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User Acceptability Testing of Mobile Application in Indian Local Languages for Cardiovascular Risk Stratification and Modification among Patients with Type 2 Diabetes

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Abstract

➢ ***Introduction:***

Cardiovascular disease is the leading cause of death in patients with type 2 diabetes. Digital health tools like mobile application have fast emerged as a technology capable of closing the gap in cardiovascular disease self-management and revolutionizing the way healthcare is traditionally delivered. One of the causes for low app engagement of Apps in India is perhaps that few of these apps are available in local languages. The goal is to reach as many diabetic patients as possible while avoiding linguistic hurdles.

➢ ***Methodology:***

The 'healthy heart' mobile app was developed and translated into Hindi and Marathi languages for CVD risk stratification and risk management among Type 2 diabetes mellitus patients. User acceptability testing of the app on its design, presentation, content, and user-friendliness was undertaken. The feedback on utility of the app for CVD risk stratification and modification was assessed. A total 100 multilingual app users profile were noted for CVD Risk Status, Life Style Practices and CVD Risk Factors.

➢ ***Results:***

The Healthy Heart multi-lingual app was successfully developed for CVD risk classification and risk management among Type 2 diabetes mellitus patients. The patients had the choice to select the desired language of the app from the versions available in English, Hindi and Marathi. The Mobile App's Home Screen displayed the CVD risk score and category, a health tracker to monitor compliance with WHO recommendations regarding diet, physical activity, addictions, medication adherence, diabetic, and CVD Risk Profile. The majority of respondents rated the App's design, presentation, content, and user-friendliness favorably and emphasized the utility of App for CVD self-management and risk reduction. Characteristics of Type 2 Diabetic patients demonstrated poor compliance for total fruits and vegetable intake, total fat intake and total salt intake, physical activity Guidelines apart from poor control for blood pressure, glycemic control and lipid targets.

➢ ***Conclusion:***

The multilingual mobile App for CVD risk stratification, self-management and CVD risk reduction among diabetic patients was successfully developed in Hindi and Marathi language. User acceptability testing results were found to be favorable for the mobile app.

Keywords:- *Mobile App, Type 2 Diabetes Mellitus, Cardiovascular Diseases.*

I. INTRODUCTION

The primary cause of mortality and morbidity among diabetics is cardiovascular disease, which also raises the cost of both direct and indirect medical care. Therefore, it is critical to concentrate on actively changing cardiovascular risk factors in people with diabetes [1]. Consequently, the creation of treatments for the primary prevention of cardiovascular disease in diabetics is the most important therapeutic objective. [2]

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Primary care physicians can utilize a variety of CVD risk prediction algorithms, including the Framingham Risk Score, the UKPDS Risk Engine, and WHO charts, to assess a patient's risk of CVD and select the best course of therapy. [3-5] When resources are scarce, individual counseling and care must be prioritized according to cardiovascular risk. [4] If diabetic patients receive the right message for cardiovascular risk modification based on their unique CVD risk profile, it is feasible that they will be more likely to follow healthy cardiovascular self-management practises that will either delay or prevent cardiovascular adverse events.

There is a chance to employ mobile phone technology to lower cardiovascular risk as the number of people in India who own mobile phones keeps growing. Since mobile phones have a great potential to reach a large audience, they should be investigated as a health communication strategy. It is generally known that word-of-mouth is crucial in spreading health information. [6] Particularly in environments with limited resources, a smartphone app designed especially for primary CVD prevention can help doctors identify and treat diabetes patients at risk of CVD aggressively. The app will motivate and assist diabetics at high risk of cardiovascular disease to reduce their risk by making healthy lifestyle changes. Using this justification, the healthy heart mobile app was created in compliance with CVD prevention guidelines and WHO risk prediction charts. The "healthy heart" mobile app is the first to be created in India and is available in regional languages. Its special features allow patients and doctors to follow their health in order to prevent the negative consequences of CVD.

India is second in the world in terms of both the prevalence of type 2 diabetes and the number of mobile phone users. [7] Because of the tremendous rise and adoption of technology, mHealth has emerged as a viable option for providing individual-level self-management assistance beyond traditional clinic-based treatment. Appropriate self-management behaviours, in which patients actively participate in their own care, needs to be further emphasised in order to manage type 2 diabetes efficiently and prevent its undesirable consequences. Studies have shown that self-management treatments improve life style practices, medication adherence and have clinically significant advantages for glycemic outcomes and mental health outcomes. Mobile applications (apps) have been used to provide efficient self-management support by promoting healthy lifestyle modifications and medication adherence. [8]

Low app engagement, however, may prevent users from enjoying the advantages of mobile apps. [9] Increasing the accessibility and acceptability of digital health technology among diabetic patients could increase their sense of empowerment and engagement, which would help mobile health (mHealth) apps provide better support. Perhaps because there aren't much such apps available in regional languages, there isn't much use of digital health technologies for lowering CVD risk in India. [10] The majority of the CVD risk assessment tools available in India are in original languages (mainly English) and not designed primarily for use by patients or the general public, but rather healthcare professionals. Therefore, the android version of the Healthy Heart Mobile mobile app was developed and translated in local languages for CVD risk stratification and risk management among Type 2 diabetes mellitus patients.

The healthy heart mobile app is a unique multilingual app having the Patient Doctor and Admin log in. The app was uploaded on Play store for easy assessibility of diabetic patients. By translating the healthy heart mobile app into Hindi and Marathi and conducting a pilot test of both the Hindi and Marathi versions of its mobile applications in India, the study attempted to bridge this gap and improve the acceptability of the app for CVD self-management and risk reduction. An app available in multilingual language will motivate and assist high-risk diabetic individuals for self-management to lower their CVD risk by making appropriate life style changes. User acceptability testing and feedback of the diabetic patients as well as clinicians regarding design, content, user-friendliness was undertaken. In addition, the utility of the app as a tool for CVD risk stratification, self-management and risk modification was also assessed.

II. MATERIALS AND METHODS

- *Institutional Ethics Committee Approval No: MGMIHS/RES./02/2020-21/72 and each participant provided the required informed consent.*
- *Study Design: Prospective type of Observational Study*
- *Study Site: Department of Pharmacology and Department of Medicine MGM Medical College, Kamothe, Navi Mumbai.*
- *Study Population: Type 2 diabetes mellitus patients who conform to the following Criteria will be enrolled.*

- *Inclusion criteria:*

- Diagnosed cases of Type 2 DM Aged ≥18 years of age
- Patients Using Android Smart Phone
- Patients who agree to sign the informed consent form

- *Exclusion criteria:*

- Patients with Type 1 diabetes mellitus
- Pregnant women, including those with gestational diabetes
- People with established coronary heart disease, cerebrovascular disease and peripheral vascular disease
- Patients who do not agree to sign consent form

- *Sample Size: 100 Type 2 Diabetic Patients*

Prior data indicate that the cardiovascular disease risk among diabetic controls is 0.35. To detect a difference of 15% with power 0.8 to reject null hypothesis the total Sample size is 85 Considering a 10 % drop out the sample size will be increased to 100.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN424

➢ *Designing of 'Healthy Heart' Mobile App for patients with Type 2 diabetes mellitus*

"Healthy Heart" mobile app (English version) was initially created in English for diabetic patients to use for self-management and CVD risk mitigation. The Android app was created in Kotlin and Java and is compatible with Android. Laravel was used for the backend and Kotlin was used for the front end.

A patient and physician user case was integrated into the Healthy Heart App as a comprehensive cardiovascular risk reduction plan. The patient case home screen on the app shows the WHO recommendations for medication adherence, physical activity, diet, addictions, as well as the diabetic patient's CVD risk score and categorization (mild, moderate, high, and very high). Patients are required to provide 24-hour data about their food, exercise, and addiction habits every day. The app includes a health tracker that shows weekly, monthly, and three monthly graphs to track patients' adherence to WHO standards. Patients are also given reminders to make sure they consistently complete out the daily inputs.

Monthly compliance status of the patient to WHO recommendations is also captured by the app. This has a printable option where the patient summary of previous month is displayed which can be printed and downloaded. The patient summary feature of the app provides feedback to patient regarding specific self-corrective measures to initiative for CVD risk modification and supports the physicians to make treatment decisions by selecting the appropriate pharmacological therapy based on individual CVD risk profile.

➢ *Translation of Mobile App in Hindi and Marathi language*

- *Language translation Process*

An expert translator who are native Hindi and Marathi speakers and are proficient in English did the forward and backward translation of the data points. The software developer team members then met to discuss the differences between the original and back-translated English versions of the data and finalized the language translation into Hindi and Marathi.

