DEVELOPMENT AND EVALUATION OF WEB APPLICATION TO MANAGE GESTATIONAL DIABETES AMONG EXPECTANT MOTHER'S

By
Kamei Lanjellu Kabuini
(20PFD013)

Thesis submitted to
Avinashilingam Institute for Home Science and Higher Education for Women
Coimbatore – 641043

In partial Fulfillment of the Requirements for the Degree of Master of Science in
FOOD SERVICE MANAGEMENT AND DIETETICS

May 2022

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Certified as a bonafide Research work

Signature of the Supervisor

Signature of the Head of the Department

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INTRODUCTION

I. INTRODUCTION

"It is health that is real wealth and not pieces of gold and silver"

- Mahatma Gandhi

Being healthy should be an integral part of one's overall lifestyle. Living a healthy lifestyle can aid the prevention of chronic diseases as well as long-term illnesses. Health is at the center of our life. Our lives revolve around our health. Every aspect of our lives depends on us being healthy and free of illness. It is critical to feel good about ourselves and take good care of our health in order to have self-esteem and self-image.

Nutrition is extremely important in our daily lives. Each food or beverage carries specific nutrients that has an impact on our bodies and is essential on our bodies and is essential for physical and mental development. Our bodies require specialized nutrients. As a result, we should know what food we ate, when ate it, what type of food it was, how much we ate, and what type of food it was, how much we ate, and what nutrients it included.

Cardiovascular disorders, cancer, diabetes, and chronic respiratory diseases are among the diseases classified as non-communicable. Noncommunicable illnesses affect 5.87 million people in India, or 60% of the population. Non-communicable diseases, such as cardiovascular disease, chronic respiratory disease, cancer, and diabetes, are mostly responsible for a person's death and morbidity. About 82 percent of deaths are caused by noncommunicable diseases. (World Health Organization, 2014)

Diabetes is a chronic metabolic disorder marked by high blood glucose (or blood sugar) levels, which can cause long-term damage to the heart, blood vessels, eyes, kidneys, and nerves. Each year, nearly 1.5 million people die as a direct result of diabetes. Diabetes affects around 422 million individuals globally. The bulk of diabetes cases were found in low- and middle-income nations. (WHO)

Diabetes has become one of the most significant chronic diseases in today's world, according to Sun et al. (2021). This condition has life-threatening, disabling,

and expensive effects, as well as a shorter life expectancy. The growth in diabetes prevalence has been attributed primarily to population ageing. There are also some major drivers of rising diabetes prevalence, such as reducing diabetes mortality due to improved medical care and increases in diabetes risk factors, particularly obesity.

The study done by Cho *et al.*, (2018) stated that diabetes mellitus is a term used to describe a group of metabolic disorder characterized by excessive blood glucose levels. Diabetic people are more prone to develop a number of severe life-threatening health issues, resulting in greater medical expenses, worse quality of life, and an increased risk of death. Rapid urbanization major shifts toward sedentary lifestyles have exacerbated the rise in diabetic prevalence in many countries and areas.

According to Pappachan (2011), metabolic syndrome (a condition characterized by central obesity, high blood pressure, insulin resistance, and dyslipidemia) has reached pandemic levels in India. In some areas, the prevalence of metabolic syndrome ranges from 23.2 to 41.1 percent. The fundamental predictors of insulin resistance and significant components of metabolic syndrome were abdominal obesity and visceral adiposity.

According to the World Health Organization, there are disorders that affect just women and have negative health consequences that only women experience. Pregnancy and childbirth, for example, are not disorders in and of themselves, but rather normal physiological and social events that involve health hazards and necessitate medical attention. Women's health is important to everyone, not just women. It's also important for the health of the children they'll have.

Gestational diabetes is a well-known and growing health problem among pregnant women around the world. Insulin needs are raised during pregnancy in gestational diabetes due to the presence of insulin antagonists such as human placental lactogen and cortiol, which stimulate lipolysis and limit glucose utilization. If a woman has gestational diabetes, she is more likely to have issues such as premature labor, type 2 diabetes mellitus (T2DM), high blood pressure, and preeclampsia. Additionally, babies born to mothers with gestational diabetes mellitus had an

increased chance of having excess birth weight, respiratory distress, and low blood sugar levels. (Zhang et al., 2017)

Agarwal *et al.,* (2016) stated that gestational diabetes mellitus is diabetes diagnosed in the second or third trimester of pregnancy that is not type 1 or type 2 diabetes. It is also advised that a 75g or 100g oral glucose tolerance test be performed to confirm the diagnosis of gestational diabetes mellitus. Nutritional assessment, clinical risk factor, and dietary assessment can all be used to screen for gestational diabetes mellitus.

According to Morampudi et al., (2017), gestational diabetes is any degree of glucose intolerance that begins or manifests during pregnancy. In India, around 5 million women have gestational diabetes. According to the WINGS program, which is collaboration between the International Diabetes Federation (IDF), the Madras Diabetes Federation, and the Abbott Fund, approximately six million births in India are affected by prediabetes and diabetes, with 90 percent of those affected due to gestational diabetes mellitus.

According to Bapat et al., (2016), various maternal and foetal factors influence the baby's growth. Hypertension, diabetes, malnutrition, and a high-stress lifestyle can all damage the foetus. Apart from all of these factors, mothers' psychological stress, worry, and anxiety can also contribute to bad outcomes. Yoga has been used for ages to alleviate stress and promote health in order to prevent certain lifestyle diseases.

Having a high BMI, which means the individual is overweight, a history of first-degree relatives, a previous macrosomic child, and a history of gestational diabetes mellitus in previous pregnancies are all risk factors for the development of gestational diabetes mellitus. As a result, consuming the recommended amount of dietary fibre was strongly and inversely linked to a lower risk of gestational diabetes mellitus. Pre-pregnancy vigorous physical activity, such as moderate intensity exercises, and continued physical activity during pregnancy may lower a woman's risk of gestational diabetes mellitus. For women with gestational diabetes mellitus, the calorie need is 30-35 kcal/kg for normal weight, 25-30 kcal/kg for overweight women, and 35-40 kcal/kg for underweight women. (Poomalaar*et al.*, 2015)

According to the study done by Jo et.al., (2016), the role of gestational diabetes mellitus treatment is relatively similar to that of diabetes mellitus management, in that both conditions need maintaining a normal blood glucose level. Patients with gestational diabetes and diabetes should know how to engage in self-monitoring, which includes healthy food, physical activity, regular blood glucose monitoring, and taking regular medication. Gestational diabetes mellitus is also withheld after childbirth, unlike other types of diabetes. So, for gestational diabetes mellitus, various activities such as blood glucose self-monitoring, medical nutrition therapy, exercise intervention, and medication must be included for 3-4 months from the time of diagnosis till delivery.

Harrison *et al.,* (2016) stated that usually, the management of gestational diabetes mellitus consists of dietary modifications, and also exercise which is associated with a reduction of glycated hemoglobin. An exercise training of 150 minutes at a moderate intensity will enhance gestational diabetes mellitus among pregnant women. Exercise is recommended both for complicated pregnancies.

According to Dhingra *et al.,* (2016) certain types of exercise that is reported to be safe during pregnancy are low impact aerobic exercises, progressive resistive strengthening, stretching exercise, yoga, water exercise, walking, jogging, treadmills, aerobic dance, etc. and those exercise include are basketball, horseback riding, gymnastic, scuba diving, skipping, hopping etc.

According to Bain *et al.* (2015). Regular aerobic exercise decreases fasting and postprandial blood glucose concentrations in secondary people. During and after an exercise session, exercise may assist lower circulating glucose levels and insulin levels in the body. Outside of pregnancy, exercise can also lessen the chance of developing type 2 diabetes and postpone its start.

Some of the women tend to avoid exercise due to uncertainty of risk and focus on the ancient practices of Indian science yoga which include mental attitudes, the diet they can followed, and practices of certain yoga technique such as yoga postures (asanas), breathing practices (parayanas), and meditation. (Balaji *et, al.,* 2017)

The study conducted by Overdijikink*et al.,* (2018) stated that the international organisation has defined mhealth as the use of mobile devices for medical and public health reasons. mhealth has been developed to promote a healthy lifestyle, such as diet and weight loss, as well as medical health care, such as diabetes treatment.

Marcolino et al. (2018) state that mhealth is being increasingly used for patient communication, monitoring, and education, as well as reduce the burden of illnesses linked with poverty related disease, enhance access to health care, clinical diagnosis and treatment adherence, and chronic disease management.

Daley *et al.,* (2021) stated that usually Diabetes mellitus during pregnancy is handled in a secondary clinic environment by a multidisciplinary team of diabetologists, obstetricians, expert midwives, and nutritionists. Women typically encounter significant clinic wait periods and several physician contacts. As a result, online apps are one technology solution that is rapidly being encouraged to help patients with self-management and communication.

According to Lee *et al.,* (2016), because of the lack of knowledge, inexperience, or the desire to share their experience with others. Pregnant women often try to seek and collect information about their future or more current pregnancies. Women have been seeking professional guidance and comfort via instant connectivity in order to meet their needs, which include having a healthy pregnancy or a safe birth.

Chen *et al.* (2017) stated that being a woman with diabetic during her pregnancy is challenging. So, they need to thoroughly access information about gestational diabetes mellitus otherwise it will create a high level of stress and anxiety. In order to face the challenges, web applications become one of the parts to lower the health literacy.

The study done by Lee *et al.,* (2016) stated that with the advancements of current technology electronic media such as the internet, social media, and television give fast and accessible access to maturity information, making women reliant on doctors/dietitians.But such technology was not there in the past. So, all pregnancy-

related information must be obtained by pregnant moms from midwives, physicians, acquaintances, or relatives.

Using mhealth expands the facilities for providing assistance to those who have gaps in getting healthcare information, such as poor education, low income, or living in difficult-to-reach areas. People in low socioeconomic status have a higher risk of illness, less resources, and are more likely to suffer chronic health issues such as diabetes. As a result, mhealth is one of the most practical and cost-effective methods of providing nutrition and lifestyle advice. (Greene *et al.,* 2021)

According to Mackillop et al. (2014), women with GDM must be evaluated by a maternal diabetes team as soon as possible, most typically in a hospital setting. The idea of monitoring blood glucose levels at home and sending the results to a health care physician in real time is enticing. Smartphones are used to transport data and run software programmes to interface with health technology services in mhealth, a subgenre of digital health. Since it is becoming more prevalent, evidence has revealed that mhealth has been well established as an intervention to enhance glycemic control in diabetes.

Mhealth, particularly the pregnant app allows for the possibility of providing vast number of health-related information that women could access at their leisure and also following the consultation. Furthermore, because they are the only people who understand how to use mhealth tools, health care professionals play an important role in their implementation and efficacy. Because the majority of women are unfamiliar with the use of mobile phone apps. (Holme*et al.,* 2018)

With the advent of web applications, a vast number of health-related web applications have been developed and are non-being widely used to tackle health problems. There are more than 100,000 websites falling into the health fitness or medical category.

A website is a collection of software applications that serve a certain function. Texts, photos, and videos may all be presented on the internet thanks to a web. As a result, websites are created in such a way that people are aware of the services and

have the opportunity to actively participate in public affairs. When it comes to creating a successful online platform, the user must be able to navigate easily.

Websites have become increasingly popular and useful to consumers in recent years. In general, using websites to give treatments such as goal setting, incorporating evidence-based behaviour modification strategies, self-monitoring, and personally customised feedback, and providing periodic summaries has been associated with increased efficacy. Furthermore, this website would assist expecting mothers in reducing their reliance on doctors/dietitians for nutritional and lifestyle advice. Dietitians can also utilise this web tool for simple counselling.

Taking into account the above facts the study was design with the following objectives:

- To develop a web application for expectant mothers.
- To educate and encourage expectant mothers to lead a healthy lifestyle with the help of the developed web application.
- To find out impact of using the web application.

REVIEW OF LITERATURE

II REVIEW OF LITERATURE

Review of literature pertaining to study "**Development and Evaluation of Web Application to Manage Gestational Diabetes among Expectant Mother"** is discussed under the following headings

A. Global scenario of gestational diabetes

B. Causes, risk factors and management of gestational diabetes

C. Pregnancy related health apps for expectant mothers

A. GLOBAL SCENARIO OF GESTATIONAL DIABETES

World-wide:

According to Zhu *et al.,* (2019), Gestational diabetes mellitus that may be imposed as the sevenfold increased risk of type 2 in later life. So, in overall estimation, the Middle East and North Africa had the highest prevalence, followed by Southeast Asia, western Pacific, South, and Central America, Africa, and North America, and the Caribbean and Europe had the least prevalence.

A statement released by Diabetes Australia reports that almost 41,000 Australian women were diagnosed with GDM. This rapid increase in the prevalence is because of the high variability based on ethnic representation, obesity rates, and maternal age. Half of the women in Australia are overweight and obese. Increased rates of GDM carry a burden both physically and emotionally for the affected women themselves. (Laurie *et al.,* 2020)

The study done by Macaulay *et al.,* (2014) shows that women affected by GDM pose a risk for the need for cesarean section due to fetal macrosomia. This occurred due to the accelerated fetal growth felled by maternal hyperglycemia. About 95% of the GDM cases return to normal after the delivery of the baby. Africa has been plagued with undernutrition and GDM may not be considered a public health concern.

Over the years GDM is expected to increase over years, especially in Asia. This may be because of the increase in maternal age and obesity. The prevalence of GDM by country was highest in Taiwan followed by Hong Kong and Saudi Arabia and the lowest prevalence was by Nepal followed by Japan. The meta-analysis found that the odds of GDM were increased by history of previous GDM. (Lee *et al.*, 2018)

Using the WHO criteria, consistent associations were seen for macrosomia, large for gestational age, perinatal mortality, preeclampsia, and cesarean delivery. The WHO and the IADPSG (International Association of Diabetes in Pregnancy Study Group) criteria for GDM identified women at a small increased risk for adverse pregnancy outcomes. However, high inconsistency was seen for those with the IADPSG criteria. (Wendland *et al.*, 2012)

According to Hirst *et al.*, (2012), in China the prevalence of GDM is rising with similar trends noted in India and other low-income countries. Tight blood glucose regulation largely ameliorates the adverse outcomes associated with GDM. From the study, it was also demonstrated a lack of health literacy and knowledge of GDM in Vietnamese women. Lack of knowledge resulted in women with GDM feeling anxiety and concern about the diagnosis.

In the study done by Kangur*et al., (*2014) An estimated 30-50 percent of women with previous history of GDM develop it again in subsequent pregnancies, and within 5-10 years, 50 percent of these women will develop type 2 DM. Currently, it is estimated that 28 million women of reproductive age suffer from DM worldwide. Majority of these women have type 2 DM, and 80 percent is found in low-income and middle-income countries.

GDM has been found to be more prevalent in urban areas than in rural areas. Chances of having diabetes in children are about 6 percent when the father is diabetic, it raises to 20 percent if both the parents are diabetic. GDM affects the health of the women, the fetus, and even after birth, the baby or child. Due to the uncertainty of risks and benefits of exercise during pregnancy, women tend to avoid exercise. (Varne*et al.*, 2017)

India

According to Raja *et al.,* (2014), Moderate to severe maternal hyperglycemia in pregnancy has unique diabetes-related risks in those potential long-term consequences. It is needed to give immediate attention in terms of prevention and health education since there is an increasing prevalence of gestational diabetes mellitus and its co-morbidities among females.

