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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Keywords:

Nutrition Prediction, Machine Learning, Linear Regression, BMI Analysis, Data Preprocessing.

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.

In India, adolescent girls often face systemic discrimination, particularly in access to education, nutrition, and healthcare. This societal behaviour significantly impacts their physical and mental health, posing long-term risks not only to their well-being but also to the development and prosperity of the nation. Protecting and promoting the health of adolescent girls is, therefore, vital to reducing future health risks, improving quality of life, and ensuring sustainable national development.

To address these challenges, the Government of India has implemented several schemes aimed at adolescent welfare. One such initiative is the Kishori Shakti Yojana (KSY), which is exclusively designed for adolescent girls. The scheme aims to improve

their nutritional, health, and development status; promote awareness about hygiene, nutrition, and family care; facilitate access to education and life skills training; and empower them to make informed decisions to become productive and responsible members of society.

Despite these efforts, the utilization of KSY services remains suboptimal in many regions due to a variety of socio-economic and cultural factors. In this context, machine learning offers a powerful tool to analyze 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.

Objectives:

• Nutritional Assessment:
- Monitor and analyze the nutritional status of adolescent girls using machine learning models.
- Predict malnutrition risk and recommend appropriate interventions.

• Health Monitoring:
- Use predictive analytics to identify potential health risks based on medical and environmental data.
- Provide tailored health and hygiene tips.

• Self Development:
- Promote skill-building and self-awareness through personalized learning modules.

Methodology:

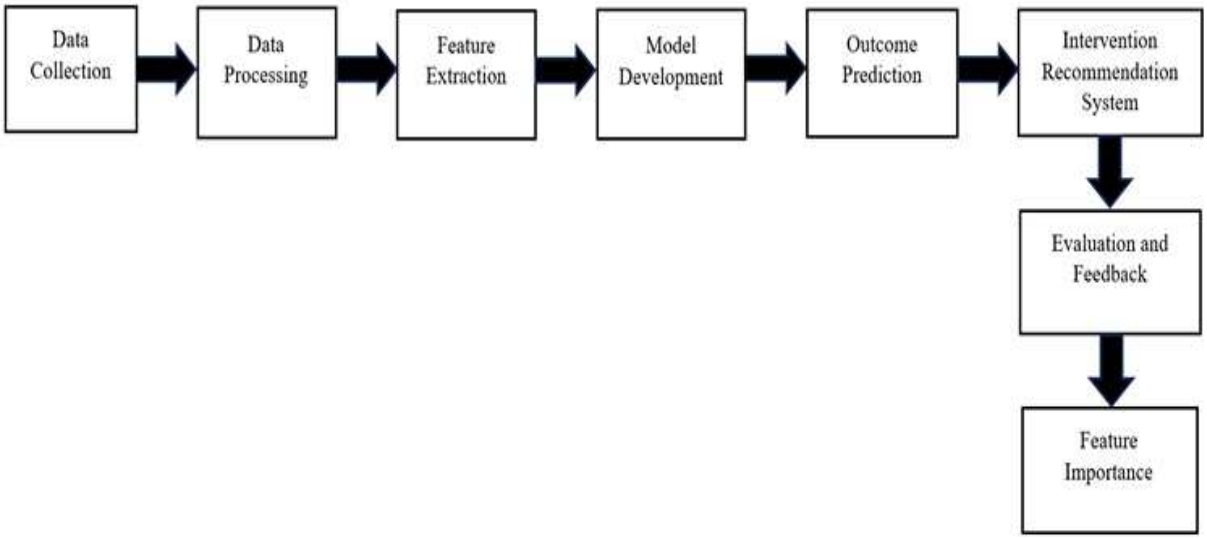


Figure 1: Machine Learning-Based Decision Support System for Improving Health, Nutrition, and Self-Development Outcomes in Adolescent Girls (11–18 Years) under Kishori Shakti Yojana