- *Development of Multilingual Healthy Heart' Mobile App for CVD risk stratification and Management*

The Multilingual app had a user case for Type 2 diabetic patients for cardiovascular risk assessment and risk management.

➢ *Cardiovascular Risk Assessment:*

Following steps are needed to calculate the CVD risk score and stratify the patients into various risk categories

- *Steps for CVD Risk Assessment*

✓ *Registration & Login:*

It is required for patients to register and log in in order to utilize the mobile application.

✓ *Patient profile:*

The patient profile displays baseline medical records as well as the patient's personal information, including their anthropometric parameters, lifestyle habits, disease profile, and medication history.

- *CVD Risk Calculation and Stratification:*

After Registration & Login and baseline patient profile WHO Risk Prediction Chart served as basis for CVD risk score that was included into mobile app. The scoring system of WHO ISH Risk Prediction Chart is for Low Category is <5%, Moderate is 5% to<10%, High is 10% to <20%, Very High is 20% to <30% and those who have >30% risk also comes under Very High Risk category as per Prediction Chart.

- *CVD Risk Status is Reflected on the Home Screen of App:*

✓ *Colour Coding for CVD Risk Assessment:*

The Healthy Heart Mobile App features color-coding for CVD risk in accordance with the WHO ISH Risk Prediction Chart, which is displayed on the app's dash board. Varying colours are assigned varying levels of risk: Green represents low risk, yellow represents moderate risk, orange represents high risk, and red and deep red represent very high risk.

✓ *Comparison with WHO Risk Prediction Chart:*

In order to verify the legitimacy and precision of the Healthy Heart Mobile App's CVD Risk Calculation, the CVD risk for every patient was also computed by a paper-based method utilizing the WHO ISH Risk prediction table. There was agreement in the CVD risk category between the Mobile app and WHO charts. This made sure algorithm in the app replicates the WHO chart's algorithm accurately.

➢ *CVD Risk Management:*

Patients with Type 2 diabetes may also utilize app for risk reduction and Life Style Monitoring in addition to CVD risk assessment.

- *Home Screen of Mobile App:*

The following capabilities have been added to the Patient User Case Dashboard for modifying CVD risk:

✓ *Self-Management Practices*

▪ *Daily Inputs Regarding Life Style Practices:*

The patient must follow a daily schedule for nutrition, exercise, addictions, and medication compliance.

✓ *CVD Risk Factor Modification*

▪ *CVD Risk Factors:*

Data related to disease profile (HBA1c, blood sugar), lipid levels, BP readings and weight needs to be entered in the mobile app either monthly or quarterly**.**

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN424

✓ *Additional Features for CVD Risk Management*

▪ *Health Tracker:*

Weekly, monthly, and quarterly graphs are graphical representations of patient health records.

▪ *WHO Recommendation (Non-Pharmacological):*

In order to lower the risk of CVD, WHO recommendations on nutrition, exercise, and addictions are also included.

➢ *User Acceptability Testing:*

• *Design, User Friendliness and Content of App:*

Forty-One and Twenty-Eight patient replies in each of the Hindi and Marathi versions of "Healthy Heart" mobile application respectively were gathered for the purpose of usability testing. Patients' opinions about the mobile app's Design and Presentation, content, and user-friendliness were gathered. The patients were also questioned about their ability to dedicate the necessary time each day to filling out daily inputs.

• *Utility of App for Self-Management and CVD Risk Reduction:*

User acceptability feedback was obtained from all mobile app user after 6-month post usage regarding Mobile Apps utility. Feedback was obtained regarding usefulness of the app for self-monitoring as well as CVD risk factor modification, feasibility for use on daily basis and completeness and quality of the information provided in the app

➢ *Profile of Multilingual App Users;*

The mobile app users' baseline demographics, including age, gender, BMI, and CVD risk factors like blood pressure, glycemic control, weight control, and dyslipidemia, as well as their habits for managing their condition (diet, exercise and addiction were noted. The mobile app automatically determined the CVD Risk status and score after the baseline data was filled out. The paper version of the WHO CVD risk prediction charts was compared with the diabetes patients' calculated CVD risk category.

• *CVD Risk Status:*

Type 2 diabetic patients CVD risk status was computed using the mobile app at baseline and six months later, and it was shown digitally on the dashboard and in the health tracker.

Preference of Language Selected by Users was noted

• *Self-Management Practices:*

The Physical Activity, Diet patterns and Addictions of the Type 2 diabetic patients was recorded on the app.

• *CVD Risk Factor Profile of Type 2 Diabetic Patients:*

CVD risk factors such as Glycemic status, Blood Pressure and Dyslipidemia were recorded.

➢ *Statistical Analysis:*

SPSS version 22 was used for the statistical analysis after the data was entered into Micro Soft Excel. The data was presented as a percentage and an actual quantity. Kappa statistics was used to evaluate the agreement between the two measurements (cardiovascular risk and the evaluation scale mobile app). A statistically significant P value was defined as one that is less than 0.05. Descriptive statistics were used to express the results which included actual number, Mean with standard deviation, Median and percentages. Data normality was assessed. For normal distributed data, parametric test was used which included independent t test for comparing the variables between two groups. For non-parametric data, Mann-Whitney Test was used to compare the outcome variables between the two groups at different time points. Categorical data was assessed using Chi square test. Agreement between the two variables/ scales was assessed using Kappa Statistics. McNemar Bowkers test was applied for comparing the differences of variables with categorical data.

III. RESULTS

A. *Overview of Mobile App*

Mobile Application's framework and transcript were created and refined following consultations with diabetologists, physicians, dietitians, scientists, and individuals with diabetes.

B. *Translation of English version of App in Hindi and Marathi*

Mobile App was translated successfully in local languages i.e. Hindi and Marathi for ease of use by Type 2 diabetic patients. From all 100 Patients who were mobile App users 31 were using English Version, 41 patients were using Hindi version and 28 were using Marathi version of Mobile App. Majority of the Type 2 diabetic patients selected local languages compared to English.

➢ *The App Included the Following Features*

• *Cardiovascular Risk Assessment*

✓ *Baseline Data:*

The smartphone app recorded age, gender, BMI, and CVD risk factors (blood pressure, dyslipidemia, glycemic control), in addition to CVD self-management behaviours (addiction patterns, exercise, diet, and disease monitoring) of the patients.

✓ *CVD Risk Calculation:*

Mobile application automatically determined CVD score after the baseline data was filled out.

✓ *Home Screen of Mobile App:*

Graphs for health tracking was used to assess compliance with WHO recommendations on nutrition, exercise, disease, addictions, and CVD risk profile was included in the mobile app's dashboard. Color coding was used to indicate the level of CVD risk (mild, moderate, high, and extremely high). (Table 1)

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN424

- *Cardiovascular Risk Management*

✓ *Self-Management Practices:*

The daily input (past 24 hours) data about medication adherence, exercise, diet, and addiction behaviours was entered into the mobile app with the goal of encouraging self-management practices. The dashboard panel showed the 24-hour adherence to WHO recommendations for medication adherence, exercise, diet, and addiction behaviours based on data entered. When a patient does not comply, a pop-up message appears on their mobile home screen and directs them to the WHO Recommendations portion of the app.

➢ *Cardiovascular Risk Factor Monitoring:*

- *Health Tracker:*

✓ *Weekly Graphs:* (Dietary Intake, Physical Activity and Addictions),
✓ *Monthly Graphs:* (Diabetes Profile and Compliance to WHO Recommendations for Diet, Physical Activity and Adictions)
✓ *Quarterly Graphs:* **(**Anthropometric parameters, medication adherence patterns, disease profile and CVD Risk Category) feature were available in the mobile application (Table 1)

➢ *Additional Features for CVD risk management*

- *WHO Recommendation (Non – Pharmacological):*

The CVD Risk Prevention Guidelines served as the foundation for WHO recommendations including dietary, physical activity, and addiction guidelines. The mobile app's language was made simpler and an extra information part was added for the patient's benefit. (Table 1)

- *Compliance to WHO Recommendations:*

The monthly compliance to life style changes of the patients according to WHO Guidelines was included in the form of graphs.

- *Reminders:*

Daily messages to remind patients to follow healthy lifestyles was provided.