The study compiles data regarding the prevalence of GDM from western Rajasthan. It includes pregnant women at the 24th-28th week of gestation, while all patients with h/o of diabetes mellitus prior to the onset of pregnancy, major chronic diseases like carcinoma, tuberculosis, congestive cardiac failure, renal failure. The most common complications seen in GDM mothers were gestational hypertension followed by vaginal candidiasis, premature rupture of membranes, and abruption of placentae.(Kalra *et.al.,* 2013)

The study done by Wahi*et al.,* (2011) was a hospital-based, which was undertaken in the Jammu region. So, it was revealed that the most common complications seen in GDM mothers were gestational hypertension followed by postpartum haemorrhage abortion and premature rupture of membranes. 22.58% of non-intervention GDM ladies delivered via cesarean section while only 8.5% of treatment GDM ladies delivered via cesarean section.

According to Rajput *et al.,* (2011), GDM rate increased with increasing educational qualifications of the participants with the highest being in graduate and above. Women with upper class have the highest prevalence of GDM. The prevalence of GDM increased with increasing age. A family history of diabetes has been reported to be associated with higher chances of developing GDM.

The overall prevalence is approximately 7% higher in urban vs rural areas, among older age groups, and among the higher socioeconomic status group. The age-adjusted prevalence of gestational diabetes was highest in the southern stated of Telangana and Kerala, respectively. Several stated from the north and northeast regions had rates of GD in the lowest quartile, including Meghalaya, Rajasthan, Himachal Pradesh, Manipur, Assam, and Mizoram. (Swaminathan *et al.,* 2020)

The study done by Bhat *et al.,* (2010) stated that patients were monitored with Glucose Challenge T est (GCT) at 24 - 28 weeks and 32-34 weeks. If the GCT was positive, a gestational diabetes status was confirmed with the oral Glucose Tolerance Test. The risk factors that were assessed included sociodemographic characteristics, menstrual history, obstetric history, history of infertility, family history of diabetes in first degree relatives, recurrent UTI, moniliasis, and premature labour pains.

According to Rajput *et al.,* (2014) the prevalence of GDM is high in the Indian population as compared to other populations of southeast Asia. It was found that maternal age >25years, hypertension, history of macrosomic baby, and family history of diabetes were found to have an independent association with prevalence of GDM. Education, socioeconomic status, past history of abortion, stillbirth, the birth of a baby with congenital anomaly, history of previous GDM, and cesarean section were not related to GDM.

Hyperglycemia in pregnancy is highest in women over the age of 45 and rises rapidly with age. Hyperglycemia becomes more relevant during pregnancy because Indian women are 11 times at risk of developing GDM in contrast to other regions. Pre-pregnancy counselling and multidisciplinary team management is the key to achieve good pregnancy outcomes. (Hussain *et al.,* 2020)

The study done by Unnikrishnan *et al.,* (2020) highlighted that the mean age of GDM is 29.30. The risk of having GDM was detected to be higher in women from rural areas with lower socioeconomic status. Pregnancy induces hypertension showed as association with GDM as did polyhydramnios and oligohydramnios during initial months of pregnancy. The risk factor for GDM based on history of previous pregnancies, gap between pregnancies showed that women having <2 years spacing between pregnancies had a significantly higher risk of developing GDM.

According to Dwarkanath*et al.,* (2019) the high prevalence of vitamin D deficiency in developing countries, especially in Indian pregnant women, and evidence that vitamin D supplementation in gestational diabetes patients had beneficial effects on fasting plasma glucose and serum insulin level. 81.5 percent of the women had plasma vitamin D concentrations that would classify them to be

“insufficient” and about 50 percent of the women diagnosed to have GDM had vitamin D concentrations.

The study done by Balaji *et al.,* (2011) stated that in India more than 70 percent of the population live in rural settings, and facilities for diagnosing diabetes itself are limited. In this scenario, performing OGTT recommended by other associations to diagnose GDM is not possible. Most importantly detection and care of GDM have become a public health priority as the stillbirth rate is high in India and one of the causes is gestational diabetes mellitus.

Study done by Seshiah*et al.,* 2020 showed that it has become necessary that all pregnant women should be screened for GDM, even if they have no symptoms. Pregnant women are at no greater risk of becoming seriously unwell than other healthy adults if they develop coronavirus. Hence even in the period of this pandemic of COVID-19, appropriate advice can be provided to GDM women by personal contact or using telephonic communication or other technological methods.

According to Rani *et al.,* (2016) high prevalence of DM and genetic predisposition to metabolic syndrome among Asians, particularly in Indian women, predisposes women to develop GDM and its complications. The high rate implies that the Indian population has a higher incidence of DM and impaired glucose tolerance and is at a greater risk of developing GDM. Screening and diagnosis of GDM and treating it effectively not only prevent adverse maternal and perinatal outcomes but also futurediabetes in both mother and child.

This study done by Goyal *et al.,* (2019) shows high rates of concordance for glycaemic and cardiometabolic variables between women with a history of GDM and their spouses. Approximately one in three couples showed concordance for dysglycaemia, while around one in two couples and one in four couples were concordant for overweight/obesity and metabolic syndrome, respectively.

The odds of having GDM were almost 3 times higher in multigravida as compared to primigravida prevalence of GDM was also significantly associated with increasing age, past history of abortion, past history of macrosomic baby, and parity.

The prevalence of GDM is rising and it is important to diagnose it as early as possible to prevent maternal and fetal complications. (Gohel*et al.,* 2021)

Tamil Nadu

In study was conducted in urban, semi urban, and rural areas of South India (Tamil Nadu). The prevalence of GDM was significantly lower in rural areas. The highest prevalence was observed in the age group of 30-34 years. Also, among the women, BMI with > 25 kg/m^2 has the highest prevalence. Physical inactive group has found to be highest prevalence of GDM and it's the urban areas. (Seshiah*et al.,* 2008)

A study done by Bhavadharinial., *et al.,* (2016) in PHC of Kancheepuram district Chennai city in Tamil Nadu shows that the prevalence rates of GDM were not significantly different between urban and rural areas both using IADPSG criteria and WHO 1999 criteria after correcting for the confounders. The $HbA_{1c,}$ previous history of GDM, family history of diabetes and age were significantly associated with GDM. The prevalence of GDM in Tamil Nadu was found to be 15.7% by IADPSG criteria and 10.5% using the WHO 1000 criteria.

According to Rajasekar *et al.,* (2019), GDM would be diagnosed at first visit by either HBA1c > 6.5 percent or fasting blood glucose > 92mg/dl. Those who tested normal would again undergo testing between 24 to 28 weeks with oral glucose tolerance test (OGTT) with 75g of glucose. From the study, it appeared that women without GDM were more physically active than those with GDM but was not significant.

A prospective study that was conducted in the rural area of Tamil Nadu, to find out the prevalence of GDM among pregnant women registered in primary health center. The prevalence of GDM in the study was found to be 3.8 percent also it has shown that the risk of GDM increases with age which is statistically significant. Gestational diabetes mellitus was found to be significantly higher in women with higher BMI. (Arulmani *et al.,* 2016)

A study done by Padmanabham*et al.,* (2019) in a community base study in Tamil Nadu under the DIPAP -Diabetes in Pregnancy Awareness and Prevention Project the overall prevalence of GDM was 13.9 percent. Energy requirement during

pregnancy comprises the normal requirement for an adult woman and an additional requirement for foetal growth plus the associated increase in body weight during pregnancy. Diet should come from a normal varied diet and not from commercial high protein supplements.

According to the study done by Vareed*et al.,* (2017) the prevalence of GDM was found to be 11.9 percent. The prevalence of GDM is more in women of age group of 25 - 31 years. Incidence of maternal complications was higher in non-GDM women 63 (52.9 percent). The prevalence of low birth weight was 1 (6.2 percent) in GDM women and prevalence of low-birth-weight baby in non-diabetic women was 24.

B. CAUSES, RISK FACTORS, AND MANAGEMENT OF GESTATIONAL DIABETES

According to Petitt*et al.,* (2017) the prevalence of GDM was higher in women who were in the lower birth weight category. Type 2 diabetes is being found increasingly in younger members of other populations as well. GDM, Since, it is a condition of women of childbearing age, also develops at a relatively young age. One reason may be that for young people today, a large birth weight was more likely due to an abnormality during pregnancy.

From the study conducted by Lee *et al.,* (2017) when compared to women without GDM in the second pregnancy, women who developed GDM in the second pregnancy were more likely to be older, have had multiple pregnancies, undergone a prior caesarean section, and had a significant time interval between their two pregnancies. Women with GDM in the second pregnancy had higher rates of prior preeclampsia and GDM in the first pregnancy.

In all pregnancies, women with polycystic ovarian syndrome (PCOS) were more likely to develop gestational diabetes pregnancy-associated hypertension, gestational hypertension, pregestational diabetes, thyroid disease, smoking and recreational drug use. In women, pregnant with multiple fetuses, PCOS only conferred a statistically significant increased risk of developing GDM. (Mills *et al.,* 2020)

According to Poomalar*et al.,* (2015) less dietary intake has been associated positively with GDM. There is no adverse effect on maternal and fetal on women who engaged in mild and moderate physical activities. Probiotic use in pregnancy could significantly reduce maternal fasting glucose levels and also there is a significant decrease in the incidence of GDM and pre-eclampsia rates. For women who had GDM in the first pregnancy, there is 2fold increased risk of developing GDM during the second pregnancy.

In the study conducted by Denice *et al.,* (2008) it was found that diabetes developed within 9 years after the index pregnancy of women with previous gestational diabetes. The rate of development of diabetes was rapid in the first 9 months post-partum and remained relatively constant thereafter. Women with undiagnosed type 2 diabetes in pregnancy had worse perinatal outcomes than women known to have type 2 diabetes. The most significant risk factor for the development of diabetes was previous gestational diabetes.

According to Lee *et al.,* (2017) preeclampsia is most common in the first pregnancy. Since preeclampsia increases the risk of GDM in the subsequent pregnancy, women with a history of preeclampsia should also be screened for type 2 DM and GDM earlier than the regular screening schedule that calls for testing between the 24^{th} and 28^{th} weeks. The increased incidence of GDM might reflect or contribute to the ongoing pattern of increasing rate of pregnant women with risk factor for GDM such as old age and obesity.

Vitamin D supplementation in pregnant women with low levels of vitamin D cannot prevent the incidence of gestational diabetes. Vitamin D supplements are associated with a decreased risk of GDM. There is an inverse relationship between circulating vitamin D levels and markers of glucose homeostasis associated with gestational diabetes or an increased risk for GDM associated with reduced maternal levels of vitamin D between 24 and 30 weeks of gestation. (Tehrani *et. al.,* 2017)

According to Cai *et al.,* (2017) stated that based on (Glucose Tolerance Test) OGTT result, the absolute frequency of GDM was highest in women who reported sleeping <6h per night and lowest in women with 7-7.99 h of sleep per night. Poorer sleep quality in diabetic patients has been associated with higher levels of hemoglobin

A1c, a marker reflecting increased blood glucose levels, after adjusting for age, sex and BMI.

The study conducted by Schneider *et al.,* (2010) stated that women with lower social status, migrants and occasional smokers were more likely to suffer from GDM. Smoking by inhibiting insulin resistance-related inflammatory activity, could diminish hyperglycemia. Nicotine consumption is known to inhibit fetal growth. Multiple birth pregnancies are characterised by higher levels of insulin antagonistic hormone.

GDM had been diagnosed at a mean of 30 weeks of gestation. The women with GDM had higher BMI. The presence of chronic HTN increases the risk of developing HTN. Most of the death here occurred in neonates with birth weight which was less than average for gestational age. It appears that addressing the causes of low birth weight rather than intensively treating diabetes will reduce mortality in women. (Prakash *et al.,* 2017)

Polycystic ovary syndrome has multiple reproductive manifestations, including infertility and adverse metabolic outcomes both in and out of pregnancy. It was demonstrated that women with PCOS were at almost three times higher risk of developing gestational diabetes, and were three to four times more likely to develop GHTN and PEC. PCOS had a lower fecundity rate over their lifetime and gave birth to fewer children than women without PCOS. (Mills *et. al.,* 2020)

The study done by Farrar *et al.,* (2017) stated that factor screening involves the assessment of maternal characteristics, such as family history of diabetes, being of an ethnicity with a high prevalence of diabetes, history of having GDM or macrosomic infant, maternal obesity and occasionally biochemical markers. Regardless of the methods used, correctly identifying most women with GDM, requires an OGTT to the majority of women.

The WHO recommended the OGTT for diagnosis of DM in non-pregnant adults using 2 values: fasting plasma glucose and the 2-h plasma glucose levels after 75g of oral glucose. WHO has divided hyperglycemia in pregnancy as follows:

Diabetes in pregnancy; Pre-gestational diabetes, and overt diabetes - diabetes first detected during pregnancy and Gestational diabetes mellitus. (Agarwal *et al.*, 2015)

According to Balut *et al.,* (2017) GDM can reduce with an early-moderate nutritional intervention based on the supplementation of the Med Diet with an increased intake of Extra Virgin Olive Oil (EVOO) and pistachios. Increased EVOO and pistachio consumption were clearly beneficial. EVOO is a rich source of monounsaturated fatty acids and has been found to lower postprandial glucose levels as well as to improve the inflammatory profile.

Ma *et al.,* (2018) stated that among women with prior GDM, a reduced possibility of progression to T2DM was found in women with longer breastfeeding of any intensity. Compared with women with shorter breastfeed, those with longer breastfeed manifested more favorable metabolic parameters, including lower BMI, fasting glucose, triglycerides.

The study done by Ou Yang *et al.,* (2021) stated that anxiety, depression, and other negative emotional stated can cause imbalances in the body's hormone levels and increase blood sugar, which will have adverse effects on pregnant women with GDM. Studies found that HbA1c in pregnant women with GDM in the anxiety group was significantly higher than that in the control group and the level of HbA1c was positively correlated with anxiety and depression scores in pregnant women with GDM.

According to Gui *et.al.,* (2013) metformin reduces hyperglycemia by suppressing hepatic glucose output, increasing insulin sensitivity and enhancing peripheral glucose uptake. These effects are potentially useful during pregnancy when glucose control deteriorates with changes to insulin resistance. neonatal outcomes don't deteriorate with the use of metformin. Metformin inhibits hepatic gluconeogenesis and glucose absorption and stimulates glucose uptake in peripheral tissues, with the effect of reducing weight gain.

The study done by Tieu *et al.,* (2014) stated that even with screening protocols in place, GDM is diagnosed at the end of the second trimester or early third trimester based on physiology. Without screening, the diagnosis of GDM, and therefore

treatment, is potentially delayed. Screening for GDM is often implemented despite the uncertainty of its utility.

Caloric requirements and optimal weight gain for women with GDM has been limited. If a caloric restriction is necessary, it must be controlled because food restriction during pregnancy leads rapidly to a predominantly fat-utilizing and glucose-sparing metabolic state. Sugar alcohols and non-caloric sweeteners are safe for women during pregnancy when consumed within the acceptable daily intake levels established by the Food and Drug Administration. (Castilla *et al.,* 2016)

According to Seshiah *et al.,* (2020) all pregnant women who test positive for GDM for the first time should be started on MNT and physical exercise for 2 weeks. Women should walk/exercise for 30 min or perform household work. Women with normal BMI (19.8-26.0 kg/m^2) have been recommended to gain a total of 11.4-15.9 kg; for the ones who are overweight (BMI 26.1-29.0 kg/m^2), the weight gain recommendation is 6.8-11.4 kg, whereas obese women with a BMI > 29 kg/m^2 are permitted weight gain only up until 7 kg.

The study done by Pandayachee *et al.,* (2015) stated that exercise decreased lower back pain in pregnant women also improve cardiovascular function such as fitness, blood pressure and peripheral edema. Preeclampsia has also been showing to decrease with an increase in physical activity. Recreational physical activity is encouraged and has been shown to improve general wellbeing, pregnancy outcomes. High-intensity short duration interval training has been shown to be safe during pregnancy.

