1 indicate the presence of multicollinearity, with values greater than 5 or 10 indicating serious problems.

VIF is calculated for each predictor variable in a regression model, and a high VIF value indicates that the variance of the estimated regression coefficients for that predictor variable is inflated due to multicollinearity. This can lead to unstable and unreliable regression models, as well as incorrect inferences about the relationships between the predictor variables and the response variable.

VIF is a commonly used diagnostic tool in regression analysis, and is often used to identify and mitigate issues related to multicollinearity in the data. There are a variety of methods for reducing multicollinearity, such as removing highly correlated predictor variables or using principal component analysis to create orthogonal predictor variables.

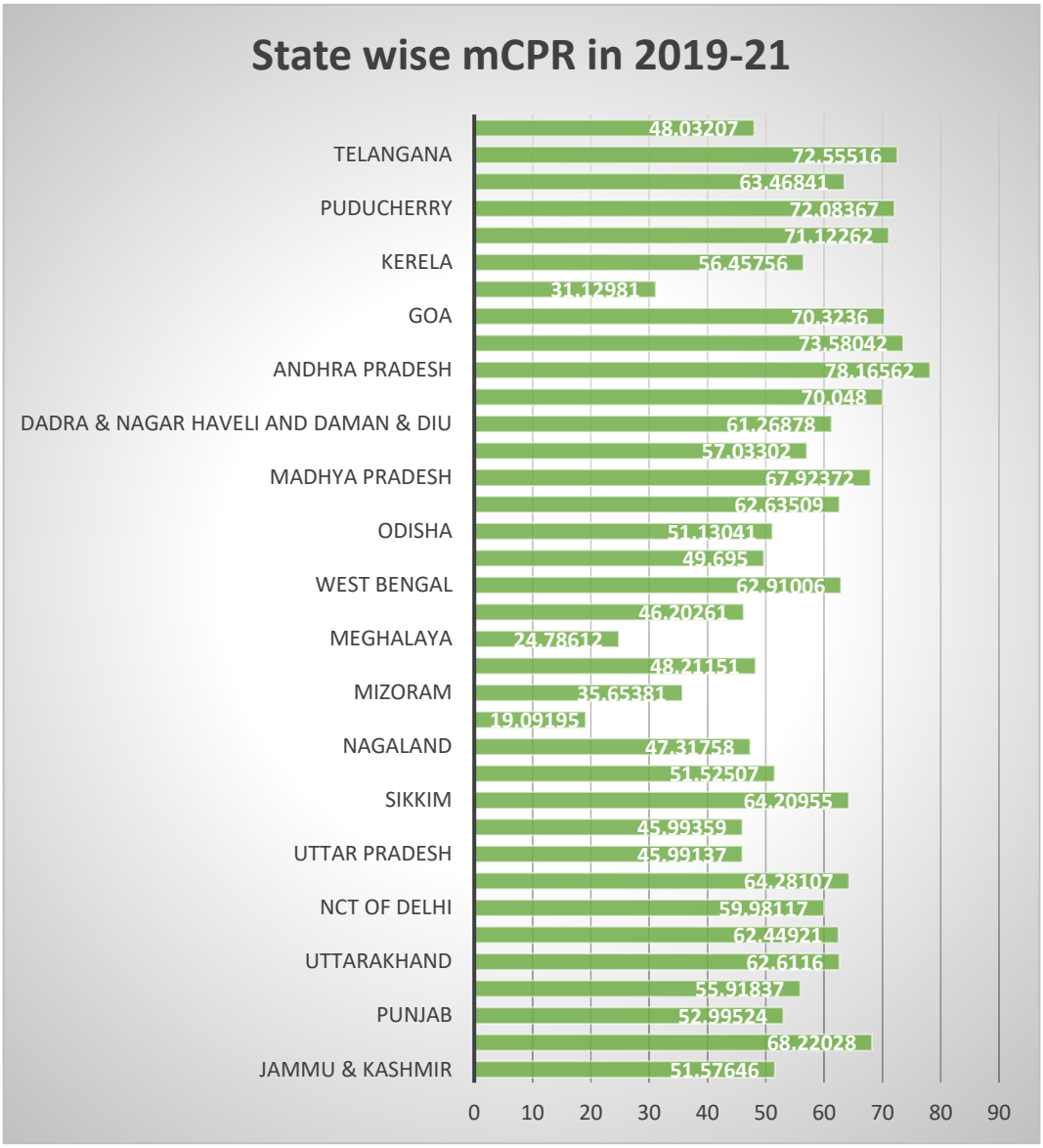
Chapter III
Data Analysis

Chapter III

DATA ANALYSIS

3.1 Exploratory Data Analysis:

3.1.1 State wise mCPR in 2019-21



The content of this chapter has been prepared with the help of various books and websites whose references are provided at the end in the “Reference section”

Interpretation: Modern Contraceptive Prevalence Rate(mCPR)is highest in Andhra Pradesh (**78.16562**) whereas, the lowest mCPR is reported in Manipur (**19.09195**).

A high MCPR indicates that a large proportion of women are using modern contraceptive methods, which can help to prevent unintended pregnancies, reduce maternal and infant mortality, and improve maternal and child health outcomes. High levels of contraceptive use are associated with lower maternal mortality rates, lower infant mortality rates, and higher rates of educational attainment and economic participation among women.

A low MCPR indicates that a smaller proportion of women are using modern contraceptive methods, which can lead to higher rates of unintended pregnancies, unsafe abortions, and maternal and infant mortality.

Low levels of contraceptive use may be due to a range of factors, such as limited access to family planning services, cultural or religious beliefs, lack of information about contraceptive options, or stigma around contraceptive use.

The World Health Organization (**WHO**) recommends that countries aim to achieve a **modern contraceptive prevalence rate of at least 50%** to ensure that women are able to make informed choices about their reproductive health.

3.2 Chi-squared test for independence(crosstabs)

3.2.1 Testing the independence between modern contraceptive method used and education status in 2019-2021.

H_o: The Method of contraceptive used and education status are independent.

v/s

H_1: The Method of contraceptive used and education status are not independent.

Current use by method type * Highest educational level Crosstabulation

Count

		Highest educational level				
		No education	Primary	Secondary	Higher	Total
Current use by method type	No method	59890	32577	213910	67334	373711
	Folkloric method	4	2	0	1	7
	Traditional method	14994	7493	27767	7032	57286
	Modern method	92415	44909	128329	27448	293101
Total		167303	84981	370006	101815	724105

- From the above crosstab, it can be seen that the frequency of folkloric method is less than 5, therefore it is pooled with the traditional method in order to fulfil the assumptions of Chi-squared test, otherwise Fisher's Z-test has to be used.