C. User Acceptability Evaluation

➢ *Patients Perspective of the Hindi Version of APP*

Patients' responses were recorded regarding the following: the mobile app's design and presentation (53.3% say it's good, 40.0% say it's excellent); its content (53.3% say it's good, 46.7% say it's excellent); its user-friendliness (53.% say it's good, 26.7% say it's excellent); its utility (73.3% agreed and 26.7% strongly agreed); Practicability to devote adequate time to fill daily inputs (33.3% agreed, 66.7% strongly agreed); and its information was structured and balanced (33.3% agreed, 60.0% strongly agreed). (Fig 3)

➢ *Patients Perspective of the Marathi Version of APP*

The patients' responses were recorded regarding the following: 60.0% of them said the design and presentation was good, 40.0% said the app's content was excellent, 40.0% said the app's user-friendliness was excellent, 46.7% agreed that the mobile app was useful, and 53.3% strongly agreed; 46.7% agreed that Practicability to devote adequate time to fill daily inputs; and 33.3% strongly agreed that the information provided by the mobile app was structured and balanced. (Fig 3)

➢ *Utility of App for Self-Management and CVD Risk Reduction:*

In utilization of mobile application majority of users gave the responses for the feedback question as Very or Somewhat. For Usefulness 50% says it was very useful, for Completeness 35% says Somewhat it was useful, 38% patient says it was fair and balanced and 44% says it was very much feasible to use on daily basis. (Fig. 1)

D. Profile of Multilingual App Users

The mean age of the users of Mobile App was 50.55±10.47 yrs. and 40.4 +SD yrs. 26.7% of the users of the Hindi version of App were smokers compared to 20% among the Marathi app users. Mean systolic and diastolic blood pressure among Hindi app users were 127.7±14.1 and 85.75±9.41 mmHg respectively.

➢ *CVD Risk Status:*

After enrolment, patients' CVD Risk status was calculated on the mobile app and found that 38% were in the low risk category, 52% were in the Moderate risk category, 06% were in the high risk category and 04% was in Very High Risk Category. (Fig. 2)

➢ *CVD self-Management (Life Style) Practices:*

Self-Management practices such as Heart Healthy Diet, Physical Activity and Addictions were recorded. Mean baseline consumption of total fruits and vegetables was found to be 279.5±93.23 gms, total fat intake 8.16±3.42 ml, Consumption of Free Sugar 1.78±1.03 Tsp and total salt intake were 1.62±0.62 gms among diabetic patients. Average weekly moderate physical activity was found to be 93.35±58.69 min and vigorous Physical activity 10.65±24.8 min. Average weekly tobacco consumption was 0.34±1.07 times and alcohol consumption was found to be1.62±0.62 Units. (Fig 4)

Compliance of Type 2 diabetic patients to WHO Recommendations for Life style practices was assessed. It was found to be 19% for total fruits and vegetables intake, 11% for total fat Intake, 45% for total salt intake and 100% for free sugar consumption. For Physical Activity compliance to WHO Recommendations was 5% for Vigorous Activity and 13% for Moderate Activity. 96% & 88% patients followed the WHO Recommendations for Alcohol Intake and Tobacco consumption. (Table 2)

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN424

➢ *CVD Risk Factors:*

The CVD Risk Factors such as uncontrolled blood Sugar, blood pressure and lipid profile were noted. Patients mean Fasting Blood Glucose was 170.66±48.99 mg/dl and Post Prandial Blood Glucose were 244.42±63.99 mg/dl. Mean Systolic Blood Pressure was 127.7±14.1 mmHg and diastolic pressure were 85.75±9.41 mmHg. Patients' total cholesterol level was 173.72±49.56 mg/dl, triglyceride level was 146.73±53.95 mg/dl, HDL were 44.1±9.62 mg/dl and LDL were 90.53±29.79 mg/dl. (Fig 4)

25 % of patients had good glycemic control, 50% and 42% respectively showed good Systolic and Diastolic Blood Pressure control and 30% patients met the total cholesterol lipid targets. None of the patients showed compliance to LDL-C lipid targets. (Table 2)

IV. DISCUSSION

The main cause of morbidity and death in this population is cardiovascular disease (CVD), which is more likely to occur in patients with Type 2 diabetes. [11] The majority of people with type 2 diabetes are uninformed of their risk of CVD, despite the fact that there is a well-established link between the two conditions. Resolving the unmet needs of diabetic patients for CVD disease prevention and risk management is one of the largest difficulties facing today's healthcare professionals. [11-12]

In order to manage the increasing burden of diabetes-related cardiovascular disease, patients and physicians need novel technologies. Real-time health education, feedback, and innovative self-monitoring techniques show enormous promise for improving the quality and accessibility of diabetes care as health care providers advance their information technology capabilities. Involving people in healthcare is a crucial part of improving healthcare because it can help them manage their health and reduce their risk of diabetes-related death and morbidity. A few information technologies providing health care benfits are voice agents, interactive chat bots, emails, SMS messaging, apps, and the internet. [13]

Mobile applications offer range of behavioural interventions to assist diabetes patients in leading better lifestyles and potentially reducing their CVD risk. [9] There is a great potential to utilize Information technology for addressing the CVD burden of the diabetic patients and live healthier lifestyles. [14] There isn't much utilization of digital health technology in India to reduce the risk of CVD, possibly because there aren't many apps available. Additionally, none of these apps are available in regional languages. Perhaps because there isn't much material available in regional languages, there isn't much use of digital health technologies for lowering CVD risk in India.

Additionally, the majority of CVD risk calculators for CVD risk assessment are available in English primarily for use by healthcare professionals rather than patients or the general public. The study aimed to close this gap proposed to develop a unique patient centric application (Multi-lingual Mobile app), the main feature of which was a calculator designed to help diabetic patients assess their CVD risk and use the app for CVD risk modification. Based on WHO Guidelines, the Android version of the Mobile app was developed for T2DM to help with CVD risk management and stratification. Efforts were directed to translate the mobile in local langiages (Hindi and Marathi) to improve the assess of the app among diabetic patients not conversant in English.

➢ *Development of the Multilingual Mobile App*

- *Features of Hindi and Marathi version of the App's Dashboards*

The Home Screen of app shows patients' CVD risk score based on WHO Risk Chart. Patient daily input key, profile, health tracker, (Non-Pharmacological) WHO Recommendations, and patient summary report are further features of the dashboard. The study conducted by Ocares et al., in the year 2023, the mobile app for real time monitoring of blood glucose in their mobile application's main screen, which includes patient data, diabetes control, monitoring, daily reports, and an emergency button in case the patient needs it. [15] EPI.RxISK™ App is currently available to calculate a person's CV risk, based on age, sex, ethnicity, medical history, family history, blood pressure, status as a smoker, and laboratory markers (such a lipid panel). The CVD status in the EPI.RxISK™ App is displayed on main screen of the mobile application. [16]

- *Daily Inputs and Health Tracking*

Our mobile app, Healthy Heart, now offers a Daily Input option that allows users to track daily recommendations related to medication adherence, physical activity, food, and addictions. In order to understand patients' compliance patterns with the 2020 WHO CVD Risk Reduction guidelines, daily input from the patients was recorded and reflected in the health trackers. [6] Weekly, monthly, and quarterly graphs are included in the health tracker to help diabetic patients be better monitored.

Weekly graphs display the average weekly intake of total fat, free sugar, salt, and fruits and vegetables. The amount of time spent engaging in moderate-to-intense physical activity is displayed under the physical activity section. The Weekly Health Tracker also provides information on addictions, including weekly usage data for alcohol, smokeless tobacco, and tobacco. Monthly graphs display diabetes profile data, such as fasting and postprandial blood glucose levels. Graphs showing WHO compliance to life style practices. There are suggestions for diet, exercise, and addiction treatment based on WHO recommendations. Anthropometric parameters, lipid profile and HbA1C changes are tracked on quarterly graphs.

The Buss et al., 2022 app seeks to raise users' risk awareness and encourage behavior modification for prevention of cardiovascular disease and T2DM. Users may monitor their behavior and get feedback on how they were doing in reaching their own goals in the health measurements section [14]. The healthy heart app is distinct,

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though, because it was created especially for diabetic people to reduce their risk of CVD.

- *WHO Recommendations for CVD Risk Modification*

The produced mobile app (Health Heart) incorporates WHO recommendations on the amount of time that should be spent engaging in moderate to intense physical activity, as well as tips on quitting alcohol and tobacco addiction. In order to make the WHO recommendations understandable to lay people, they translation into lay languages was undertaken. Also Included was comprehensive information on the recommended daily intake of total fat, fruits and vegetables, salt and free sugar.