Women with GDM who lead an active lifestyle should be encouraged to continue a program of exercise approved for pregnancy. Planned physical activity of 30 minutes/day is recommended. Advising GDM patients to walk briskly or do arm exercise while seated in a chair for at least 10 minutes after each meal accomplishes this goal. A six weeks ergometry exercise program was successful in normalizing fasted plasma glucose concentrations and glycosylated hemoglobin. (Mottola *et al.,* 2007)

From the study conducted by Wang *et al.,* (2016) stated that women with diabetes who are planning pregnancy and those using insulin should control their hemoglobin A1c (HbA1c) levels at <6.5% and <7.0%, respectively, to prevent hyperglycemia. For women without contraindications to exercise, an accumulated time for moderate exercise of ≥30 min on most, if not all, days of the week (at least 150 min/week) is needed during pregnancy and the postpartum period.

According to Abirami *et al.,* (2015) yoga has 5 vital tools (yoga exercises, Breathing Exercises or Pranayama, Mudras, meditation, and deep relaxation) for pregnancy. It improves the well-being of antenatal mothers and increases the chances of normal pregnancy and delivery. these exercises are helpful in carbohydrate metabolism by absorbing excessive glucose, thereby reducing the blood sugar level.

The level of stress was considerably lowered and the quality of life was greatly improved following the shirt-course practice of yoga in GDM patients. With seven to ten days of yoga practice, blood glucose, heart rate, blood pressure were substantially reduced in GDM women. Quality of life assesses in GDM in this study with three months of yoga intervention reported increased a higher quality of life with intervention. (Renugasundari *et al.,* 2021)

C. PREGNANCY HEALTH-RELATED APPS FOR EXPECTANT MOTHERS

According to Hughson *et al.,* (2018) the provision of digital technologies such as website is fast becoming practice in health services, steps must be taken to ensure that these resources are fit to purpose. Consideration should be given to include different types of users, including those with higher or lower education levels and literacy as well as to address cultural, social and educational barriers to effective use of resources. Half of the women were willing to participate in a computer-based intervention.

The study conducted by Musgrave *et al.,* (2020) stated that Pregnant women are increasingly turning to mobile health to receive health information and support rather than relying on face-to-face and paper base delivery methods. Health behaviours such as maternal awareness of decreased fetal movements, maintaining a healthy weight in pregnancy and breastfeeding are modifiable behaviours with known benefits for both mothers and babies.

According to Frid *et al.,* (2020) internet use during pregnancy is common. Due to the number of apps available to pregnant women, knowing what apps are available, how to select among them. And what information and features women are seeking is important. The most common app-specific features were contraction timers journaling/photo uploads, and appointment trackers, checklists and calendars. The least common were tools for obtaining safety information and health/fitness, despite being common reasons pregnant women seek out apps.

Mobile phone web presented a unique opportunity to connect teens to contraceptive information and sex education, behaviour change interventions and reproductive health services that could not be achieved previously. (Chen *et al.*, 2016)

According to Mackillop *et al.,* (2014) women with GDM provide a compelling scenario for telehealth solutions as they are young and generally technically literate; they are usually highly motivated to engage with health care professionals and improve their health to nurture their growing fetus. Finally, for women with mild GDM, the frequent clinic visits are entirely for the review of Blood Glucose (BG) measurements, and therefore there is scope to reduce the number of outpatient clinic appointments and provide a cost saving to both patients and the health care system.

The development and implementation of technology-assisted dietary assessment, including, for example the use of websites, mobile phone cameras, and mobile apps to log food intake, is proving to be an alternative to these traditional methods. Such technologies in healthy populations are being shown to reduce costs, improve completion rates, and increase the accuracy of the dietary assessment. (Gianfranceso *et al.,* 2018)

The study done by Su *et al.,* (2021) stated that the development of the nurse-led web-based health management program was guided by discussion with an obstetrician, gynecologist, dietitian, sports coach, nurse, and information technology engineer. The intervention group had significantly improved TG levels, significant difference was also noted in diastolic blood pressure, the difference was in the normal range and was not deemed clinically significant.

According to Dijk *et al.,* (2021) in order to translate the scientific evidence currently available into accessible periconception care, various barriers need to be overcome. These barriers include the lack of intrinsic motivation for changing lifestyle in the target population; low levels of awareness; and a lack of clarity regarding responsibility, organization, and costs. One way of overcoming some of these barriers is to make use of recent developments in electronic health (eHealth)

Young women in their reproductive years are frequent users of internet, social media, and smartphone apps. The internet is ever more utilized for the search of health information on prenatal, perinatal, and postnatal topics. The effect on health is the most important issue to address in the effective implementation of eHealth in perinatal care. Pregnancies with GDM are associated with perinatal complications such as caesarean section, shoulder dystocia, and neonatal hypoglycemia. (Heuvel *et. al.*, 2018)

The study done by Chan *et al.*, (2019) stated that the use of social media and mHealth apps has been increasing in pregnancy care because of the low cost and easy access regardless of time and geographic location. There was a moderate effect in maternal weight control and maintaining optimal body composition by promoting lifestyle change and self-monitoring. GDM control also relies on self-monitoring the change of unhealthy lifestyle and listening to clinical decisions, and patient compliance is particularly important.

The study done by Goetz *et al.,* (2017) stated that the use of eHealth during pregnancy showed that most participants trusted web-based information. Mothers of young children mainly accessed commercial websites for health information. Most women regardless of age and health status, criticized the poor quality of existing web-based information sources and mobile apps. Usability requirements were high and the women stressed the need for a user-friendly interface in web-based applications and mobile apps.

The study done by Kyto *et al.,* (2021) stated that mental effects of GDM revealed “loss of normal pregnancy” as a common theme. To avoid this, the feeling of a normal pregnancy should be supported, and thus features of normal pregnancy apps should be incorporated into GDM apps. It was also revealed that a large body of

research has been and is being performed in the field of pregnancy mHealth and eHealth using apps and web-based platforms.

The study conducted by Ekezie *et al.,* (2021) stated that self-management electronic and mobile health technology-based interventions have shown positive impacts on behaviour change and diabetes control. Most assessments of GDM digital interventions have mainly focused on clinical impact and usability, while information on user experiences is lacking. Providing information that is reliable and actionable through digital services, in addition to knowledge gaps, barriers to diabetes prevention.

According to Surendran *et al.,* (2021) the usage frequency of the application's components varied greatly among the users. Tracking diet was the least commonly used component. On the contrary, the weight tracking component was the most used due to its ease of use. Educational lessons in the mHealth application have a key advantage as they provide vast quantities of health-related information.

In addition, the of study sites was a limitation to Web-based education due to lack of or poor remoteness access to the Web. Technological problems such as poor reception, lost and damaged phones, and difficulty with certain mobile phone models were also identified. mHealth interventions that are dependent on existing information systems, with modular systems that are not interoperable, cannot be linked to other settings and data structures. (Coleman *et al.,* 2016)

The study done by Dansharif *et al.,* (2020) stated that women in low-resource settings are aware of mHealth tools for self-management and are also open to using these technologies for self-management during pregnancy. The perceived benefits of self-management mHealth tools during pregnancy are in line with the benefits of self-management apps identified in the literature which includes improved healthcare. While it is possible that maintaining a healthy lifestyle could create fewer complications and less need to visit the hospital except during an appointment.

According to Edward *et al.,* (2021) mobile health interventions can offer the advantage of being low cost, tailored to individual needs and can collect and relay data to healthcare professionals. Studies have found pregnant women commonly use

their smartphones to access information to help them prepare for birth, share experiences and seek support with others via social media. An mHealth economics report found that apps for diabetes were one of the strongest markets within digital health innovation.

Mobile app for self-management of type 2 diabetes is feasible because of high response rate. mHealth play a potential role in diabetes management like text messages showed mixed result on HbA1c levels. Lifestyle apps with a target on improvement of health behaviour, less gestational weight gain, and smoking cessation showed positive result on effectiveness. (Overdijkink *et. al.,* 2018)

Mobile apps for pregnancy, childbirth, and child care are some of the most common healthcare apps used by women. Over half the smartphone users among used at least one pregnancy app, furthermore, younger women with less experience with pregnancy tended to use more apps. It was also suggested that mobile apps could be appropriate tools for young expectant mothers. Most participants stated that they used apps toobtain information. (Lee *et al.,* 2016)

The aims of the 'Mobile-based lifestyle intervention in women with glucose intolerance after gestational diabetes mellitus study are to evaluate the prevalence and risk factors of glucose intolerance after a recent history of GDM and to evaluate the efficacy and feasibility of a telephone- and mobile-based lifestyle intervention in women with glucose intolerance after GDM. Lifestyle modifications also effective in the prevention or delay of T2DM when offered to high-risk middle-aged individuals. (Minschart *et al.,* 2020)

The study done by Musgrave *et al.,* (2019) stated that preconception health care interventions consolidate knowledge and information related to current preconception and inter-conception health care interventions. The aim is for the effectiveness of mobile phone applications in women of reproductive age for promoting healthier behavior change and improving future outcomes for mothers and babies.

A smartphone app is a convenient and economical tool for communication as well as a potential additional support for those with few resources to obtain health

care information. In order to ensure that smartphone apps communicating diet and lifestyle information are reached to lower socioeconomic groups, lower-income populations should be considered. Dietary and lifestyle approaches are effective in improving outcomes and several diet and exercise interventions carried out in pregnant women. (Greene *et al.*, 2021)

METHODOLOGY

III. METHODOLOGY

The research design pertaining to the study **"Development and Evaluation of web application to manage gestational diabetes among expectant mothers"** is presented under the following headings.

PHASE I

A. Collection of material for the development of the web application
B. Developing screens using resource materials

PHASE II

Development of the web application

PHASE III

A. Creating awareness to the expectant mothers with the developed web application
B. Evaluation of the developed web application and feedback

The study was approved by the Institutional Human Ethical Committee (IHEC) IHEC/21-22/FSMD-12 (Appendix 1)

PHASE I

A. Collection of Material for the Development of Web Application

The foremost steps in the development of the web application is charting out an effective plan. The first step of the plan involved reviewing and synthesizing various materials. Towards this, reliable information was collected from various literatures.

The materials collected for module 1 includes nutritional assessment include IOM weight gain recommendations for pregnancy by pre-pregnancy weight status; Waist Hip Ratio (WHR) according to the world health organization; standard height and weight for Indian women; pregnancy weight distribution; pregnancy weight gain calculation, were the weight gain for the 40 weeks of pregnancy was shown according to their BMI; pregnancy belly size chart. For clinical assessment, general nutrient deficiency was collected. The material for dietary survey includes the 24 hours dietary

recall which include nutrients calculation refer from the IFCT book, comparison of actual intake and RDA, also material such as raw food database, processed food database, food exchange list, table for calories burn physical activity was also collected.

The materials collected for module 2, Exercise, Yoga and Meditation were the exercise that can be performed for all the 3 trimesters, yoga for all the 3 trimesters and the meditation that can be done during pregnancy.

In module 3, Diet for pregnancy, all the foods that can be included and avoided was added along with that sample menu plan for both vegetarian and non-vegetarian were given, the menu would be mainly of South Indian dishes.

In module 4, Healthy pregnancy, all the tips that is necessary to be followed were collected. Follow a healthy diet, Physical activity, maintain a healthy weight, Limit caffeine intake, do not use alcohol, Smoking and drugs, Avoid exposure to toxic substances, Take folic acid, Vitamin B12 and iron.

In module 5, gestational diabetes, all the information related to gestational diabetes were collected from books, articles, journals and reliable website. Information collected were what is gestational diabetes, symptoms, risk factors, complication, prevention and diet. Finally, before framing the package, software developers were consulted and the required steps to be taken were obtained.

B. Developing Screens Using Resource Materials

After gathering the information, a powerpoint presentation was created on a laptop, with each slide identifying the requisite diagrammatic representations where needed. Following that, screens were created using text-editing software, with all texts entered in text boxes and scanned images pasted to the slides, with each screen generated by modifying the font size, text colour, fore colour, and backdrop colour of the screens

PHASE II

A. Development of a Web Application

The application was developed by using PHP (Hypertext Preprocessor)

PHP

PHP (short for PHP: Hypertext Preprocessor) is a broadly used open source general-purpose design language that can be incorporated in HTML (Hypertext Markup Language).

PHP differs from client-side JavaScript in that the code is executed on the server, which generates HTML which is then provided to the client. The client would receive the results of the script's execution, but would not be aware of the underlying code. You may even set up your web server to process all of your HTML files with PHP, making it virtually impossible for users to figure out what you're up to.

PHP is a fantastic and widely used programming language:

1. It's powerful enough to power the internet's largest blogging system (WordPress).
2. It has sufficient depth to support massive social networks.
3. PHP is available on a variety of platforms (Windows, Linux, Unix, Mac OS X, etc.).
4. PHP is compatible with nearly all modern servers (Apache, IIS, etc.).
5. PHP can work with a variety of databases.

PHP framework:

A PHP Framework is a basic platform for developing web applications. In other words, it serves as a framework. Using a PHP Framework will save you a lot of time by eliminating the need to write repetitive code and allowing you to build applications quickly (RAD). For web application development, we use the Codeigniter Framework.

Codeigniter framework:

CodeIgniter is an extremely sophisticated PHP framework. It was created for developers that appreciate a simple and attractive toolset for building full-featured

web apps. CodeIgniter is one of the greatest frameworks available for generating dynamic websites using PHP.

Codeigniter provides clear and organised documentation to stakeholders. It provides exceptional stability and support. It enables a straightforward routing approach. It also directs you to the cached website for improved performance and loading times.

It gives consumers unlimited independence, removing the need for them to rely on the MVC development paradigm. The nicest feature about CodeIgniter is that it supports third-party plugins, which aid in the implementation of complex functionality. Another noteworthy characteristic of CodeIgniter is its excellent security and encryption techniques.

Features of Code Igniter

1. Error Logging
2. Search engine friendly URLs
3. Object Oriented
4. It supports the class extensions and hooks
5. File uploading class
6. It validates the forms and data
7. Library with image manipulation programs
8. It offers the session management
9. Data is encrypted
10. XSS filtering and higher security levels
11. The framework is extremely light weighted
12. Supports for data encryption and paging

MYSQL Database:

MySQL is an Oracle relational database management system (RDBMS) based on structured query language (SQL).

A database is a structured collection of data. It might be anything from a simple grocery list to a photo gallery or a spot on a business network to store enormous amounts of data. A relational database, in particular, is a type of digital

storage that uses the relational paradigm to gather and organise data. In this paradigm, tables are made up of rows and columns, and all relationships between data items follow a strict logical structure. An RDBMS is essentially a collection of software tools used to build, manage, and query a database.

MySQL is an essential component of many of the most popular software stacks for designing and maintaining everything from customer-facing web applications to complex, data-driven B2B services. MySQL backends are utilised by internet-critical organisations such as Facebook, Flickr, Twitter, Wikipedia, and YouTube due to their open-source nature, stability, and comprehensive feature set, along with constant development and support from Oracle.

Water/Fall model:

The Waterfall technique was the first SDLC Model extensively utilised in Software Engineering to assure project success. The "Waterfall" approach divides the whole software development process into parts. In the Waterfall model, the end of one stage is often used as the input for the next phase. The graphic below depicts the many phases of the waterfall model.

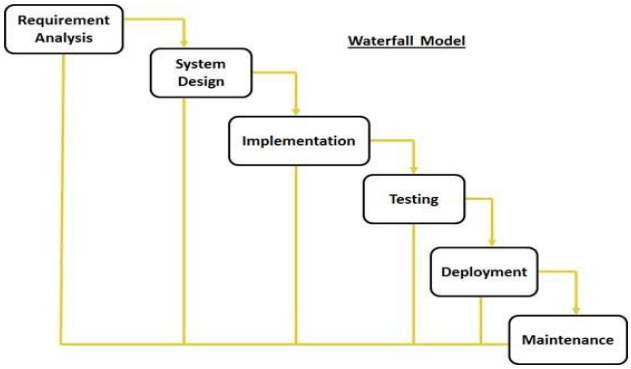


Fig 1: Flow diagram of waterfall model

Waterfall Model Application

Every piece of software created is unique and necessitates a unique SDLC strategy depending on internal and external considerations. The Waterfall approach is best suited in the following situations: • Requirements are extremely well defined, explicit, and fixed.

