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Kishori Shakti Yojana to Improve the Nutritional and Health Status and Self Development of Girls in the Age Group Of 11-18 Years Using Machine Learning

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Abstract - Kishori Shakti Yojana (KSY) is a government initiative aimed at empowering adolescent girls aged 11–18 years through improved health, nutrition, and life skills. The scheme operates under the broader framework of the Integrated Child Development Services (ICDS). KSY focuses on adolescent girls who are out of school, especially in rural and marginalized communities. The project seeks to improve the nutritional and health status of these girls by providing regular health check-ups, iron and folic acid supplementation, and awareness programs. It also promotes personal hygiene, reproductive health education, and proper dietary practices.

Key Words: *Health, Nutrition, Life skills, Hygiene, Machine Learning.*

1. INTRODUCTION

Adolescence is an intermediate phase of growth and development between childhood and adulthood. According to the World Health Organization (WHO), an adolescent is any person between the ages of 11 and 18 years. Globally, adolescents account for around 1.2 billion people, representing approximately one-sixth of the world's population. While adolescents are generally considered a healthy group, many still face preventable or treatable health challenges that can lead to premature mortality. These challenges range from nutritional deficiencies and mental health issues to reproductive health concerns and lack of access to quality healthcare and education. In India, adolescent girls often face systemic discrimination, particularly in access to education, nutrition, and healthcare. These inequalities are compounded by social norms, early marriages, poverty, and a lack of awareness about health and hygiene. Studies across India have shown that the health and nutritional status of adolescent girls (10–19 years of age) is alarmingly poor. Girls face greater social disadvantages, are generally less educated, and often lack adequate access to vital health and nutrition information or services.

Many adolescent girls get married at an early age and are drawn into the cycle of early pregnancy, childbearing, and childrearing. This often results in them dropping out of school due to responsibilities like household chores, caring for younger siblings, the distance from schools, and the lack of safety and female teachers. According to the National Family Health Survey – 3 (NFHS-3), 11.7% of girls aged 15–19 years are stunted, 47% are underweight, and 56% are anaemic. Moreover, a significant number of adolescent girls lack knowledge of menstruation, sexuality, and reproduction. To address these multifaceted challenges, the Government of India has implemented several schemes focused on the welfare and empowerment of adolescent girls. One such initiative is the Kishori Shakti Yojana (KSY). This special intervention was introduced as a part of the Integrated Child Development Services (ICDS), building upon the experiences of empowerment programs carried out by NGOs and researchers. The scheme is aimed specifically at adolescent girls, particularly those from disadvantaged and marginalized communities.

In this context, machine learning offers a powerful tool to analyse and interpret large-scale data

related to adolescent health and scheme utilization. By applying machine learning techniques, patterns and insights can be extracted to identify gaps in awareness, predict nutritional deficiencies, assess the impact of interventions, and recommend targeted strategies for improving program outreach and effectiveness. This study aims to assess the awareness and utilization of the KSY scheme among adolescent girls and to explore the various influencing factors using machine learning model.

2.1 METHODOLOGY

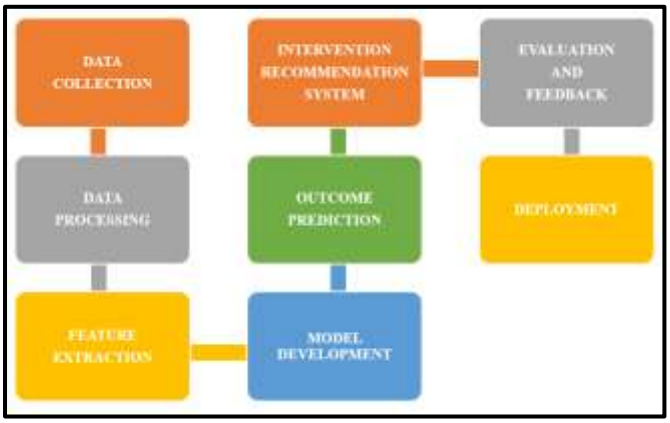


Fig 1: Machine Learning-Based Decision Support System for Improving Health, Nutrition, and Self-Development Outcomes in Adolescent Girls under Kishori Shakti Yojana