Few apps are available which provide information regarding WHO Recommendations for CVD risk Modification. However, none are available in India. Further details on the idea of cardiovascular risk are given in the third PAHO/WHO app module, along with particular suggestions for quitting smoking, altering one's diet, getting more exercise, managing one's weight, and using alcohol and other drugs. [16] An intuitive instruction, unambiguous messaging regarding risk assessments, therapeutic suggestions, and approximations of the anticipated impact of altering conventional risk variables on cardiovascular disease risk are all included in the HEARTS app. On the other hand, the HEARTS app was designed with hypertension patients in mind.

- *Patient Summary Report*

The mobile app includes a patient monthly summary report to track whether non-pharmacological recommendations from WHO CVD risk prevention guidelines are being followed. The summary report shows how many days in the past month each patient adhered to WHO recommendations. The patient summary report compiles and presents the data that was gathered from the patient's daily inputs. The patient can save or download the report for later use and can be used by Physicians to understand the life style pattern of diabetic patients. This function is exclusive to the app and was included to help doctors better understand patients' lifestyle choices so that they can give them the right advice. Patient summary report generation is unique feature which is not available in any of the other apps.

- *User Acceptability Testing*

User acceptability testing of the app was undertaken in T2DM ptients. A total of 100 participants, 31 from English, 41 from Hindi and 28 from Marathi language, were enrolled in the study. In both languages, the participants' ages ranged from 30 to 40 years. Similar to this study, participants in Kwan et al.'s study ranged in age from 40 to 69 years. [10] Participants' CVD risk status was compared using the smartphone app and WHO's CVD risk prediction charts. The majority of respondents gave the app's presentation, content, and user-friendliness excellent or good ratings. New features were introduced to the app in response to participant comments. The procedures were repeated until the feasibility study produced an app version that diabetes people may use to lower their risk of CVD.

Similar user acceptability study with EMPOWER app was undertaken. [10] When asked if they would use the EMPOWER app every day, the majority of participants either said no or expressed doubt about their capacity to do so, citing factors including a busy schedule and the repetitive nature of the data that needed to be supplied. The issue of whether the app would be appropriate for elderly patients who might not be digitally aware was also brought up by the participants. Other issues included the potential for patient privacy to be violated and the absence of HbA1c and lipid test findings in the EMPOWER app. [10]

- *Profile of Multilingual App Users*

A total 100 multilingual app users' profile were noted for CVD Risk Status, Life Style Practices and CVD Risk Factors. It was found that majority of the diabetic patients had either moderate of high CVD risk (52% had Moderate 06% high and 04% very high CVD risk category) Similar, study done by Sukra S et al showed lower CVD risk among diabetic patients {Moderate Risk (4.8%); Moderate-High Risk (2.1%); Low-Moderate Risk (16.8%); High Risk (1.7%).} [5]

In the present study, majority of diabetic patients showed poor glycemic and lipid control. Blood pressure control was also found to be around fifty percent among the diabetic patients. Thus, high presence of CVD risk factors and its poor control was observed among diabetic patients. Similar results were found in a study done by Lee-Ling Lim et al identified in their study that 34.2 % participants showed good glycemic control, 23.2% participants were in compliance to recommendations for blood pressure control and 56.3% patients met the lipid targets in accordance to WHO recommendations. [17]

The study results emphasize poor life style practices and high burden of CVD risk factors among diabetic patients Based on the results from the study it is necessary to empower Type 2 Diabetes patients to identify their CVD Risk and modify their lifestyles. This, in our opinion, is what distinguishes our study from earlier research, which has a patient centric approach for CVD self-management and risk modification. In order to make the mobile app usable by laypeople on their own, we tried to keep its design as straightforward as possible and made it available in local languages.

To conclude, the multilingual mobile App for self-management and CVD risk reduction among diabetic patients was successfully developed and uploaded on the android play store. The app was found to be acceptable by diabetic patients for CVD self-management and risk management. Optimizing the usage of mobile applications through user acceptance testing, guided by the multilingual app's accessibility and availability in local languages, may remove obstacles for the prompt and efficient management of CVD burden amongst diabetic patients. Thus, regular use of the app will motivate the diabetic patients it to make healthy lifestyle changes and perhaps lower their CVD risk. The Healthy heart app would encourage a greater adoption of CVD prevention measures across the nation and

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encourage patients to take a more active part in their own self-care. To enable its use on a national scale, the study team is currently conducting a clinical study and evaluating the application on a sizable group of diabetes patients during a six-month follow-up period.

V. CONCLUSION

The android version of the multilingual mobile app was successfully developed in English and translated in Hindi and Marathi for CVD risk reduction among diabetic patients. Healthy heart app design, content and presentation was found to be favorable and acceptable for self-management and CVD risk reduction by diabetic patients. Characteristics of Type 2 Diabetic patients demonstrated high CVD risk burden, poor life style practices and presence of uncontrolled CVD risk factors (inadequate control of blood sugar, lipids and Blood pressure) emphasizing the need of such an app for cardiovascular risk stratification, self-management and modification. The mobile app known as 'Healthy Heart' app has been uploaded to the google play store for easy access to diabetic patients.

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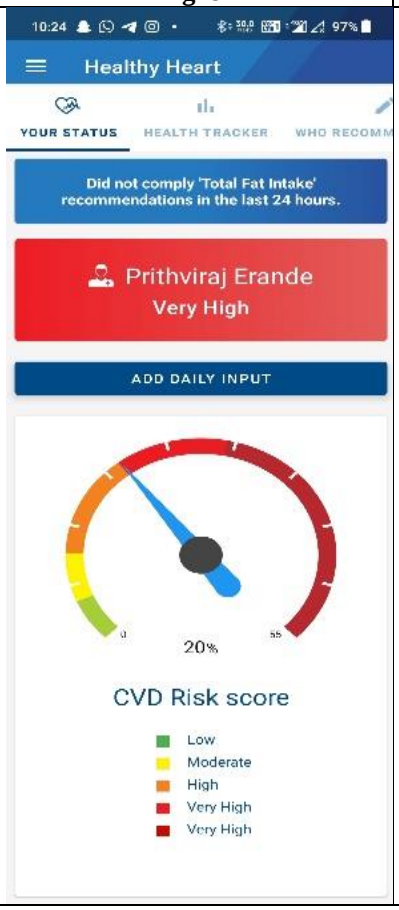
Statement of Informed Consent: Written Informed Consent has been obtained from all the Participants in the study.

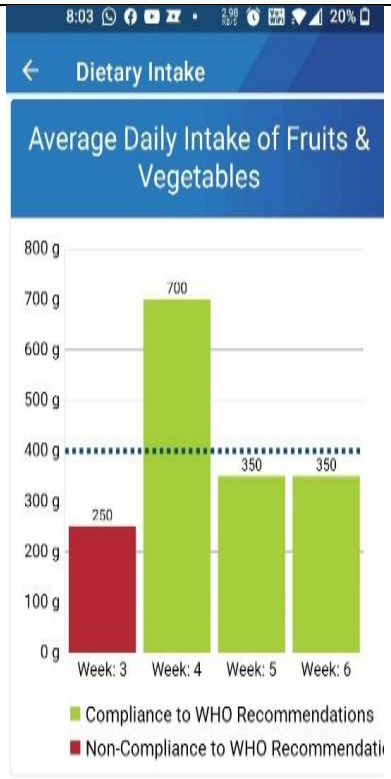
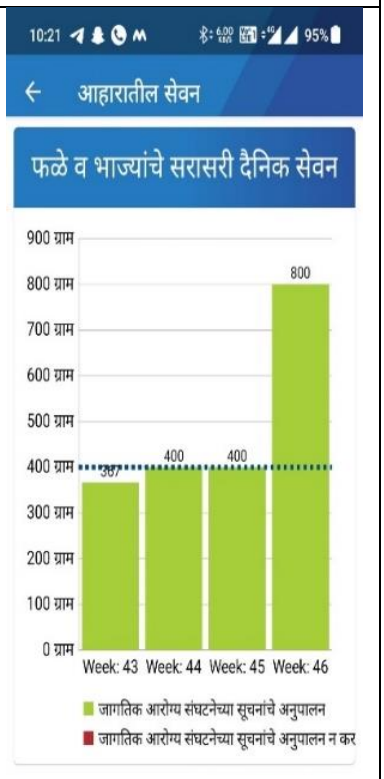
➢ *Legends*

- *Table 1: Screenshots of the Healthy Heart Mobile App*
- *Table 2: Compliance to WHO Recommendations*
- *Fig 1: Utility of App for Self-Management and CVD risk reduction*
- *Fig 2: CVD Risk Profile among Mobile App Users*
- *Fig 3: Feedback from multilingual app users*
- *Fig 4: Profile of the Multilingual Mobile App users*