- The product definition is consistent.
- Technology is known and static.

- There are no ambiguities in the specifications.
- Enough resources with the necessary skills are available to support the product.
- The project is brief.

ER (Entity Relationship Model) DIAGRAM:

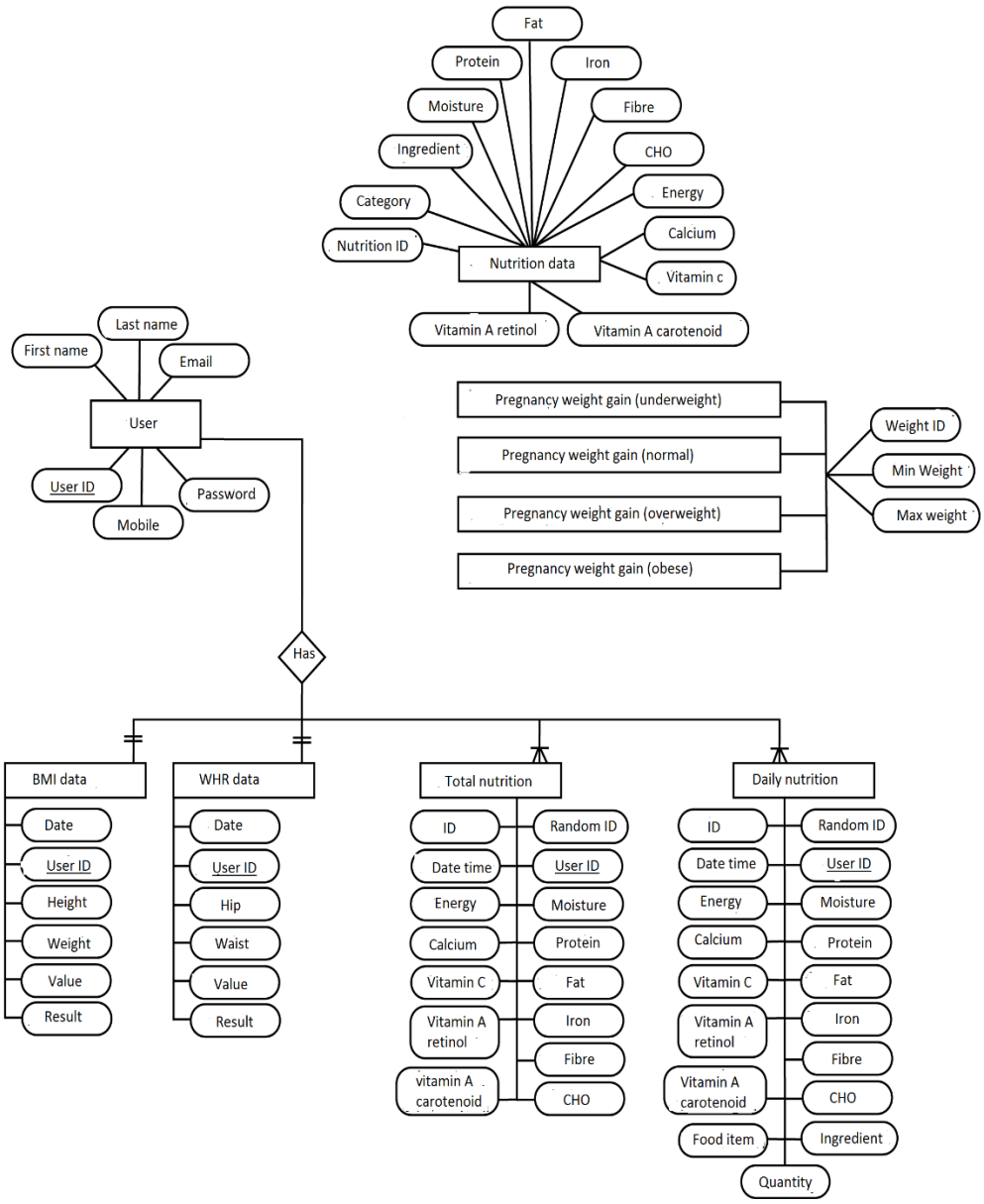


Fig 2: ER (Entity Relationship Model) Diagram

Data Flow Diagram

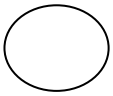
The Data Flow Diagram (DFD) is a visual tool for articulating system requirements. The DFD, often known as the "bubble chart," describes system requirements and highlights significant modifications that will become system design programs. Thus, DFD may be defined as the moment at which the needed specifications are functionally decomposed to the minimum degree of detail. The DFD is made up of a series of bubbles linked together by lines. In the system, data transformations are represented by bubbles, while data flows are represented by lines.

Rules Used for Constructing a DFD

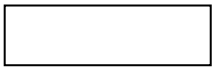
For ease of reference, each process should be called and numbered. Each name should be descriptive about the procedure. The flow direction is top to bottom and left to right. In other words, data should flow from source to destination. When a step is divided into smaller sections, they are numbered. All of the data repositories, sources, and destinations have their names capitalised. The initial letter of each word in process and data flow names is capitalised. The DFD is specifically intended to facilitate communication. It becomes unmanageable if it comprises dozens of processes and data storage. The general guideline is to burst the DFD into a functional level. It is advisable to extend each function independently. A data flow diagram is a depiction or approach which shows how data flows and transforms as it moves from source to destination. The DFD is divided into layers, each representing a higher level of information flow and functional detail. The Data Dictionary describes the operations, data repository, data flow, and so on.

Data flow: 

Data travels from one point to another in a precise direction.

Process: 

Procedures, personnel, or technology used to process or convert data

External entity: 

This identifies a system data source (originator) or destination.

Data Store:

This identifies the location of data in the system.

Data Flow Diagram

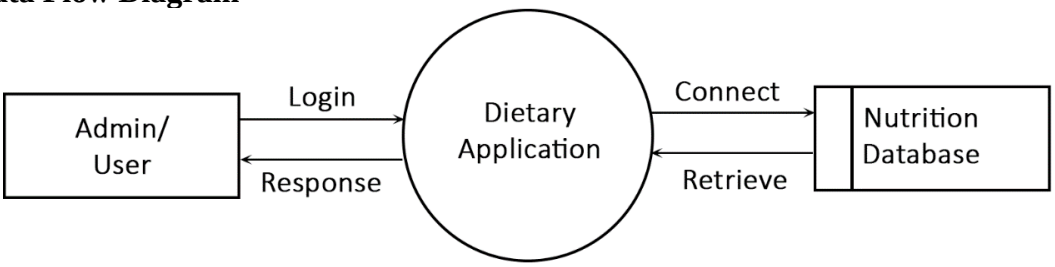


Fig 3: Data Flow Diagram

The first step involved registration of the user which will enables the user to view the application. To register the user has to first enter all the details consisting of First name, last name, role selection, the user can choose two options by clicking on the dropdown button, whether they are admin or user, email, mobile number, occupation, food category whether they are vegetarian or non-vegetarian, qualification, age, address and password. After registering log in page will be provided with privacy protected log in page for the user to proceed further into 5 modules.

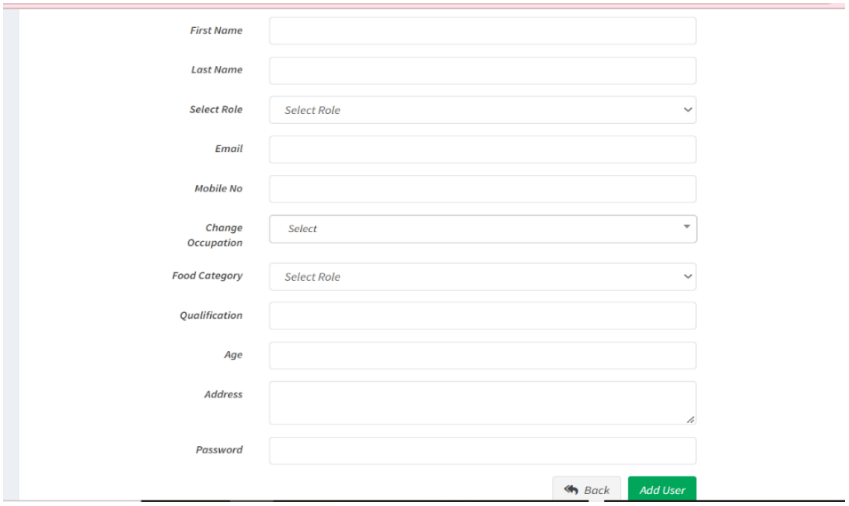


Fig 4: Screenshot of User Registration

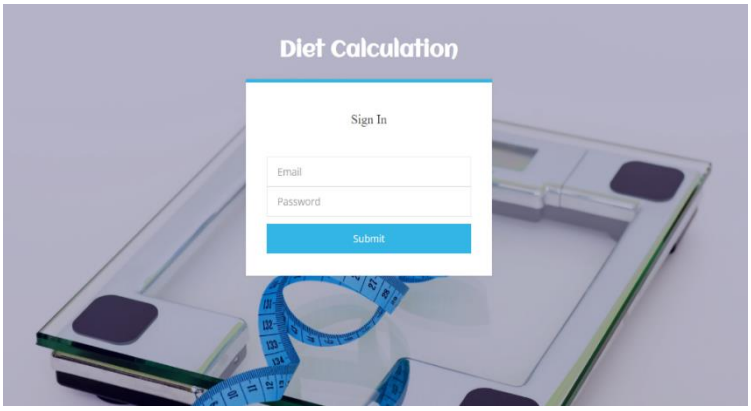


Fig 5: Screenshot of Log in screen

Home Screen

The home page of the application was designed and consisted of the details such as the ones below. 5 module logos would be displayed on the screen. They are:

- MODULE 1: Nutritional Assessment
  - Anthropometry measurement
  - Clinical assessment
  - Dietary survey
- MODULE 2: Exercise, Yoga, meditation
- MODULE 3: Diet for pregnancy
- MODULE 4: Healthy pregnancy
- MODULE 5: Gestational diabetes

Fig 6: Screenshot of Home Screen (Dashboard)

Module 1: Nutritional Assessment

While clicking module 1, “Nutritional assessment”, three buttons would be displayed - Anthropometry measurement, Clinical assessment, and Dietary survey.

Anthropometry

Clicking on the anthropometry measurement, certain options was shown - BMI (Body Mass Index), WHR (Waist Hip Ratio), Pregnancy weight gain calculation, Normal height and weight references, Pregnancy belly size chart, pregnancy weight distribution.

By clicking on the BMI options, first the user had to enter their height in cm and weight in kilograms. Based on the entered value, the Body Mass Index (BMI) was calculated and the result was displayed. Form that they it was able to know whether they have Normal BMI, Underweight, Overweight and Obese. A reference table of IOM weight recommendation for pregnancy by pre-pregnancy weight status was also shown.

Similarly, as for the waist hip ratio the user had to fill their hip and waist circumference. The waist-hip circumference ratio was calculated automatically and the value was shown, and the result like low, medium, or high was indicated according to the result value. A reference table was displayed which was given by the World Health Organisation.

Next the pregnancy weight gain calculator option was shown, first the user had filled all the details i.e., height, weight, and weeks of pregnancy only then the results for BMI was shown and also the minimum and maximum weight needed for the particular weeks was automatically displayed. The required minimum and maximum weight gain needed for obese BMI pregnant women is 5-9.1 kgs, for overweight women is 6.8 -11.3 kgs, for normal BMI women is 11.3 -15.9 kgs, underweight women are 12.7-18.1 kgs. A reference table was shown which include how much of weight the women need to gain during the whole 40 weeks of pregnancy. The table shown was based on the BMI result.

Next is the pregnancy belly size chart, here a brief on how much the belly size would be for the 9 months was given. The shape and size of the belly and also the size of the fetus for each month was displayed. For e.g., in 1st month (1-4 weeks), there would be no changes in the belly size and the fetus is just about the size of ¼ inch. for the Next option would be standard reference height and weight for women, this would give the women a knowledge on how much weight they should maintain according to their height. Up next was the pregnancy weight distribution. In this how much of weight should be the breast, baby, placenta, uterus and amniotic fluid during pregnancy was shown.

Fig 7: Screenshot of Anthropometry Measurement

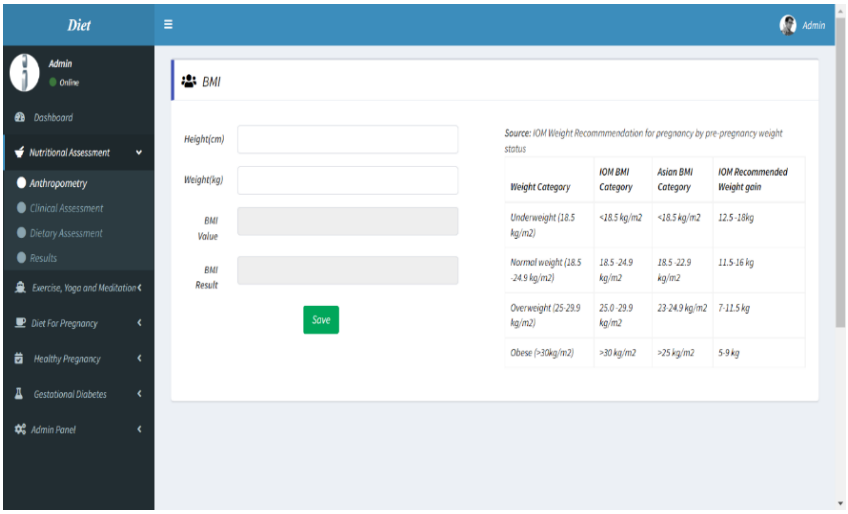


Fig 8: Screenshot of BMI Calculator

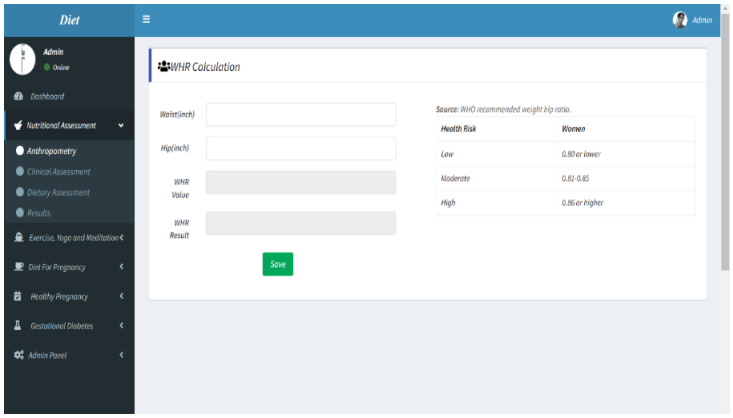


Fig 9: Screenshot of Waist Hip Ratio Calculator

Clinical Assessment

After completing the anthropometry assessment, next is the clinical assessment screen, it involves assessing the nutritional status like checking signs of deficiency at specific places on the body of the user.

Here some questions related to signs and symptoms of some nutrient deficiency was given. For each question, options were given from that the user had to select if she is having any symptoms. If she was experiencing any symptoms from the given option, this means she had certain nutrient deficiency. So, according to the condition the result will be shown automatically. If she doesn't have any symptoms then she can go for the normal option. In order for the user to know clearly the sign and symptoms images was provided. The nutrients deficiency regarding general appearance, subcutaneous fat, muscle mass, skeleton, teeth and tongue, gastrointestinal, cardiovascular, endocrine, neurologic, hair, skin, mouth, eyes, neck, extremities was given.