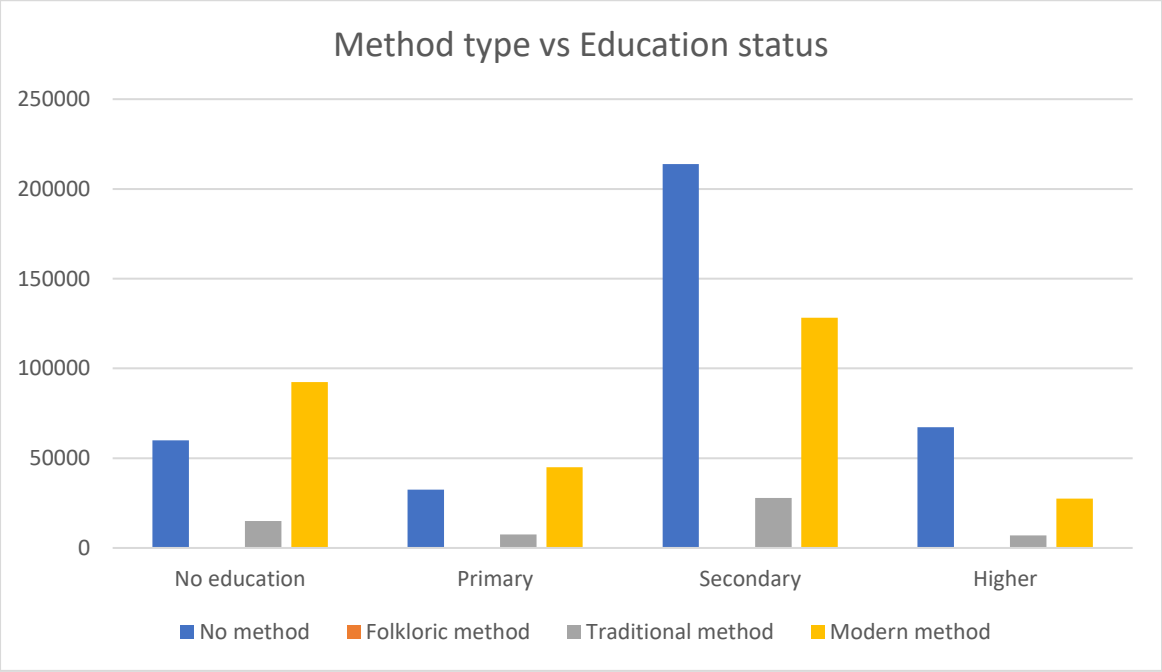
Test for independence

```
> x
                    No Education  Primary Secondary Higher
No method                  59890    32577    213910  67334
Traditional method         14998     7495     27767   7033
Modern method              92415    44909    128329  27448
> chisq.test(x)

        Pearson's Chi-squared test

data:  x
X-squared = 38340, df = 6, p-value < 2.2e-16
```

Decision:

Here, it is clear that p-value is less than 0.05, therefore we reject the null hypothesis at 5% significance level.

Conclusion: There is an association between usage of modern contraceptive method and highest education status.



3.2.2 Testing the independence between modern contraceptive method used and type of place of residence in 2019-2021.

H_o: The Method of contraceptive used and the type of place of residence are independent.

v/s

H_1: The Method of contraceptive used and the type of place of residence are not independent.

Current use by method type * Type of place of residence Crosstabulation

Count

		Type of place of residence		
		Urban	Rural	Total
Current use by method type	No method	92847	280864	373711
	Folkloric method	1	6	7
	Traditional method	14252	43034	57286
	Modern method	72433	220668	293101
Total		179533	544572	724105

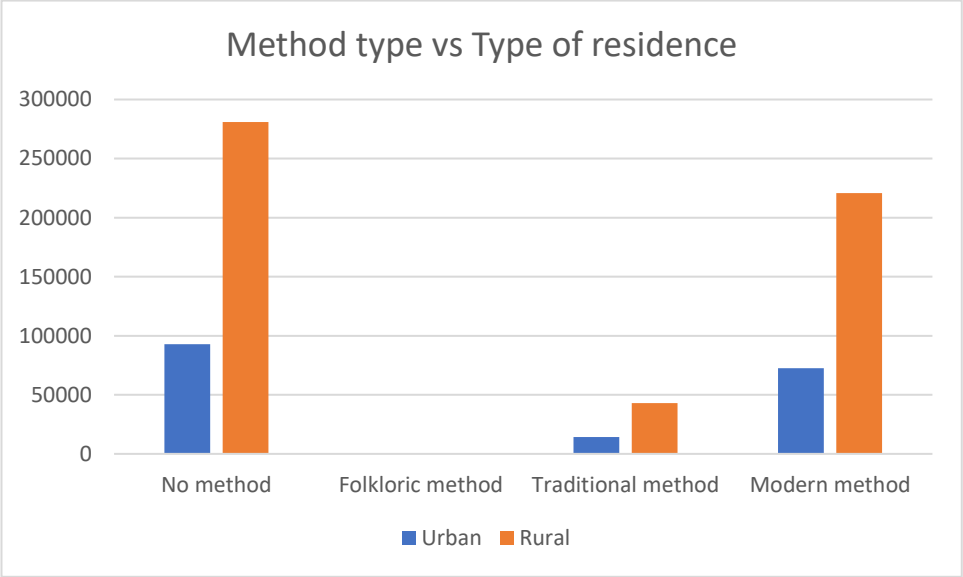
Test for independence

```
> z
                    Urban  Rural
No method           92847 280864
Traditional method 14253  43040
Modern method       72433 220668
> chisq.test(z)

        Pearson's Chi-squared test

data:  z
X-squared = 1.7672, df = 2, p-value = 0.4133
```

Decision:

The p-value obtained is greater than 0.05, therefore null hypothesis is to be accepted at 5%level of significance.

Conclusion: There isn't any significant association between usage of modern contraceptive method and the type of place of residence.



3.2.3 Testing the independence between modern contraceptive method used and wealth index in 2019-2021.

H_o: The Method of contraceptive used and wealth index are independent.

v/s

H_1: The Method of contraceptive used and wealth index are not independent.

Current use by method type * Wealth index combined Crosstabulation

Count

		Wealth index combined					
		Poorest	Poorer	Middle	Richer	Richest	Total
Current use by method type	No method	81129	83505	77086	71039	60952	373711
	Folkloric method	4	0	2	1	0	7
	Traditional method	13624	13000	10633	9720	10309	57286
	Modern method	55085	63831	63783	58846	51556	293101
Total		149842	160336	151504	139606	122817	724105

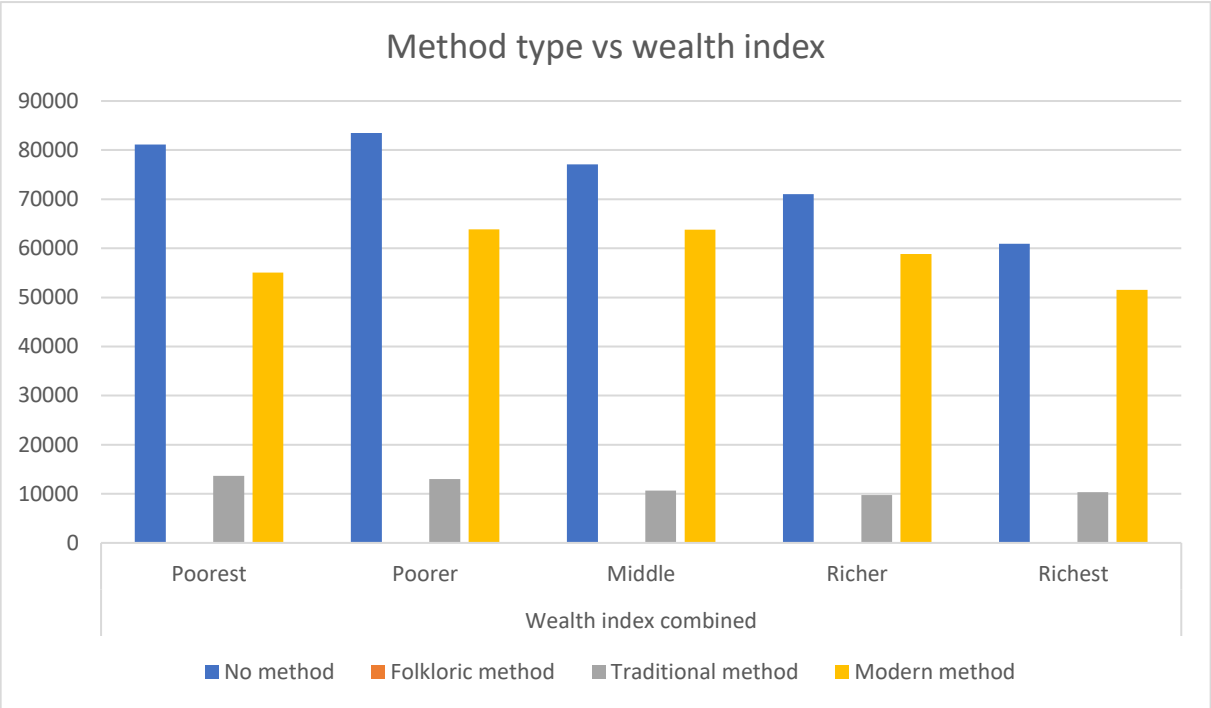
Test for the independence

```
> A
                   Poorest Poorer Middle Richer Richest
No method            81129  83505  77086  71039   60952
Traditional method   13628  13000  10635   9721   10309
Modern method        55085  63831  63783  58846   51556
> chisq.test(A)

        Pearson's Chi-squared test

data:  A
X-squared = 1728.7, df = 8, p-value < 2.2e-16
```

Decision:

Here p-value is less than 0.05, therefore we reject the null hypothesis at 5% level of significance.