This project aims to leverage machine learning and data-driven approaches to improve health, nutrition, and self-development outcomes for girls, particularly within the ICDS (Integrated Child Development Services) framework. The first step is to collect data from various sources like surveys, government health records, and ICDS centers, ensuring a comprehensive view of demographics, health, and nutrition. Additionally, it's crucial to expand data sources to include community health workers and even mobile apps for self-reporting, offering a more holistic dataset. Once data is collected, it will undergo preprocessing, such as handling missing data, detecting outliers, and converting categorical variables into numerical features, to ensure that the model learns from clean and relevant information.

Feature extraction is the next step, where key factors like BMI, dietary habits, education levels, and socioeconomic background will be identified. This step will also consider mental health, physical activity, and access to healthcare as important predictors of health and development. With clean data and relevant features, machine learning models such as decision trees, random forests, and neural networks can be trained to predict outcomes like malnutrition risk, educational needs, or skill development gaps. These models will not only predict risk categories but also suggest personalized improvement plans, offering recommendations for targeted interventions.

The intervention recommendation system will employ collaborative filtering, content-based filtering, or hybrid approaches to suggest specific interventions like dietary plans, health checkups, or educational support based on the individual's profile. Once interventions are implemented, real-time feedback will be collected to evaluate their effectiveness and ensure that the model is continually updated to improve outcomes. The system can be deployed through a mobile or web-based platform, allowing ICDS workers and health officers to access it easily. Features like automated alerts, OTP verification, and message tracking through APIs (e.g., Twilio) will enhance communication and ensure that the right support reaches the right individuals at the right time.

By integrating machine learning, this system will not only provide predictive analytics for early identification of high-risk individuals but also optimize interventions based on real-time data. Long-term monitoring of beneficiaries will allow for adaptive learning, improving the system's accuracy and the impact of its interventions. Ultimately, the goal is to empower communities with data-driven decision-making, maximizing the effectiveness of interventions and improving the well-being of girls through personalized support.

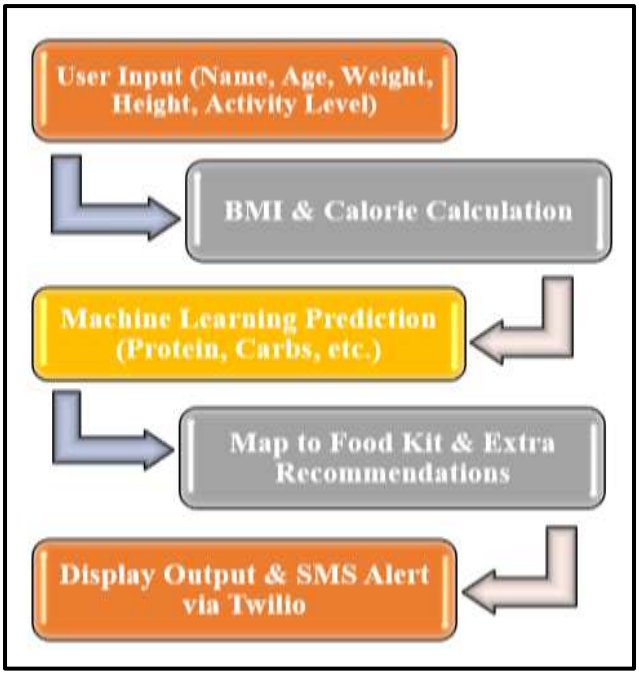
2.2 WORKING PRINCIPLE

The project is developed as a machine learning-based simulation using Python in Jupyter Notebook, without involving a physical working model, and effectively replicates real-world nutritional analysis and prediction scenarios in a digital environment. It processes user inputs-specifically age, weight, and height of adolescent girls-to calculate Body Mass Index (BMI), helping identify individuals at risk of malnutrition by classifying them into healthy, underweight, or overweight categories. A Linear Regression model, trained on historical nutritional data, predicts daily nutrient requirements such as protein, carbohydrates, fats, vitamins, minerals, and iron. Based on these predictions and the individual's activity level, the system calculates daily calorie needs and recommends personalized food portions using

affordable, making dietary plans both practical and sustainable.