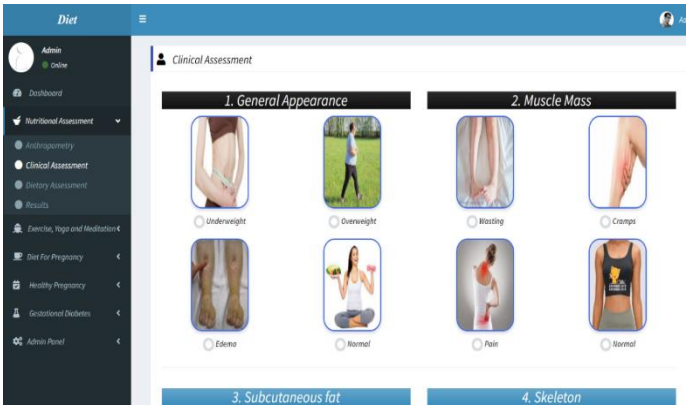


Fig 10: Screenshot of Clinical Assessment

Dietary Survey

Clicking the dietary survey button, the screen was shown for the 24-hour diet recall, here the food pre-taken in the form of main meals and the sub meals were collected from the user side. Seven types of meals like Early-morning, Breakfast, Mid-morning, Lunch, Evening snacks, Dinner and Bedtime

In the screen different column was displayed - Meal, Recipes, Food groups, Ingredients, Ingredient quantity, and nutritive value. First, the user had to select the meals whether it is breakfast or lunch, then they had to enter what dishes they had taken for the particular meals after that there would be food group buttons there, they need to select the food groups. So that according to the food group selected the ingredients was displayed.

The user can easily select all the ingredients that she had taken. The amount taken for the ingredient should manually entered in the given button. From the added ingredients the nutritive value of such nutrients like energy (kcal), carbohydrates (g), protein (g), fat (g), fiber (g), calcium (g), iron (g), calcium (g), vitamin C (µg), was automatically calculated and displayed in the screen. Similarly for the other meals also it can continue as same. The value for all the nutrients would be according to the IFCT nutrients value.

After entering all data, the total nutrients were displayed, this was the actual intake of the user. After that the actual intake was compared to RDA allowances to figure out whether it is less, adequate or just right or in excess amount of the nutrients. Result was shown if it got excess calorie in the result exercise was suggested in order to burn the extra calories and also to maintain their diet. According to the physical activity, the approximate calories burnt was also displayed. The user can choose an activity of their convenience to burnt the extra calories.

A separate button was shown “Data Reference” here other information like raw food database, processed food database, food exchange list, was also added for the extra knowledge to the user.

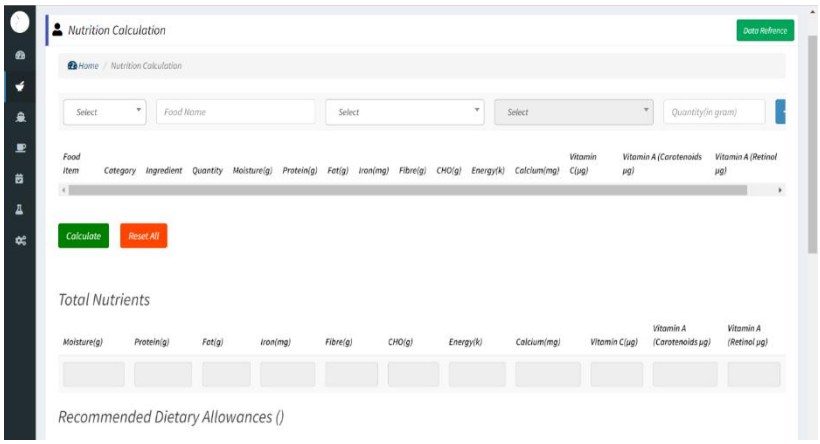


Fig 11: Screenshot of Dietary survey (Nutrient calculation)

After filling all the details, a separate screen was shown there all the result of Anthropometry measurement was displayed - BMI value, Clinical data, Total Nutrition, Total calorie.

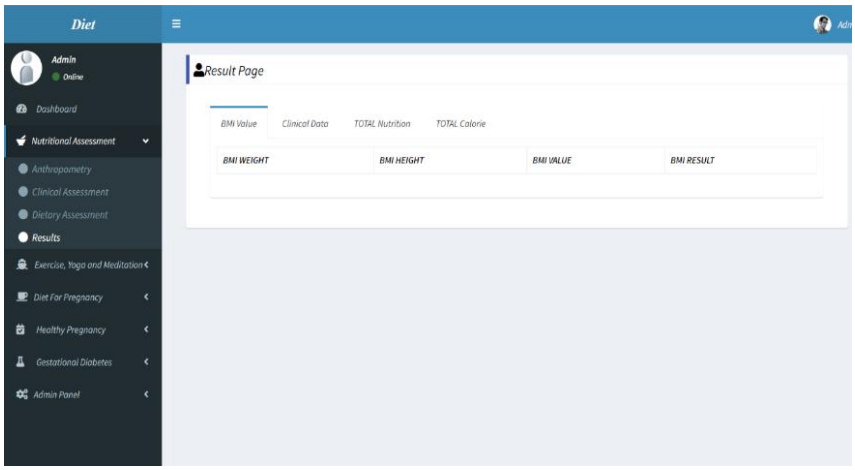


Fig 12: Screenshot of Result of Nutritional Assessment

Module 2: Exercise, Yoga, Meditation

Clicking on Module 2 exercise, yoga, meditation. Information related to exercise, yoga, meditation for all the three trimester of pregnancy was shown.

Exercise

While clicking on the exercise button, three buttons was shown - exercise for 1st trimester, 2nd trimester, 3rd trimester. Under each trimester different types of workouts were displayed - exercise for beginners, abs, butt and legs, pregnancy stretching routine, ball exercise, low impact cardio workout, pilates exercise etc.

The user had to click to the displayed buttons then, for each exercise youtube videos would be given there they can click and see how the exercise is perform also under the videos, instruction was shown which contain information like how to perform the exercise. A timer would also be given, for each exercise 30 seconds timer was set. Similarly for the other trimester also the procedure was the same. For each workout different types of exercise were given. A youtube video, instruction, and timer was also displayed.

Yoga

Same for the yoga also, clicking on the yoga button there was three buttons - 1st trimester, 2nd trimester, 3rd trimester. Under each trimester different types of yoga pose were displayed. For example - Gentle neck and shoulder rolls, half butterfly, full butterfly, cat stretch pose, seated forward bends, etc. By clicking on the particular yoga pose a youtube video was appeared, details to performed the yoga would be displayed. The same procedure was to be followed for the other trimester.

Meditation

By clicking on the meditation button, two audio buttons was displayed which would show the two types of meditation technique, one was meditation with abdominal or diaphragmatic breathing and the second one was meditation to be more aware of here and now. The meditation procedure will be voice over. By clicking on the start button the meditation procedure was played. The user can perform the meditation in just one click. Both audio and written tips was provided for the user.

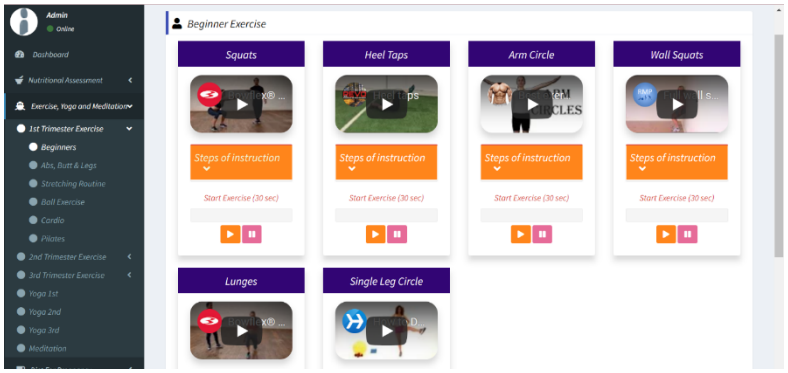


Fig 13: Screenshot of Exercise for 1st trimester

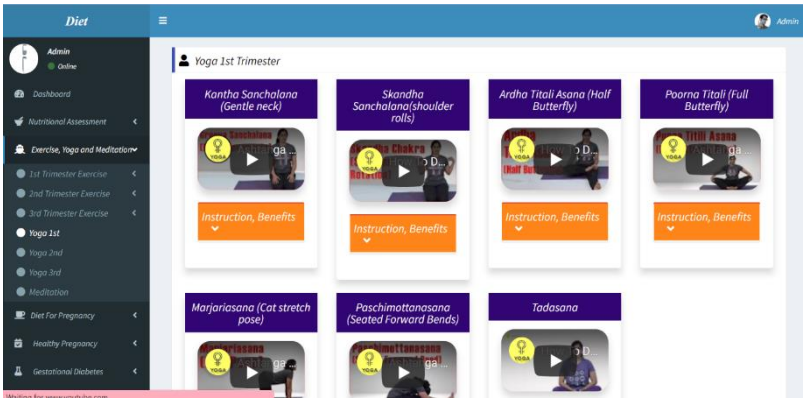


Fig 14: Screenshot of 1st Trimester Yoga

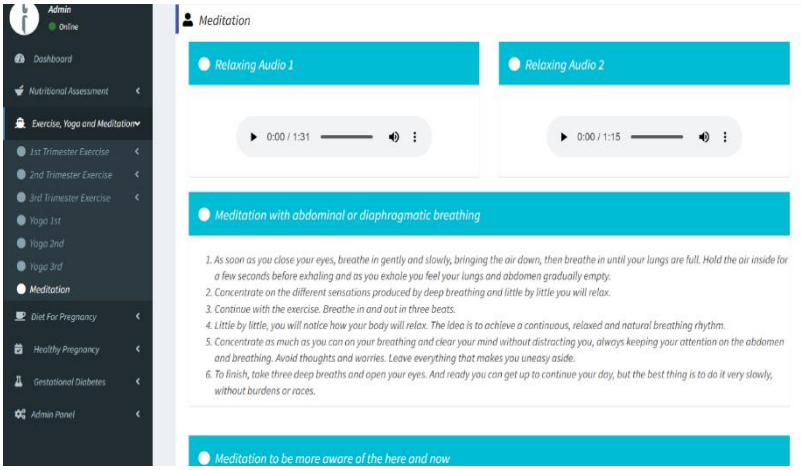


Fig 15: Screenshot of Meditation for Pregnancy

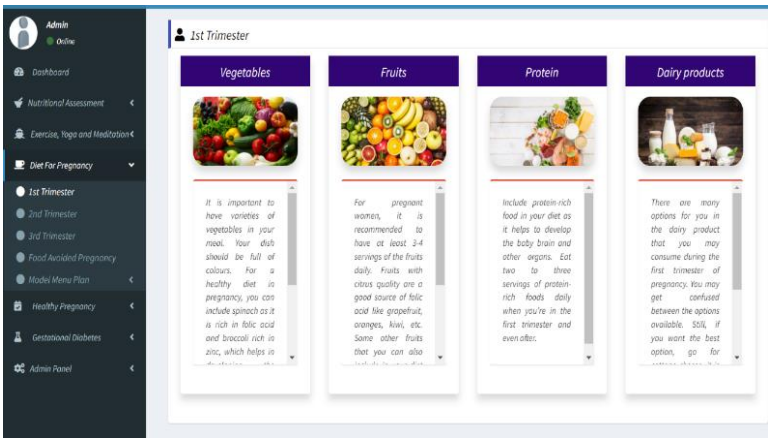


Fig 16: Screenshot of foods to be included for 1st trimester

Module 3: Diet for Pregnancy

While clicking on diet for pregnancy, three buttons would be shown - foods to be included during pregnancy, foods to be avoided during pregnancy and sample menu plan for for 1st trimester, 2nd trimester and 3rd trimester would be included. Different option of food (vegetables, fruits etc.) that has to be included would be displayed. By clicking the particular option or images, the benefits of that food, how much it should be taken, what sources of nutrients are present in it all this was displayed.

Similarly for the foods to be avoided different food list was displayed from that the user can click on the images and get to know why all those food needs to be avoided during pregnancy.

There will be another button that shows the sample menu plan for all the three trimesters. The menu would be plan separately as vegetarian and non-vegetarian. The diet plan was for 1 whole week. The menu included was mainly of south Indian cuisines. The user can refer to the menu plan that was displayed. A nutrient calculation for 1 week menu plan was displayed for the user information.

Fig 17: Screenshot of menu plan for 1st trimester vegetarian diet plan

Module 4: Healthy Pregnancy

Before taking care of the new baby, first it is important to take care of the mother health and unborn child. There's lot of advice out there but here some of the tips that is needed to be taken care by the expectant mother was displayed in this

screen. The user can go through the tips. Some of the tips was displayed like - Intake of folic acid; No alcohol, smoking, or drugs; Avoid exposure to toxic substances; Maintaining and following a healthy diet; Limit caffeine intake; Eat a safe and healthy diet; Physical activity; Maintain a healthy weight; Maintaining Nutrition status; Get regular dental follow up; Prevent infections that can affects pregnancy

By clicking on the images shown, the user was able to get the information in details, why it is needed, why should it be taken and how much, why it is important, what are its benefits etc. all this information would be included.

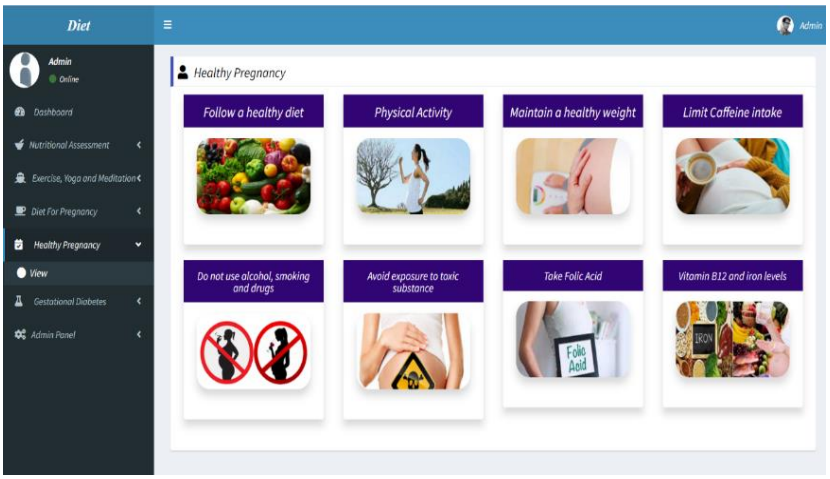


Fig 18: Screenshot of Tips for Healthy Pregnancy

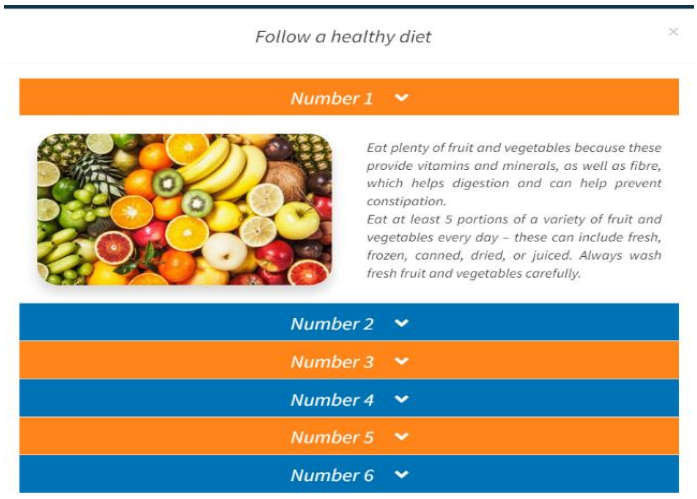


Fig 19: Screenshot of Tips to follow a Healthy Diet during Pregnancy

Module 5: Gestational Diabetes Mellitus

To show the information about Gestational Diabetes the user has to click on the Gestational diabetes mellitus. The user had to undergo some questionnaire like "Do you know what is gestational diabetes mellitus, if she wants to know there would button in that the user can click on it and all the details was automatically displayed. Similarly, as for the symptoms, if the user wants to know the symptoms first, she needs to click the yes button, then images would be displayed. By clicking on the images, she got the details. The process was same for risk factor. For complication first the user undergoes some question, whether they had some term related to complication of GDM, then by clicking on the displayed button she can proceed to the details of GDM complication. The user can get the knowledge about the prevention by clicking on the images shown in the screen.