Conclusion: There is an association between usage of modern contraceptive method and wealth index.



3.2.4 Testing the independence between modern contraceptive method used and meeting a community health worker 2019-2021.

H_0: The Method of contraceptive used and meeting a community health worker are independent.

v/s

H_1: The Method of contraceptive used and meeting a community health worker are not independent.

Test for independence

Current use by method type * Met with an anganwadi worker, ASHA or other community health worker in last 3 months Crosstabulation

Count

		Met with an anganwadi worker, ASHA or other community health worker in last 3 months		
		No	Yes	Total
Current use by method type	No method	278449	95262	373711
	Folkloric method	6	1	7
	Traditional method	38333	18953	57286
	Modern method	203158	89943	293101
Total		519946	204159	724105

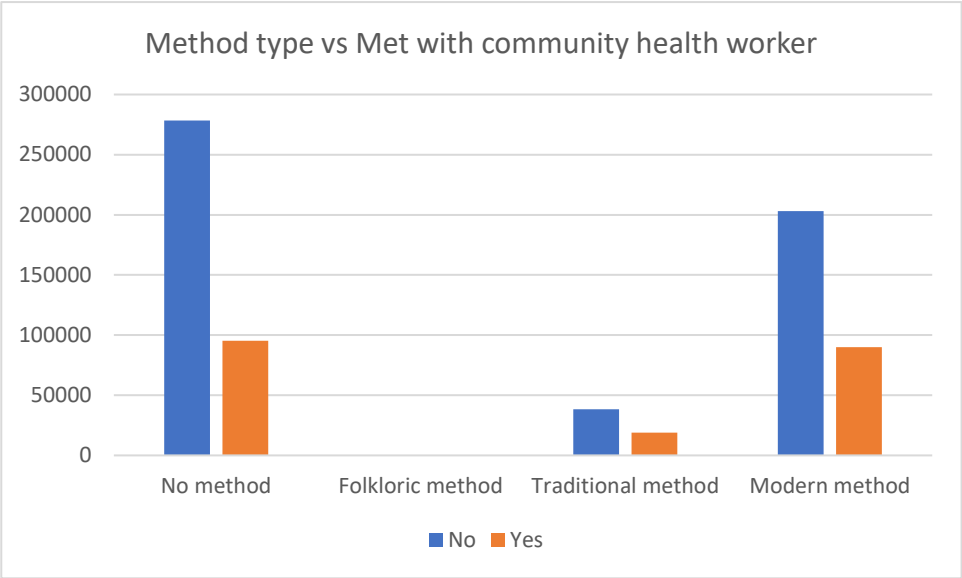
```
> data3
              No    Yes
Not Using 316788 114216
Using     203158  89943
```

```
> chisq.test(data3)

        Pearson's Chi-squared test with Yates' continuity correction

data:  data3
X-squared = 1510.3, df = 1, p-value < 2.2e-16
```

Decision:

Here p-value is less than 0.05, therefore we reject the null hypothesis at 5% level of significance.

Conclusion: There is an association between usage of modern contraceptive method and meeting a community health worker.



3.3 Calculation of mCPR

The mCPR for different states is calculated by

$$mCPR = \frac{V313(=3)}{V501(=1)} \times 100$$

Where,

- V313 is current contraceptive use by method type in NFHS-V data set. It is a categorical variable with 4 levels/categories (0,1,2,3) where, category equal to 3 denotes modern contraceptive methods.
- V501 is current marital status with category equal to 1 denotes married.

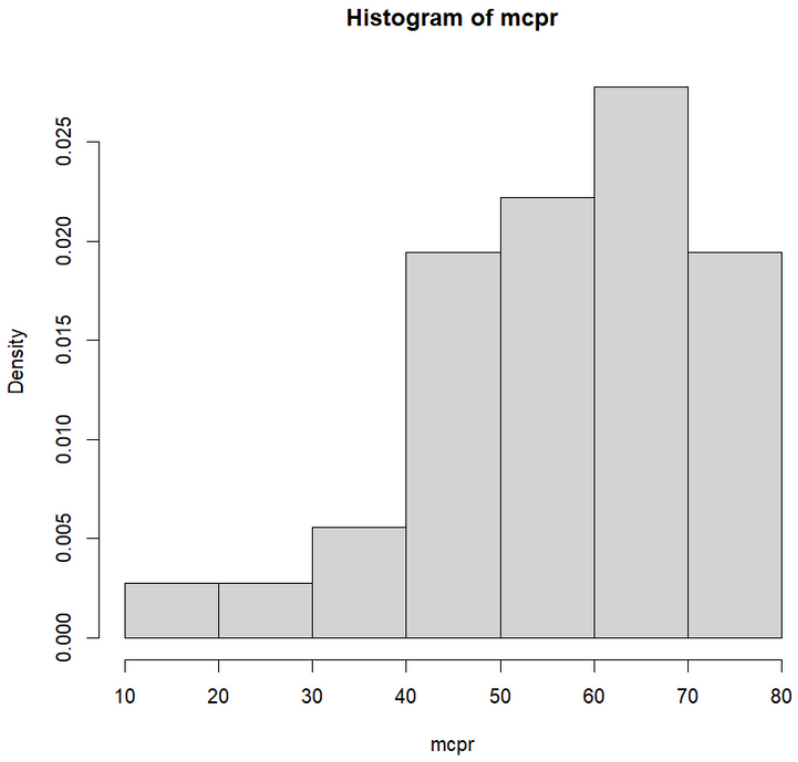
```
> #MCPR calculation
> mdrn_mtd=c(7214,5240,8130,274,5821,9837,4459,19760,29004,14637,1385,6926,2743,
+ 1005,1516,2790,2028,11881,10394,9613,10245,11823,23901,13871,1101,17657,6494,
+ 16081,891,259,4590,13184,1792,1065,14831,659)
> married=c(13987,7681,15341,490,9297,15752,7434,30740,63064,31824,2157,13442,
+ 5797,5264,4252,5787,8182,25715,16522,19344,20037,18876,35188,24321,1797,
+ 25207,8308,21855,1267,832,8130,18537,2486,1678,20441,1372)
> mcpr=(mdrn_mtd/married)*100
```

(Refer to Appendix A, Table 1)

3.4 Test for Normality

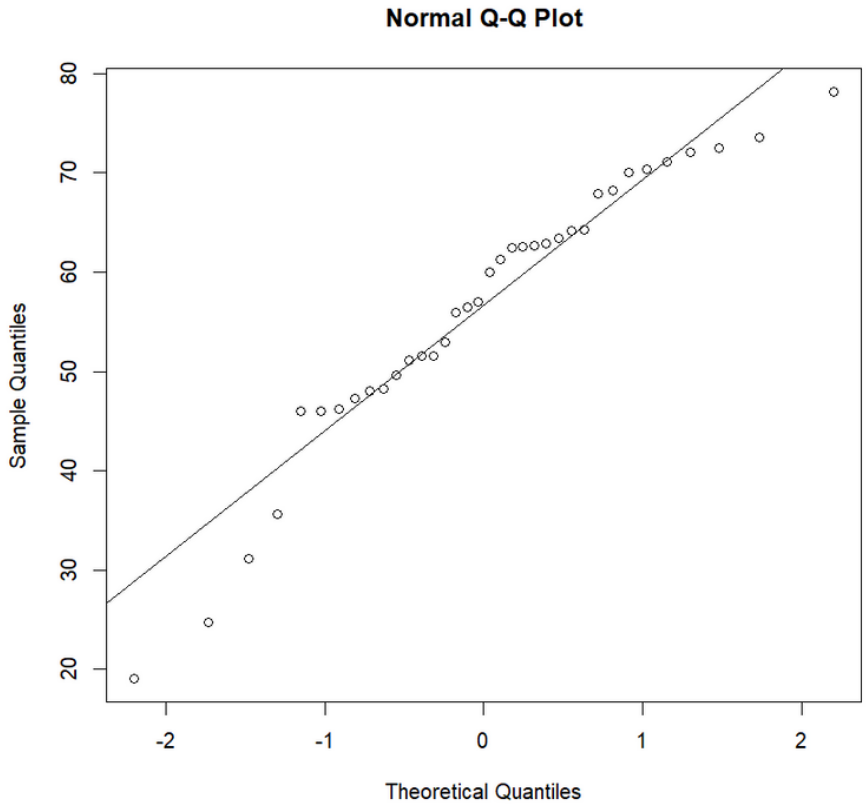
Testing for normality of the dependent variable is a crucial step in regression analysis.