It visualizes trends through Matplotlib generated charts like histograms, pie charts, and bar plots for better data interpretation. The system also integrates the Twilio API to send personalized SMS alerts to beneficiaries, updating them about their dietary needs and encouraging real-time health awareness and behavioral change. This simulation offers a valuable tool for theoretical and data-driven applications, supporting the objectives of the Kishori Shakti Yojana by improving adolescent girls' nutritional status and empowering them with accessible, personalized health insights.

Fig 2: System Workflow



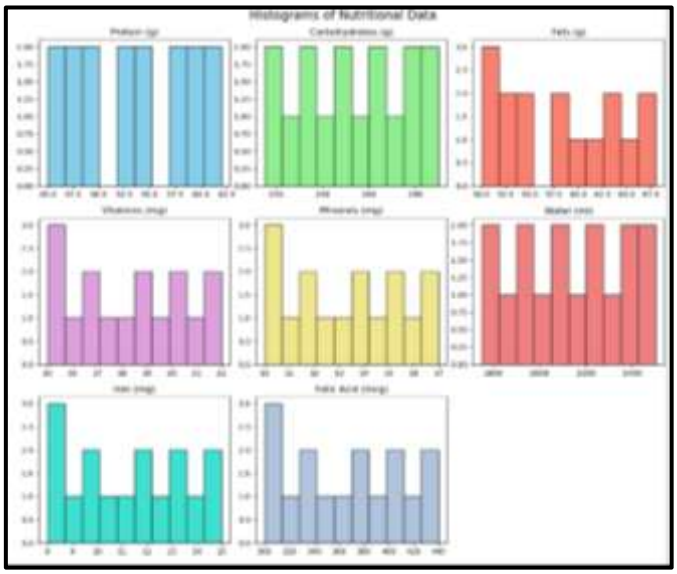
RESULTS

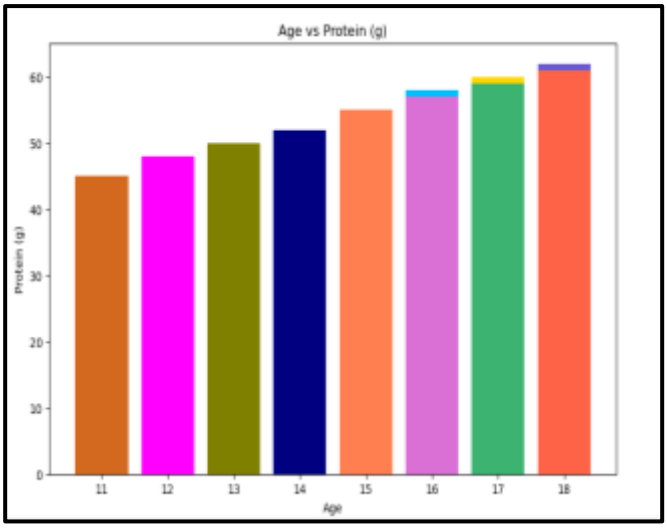
Kishori Shakti Yojana project uses machine learning to predict the nutritional needs of adolescent girls aged 11–18. It analyses key parameters like age, weight, BMI, and activity level using Linear Regression models. The system estimates daily calorie and nutrient requirements accurately. It recommends portion sizes from a fixed food kit (wheat, rice, dals, jaggery) to meet individual needs. Implemented in Jupyter Notebook, it calculates Body Mass Index (BMI) and visualizes data using Matplotlib and Seaborn. The model identifies at-risk individuals and personalizes dietary recommendations. Real-time monitoring is achieved through Twilio-based SMS notifications. The system enhances user awareness and access to proper nutrition. It supports self-development by improving health through data-driven decisions.