Table 1 Screenshots of the Healthy Heart Mobile App

App Features	English	Hindi Version	Marathi Version
Home Screen			

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN424

Health Tracker Screen (Overview of Graphs)			
Graph (Weekly) (Dietary Intake)			

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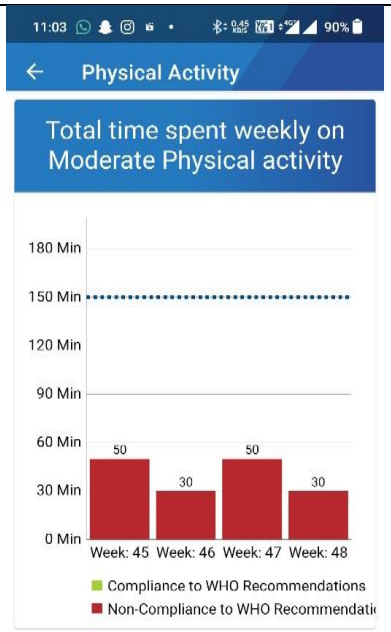
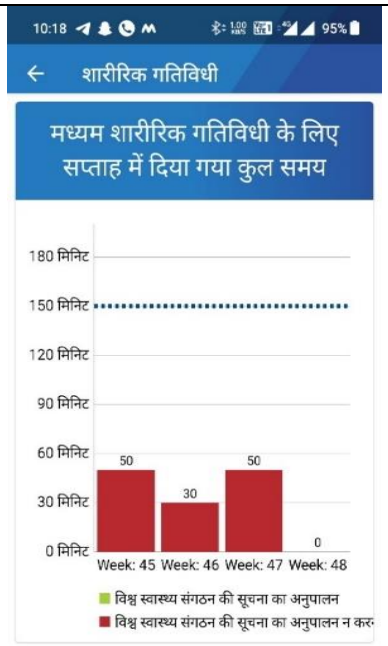
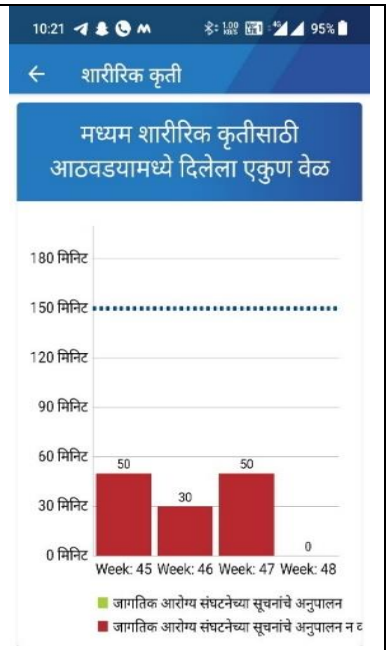
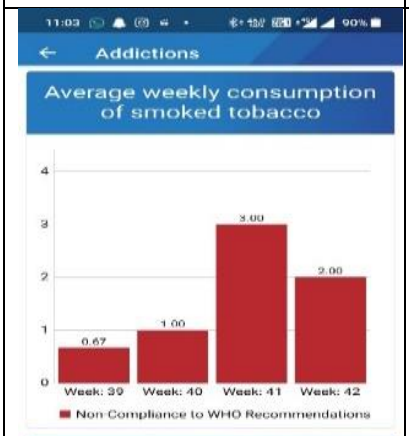
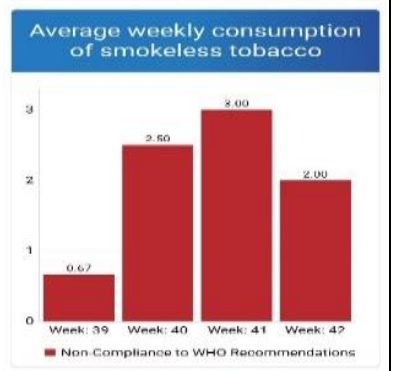
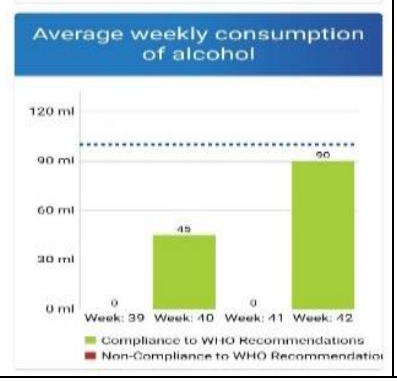
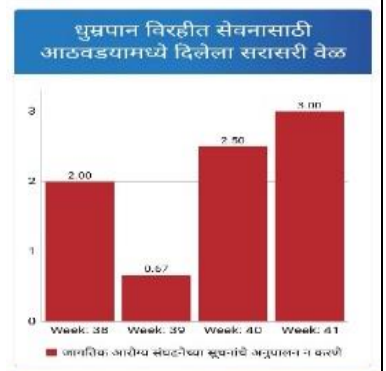
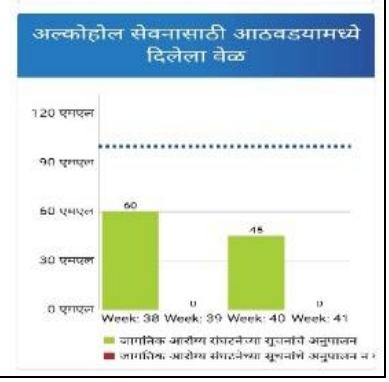
Physical Activity			
Addictions	  	  	  

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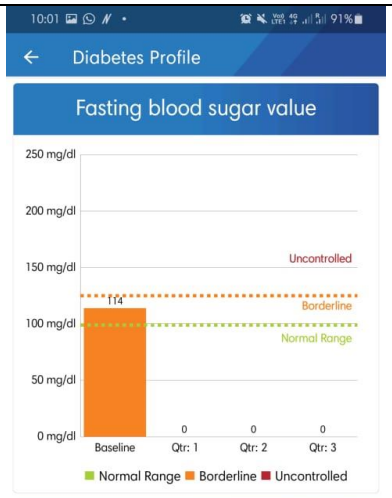
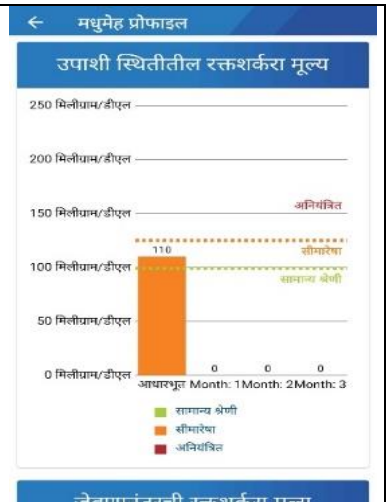
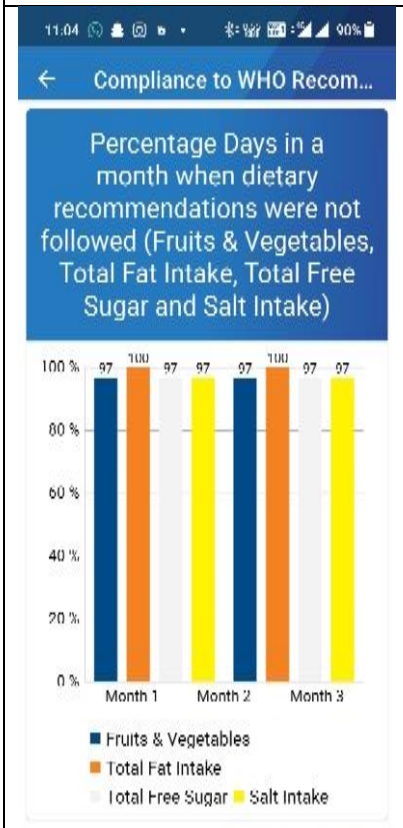
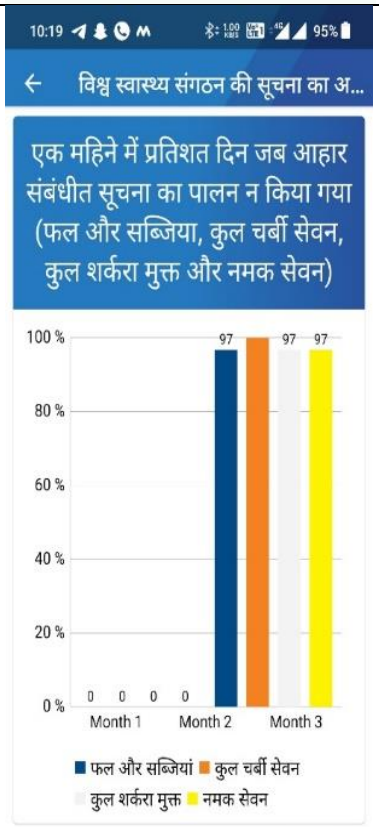
Graph (Monthly) (Diabetes Profile)