After all this above process done diet for gestational diabetes screen was displayed. Different images were displayed, by clicking on the particular images all the details like how much they have consumed, what are the benefits, what are the nutrients that are present etc. all this would be given.

If the user wants to see a menu plan. A button showing "To see a sample menu plan, click on the given button". By clicking on the button menu would be displayed. The menu was given for both vegetarian and non-vegetarian.

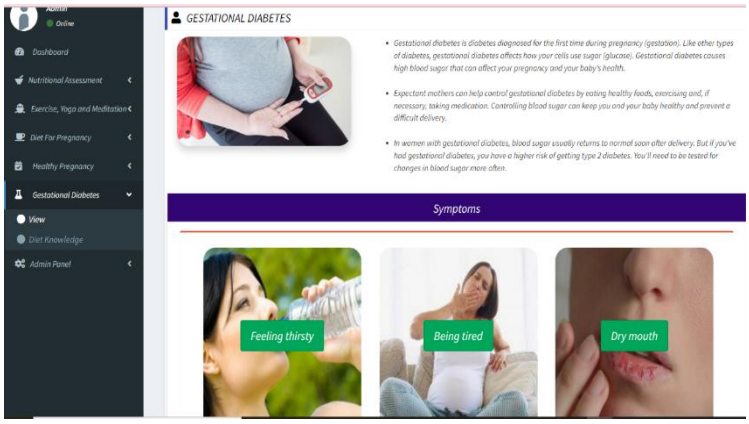


Fig 20: Screenshot of Gestational Diabetes

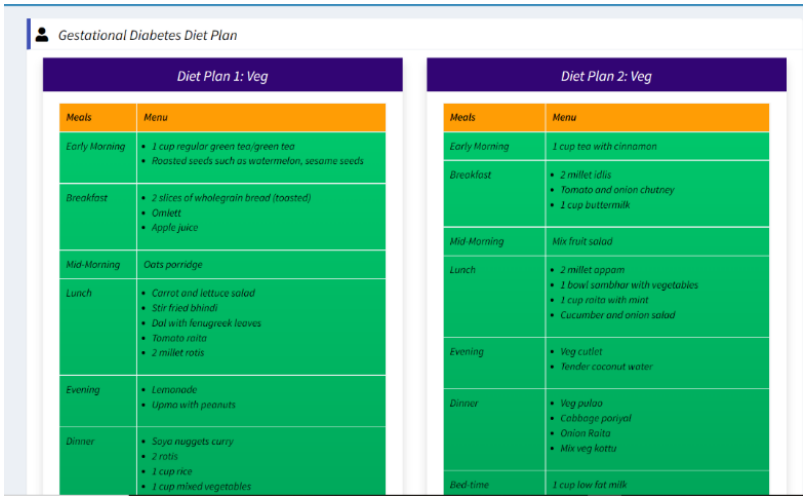


Fig 21: Screenshot of Menu Plan for Gestational Diabetes

PHASE III

A. Creating Awareness to the Expectant Mothers to Manage Gestational Diabetes with the help of the Developed Web Application

Necessary permission was obtained to conduct awareness program in Women's health clinic, Coimbatore. Also details of pregnant women were collected from different part of Imphal, Manipur and awareness was also given. The awareness was given to normal expectant mothers. It was carried out through offline and online. Before proceeding with the awareness, first, selection of the subject was necessary for those who was willing to take part in the awareness and in which mode they are preferred to do whether it may be offline or online.

The awareness was on how to manage gestational diabetes for expectant mothers. There each and every detail of gestational diabetes was included summary about gestational diabetes, sign and symptoms of gestational diabetes, complication, prevention, diet for gestational diabetes and a sample menu plan was also provided.

B. Evaluation of the Developed web Application and Feedback

The applicability of the web application for wider use was determined by collecting suggestions from the evaluators belonging to different designation including software professional, dietitians, expectant mothers and students. The

required modifications were then carried out. Development of a web application to manage gestational diabetes for expectant mother’s.

RESULT & DISCUSSION

IV. RESULT AND DISCUSSION

The findings from the study entitled **"Development and Evaluation of Web Application of Gestational Diabetes Among Expectant Mother's**" are present under the following headings:

A. Development of the web application to manage gestational diabetes among expectant mother's
B. Evaluation of the knowledge of gestational diabetes among selected pregnant women
C. Evaluation of the web application (Students, Dietitian, Computer professionals, pregnant women)
D. Awareness to manage gestational diabetes among expectants mothers.

A. DEVELOPMENT OF THE WEB APPLICATION TO MANAGE GESTATIONAL DIABETES AMONG EXPECTANT MOTHER'S

User Registration

The initial steps of the web application were first to registered the user. To get registered it requires first name, last name, email, mobile number, occupation, food category, qualification, age, address, password.

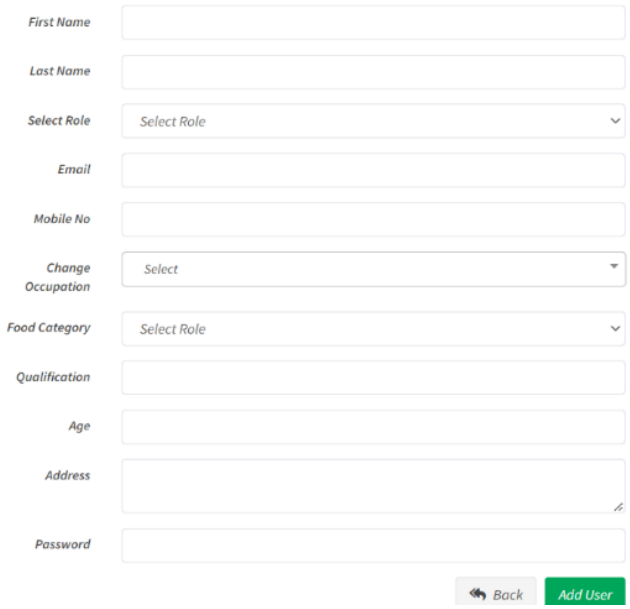


Fig 22: User Registration

Home Screen (Dashboard)

Fig 23: Home Screen

The home screen (Dashboard) was presented with 5 pictorial module which indicates the Nutritional Assessment; Exercise, Yoga and Meditation; Diet for Pregnancy; Healthy Pregnancy and Gestational Diabetes.

- Module 1: Nutritional Assessment
- Module 2: Exercise, Yoga, Meditation
- Module 3: Diet for pregnancy
- Module 4: Healthy pregnancy
- Module 5: Gestational diabetes

Module 1: Nutritional Assessment

Under Nutritional Assessment, there were 3 sections namely - Anthropometry measurement, Clinical assessment, Dietary survey.

A. Anthropometry Assessment

I. BMI (Body Mass Index)

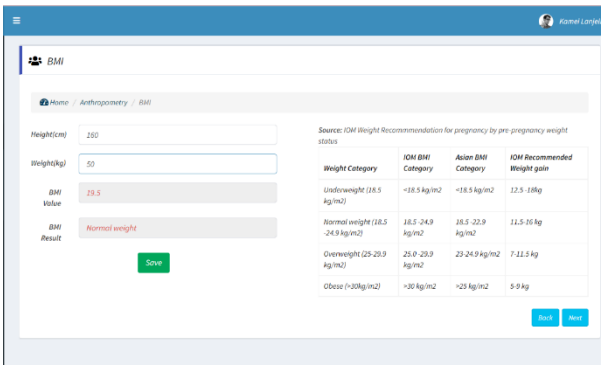


Fig 24: BMI Calculator (Nutritional assessment)

The above figure represents the BMI calculator. In BMI calculator the user has to filled their height (cm) and weight (kg) so that automatically provides the BMI value and BMI result. According to the displayed result, the Nutritional status of the person is identified. Base on the IOM guidelines if the person is underweight, her weight gain should be between 12.5-18kg, for normal weight, it should be between 11.5 -16 kg, and if the woman is overweight her weight gain should be between 7-11.5 kg. Lastly, if she is overweight, her weight gain should be between 5-9 kg.

II. Waist Hip Ratio (WHR)

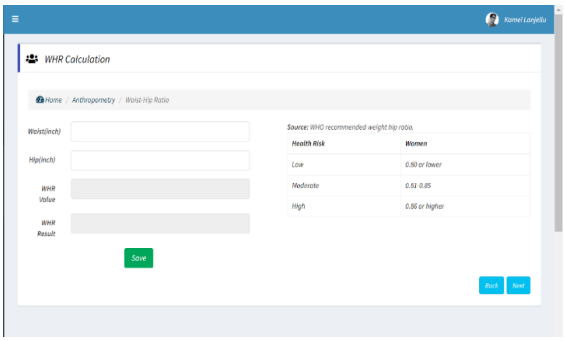


Fig 25: Waist Hip Ratio Calculator (WHR)

Fig 25 presents the Waist Hip Ratio calculation. First the user has to filled their waist (cm) and hip (cm) after that the result will be automatically calculated and displayed. From the result it indicates if the WHR was equal or lower than 0.80 it shows the present had low chances in developing any health risk diseases. The WHR value between 0.81 to 0.85 indicates that the development of health risk is moderate. Lastly if the WHR value is equal or higher than 0.86 or higher, there is high chances in developing any health risk disease.

III. Pregnancy Weight Gain Calculations

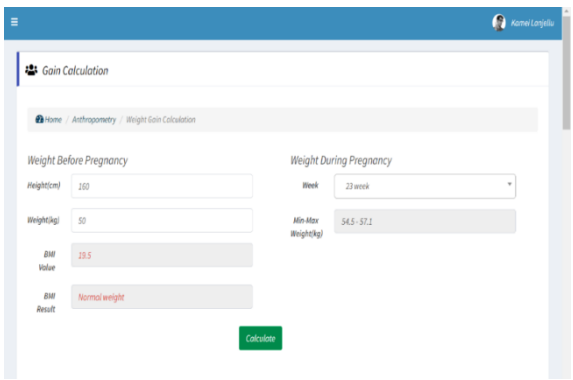
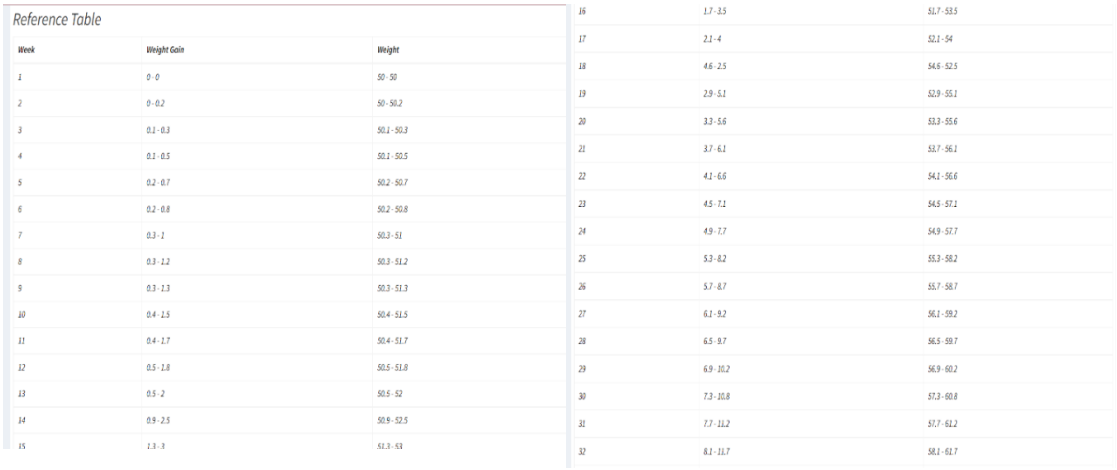


Fig 26: Pregnancy Weight Gain Calculator



Reference Table

Week	Weight Gain	Weight
1	0 - 0	50 - 50
2	0 - 0.2	50 - 50.2
3	0.1 - 0.3	50.1 - 50.3
4	0.1 - 0.5	50.1 - 50.5
5	0.2 - 0.7	50.2 - 50.7
6	0.2 - 0.8	50.2 - 50.8
7	0.3 - 1	50.3 - 51
8	0.3 - 1.2	50.3 - 51.2
9	0.3 - 1.3	50.3 - 51.3
10	0.4 - 1.5	50.4 - 51.5
11	0.4 - 1.7	50.4 - 51.7
12	0.5 - 1.8	50.5 - 51.8
13	0.5 - 2	50.5 - 52
14	0.9 - 2.5	50.9 - 52.5
15	1.3 - 3	51.3 - 53
16	1.7 - 3.5	51.7 - 53.5
17	2.1 - 4	52.1 - 54
18	4.6 - 2.5	54.6 - 52.5
19	2.9 - 5.1	52.9 - 55.1
20	3.3 - 5.6	53.3 - 55.6
21	3.7 - 6.1	53.7 - 56.1
22	4.1 - 6.6	54.1 - 56.6
23	4.5 - 7.1	54.5 - 57.1
24	4.9 - 7.7	54.9 - 57.7
25	5.3 - 8.2	55.3 - 58.2
26	5.7 - 8.7	55.7 - 58.7
27	6.1 - 9.2	56.1 - 59.2
28	6.5 - 9.7	56.5 - 59.7
29	6.9 - 10.2	56.9 - 60.2
30	7.3 - 10.8	57.3 - 60.8
31	7.7 - 11.2	57.7 - 61.2
32	8.1 - 11.7	58.1 - 61.7

Fig 27 : Reference Table of the Pregnancy Weight Gain Calculations

The above fig 26 and 27 shows pregnancy weight gain calculations. After entering all the required value i.e., height (cm), weight (kg) and their weeks of pregnancy, the result was shown. So according to the BMI result and the weeks of pregnancy their minimum and maximum weight that is required to gain during the particular weeks was shown. According to their BMI result (Underweight, normal, overweight, obese) the weight gain was different. This also shows that the weight gain value for each week during the 40 weeks of pregnancy different.

B. Clinical Assessment

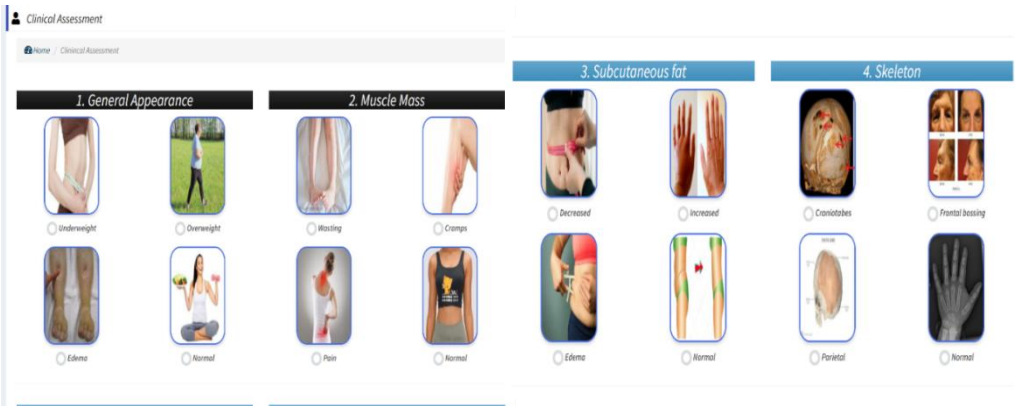


Fig 28 : Clinical Assessment

The figure 28 represents the clinical assessment. The clinical assessment indicates any nutritional deficiencies of a person. Whatever the user had selected (according to the clinical sign and symptoms entered) justification was given. The clinical assessment includes General appearance, muscle mass, subcutaneous fat,

skeleton, eyes, extremities, neck, teeth and tongue, cardiovascular, gastrointestinal, endocrine, neurologic, skin, hair and mouth.