- Visual inspection of a histogram



Conclusion: The above given histogram depicts that the distribution of mCPR is left skewed.

- Visual inspection of a Q-Q plot



Conclusion: From the above QQ-plot it can be concluded that the distribution of mCPR is approximately normal.

- **The Shapiro-Wilk test**

In addition to graphical visualization of nature of distribution of mCPR, the Shapiro-Wilk test is used to test the following set of statistical hypothesis.

$$H_o: mCPR\ follows\ normal\ distribution$$

v/s

$$H_1: mCPR\ does\ not\ follow\ normal\ distribution$$

The R-command for performing Shapiro-Wilk-test is:

```
> shapiro.test(mcpr)

        Shapiro-Wilk normality test

data:  mcpr
W = 0.93948, p-value = 0.04894
```

Conclusion:

From the results obtained, it can be seen that the p value is less than 0.05, which leads to the rejection of null hypothesis. Hence it is can be concluded that mCPR does not follow normal distribution. Therefore, the very basic assumption of linear regression i.e; normality of dependent variable (mCPR) got violated .In order to apply the linear regression, the dependent variable(mCPR) need to be transformed. The said transformation is carried out by using Box-Cox transformation.

3.5 Box-Cox Transformation

Box cox transformation is given by

$$w_t = \begin{cases} \log(y_t) & if\ \lambda = 0; \\ \dfrac{y_t^{\lambda} - 1}{\lambda} & otherwise. \end{cases}$$

Where,

y_t is the original dependent variable which does not follow the normal distribution

w_t is the transformed dependent variable which will follows normal distribution at a specific value of λ.To find the value of λ, at which transformed variable follows normal, following R-commands are used:

```
> bc=boxcox(m1)
> lambda <- bc$x[which.max(bc$y)]
> lambda
[1] 1.878788
```

Therefore, the transformed variable is calculated as follows:

```
> y=((mcpr^lambda)-1)/lambda
```

- **Testing the normality of transformed variable**

After the independent variable is transformed to new variable, Shapiro-Wilk test is again used to check the normality assumption of transformed variable.

$$H_o: Transfomed\ variable(y)\ follows\ normal\ distribution$$

v/s

$$H_1: Transformed\ variable(y)\ does\ not\ follow\ normal\ distribution$$

```
> shapiro.test(y)

        Shapiro-Wilk normality test

data:  y
W = 0.97517, p-value = 0.5821
```

Conclusion:

The p-value obtained is greater than 0.05.Therefore, the null hypothesis is accepted and it can be concluded that normality assumption got established.

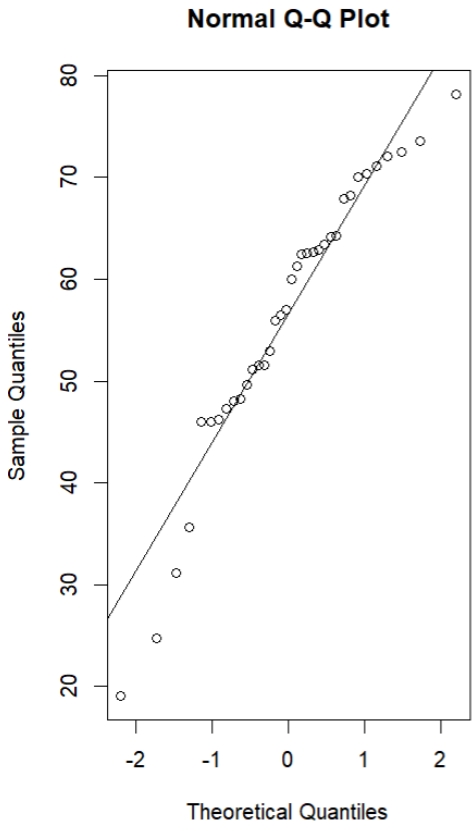
Variable after Box-Cox Transformation:

(Refer to Appendix A, Table 2)

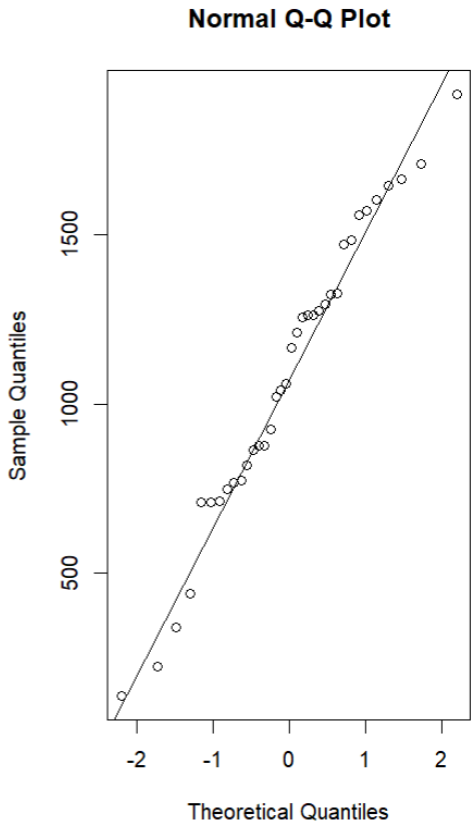
The original dependent variable and its transformed version can be compared in terms of their distribution through Q-Q plots.

- Comparison of Q-Q Plot

Before Transformation



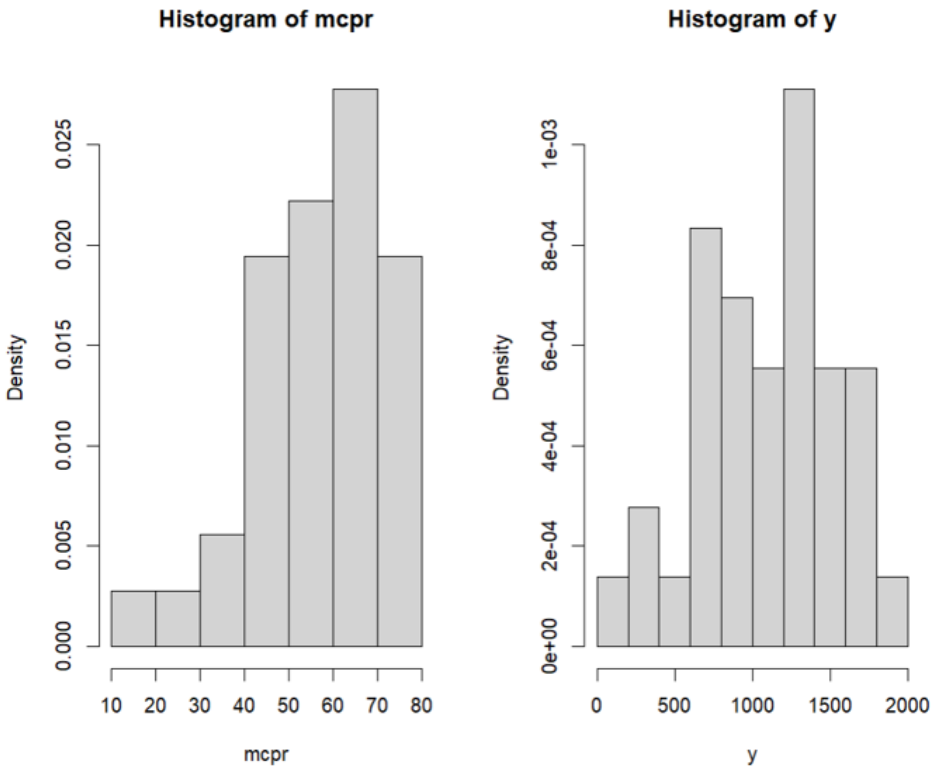
After Transformation



Conclusion: From the above drawn plots, it can be visualized that before transformation, all the data points deviate a lot from the line of reference. After applying the Box-Cox transformation almost all the data points lie on the line of reference.