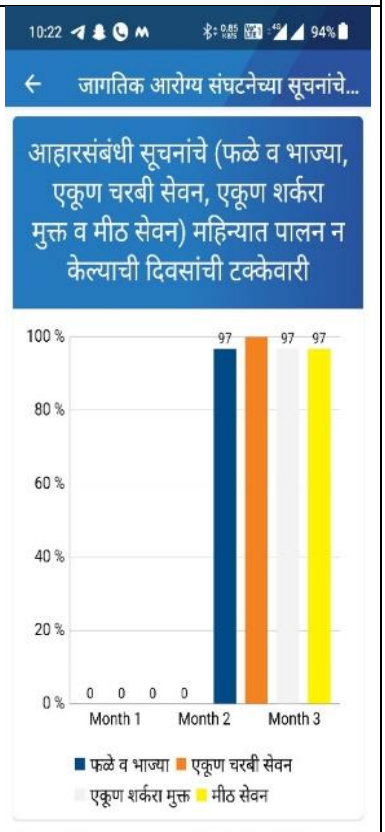
Compliance to WHO Recommendations



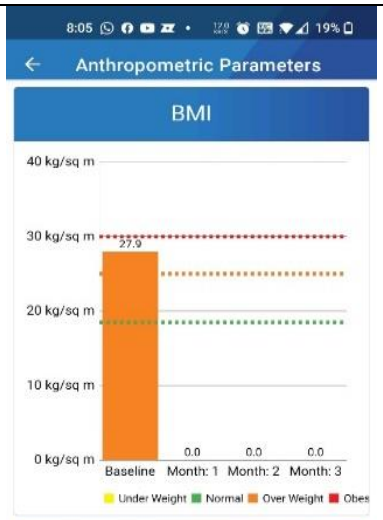
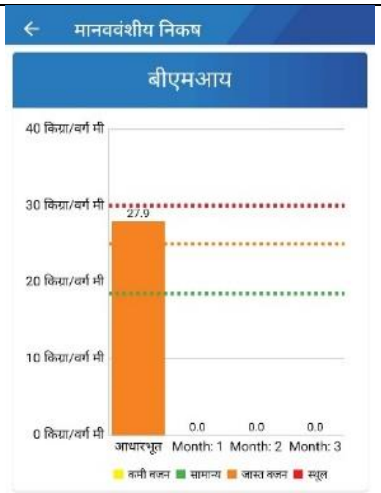
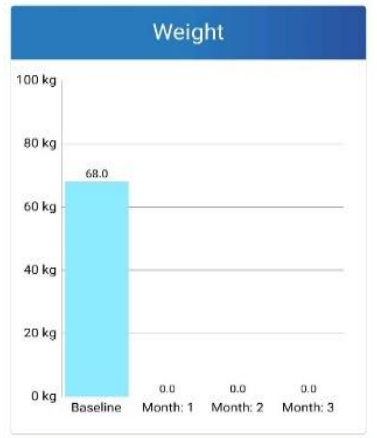
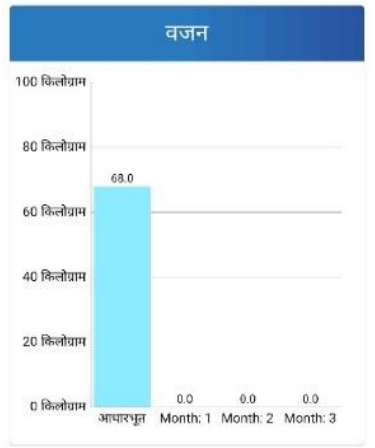
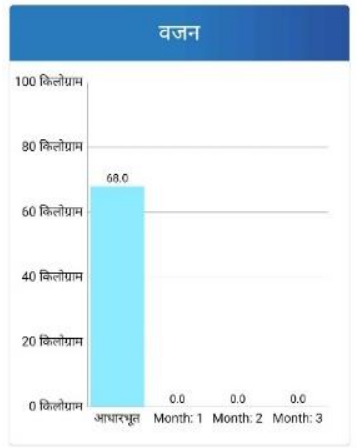
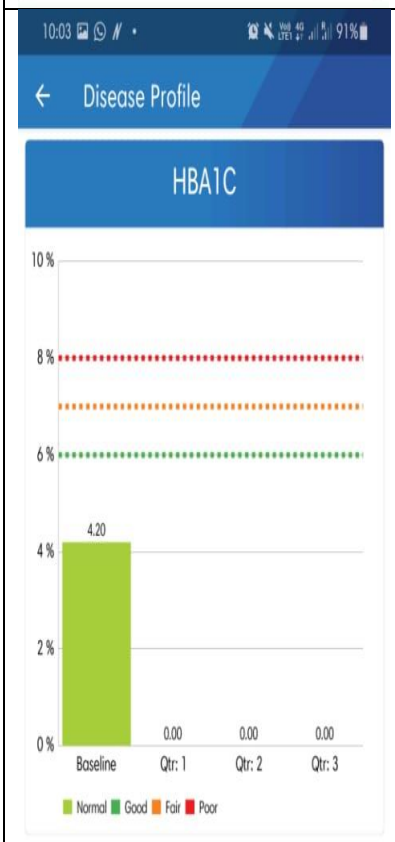
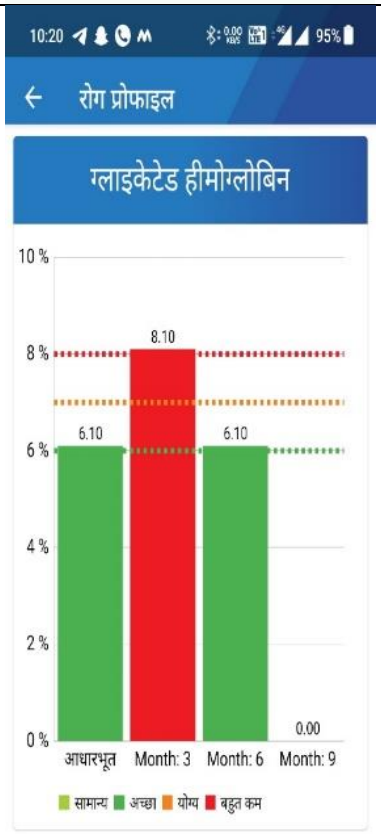
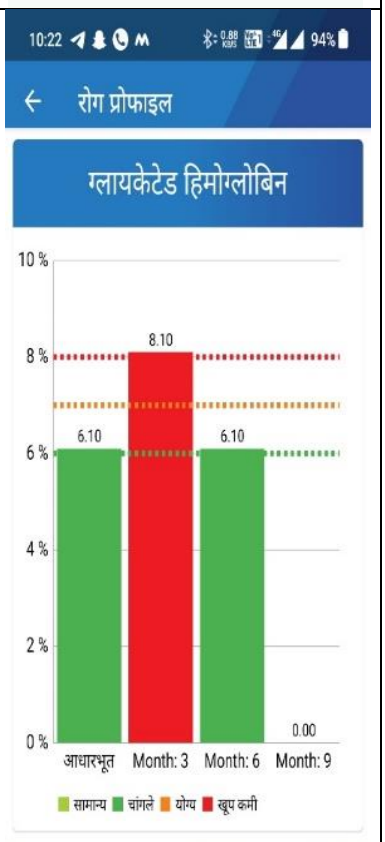








ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN424

Graph (Quarterly) (Anthropometric Parameters)			
Disease Profile			
CVD Profile			
Medication Adherence			

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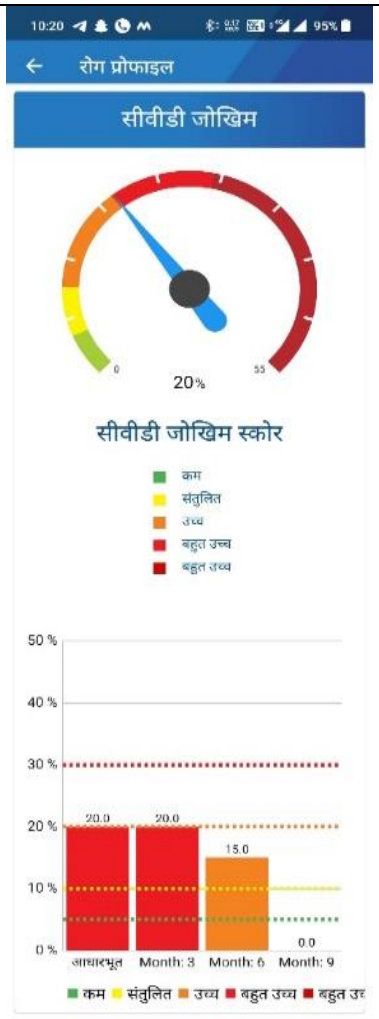