C. Dietary Survey

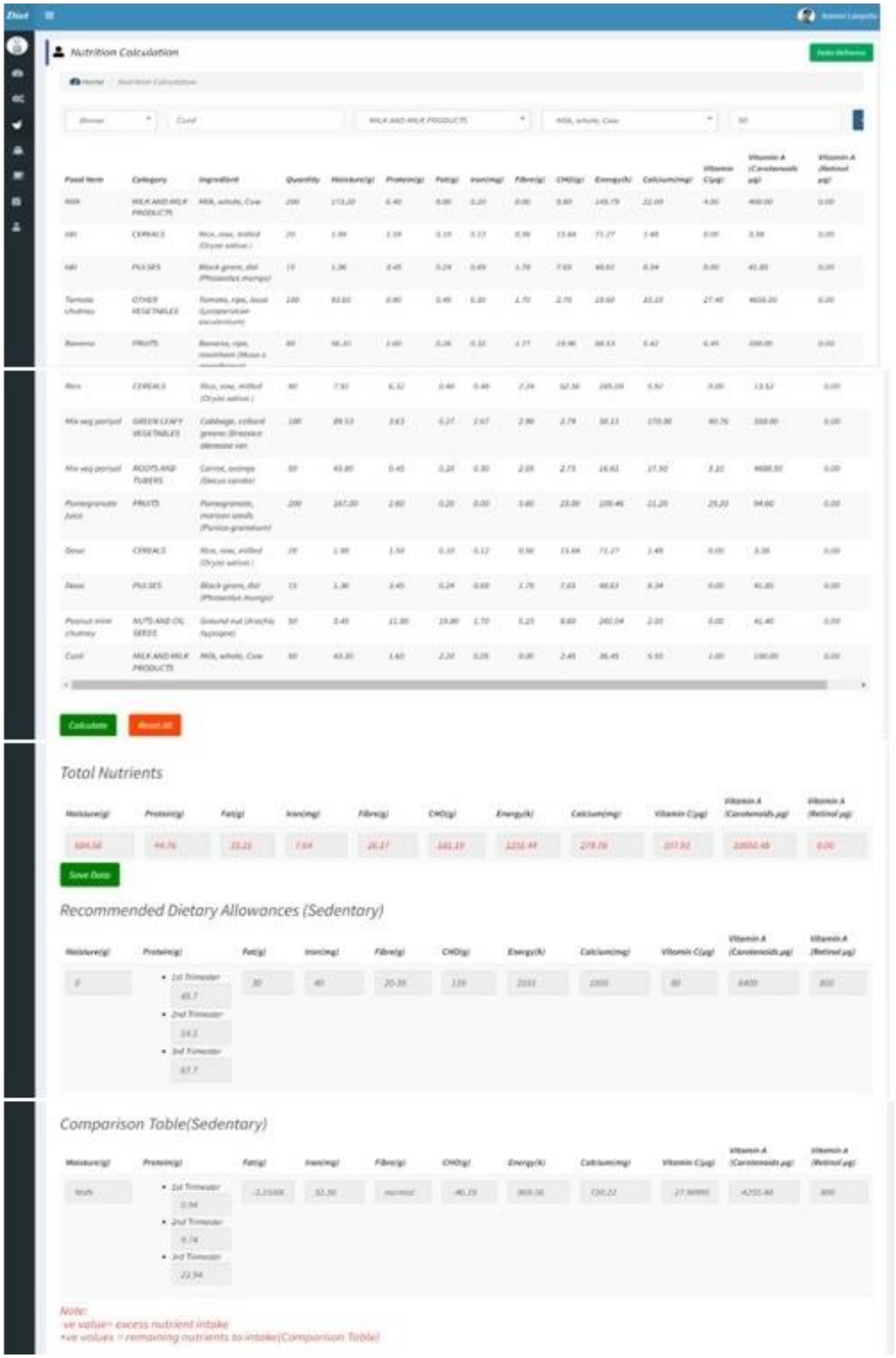


Fig 29: Dietary Survey (Nutrient Calculation & Nutrient Comparison)

The above figure elaborates on the dietary survey of the user. First was selection of the meal pattern of what had eaten for Breakfast, Mid-morning, Lunch, Mid-evening, Dinner, Bedtime. Then followed by recipes that had entered manually, after that food group was selected. According to the selected food groups, ingredients was displayed and lastly amount of the ingredients was filled. Then clicking on the add button nutritional value of each of the ingredients was displayed.

Then total nutrients of the day that was eaten was displayed. From the userprofile which was enter in the user registration, it was identified whether the person is sedentary, moderate or heavy worker. The recommended dietary allowances for each of the worker was also provided.

For each worker the RDA was different. The given RDA was based on the revised RDA 2020 - Sedentary worker: Energy - 2101 kcal; Protein - 1st Trimester: 45.7g, 2nd trimester 54.5g, 3rd trimester 67.7g; Fat - 30g; Iron - 40mg; Fibre -20-35g; CHO -135g; Calcium - 1000mg; Vitamin C -80µg; Vitamin A (Carotenoids) - 6400µg; Vitamin A - 800µg. For Moderate worker: Energy - 2480 kcal; Protein - 1st Trimester: 45.7g, 2nd trimester 54.5g, 3rd trimester 67.7g; Fat - 30g; Iron - 40mg; Fibre -20-35g; CHO -135g; Calcium - 1000mg; Vitamin C -80µg; Vitamin A (Carotenoids) - 6400µg; Vitamin A - 800µg. And for heavy worker: Energy - 3070 kcal; Protein - 1st Trimester: 45.7g, 2nd trimester 54.5g, 3rd trimester 67.7g; Fat - 30g; Iron - 40mg; Fibre -20-35g; CHO -135g; Calcium - 1000mg; Vitamin C -80µg; Vitamin A (Carotenoids) - 6400µg; Vitamin A - 800µg.

Lastly nutrient comparison with total nutrients intake and recommended dietary allowances was provided. If its shows -ve value extra nutrients had to be taken for those particular nutrients and if +ve, this indicates they are deficient with that particular nutrient and they should focus more on those nutrients.

Nutritional Assessment Result

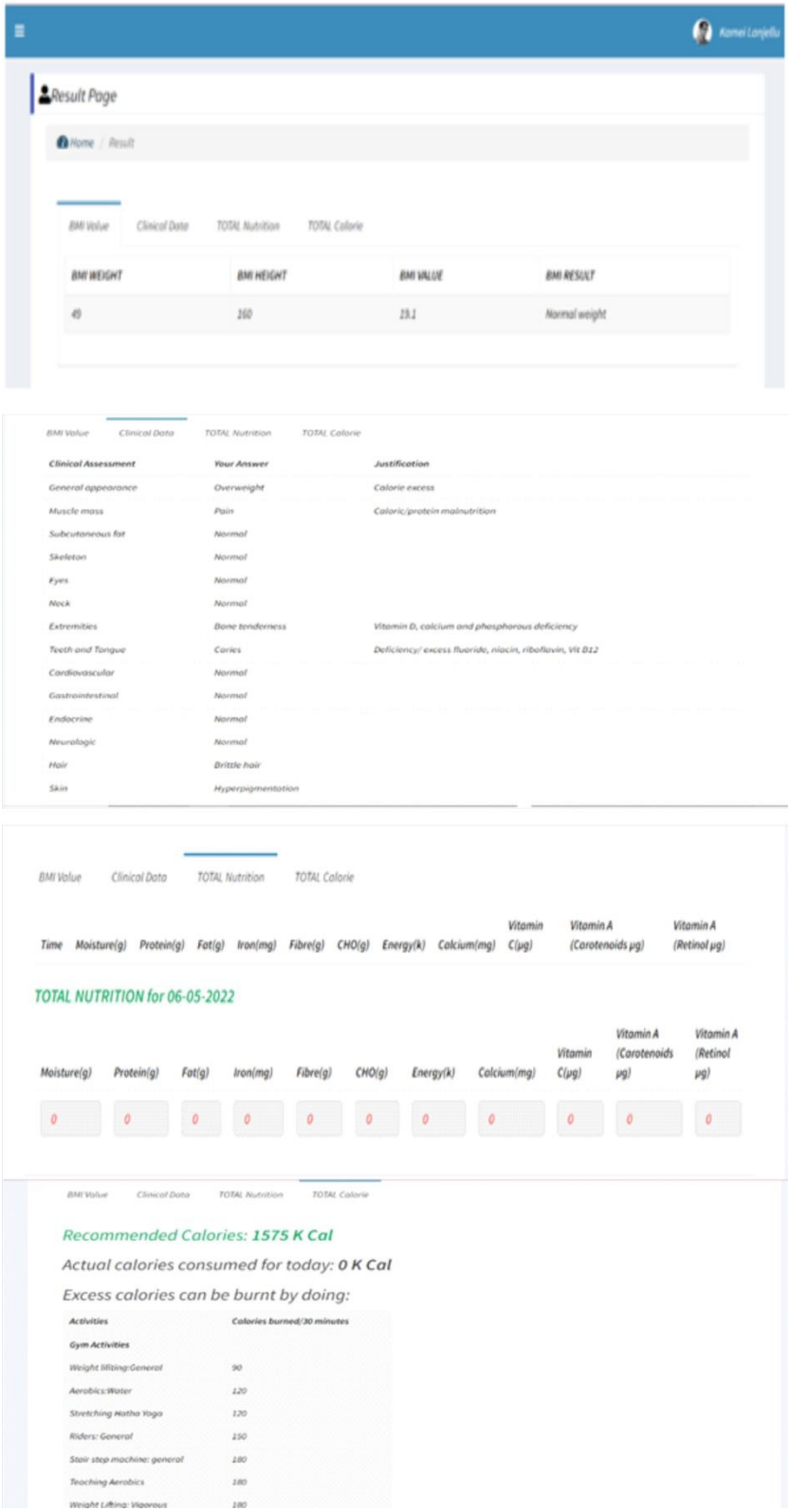


Fig 30: Nutritional Assessment Result

The above figure shows all the results of the nutritional assessment i.e., BMI, Clinical data, Total nutrition, and total calorie. For BMI whatever filled in the BMI page, the value was shown again in the result. In clinical, the assessment that was done by the user was shown along with the justification.

For General appearance, if it was underweight, edema this indicates calorie/protein malnutrition; Overweight indicates calorie excess. Muscle mass, if wasting, pains, cramps, shows calorie/protein malnutrition. Subcutaneous fat, decrease indicates calorie deficit and malnutrition, increase, edema shows excess protein; For skeleton, Craniotabes, parietal, frontal bossing indicates calcium and vitamin D deficiency. In the eyes, night blindness indicates vitamin A and zinc deficiency, Conjunctival inflammation and photophobia show riboflavin and vitamin A deficiency.

For extremities, if there was edema it indicates protein and thiamine deficiency; bone tenderness indicates vitamin D, calcium, and phosphorous deficiency; bone/joint pain shows vitamin A or C deficiency. Goiter in the neck indicates iodine deficiency, and parotid enlargement in the neck shows protein deficiency. Caries, abnormal enamel tooth, and red/ pale tongue indicate deficiency/excess fluoride, niacin, riboflavin, and vitamin B12. The presence of cardiomyopathy and arrhythmia indicates selenium, thiamine, potassium, calcium, and phosphorous deficiency. Diarrhea, hepatomegaly, and constipation indicate zinc, calorie and protein malnutrition.

Showing symptoms like hypothyroidism, glucose intolerance, and hypogonadism indicates iodine, chromium deficiency, calorie/protein malnutrition. Neurologic problems like peripheral neuropathy indicate thiamine and pyridoxine deficiency, sensory peripheral neuropathy indicates thiamine deficiency, confusion shows calorie/protein malnutrition. Dryness and scaly flaky paint of skin show vitamin A and zinc deficiency, hyperpigmentation in skin indicates Niacin deficiency, easy bruising was because of the vitamin K and C deficiency. Easily plucked hair and alopecia of hair indicate protein deficiency and Brittle hair show protein and biotin deficiency. And lastly, Glossitis in mouth indicates riboflavin, vitamin B12 and iron

deficiency, bleeding gums was vitamin C and riboflavin deficiency, cheilosis indicates riboflavin, pyridoxine, and niacin deficiency.

Coming to the total nutrition, this presents the total nutrient intake of the day. And total calorie represents the comparison of the recommended calories and actual calories consumed for the day. The greater calories in the actual calories consumed indicates excess calories and this calorie was burn doing certain exercise.

Module 2: Exercise, Yoga, Meditation

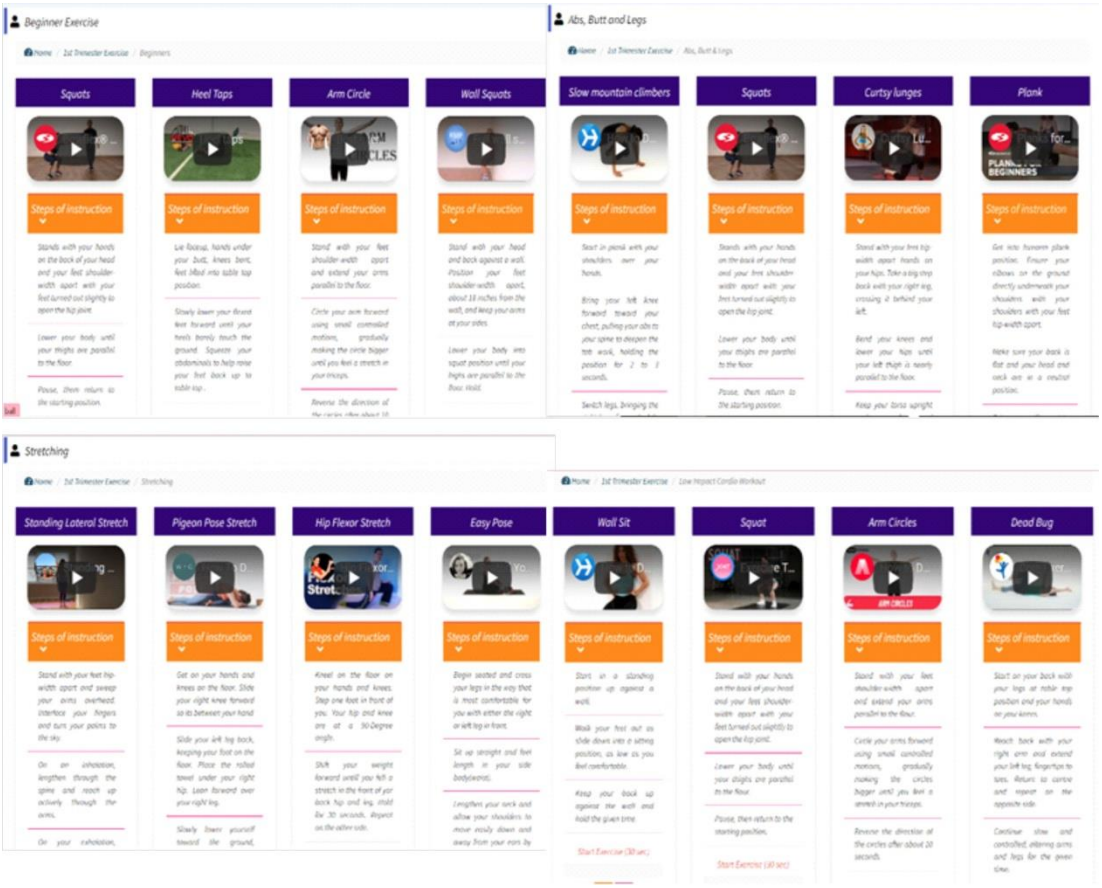


Fig 31: Exercises for Pregnancy

The above figure shows the exercises that can be done during the pregnancy. The exercise was provided for all the trimesters - 1st trimester, 2nd trimester, and 3rd trimester. The exercise was provided under different types of workouts like beginner workouts; abs, butt & legs workout, stretching routine, ball exercise, cardio and pilates workout. This shows that regular exercise throughout the pregnancy help stayed healthy. Also, during pregnancy exercise help to reduce the risk of gestational

diabetes and also other problem like relieving stress and also build more stamina needed for a safe delivery.