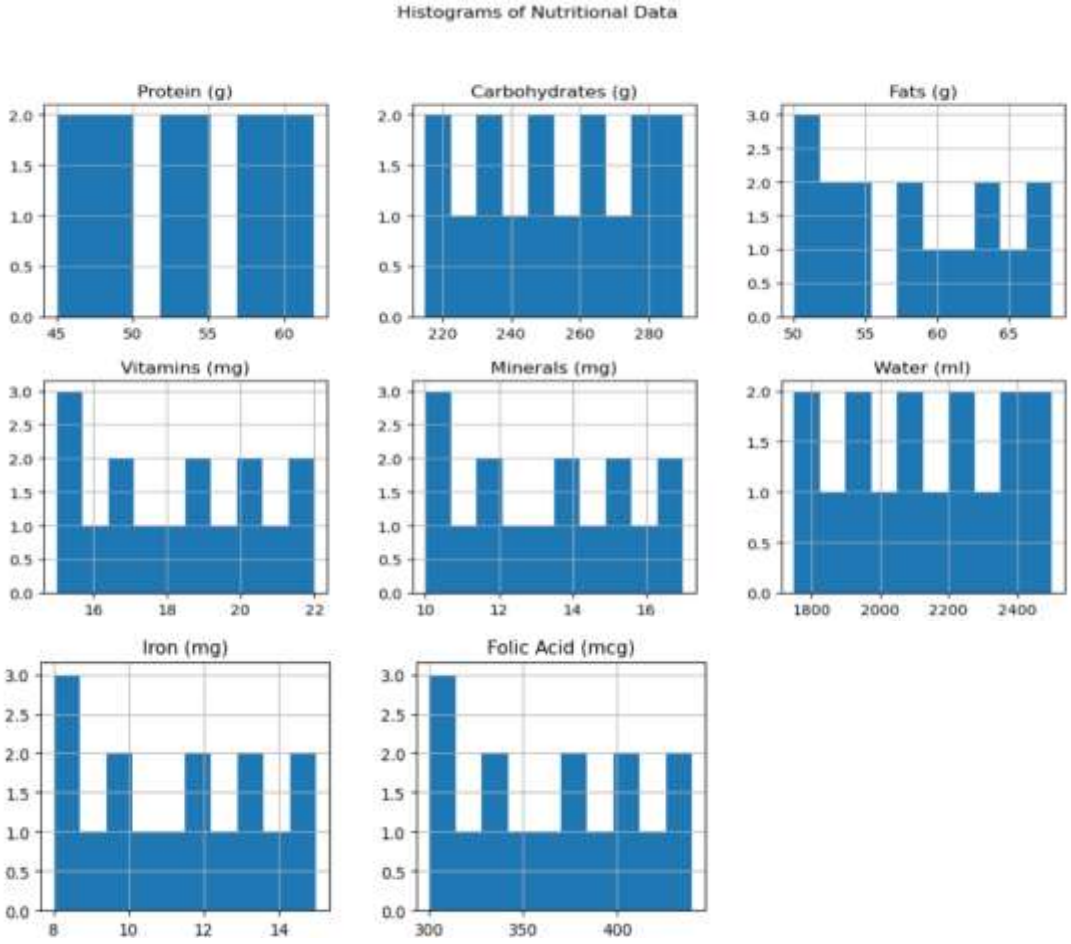
1. **Data Collection:**
    - Collect data related to girls' demographics, health, and nutrition.
    - Sources: Surveys, ICDS centres, government health records.
2. **Data Preprocessing:**
    - Clean and preprocess the data (e.g. handling missing data, outliers, normalization).
    - Convert text and categorical data into numerical features.
3. **Feature Extraction:**
    - Identify key features influencing health and self-development (e.g., BMI, dietary habits, education levels, socioeconomic background).
4. **Model Development:**
    - Train machine learning models (e.g. Decision Trees, Random Forests, or Neural Networks) to predict outcomes like malnutrition risk, educational needs, or personal skill development gaps.
5. **Outcome Prediction:**
    - Use the trained model to predict the nutritional and health status or suggest personalized improvement plans.
    - Outputs: Risk category (e.g. malnourished, normal), required interventions (e.g. iron supplements).

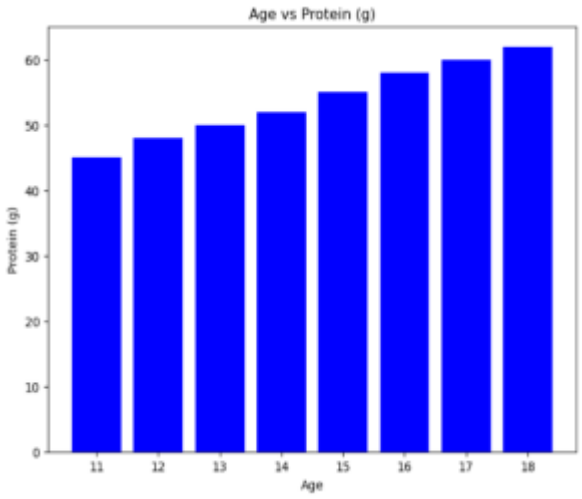
6. **Intervention Recommendation System:**
    - Develop a recommendation system for specific interventions (e.g., dietary plans, health checkups, counselling, education).
    - The system uses predefined kits and external food options to meet nutritional goals. It ensures each beneficiary gets the right support at the right time.
7. **Evaluation and Feedback:**
    - Collect real-time feedback on implemented interventions and outcomes to improve the model iteratively.
8. **Deployment:**
    - The system can be integrated into a mobile or web-based platform accessible to ICDS workers, NGOs, and health officers.
    - Includes automated alerts, OTP verification, and message-based delivery tracking via Twilio API.
    - Using machine learning (ML) methodologies, the program can be enhanced by analyzing large-scale data on demographics, health metrics, and program outcomes to identify patterns and optimize interventions.
    - ML models can predict high-risk individuals, personalize nutritional plans, and monitor progress in real-time. Additionally, ML-driven analytics can evaluate the effectiveness of training and skill development modules, enabling targeted support.
    - By integrating Machine learning, KSY can achieve data-driven decision making, improving efficiency and maximizing its impact on the beneficiaries' well-being and empowerment.