- Comparison of Q-Q Plot

Before Transformation **After Transformation**



Conclusion: It is clearly visible that the distribution of mCPR was right skewed and after applying the Box-Cox transformation its distribution has become approximately normal.

3.6 Regression Model

The multiple linear regression model is used to explore the impact of various proportions in a state on the mCPR in that state i.e. mathematically we can write:

$$mCPR_i = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + e_i$$

Where i=1,2,…,37 (no. of states)

$mCPR_i$=mCPR in the i^{th} state

X_{1i}=Proportion of individuals (women aged 15-49) with no education.

X_{2i}= Proportion of individuals (women aged 15-49) whose partner is not educated.

X_{3i}= Proportion of individuals (women aged 15-49) from middle class or lower.

X_{4i}= Proportion of individuals (women aged 15-49) who met community health workers.

3.6.1 Calculation of Proportions: The various proportions discussed above are calculated for all the states and union territories, and are reported in table 3 to 6 in Appendix A.

3.6.2 Checking Multicollinearity

- **Correlation Matrix**

To check multicollinearity between the independent variables, the correlation matrix is calculated as:

```
> cor(X)
           x1         x2         x3         x4
x1 1.0000000 0.81394897 0.47985743 0.10403827
x2 0.8139490 1.00000000 0.51549531 0.08533115
x3 0.4798574 0.51549531 1.00000000 0.02832315
x4 0.1040383 0.08533115 0.02832315 1.00000000
```

Conclusion: From the correlation matrix it is clearly visible that there is a high positive correlation between proportion of individuals with no education (x1) and proportion of individuals whose partner is not educated (x2). Therefore, it is advisable to drop variable x2 as x1 is more relevant to our model.

- **Variance Inflation Factor (VIF)**

To check and justify the dropping of our variable we will calculate the variance inflation factor before and after dropping the variable.

Conclusion: After dropping the variable our variance inflation factor for each variable was reduced.

Before dropping x2

```
> library(car)
> vif(m1)
      x1       x2       x3       x4
3.018928 3.152607 1.383090 1.011618
```

After dropping x2

```
> vif(m2)
      x1       x3       x4
1.313112 1.299942 1.011562
```

(For the data used in Regression Analysis, Refer to Appendix A, Table 7)

Now, after looking into various important assumptions required for the application of linear regression, the multiple linear regression model between transformed mCPR (y) and x1, x3 and x4 as explanatory variables is fitted.

Where,

x_1=Proportion of individuals with no education.

x_3= Proportion of individuals from middle class or lower.

x_4= Proportion of individuals who met community health workers.

For the above model:

$$\boldsymbol{H_o}: \textit{There is no significant relationship between the predictor variables and the response variable.}$$

v/s

$$\boldsymbol{H_1}: \textit{There is a significant relationship between the explanatory variables and the response variable}$$

We will use the p-value approach to check the significance of the model.

```
> #New model after BoxCox Transformation
> model=lm(y~x1+x3+x4)
> summary(model)

Call:
lm(formula = y ~ x1 + x3 + x4)

Residuals:
    Min      1Q  Median      3Q     Max
-873.15 -256.73  -52.68  327.11  734.00

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   1076.5      213.0   5.053  1.7e-05 ***
x1            1401.5      778.9   1.799   0.0814 .
x3            -824.6      302.8  -2.723   0.0104 *
x4             901.1      532.6   1.692   0.1004
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 394.1 on 32 degrees of freedom
Multiple R-squared:  0.2571,    Adjusted R-squared:  0.1874
F-statistic: 3.691 on 3 and 32 DF,  p-value: 0.02177
```

p-value: 0.02177

Decision:

Here the p-value is less than 0.05, we reject the null hypothesis at 5% level of significance.

Conclusion:

We reject the null hypothesis. Therefore, our model is significant. This means that there is a significant relationship between the response variable and the incorporated explanatory variables.

Thus, our model becomes

y=1076.5 + 1401.5 x1 – 824.6 x3 + 901.1 x4

To calculate the mCPR for different states using the given proportions we will revert the model back to its original form.

The model for mCPR becomes:

$$mCPR = (2023.561 + 2633.088\,x1 - 1549.163\,x3 + 1693.025\,x4)^{1/1.878788}$$

Chapter IV
CONCLUSIONS

Chapter IV

CONCLUSIONS

After the completion of this study, we have arrived at the following:

I. Modern Contraceptive Prevalence Rate(mCPR)is highest in Andhra Pradesh (78.16562) whereas, the lowest mCPR is reported in Manipur (19.09195) in 2021-2022.

II. There is not any significant association between usage of modern contraceptive method and the type of place of residence.

III. There is a significant association between usage of modern contraceptive method and wealth index.

IV. There is a significant association between usage of modern contraceptive method and meeting a community health worker.

V. There is a significant association between usage of modern contraceptive method and highest education level.

VI. Modern Contraceptive usage among women (aged 15-49) with no education is 0.045 times more than those with primary education.

VII. Modern Contraceptive usage among women (aged 15-49) with no education is 0.59 times more than those with secondary education.

VIII. Modern Contraceptive usage among women (aged 15-49) with no education is 1.04 times more than those with higher education.

IX. Modern Contraceptive usage among women (aged 15-49) with primary education is 0.52 times more than those with secondary education.

X. Modern Contraceptive usage among women (aged 15-49) with primary education is 0.96 times more than those with higher education.

XI. Modern Contraceptive usage among women (aged 15-49) with secondary education is 0.28 times more than those with higher education.

XII. Modern contraceptive usage among the poorest women (aged 15-49) is 0.08 times less than the poorer women of reproductive age.

XIII. Modern contraceptive usage among the poorest women of reproductive age is 0.13 times less than the middle-class women of reproductive age.

XIV. Modern contraceptive usage among the poorest women of reproductive age is 0.12 times less than the richer women of reproductive age.

XV. contraceptive usage among the poorest women of reproductive age is 0.12 times less than the richest women of reproductive age.

XVI. Modern contraceptive usage among the poorer women of reproductive age is 0.06 times less than middle class women of reproductive age.

XVII. Modern contraceptive usage among the poorer women of reproductive age is 0.05 times less than richer women of reproductive age.

XVIII. Modern contraceptive usage among the poorer women of reproductive age is 0.06 times less than richest women of reproductive age.

XIX. Modern contraceptive usage among the middle class women of reproductive age is 0.01 times less than richer women of reproductive age.

XX. Modern contraceptive usage among the middle class women of reproductive age is 0.002 times more than richest women of reproductive age.

XXI. Modern contraceptive usage among the richer women of reproductive age is 0.004 times more than the richest women of reproductive age.

XXII. Modern contraceptive usage among women of reproductive age who didn't meet with a community health worker is less than 0.12 times than women of reproductive age who met with community health worker.

XXIII. Thus, our final model contains transformed mCPR (y) as response variable and x1, x3 and x4 as explanatory variables and is given as:

$$y=1076.5 + 1401.5\,x1 - 824.6\,x3 + 901.1\,x4$$

XXIV. From p-value approach, we found that there is a significant relationship between the response variable and the explanatory variables.

XXV. The variable x1(proportion of women aged 15-49) and x4 (proportion of women aged 15-49 who met community health worker) have positive impact on mCPR and variable x3 (proportion of women aged 15-49 from middle class or lower) has negative impact on mCPR.