Fig 3: Histogram Chart

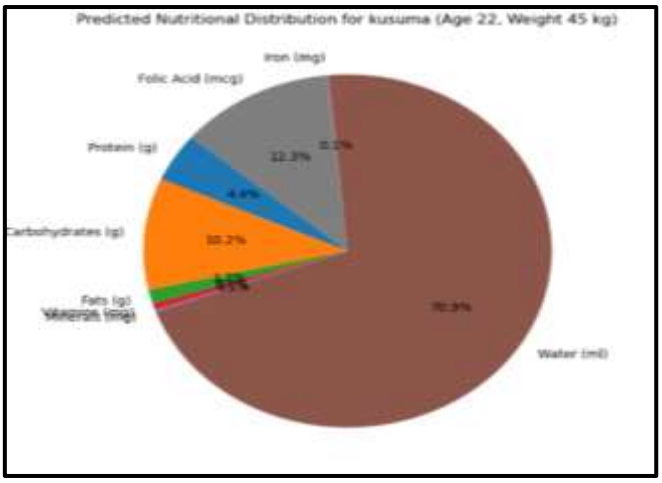
Fig 4: Bar Graph (Age vs. Protein)

Fig 5: Pie Chart





Visuals Used:

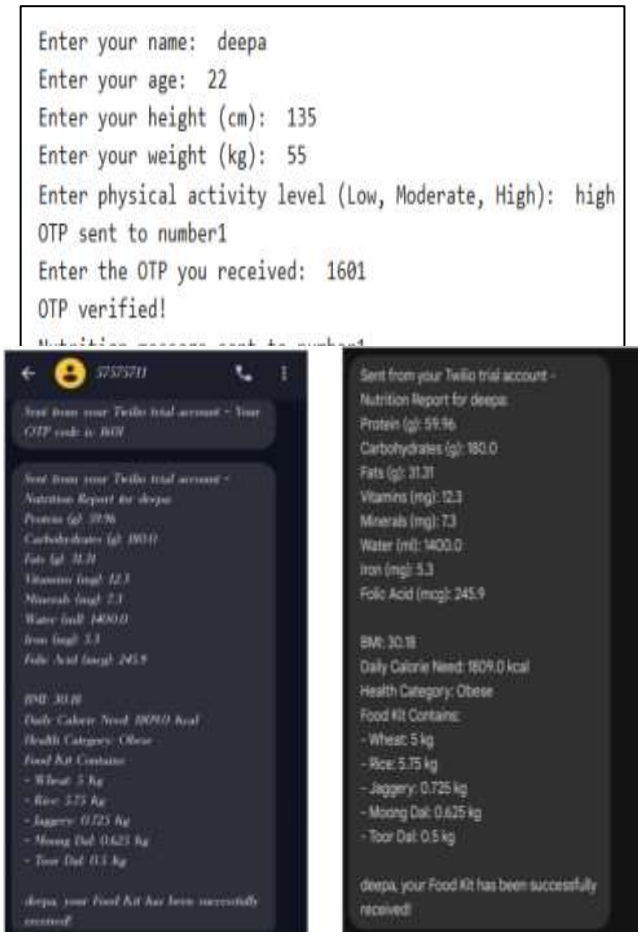


- Histogram Charts: Show distribution of nutrients like protein, fats, carbs across different age groups.

- Bar Graph (Age vs. Protein): Indicates how protein requirements rise with age.
- Pie Chart: Visualizes the percentage contribution of each nutrient in the predicted daily diet.

Fig 6: Personalized SMS alerts to beneficiaries

3. CONCLUSIONS



The Kishori Shakti Yojana project, implemented using machine learning, effectively predicts the nutritional needs of adolescent girls (11–18 years) by analyzing key parameters such as age, weight, BMI, and activity level. By leveraging Linear Regression models, it accurately estimates daily nutrient requirements and recommends optimal dietary intake based on available food kits. The system enhances intervention efficiency by identifying at-risk individuals, ensuring personalized nutrition recommendations, and facilitating real-time monitoring via Twilio-based SMS notifications. This data driven approach not only improves the nutritional and health status of adolescent girls but also supports their self-development by fostering awareness and access to essential dietary resources.

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