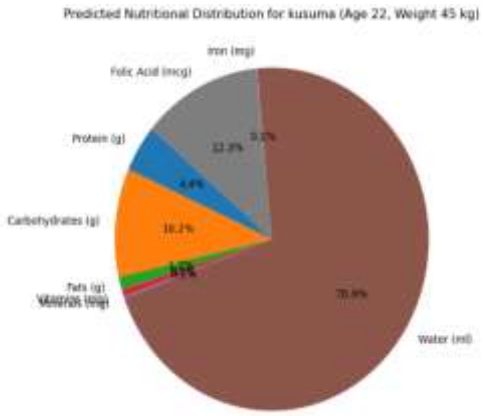
Results and Conclusion:

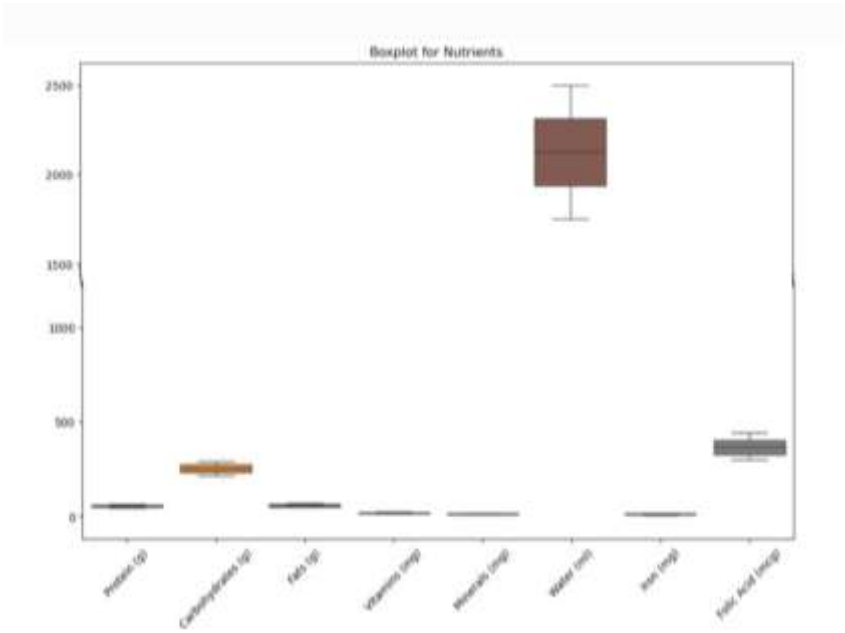
The Kishori Shakti Yojana project uses machine learning to predict the nutritional needs of adolescent girls aged 11–18. It analyses key parameters like age, weight, BMI, and activity level using Linear Regression models. The system estimates daily calorie and nutrient requirements accurately. It recommends 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. Overall, it shows the potential of Machine Learning in large-scale nutritional programs like Kishori Shakti Yojana.










```
Skewness for Protein (g): -0.05
Skewness for Carbohydrates (g): 0.00
Skewness for Fats (g): 0.14
Skewness for Vitamins (mg): 0.06
Skewness for Minerals (mg): 0.06
Skewness for Water (ml): 0.00
Skewness for Iron (mg): 0.06
Skewness for Folic Acid (mcg): 0.06
```

Figure 2: Visualizations using Matplotlib

```
Enter your name:  deepa
Enter your age:  22
Enter your height (cm):  135
Enter your weight (kg):  55
Enter physical activity level (Low, Moderate, High):  high
OTP sent to number1
Enter the OTP you received:  1601
OTP verified!
Nutrition message sent to number1.
Nutrition message sent to number2.

deepa has successfully received the food kit.
```