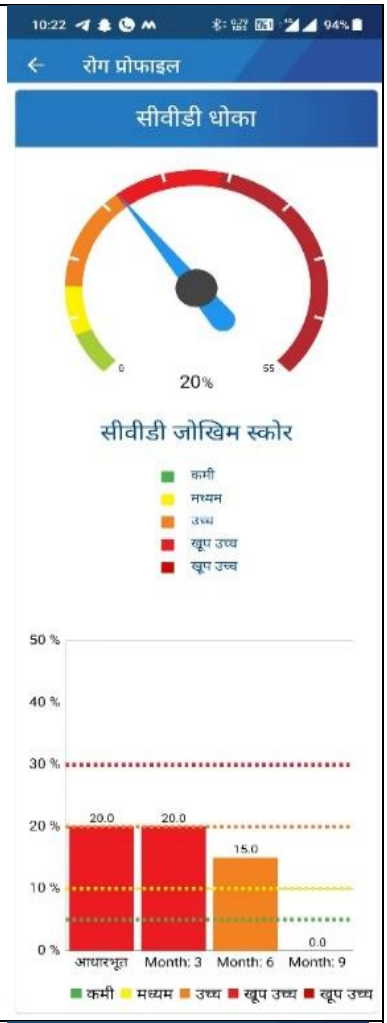

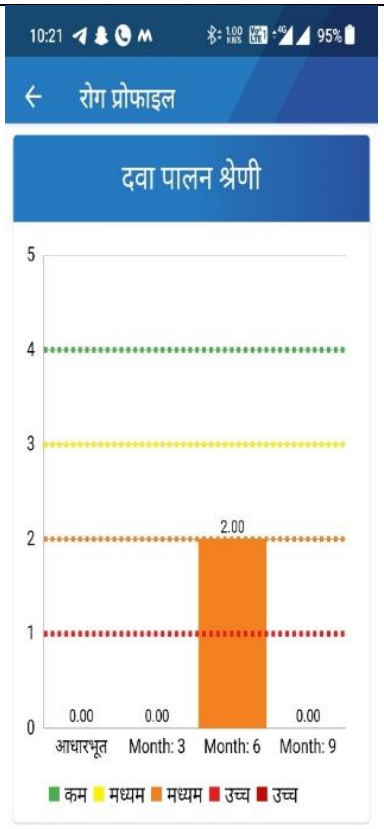

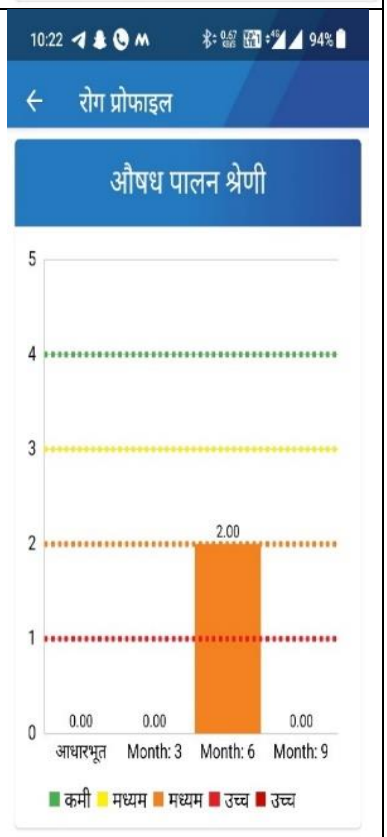

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Table 2 Compliance to WHO Recommendations

Sr. No.	Parameters	Compliance to WHO Recommendations
1	**Diet**	
1A	Total Fruits & Vegetables (gm)	19%
1B	Total Fat Intake (ml)	11%
1C	Free Sugar (teaspoon)	100%
1D	Total Salt Intake (gm)	45%
2	**Physical Activity**	
2A	Vigorous Physical Activity (min)	02%
2B	Moderate Physical Activity (min)	13%
3	**Addictions**	
3A	Smoked Tobacco & Smokeless Tobacco (times)	88%
3B	Alcohol consumption (ml)	96%
4	**CVD Risk Factors**	
4A	Systolic Blood Pressure (mm of hg)	50%
4B	Diastolic Blood Pressure (mm of hg)	42%
4C	HbA1C (%)	25%
4D	Low Density Lipoproteins (mg/dl)	0%
4E	Total Cholesterol (mg/dl)	30%