XXVI. To calculate the mCPR for different states using the given proportions we will revert the model back to its original form.

Thus, the model for mCPR becomes:

$$mCPR = (2023.561 + 2633.088\,x1 - 1549.163\,x3 + 1693.025\,x4)^{1/1.878788}$$

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Appendix

Appendix A

- Table 1

	State	Modern_Method	Married	mCPR
1	Jammu & Kashmir	7214	13987	51.57646
2	Himachal Pradesh	5240	7681	68.22028
3	Punjab	8130	15341	52.99524
4	Chandigarh	274	490	55.91837
5	Uttarakhand	5821	9297	62.61160
6	Haryana	9837	15752	62.44921
7	Nct Of Delhi	4459	7434	59.98117
8	Rajasthan	19760	30740	64.28107
9	Uttar Pradesh	29004	63064	45.99137
10	Bihar	14637	31824	45.99359
11	Sikkim	1385	2157	64.20955
12	Arunachal Pradesh	6926	13442	51.52507
13	Nagaland	2743	5797	47.31758
14	Manipur	1005	5264	19.09195
15	Mizoram	1516	4252	35.65381
16	Tripura	2790	5787	48.21151
17	Meghalaya	2028	8182	24.78612
18	Assam	11881	25715	46.20261
19	West Bengal	10394	16522	62.91006
20	Jharkhand	9613	19344	49.69500
21	Odisha	10245	20037	51.13041
22	Chhattisgarh	11823	18876	62.63509
23	Madhya Pradesh	23901	35188	67.92372
24	Gujarat	13871	24321	57.03302
25	Dadra & Nagar Haveli And Daman & Diu	1101	1797	61.26878
26	Maharashtra	17657	25207	70.04800
27	Andhra Pradesh	6494	8308	78.16562
28	Karnataka	16081	21855	73.58042
29	Goa	891	1267	70.32360
30	Lakshadweep	259	832	31.12981
31	Kerala	4590	8130	56.45756
32	Tamil Nadu	13184	18537	71.12262
33	Puducherry	1792	2486	72.08367
34	Andaman & Nicobar Islands	1065	1678	63.46841
35	Telangana	14831	20441	72.55516
36	Ladakh	659	1372	48.03207

- Table 2

```
> data2=data.frame(State=state,mCPR=mcpr,Transformed_Variable=y)
> data2
                                State     mCPR Transformed_Variable
1                       Jammu & Kashmir 51.57646             877.3888
2                     Himachal Pradesh 68.22028            1484.2294
3                               Punjab 52.99524             923.3095
4                           Chandigarh 55.91837            1021.3631
5                          Uttarakhand 62.61160            1263.2011
6                              Haryana 62.44921            1257.0504
7                           Nct Of Delhi 59.98117            1165.2975
8                            Rajasthan 64.28107            1327.2499
9                          Uttar Pradesh 45.99137             707.3133
10                              Bihar 45.99359             707.3773
11                             Sikkim 64.20955            1324.4758
12                   Arunachal Pradesh 51.52507             875.7460
13                            Nagaland 47.31758             746.1473
14                             Manipur 19.09195             135.1641
15                             Mizoram 35.65381             438.2005
16                             Tripura 48.21151             772.8700
17                           Meghalaya 24.78612             221.0547
18                               Assam 46.20261             713.4336
19                          West Bengal 62.91006            1274.5428
20                            Jharkhand 49.69500             818.1849
21                              Odisha 51.13041             863.1781
22                          Chhattisgarh 62.63509            1264.0923
23                        Madhya Pradesh 67.92372            1472.1261
24                               Gujarat 57.03302            1059.9689
25 Dadra & Nagar Haveli And Daman & Diu 61.26878            1212.7607
26                           Maharashtra 70.04800            1559.8443
27                         Andhra Pradesh 78.16562            1916.8000
28                              Karnataka 73.58042            1710.9505
29                                    Goa 70.32360            1571.3984
30                           Lakshadweep 31.12981             339.4718
31                                Kerala 56.45756            1039.9545
32                             Tamil Nadu 71.12262            1605.1217
33                             Puducherry 72.08367            1646.1267
34             Andaman & Nicobar Islands 63.46841            1295.8877
35                             Telangana 72.55516            1666.4205
36                                Ladakh 48.03207             767.4707
```

- Table 3: Proportion of individuals with no education

State * Highest educational level Crosstabulation

Count

		Highest educational level					
		No education	Primary	Secondary	Higher	Total	Proportion(No Education:Total)
State	Jammu & Kashmir	5368	1102	12520	4047	23037	0.233016452
	Himachal Pradesh	918	1140	6088	2222	10368	0.088541667
	Punjab	3418	2301	12073	3979	21771	0.156997841
	Chandigarh	90	66	378	212	746	0.120643432
	Uttarakhand	1906	1464	7005	2905	13280	0.143524096
	Haryana	3522	2474	11512	4401	21909	0.160755854
	Nct Of Delhi	1404	909	5533	3313	11159	0.125817726
	Rajasthan	14007	5797	17624	5562	42990	0.325819958
	Uttar Pradesh	27249	10542	41007	14326	93124	0.292609854
	Bihar	16693	4459	18431	2900	42483	0.392933644
	Sikkim	324	588	1836	523	3271	0.099052278
	Arunachal Pradesh	4536	2078	10684	2467	19765	0.229496585
	Nagaland	972	1267	6145	1310	9694	0.100268207
	Manipur	773	988	4988	1293	8042	0.096120368
	Mizoram	479	909	5018	873	7279	0.065805743
	Tripura	894	1398	4576	446	7314	0.122231337
	Meghalaya	1844	2576	7611	1058	13089	0.140881656
	Assam	6515	4700	21021	2743	34979	0.18625461
	West Bengal	4252	3613	11442	2101	21408	0.198617339
	Jharkhand	8699	2741	12629	2426	26495	0.328326099
	Odisha	6703	4036	14648	2584	27971	0.239641057
	Chhattisgarh	7862	3565	14224	2817	28468	0.276169734
	Madhya Pradesh	13428	7101	22991	4890	48410	0.277380706
	Gujarat	7588	4154	17749	3852	33343	0.227574004
	Dadra & Nagar Haveli And Daman & Diu	434	282	1657	340	2713	0.159970512
	Maharashtra	4470	3747	20226	5312	33755	0.132424826
	Andhra Pradesh	3172	1484	4878	1441	10975	0.289020501
	Karnataka	6370	3085	16875	4125	30455	0.209161057
	Goa	103	123	1165	639	2030	0.050738916
	Lakshadweep	19	76	889	250	1234	0.015397083
	Kerala	115	392	6933	3529	10969	0.010484092
	Tamil Nadu	2503	3115	13293	6739	25650	0.097582846
	Puducherry	223	270	1975	1201	3669	0.060779504
	Andaman & Nicobar Islands	196	219	1634	348	2397	0.081768878
	Telangana	9731	2106	11459	4222	27518	0.353623083
	Ladakh	524	116	1295	420	2355	0.222505308
Total		167304	84983	370012	101816	724115	0.231046174

- Table 4: Proportion of individuals whose partner is not educated.