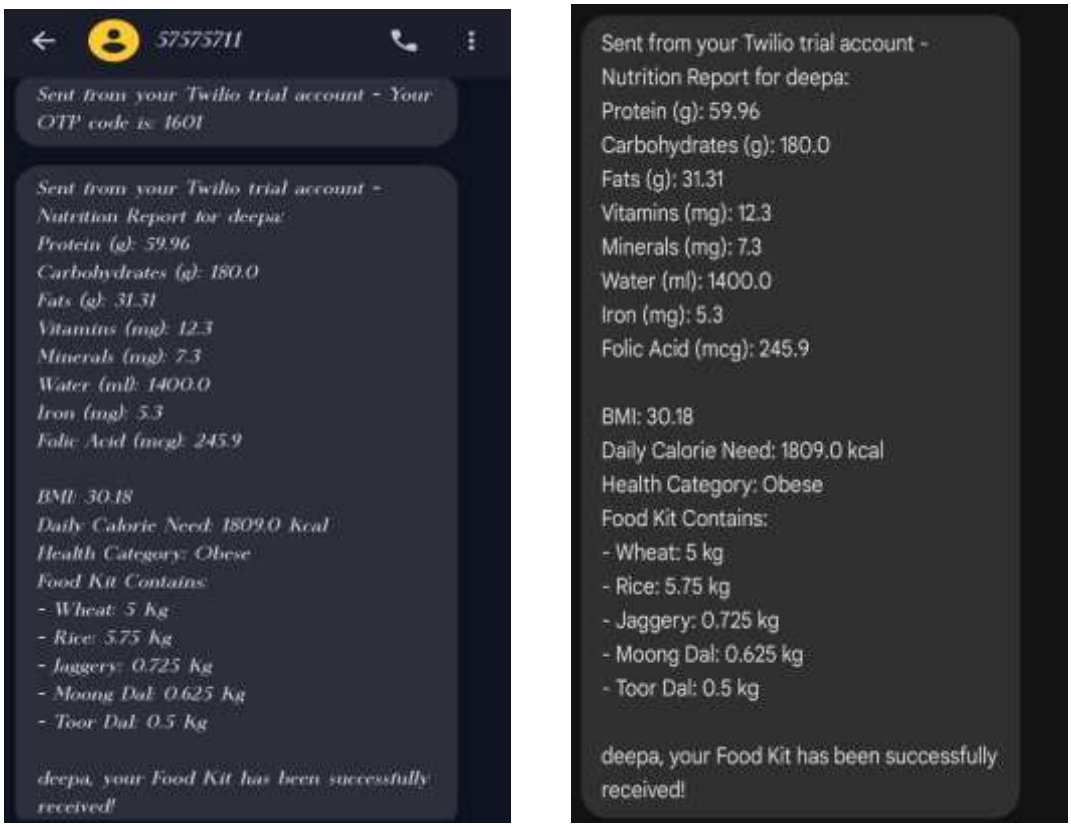


Figure 3: Personalized SMS alerts to beneficiaries

Project Outcome & Industry Relevance:

The project demonstrates how technology can enhance public health programs by personalizing nutrition based on individual metrics. It offers practical value in health tech, especially in rural or resource-limited settings, where manual dietary planning is not feasible. The system collects data such as age, weight, and height to predict daily nutrient intake, processes and cleans the data, and extracts key features like Body Mass Index (BMI) and calorie needs. A Linear Regression model trained on historical data estimates nutrient requirements, while the system recommends optimizing government food kits for effective distribution. Visualizations using Matplotlib help track nutritional trends, and authorities can monitor at-risk individuals for timely intervention. Integration with the Twilio API enables personalized SMS alerts to beneficiaries, keeping them informed about their dietary needs. The model is scalable, adaptable for various age groups and food kits, and improves over time by learning from new data, making it a powerful tool for reducing adolescent malnutrition and supporting data-driven decision-making in public health.

Working Model vs. Simulation/Study:

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 behavioural 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.

Project Outcomes and Learnings:

The key outcomes of the project include a functional machine learning model for predicting calorie needs and predicts nutrient requirements using a Linear Regression model. The use of regression models helped in understanding how different health parameters impact calorie intake. Through the process, we learned how to preprocess health-related data, build and evaluate ML models, and visualize results for better communication. We also gained experience integrating external APIs like Twilio to enhance functionality. Overall, the project strengthened our understanding of how ML can be used to solve real-world problems in public health and nutrition.

Future Scope:

1. The system can integrate real-time health data using wearable devices or mobile apps to track daily activity and dynamically adjust nutrition plans.
2. Machine Learning models can track behavioural patterns, enabling early interventions to improve health practices, exercise routines, and mental well-being.
3. Machine learning can help in efficiently distributing resources like supplements and health education programs based on geographical and demographic needs.
4. Machine learning can predict long-term health outcomes by analyzing current health data, enabling more focused efforts on improving girls' health and nutrition.
5. By analyzing personal data, machine learning can tailor self-development programs in areas such as education, skills training, and emotional well-being.