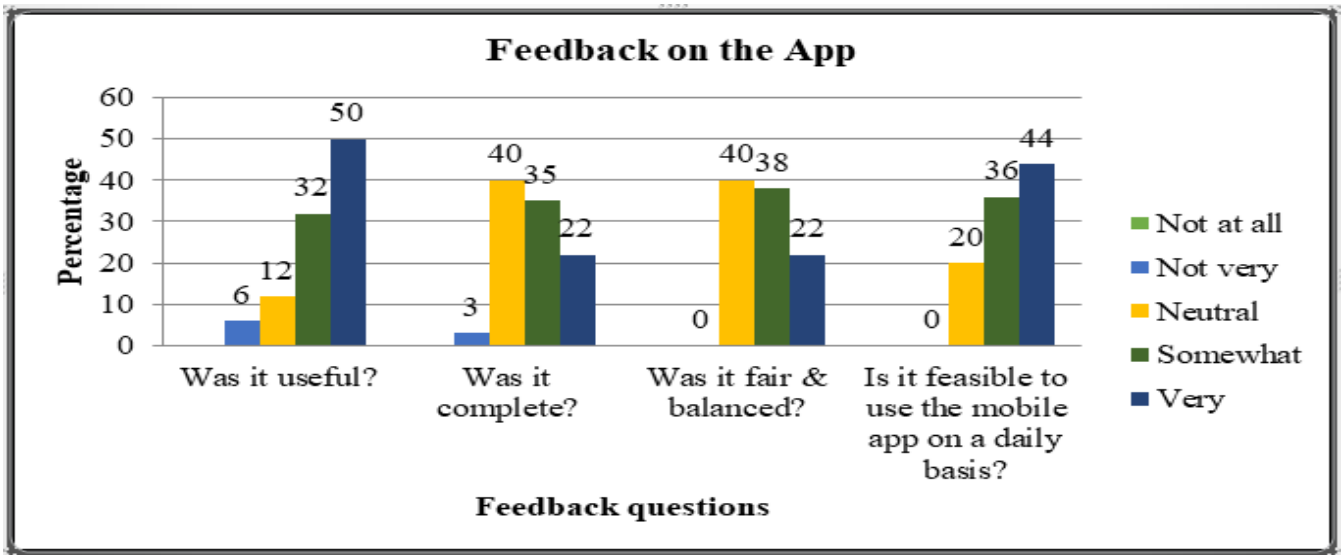

Fig 1 Utility of App for Self-Management and CVD risk reduction

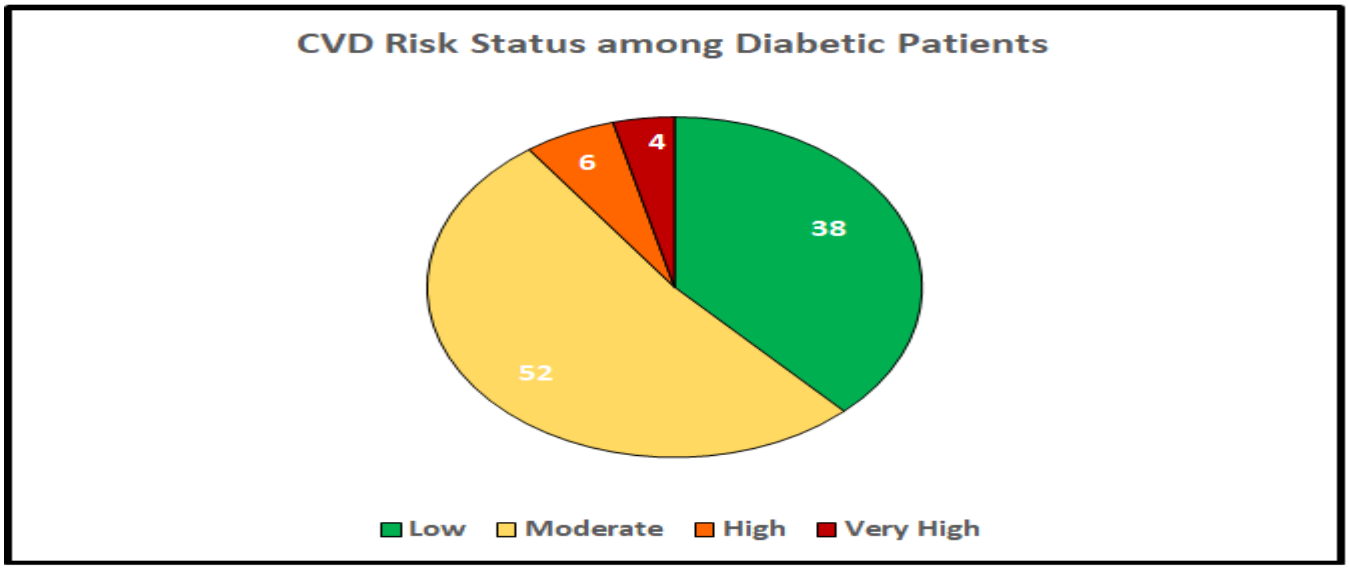

Fig 2 CVD Risk Profile among Mobile App Users

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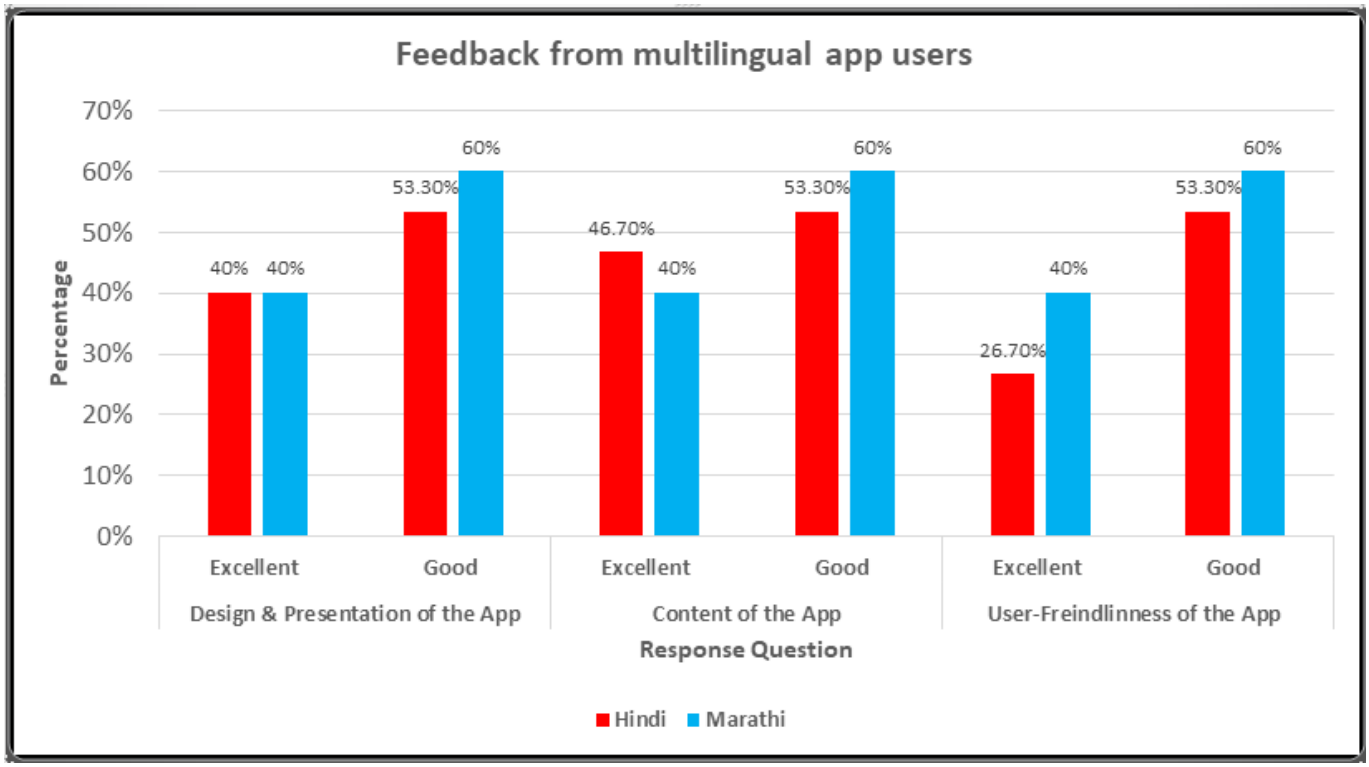

Fig 3 Feedback from Multilingual App Users

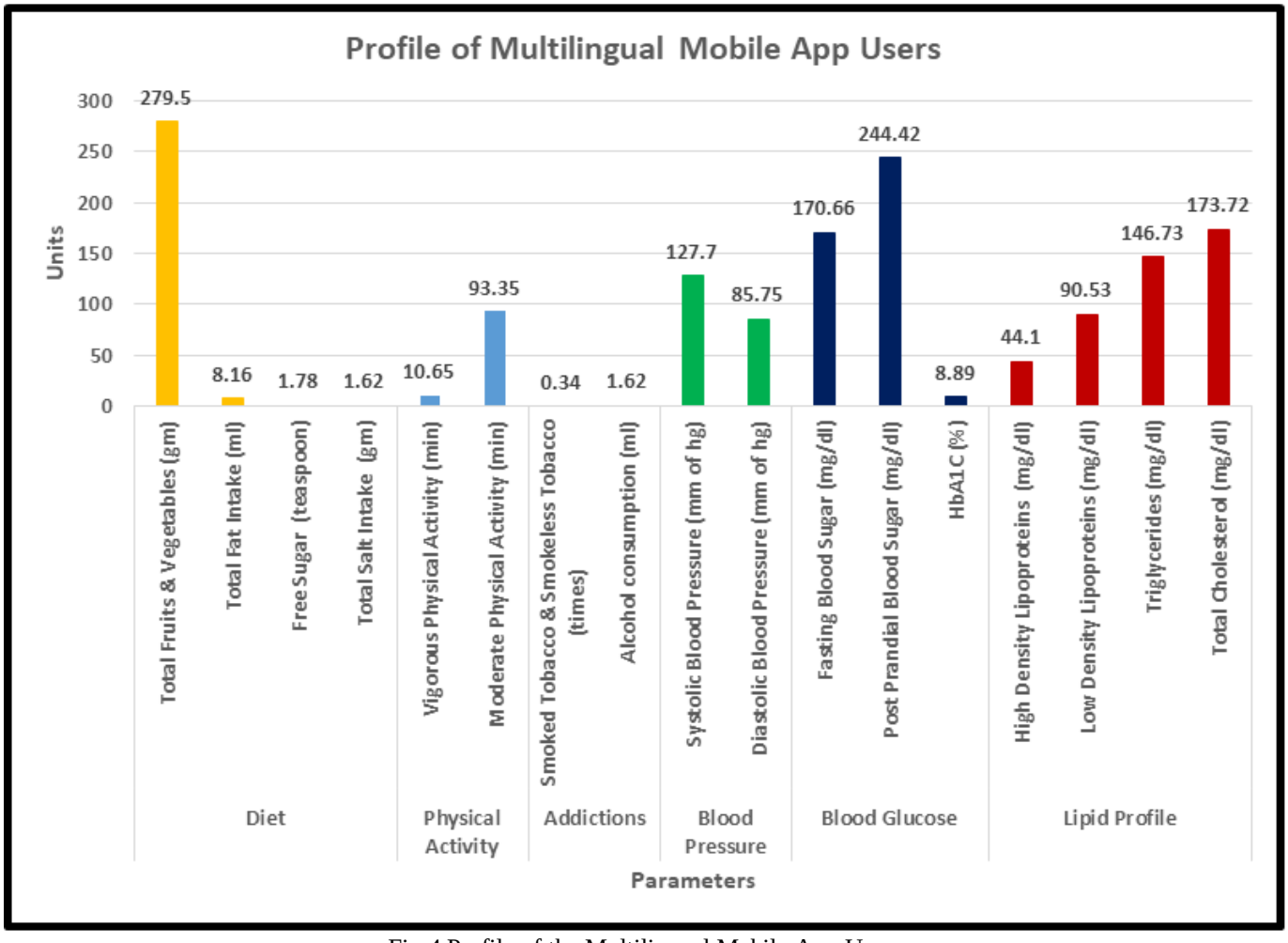

Fig 4 Profile of the Multilingual Mobile App Users

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