	Husband/partner's education level							
	No education	Primary	Secondary	Higher	Don't know	Total	New Total	Proportion(of respondents whose partners are not educated)
Jammu & Kashmir	327	83	1261	392	2	2065	2063	0.158507029
Himachal Pradesh	58	114	856	227	0	1255	1255	0.046215139
Punjab	401	262	1526	301	0	2490	2490	0.161044177
Chandigarh	10	11	53	15	0	89	89	0.112359551
Uttarakhand	97	108	877	302	4	1388	1384	0.070086705
Haryana	245	266	1506	463	2	2482	2480	0.098790323
Nct Of Delhi	103	103	666	299	2	1173	1171	0.087959009
Rajasthan	781	671	2669	891	7	5019	5012	0.155826018
Uttar Pradesh	1877	1183	4972	1668	33	9733	9700	0.193505155
Bihar	1460	648	2154	547	47	4856	4809	0.303597422
Sikkim	27	98	186	33	1	345	344	0.078488372
Arunachal Pradesh	477	245	1117	318	5	2162	2157	0.221140473
Nagaland	88	161	583	104	9	945	936	0.094017094
Manipur	68	92	553	165	2	880	878	0.077448747
Mizoram	44	123	496	92	33	788	755	0.058278146
Tripura	110	264	508	66	3	951	948	0.116033755
Meghalaya	410	259	633	79	15	1396	1381	0.296886314
Assam	830	788	2200	324	9	4151	4142	0.200386287
West Bengal	579	639	1155	259	13	2645	2632	0.219984802
Jharkhand	760	381	1577	343	15	3076	3061	0.248284874
Odisha	615	661	1739	305	16	3336	3320	0.185240964
Chhattisgarh	688	563	1491	299	5	3046	3041	0.226241368
Madhya Pradesh	1033	897	2765	618	23	5336	5313	0.19442876
Gujarat	548	526	2319	519	10	3922	3912	0.1400818
Dadra & Nagar Haveli And Daman & Diu	21	43	176	65	2	307	305	0.068852459
Maharashtra	425	587	2367	643	7	4029	4022	0.105668821
Andhra Pradesh	474	221	524	170	3	1392	1389	0.3412527
Karnataka	817	502	1765	473	8	3565	3557	0.229687939
Goa	9	11	134	49	0	203	203	0.044334975
Lakshadweep	4	8	92	20	0	124	124	0.032258065
Kerala	31	94	933	240	1	1299	1298	0.023882897
Tamil Nadu	262	499	1657	560	4	2982	2978	0.087978509
Puducherry	45	35	227	114	1	422	421	0.106888361
Andaman & Nicobar Islands	28	42	185	27	3	285	282	0.09929078
Telangana	1083	326	1503	529	6	3447	3441	0.314734089
Ladakh	27	9	101	57	1	195	194	0.139175258
	14862	11523	43526	11576	292	81779	81487	0.18238492

- Table 5: Proportion of individuals from middle class or lower.

State * Wealth index combined Crosstabulation

Count

		Wealth index combined						
		Poorest	Poorer	Middle	Richer	Richest	Total	Proportion of individuals from middle class or lower
State	Jammu & Kashmir	2730	4448	5166	6120	4573	23037	0.5358337
	Himachal Pradesh	434	1653	2628	3046	2607	10368	0.4547647
	Punjab	194	1074	2690	5080	12733	21771	0.1818015
	Chandigarh	9	17	57	82	581	746	0.1112601
	Uttarakhand	1002	3255	3441	2701	2881	13280	0.5796687
	Haryana	368	1667	3380	6012	10482	21909	0.2471587
	Nct Of Delhi	17	232	880	2217	7813	11159	0.1011739
	Rajasthan	6062	9109	9851	9496	8472	42990	0.5820423
	Uttar Pradesh	22028	23680	17993	14915	14508	93124	0.6840449
	Bihar	17582	11785	7069	4248	1799	42483	0.8576607
	Sikkim	124	818	1325	799	205	3271	0.6930602
	Arunachal Pradesh	3903	6269	5153	3417	1023	19765	0.7753605
	Nagaland	3019	3120	1920	1192	443	9694	0.8313390
	Manipur	1986	2814	1782	1063	397	8042	0.8184531
	Mizoram	605	1193	2138	2201	1142	7279	0.5407336
	Tripura	2590	2481	1508	621	114	7314	0.8995078
	Meghalaya	4214	4715	2734	1094	332	13089	0.8910536
	Assam	13014	11692	5971	3160	1142	34979	0.8770119
	West Bengal	7174	5817	4059	2920	1438	21408	0.7964312
	Jharkhand	12922	5891	3641	2440	1601	26495	0.8474807
	Odisha	10269	7514	5009	3214	1965	27971	0.8148439
	Chhattisgarh	10267	6685	4918	3941	2657	28468	0.7682310
	Madhya Pradesh	15252	11374	8467	7225	6092	48410	0.7249122
	Gujarat	4484	6437	7110	8341	6971	33343	0.5407732
	Dadra & Nagar Haveli And Daman & Diu	171	360	585	845	752	2713	0.4113527
	Maharashtra	3374	6357	8370	8969	6685	33755	0.5362465
	Andhra Pradesh	449	2113	3510	3277	1626	10975	0.5532574
	Karnataka	2333	6205	9770	8120	4027	30455	0.6011492
	Goa	6	57	212	476	1279	2030	0.1354680
	Lakshadweep	0	24	174	579	457	1234	0.1604538
	Kerala	112	591	2042	4067	4157	10969	0.2502507
	Tamil Nadu	1072	4140	7439	7699	5300	25650	0.4932164
	Puducherry	54	181	436	1087	1911	3669	0.1828836
	Andaman & Nicobar Islands	253	488	686	659	311	2397	0.5953275
	Telangana	1469	5354	8763	7750	4182	27518	0.5663929
	Ladakh	302	730	628	534	161	2355	0.7048832
Total		149844	160340	151505	139607	122819	724115	

- Table 6: Proportion of individuals who met community health workers.

State * Met with an anganwadi worker, ASHA					
Count					
		worker, ASHA or other			
		No	Yes	Total	Proportion of individuals who met a community health worker
State	Jammu & Kashmir	19466	3571	23037	0.15501150
	Himachal Pradesh	6821	3547	10368	0.34211034
	Punjab	19227	2544	21771	0.11685269
	Chandigarh	700	46	746	0.06166220
	Uttarakhand	10817	2463	13280	0.18546687
	Haryana	15475	6434	21909	0.29366927
	Nct Of Delhi	9086	2073	11159	0.18576933
	Rajasthan	33778	9212	42990	0.21428239
	Uttar Pradesh	63260	29864	93124	0.32069069
	Bihar	32153	10330	42483	0.24315609
	Sikkim	2369	902	3271	0.27575665
	Arunachal Pradesh	17206	2559	19765	0.12947129
	Nagaland	8794	900	9694	0.09284093
	Manipur	7448	594	8042	0.07386222
	Mizoram	6757	522	7279	0.07171315
	Tripura	5566	1748	7314	0.23899371
	Meghalaya	10095	2990	13085	0.22850592
	Assam	24047	10932	34979	0.31253038
	West Bengal	13746	7662	21408	0.35790359
	Jharkhand	21019	5476	26495	0.20668051
	Odisha	13870	14101	27971	0.50412928
	Chhattisgarh	17494	10974	28468	0.38548546
	Madhya Pradesh	34988	13422	48410	0.27725677
	Gujarat	20336	13006	33342	0.39007858
	Dadra & Nagar Haveli And Daman & Diu	1578	1135	2713	0.41835606
	Maharashtra	26941	6812	33753	0.20181910
	Andhra Pradesh	9057	1917	10974	0.17468562
	Karnataka	14079	16376	30455	0.53771138
	Goa	1729	301	2030	0.14827586
	Lakshadweep	896	338	1234	0.27390600
	Kerala	5386	5583	10969	0.50897985
	Tamil Nadu	19331	6318	25649	0.24632539
	Puducherry	2234	1435	3669	0.39111475
	Andaman & Nicobar Islands	2148	249	2397	0.10387985
	Telangana	20129	7388	27517	0.26848857
	Ladakh	1920	435	2355	0.18471338
Total		519946	204159	724105	

- Table 7

	State	Y	X1	X3	X4
1	Jammu & Kashmir	877.3888	0.23301645	0.5358337	0.15501150
2	Himachal Pradesh	1484.2294	0.08854167	0.4547647	0.34211034
3	Punjab	923.3095	0.15699784	0.1818015	0.11685269
4	Chandigarh	1021.3631	0.12064343	0.1112601	0.06166220
5	Uttarakhand	1263.2011	0.14352410	0.5796687	0.18546687
6	Haryana	1257.0504	0.16075585	0.2471587	0.29366927
7	Nct Of Delhi	1165.2975	0.12581773	0.1011739	0.18576933
8	Rajasthan	1327.2499	0.32581996	0.5820423	0.21428239
9	Uttar Pradesh	707.3133	0.29260985	0.6840449	0.32069069
10	Bihar	707.3773	0.39293364	0.8576607	0.24315609
11	Sikkim	1324.4758	0.09905228	0.6930602	0.27575665
12	Arunachal Pradesh	875.7460	0.22949659	0.7753605	0.12947129
13	Nagaland	746.1473	0.10026821	0.8313390	0.09284093
14	Manipur	135.1641	0.09612037	0.8184531	0.07386222
15	Mizoram	438.2005	0.06580574	0.5407336	0.07171315
16	Tripura	772.8700	0.12223134	0.8995078	0.23899371
17	Meghalaya	221.0547	0.14088166	0.8910536	0.22850592
18	Assam	713.4336	0.18625461	0.8770119	0.31253038
19	West Bengal	1274.5428	0.19861734	0.7964312	0.35790359
20	Jharkhand	818.1849	0.32832610	0.8474807	0.20668051
21	Odisha	863.1781	0.23964106	0.8148439	0.50412928
22	Chhattisgarh	1264.0923	0.27616973	0.7682310	0.38548546
23	Madhya Pradesh	1472.1261	0.27738071	0.7249122	0.27725677
24	Gujarat	1059.9689	0.22757400	0.5407732	0.39007858
25	Dadra & Nagar Haveli And Daman & Diu	1212.7607	0.15997051	0.4113527	0.41835606
26	Maharashtra	1559.8443	0.13242483	0.5362465	0.20181910
27	Andhra Pradesh	1916.8000	0.28902050	0.5532574	0.17468562
28	Karnataka	1710.9505	0.20916106	0.6011492	0.53771138
29	Goa	1571.3984	0.05073892	0.1354680	0.14827586
30	Lakshadweep	339.4718	0.01539708	0.1604538	0.27390600
31	Kerala	1039.9545	0.01048409	0.2502507	0.50897985
32	Tamil Nadu	1605.1217	0.09758285	0.4932164	0.24632539
33	Puducherry	1646.1267	0.06077950	0.1828836	0.39111474
34	Andaman & Nicobar Islands	1295.8877	0.08176888	0.5953275	0.10387985
35	Telangana	1666.4205	0.35362308	0.5663929	0.26848857
36	Ladakh	767.4707	0.22250531	0.7048832	0.18471338

Appendix B: Source Code

```
#MCPR calculation

mdrn_mtd=c(7214,5240,8130,274,5821,9837,4459,19760,29004,14637
,1385,6926,2743,

1005,1516,2790,2028,11881,10394,9613,10245,11823,23901,13871,1
101,17657,6494,

16081,891,259,4590,13184,1792,1065,14831,659)

length(mdrn_mtd)

married=c(13987,7681,15341,490,9297,15752,7434,30740,63064,318
24,2157,13442,

5797,5264,4252,5787,8182,25715,16522,19344,20037,18876,35188,2
4321,1797,

25207,8308,21855,1267,832,8130,18537,2486,1678,20441,1372)

length(married)

mcpr=(mdrn_mtd/married)*100

mcpr

max(mcpr)

#independent variables
```

```
#1Proportion of individuals with no education

x1=c(0.233016452,0.088541667,0.156997841,0.120643432,0.1435240
96,

0.160755854,0.125817726,0.325819958,0.292609854,0.392933644,0.
099052278,

0.229496585,0.100268207,0.096120368,0.065805743,0.122231337,0.
140881656,

0.18625461,0.198617339,0.328326099,0.239641057,0.276169734,0.2
77380706,

0.227574004,0.159970512,0.132424826,0.289020501,0.209161057,0.
050738916,

0.015397083,0.010484092,0.097582846,0.060779504,0.081768878,0.
353623083,

0.222505308)


#2Proportion of individuals whose partners are not educated

x2=c(0.158507029,0.046215139,0.161044177,0.112359551,0.0700867
05,0.098790323

,0.087959009,0.155826018,0.193505155,0.303597422,0.078488372,0
.221140473
```

,0.094017094,0.077448747,0.058278146,0.116033755,0.296886314,0
.200386287

,0.219984802,0.248284874,0.185240964,0.226241368,0.19442876,0.
1400818

,0.068852459,0.105668821,0.3412527,0.229687939,0.044334975,0.0
32258065

,0.023882897,0.087978509,0.106888361,0.09929078,0.314734089,0.
139175258)

#3 Proportion of individuals from Middle class or lower

x3=c(0.535833659,0.45476466,0.181801479,0.111260054,0.57966867
5,0.247158702,

0.10117394,0.582042335,0.684044929,0.857660711,0.693060226,0.7
75360486,

0.831338973,0.818453121,0.540733617,0.899507793,0.891053556,0.
877011921,

0.796431241,0.847480657,0.814843946,0.768230996,0.724912208,0.
540773176,

0.411352746,0.536246482,0.553257403,0.601149237,0.13546798,0.1
60453809,

```
0.250250707,0.493216374,0.18288362,0.595327493,0.566392906,0.7
04883227)


#4 Proportion of individuals who met community health workers
in the last 3 months

x4=c(0.155011503,0.34211034,0.116852694,0.061662198,0.18546686
7,0.293669268,

0.185769334,0.214282391,0.320690692,0.243156086,0.275756649,0.
129471288,

0.092840933,0.073862223,0.071713147,0.238993711,0.228505923,0.
312530375,

0.357903587,0.206680506,0.504129277,0.385485457,0.277256765,0.
39007858,

0.418356063,0.201819098,0.174685621,0.537711377,0.148275862,0.
273905997,

0.508979852,0.246325393,0.391114745,0.10387985,0.268488571,0.1
84713376)


state=c("Jammu & Kashmir","Himachal
Pradesh","Punjab","Chandigarh","Uttarakhand",
```

```
"Haryana","Nct Of Delhi","Rajasthan","Uttar
Pradesh","Bihar","Sikkim",

"Arunachal
Pradesh","Nagaland","Manipur","Mizoram","Tripura","Meghalaya",

"Assam","West
Bengal","Jharkhand","Odisha","Chhattisgarh","Madhya Pradesh",

"Gujarat","Dadra & Nagar Haveli And Daman &
Diu","Maharashtra","Andhra Pradesh",

"Karnataka","Goa","Lakshadweep","Kerala","Tamil
Nadu","Puducherry",

"Andaman & Nicobar Islands","Telangana","Ladakh")



#mCPR calculation

data=data.frame(State=state,Modern_Method=mdrn_mtd,
Married=married,mCPR=mcpr)

data

#original and transformed dependent variable

data2=data.frame(State=state,mCPR=mcpr,Transformed_Variable=y)

data2
```

```
#Independent variables

data3=data.frame(State=state,X1=x1,X2=x2,X3=x3,X4=x4)

data3

#Data for regression model

data4=data.frame(State=state,Y=y,X1=x1,X3=x3,X4=x4)

data4



#Multiple Linear Regression Model



m1=lm(mcpr~x1+x2+x3+x4)

summary(m1)



#Correlation among explanatory variables

X=cbind(x1,x2,x3,x4)

cor(X)

library(car)

vif(m1)
```

```
m2=lm(mcpr~x1+x3+x4)

summary(m2)

vif(m2)



#Check for normality and Box Cox transformation

qqnorm(mcpr)

qqline(mcpr)

hist(mcpr,prob=TRUE)

shapiro.test(mcpr)

library(MASS)

bc=boxcox(m1)

lambda <- bc$x[which.max(bc$y)]

lambda

y=((mcpr^lambda)-1)/lambda

shapiro.test(y)

hist(y,prob=TRUE)

qqnorm(y)
```

```
qqline(y)

par(mfrow=c(1,2))



#New model after BoxCox Transformation

model=lm(y~x1+x3+x4)

summary(model)
```

May 15, 2023

Mohammad Hamza Khan
Aligarh Muslim University
India
Request Date: 05/14/2023

Dear Mohammad Hamza Khan:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Assessment of modern contraceptive methods, its prevalence and association with various factors among women aged 15-49 in different states of India.":

India

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program