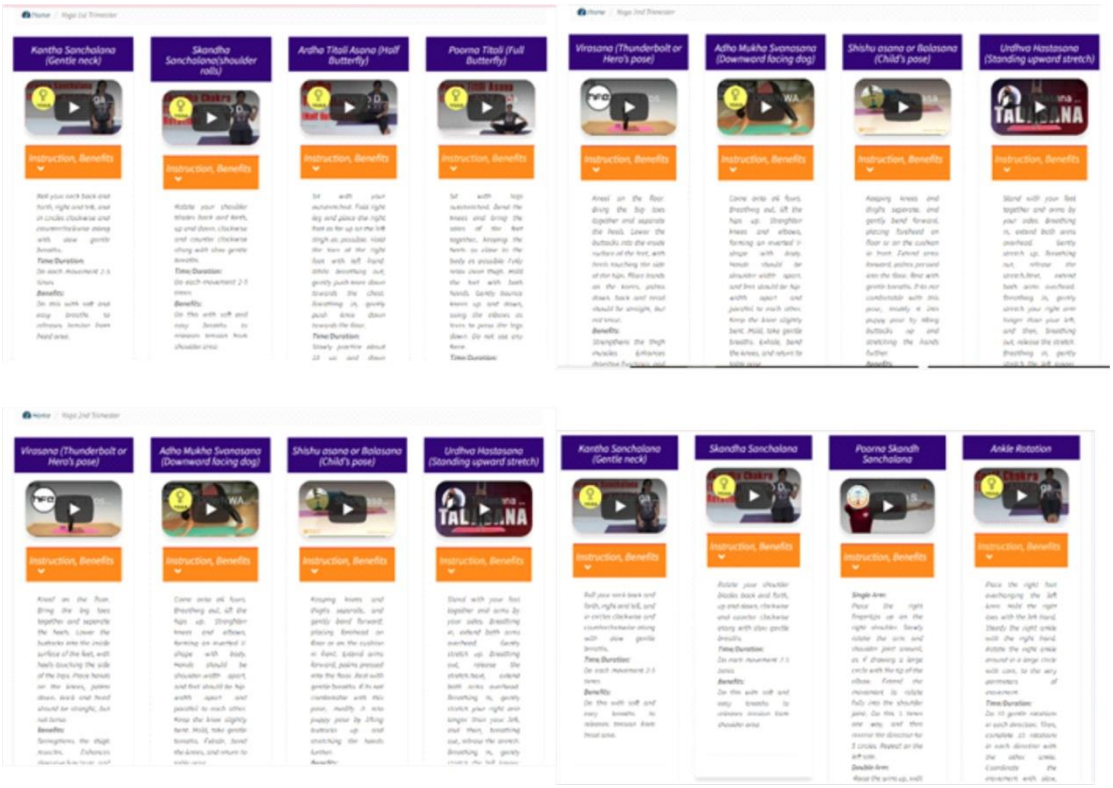


Fig 32: Yoga for Pregnancy

The figure represents the different yoga poses for all three trimesters. This shows that yoga is an effective and safe exercise for pregnant women. In addition to that, it also provides benefits to both the baby and the mother. Also gives relaxation to the mother.

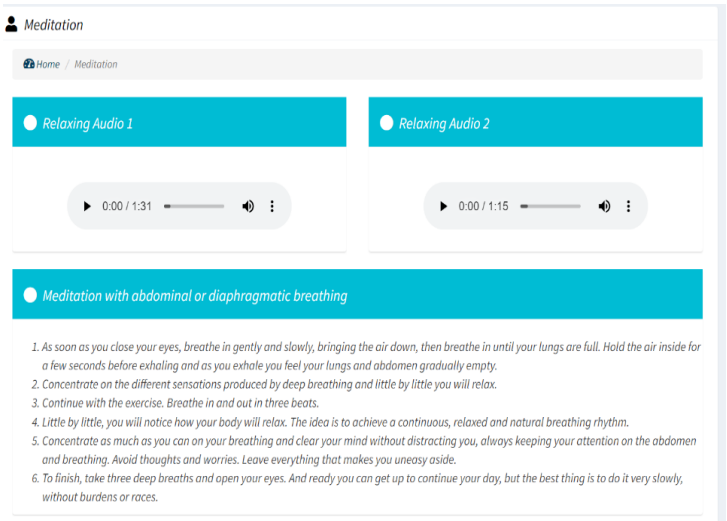


Fig 33: Meditation for Pregnancy

The above figure shows the meditation that was performed during the pregnancy. Meditation with abdominal or diaphragmatic breathing and meditation to be more aware of the here and now. This meditation shows that it helps pregnant women to ease muscle tension, lower heart rate, and also focus on the physical and emotional sensation.

Module 4: Diet for Pregnancy

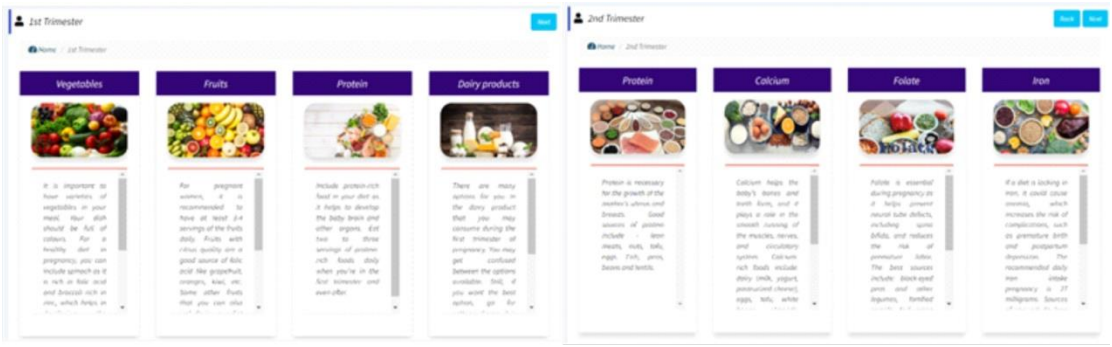


Fig 34: Foods to be Included in 1st trimester, 2nd Trimester and 3rd Trimester of Pregnancy

The above figure represents the foods to be taken during pregnancy. In the first trimester, vegetables, fruits, protein-rich foods, and dairy products were provided. The 1st-trimester diet had a variety of vegetables which includes spinach, tomatoes, sweet potatoes, etc. It was recommended to have at least 3-4 servings of fruits daily. Eat two to three servings of protein-rich foods. And also, to consume dairy products.

In 2nd trimester protein-rich food such as lean meats, nuts eggs, peas were provided. Include calcium-rich food to helps the baby's bones and teeth. Folate rich food to prevent neural tube defects. This includes dark green leafy vegetable like spinach, whole grains etc. Iron rich foods to prevent from to prevent from anemia. It recommends to take daily iron of 25 mg.

3rd trimester food provides protein rich foods to help in preparation of delivery. Calcium rich foods to reduce demineralization of maternal bones. Iron rich foods to increase volume of blood to help in steady supply of nutrients to fetus. Omega - 3 fats for neurodevelopment as well as fetal birth weight.

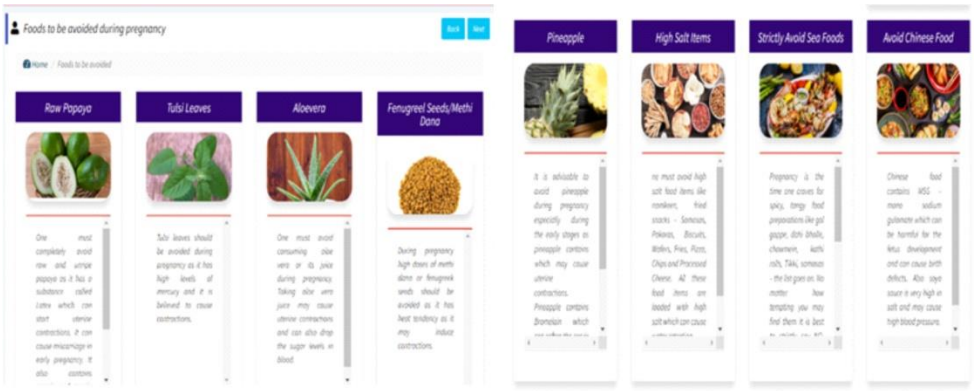


Fig 35: Foods to be Avoided During Pregnancy

The above figure depicts the foods to be avoided during pregnancy. This fig indicates that in order to prevent pregnancy-related problems they have to restrict food like raw papaya, which contains pepsin that causes a fetal developmental issue. Tulsi, which causes contraction. Aloevera, drop the sugar levels in blood. Pineapple to strictly avoid during first trimester. Avoid high salt foods which loaded with high salt which cause water retention. Also, to avoid seafood and Chinese food and unpasteurized milk.

	Breakfast	Mid-morning	Lunch	Evening Snacks	Dinner
MONDAY	• Idli • Mint Peanut Chutney • Tender Coconut Water	Orange	• Ladies Finger Sambar • Crispy Potato • Garlic Rasam • Curd • Rice	• Lemonade • Puffed rice with peanut	• Chickpea • Paratta
TUESDAY	• Oats upma with vegetables • Banana Milkshake	Kiwi	• Vegetable Biryani • Roasted Capsicum Raita	• Coffee • Sweet corn sundal	• Drumstick Sambar • Coconut Chutney • Dosa
WEDNESDAY	• Masala Dosa • Coriander chutney • Sweet lime Juice	Watermelon	• Rice • Curd • Soya Chunks Masala Dry • Brinjal Fry	• Rose Lassi • Walnuts and Raisins	• Curd Rice • Roasted papad • Mix Veg Fry
THURSDAY	• Tomato Uttapam • Coconut chutney	Guava	• Cauliflower, broccoli and potato curry • Finger Millets(ragi) roti • Pepper rasam	• Almond Milkshake • Roasted Peanut	• Rice • Kidney beans curry • Pumpkin Raita
FRIDAY	• Oats Porridge with nuts • Pineapple juice	Muskmelon	• Lemon Rice • Green Gram dal • Beans and Carrot palya	• Buttermilk • Steamed peanuts, onion and tomato salad	• Mushroom and peas curry • Chapati • Soya Payasam
SATURDAY	• Whole Green gram Dosa • Mint Chutney • Tea	Apple Milkshake	• Mixed Sprouts pulao • Bittergourd masala dry • Cucumber and onion Raita	Tender coconut water	• Stuffed potato and capsicum parotta • Coconut chutney

1ST TRIMESTER VEGETARIAN NUTRIENT CALCULATION

Monday	Meals	Menu	Ingredients	Amount	Energy (kcal)	CHO (g)	Protein (g)	Fat (g)	Fiber (g)	Iron (mg)	Calcium (mg)
	Breakfast	Idli (3)	Rice	30g	103.50	23.46	2.04	0.15	0.06	0.21	3.00
			Black gram dal	15g	52.05	8.94	3.60	0.21	0.14	0.57	23.01
		Mint peanut chutney (1/2 katori)	Mint	5g	2.40	0.29	0.24	0.03	0.10	0.78	10.00
			Peanut	30g	171.00	8.01	7.86	11.94	0.93	0.93	23.10
		Tender coconut water	Tender coconut water	150 ml	36	6.60	2.10	11.94	0.00	0.93	23.10
	Mid-morning	Orange	Orange	150ml	13.50	2.85	0.30	0.15	0.00	1.05	7.50
	Lunch	Ladies finger sambar (1 katori)	Lentil	20g	68.60	11.80	5.02	0.14	0.14	1.32	13.80
			Ladies finger	50g	17.50	3.20	0.95	0.10	0.60	0.18	33.00
			Onion	50g	10.00	2.22	0.34	0.02	0.12	0.12	9.34
		Crispy potato	Potato	100g	97	22.60	1.60	0.10	0.40	0.48	10.00
		Garlic rasam (1/2 katori)	Garlic	5g	7.25	1.49	0.32	0.01	0.04	0.06	1.50
			Tomato	40g	9.20	1.44	0.76	0.04	0.28	0.72	8.00
			Curd	50g	30	1.50	1.55	2.00	0.00	0.10	74.50
			Rice	Rice	60g	207	46.92	4.08	0.30	0.12	6.00
	Evening snacks		Lemonade (150ml)	Lemon juice	30ml	17.10	3.33	0.30	0.27	0.51	0.08	21.00
				Sugar	10g	39.80	9.94	0.01	0.00	0.00	0.02	1.20
			Puffed rice with peanut	Puff rice	20g	65.00	14.72	1.50	0.02	0.06	1.32	4.60
				Peanut	30g	171.00	8.01	7.86	11.94	0.93	0.93	23.10
	Dinner	Chickpea curry (1 katori)	Chickpea	30g	109.2	18.3	5.7	1.8	5.1	10.2	3
				Onion	20g	10.00	2.22	0.34	0.02	0.12	0.12	9.34
		Paratta (2)	Wheat flour	40g	130.20	29.56	4.40	0.36	0.12	1.08	9.20
					360			40				
	Oils				40ml							
	Actual intake (Total)					1736.3	227.4	47.07	81.54	9.77	21.82	317.37

Fig 36: Model Menu Plan for Pregnant Women and Nutrients Calculations for 1st Trimester Vegetarian Diet

Above fig 36 shows the model menu for pregnant women and nutrients calculations for the 1st-trimester vegetarian diet. The menu provides 5 meal patterns for 6 days. The menu was basically of South Indian dishes. The menu content only vegetarian dishes. The provided menu plan contains all the four foods groups.

The model menu provides high protein rich foods, high fiber foods, moderate fats, high vitamins and minerals and adequate amounts of energy. The nutrient provides for each day were approximately 1523 kcal of energy, 198g of proteins, 41.53g of proteins, 66.53 of fats, 9.76g of fiber, 15.89mg of iron and 593 .29mg of calcium.

Module 4: Healthy Pregnancy

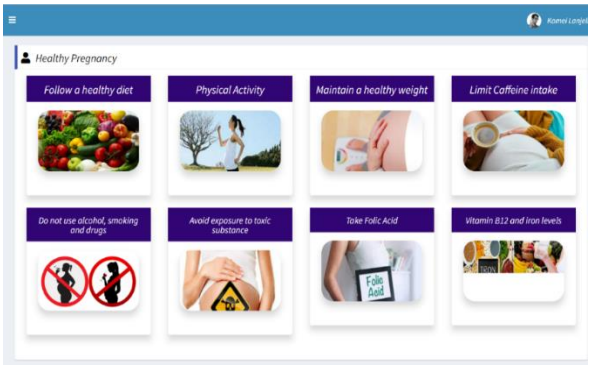


Fig 37: Tips for Healthy Pregnancy

Fig 37 shows the tips to have a healthy pregnancy. It indicates that in order to have a healthy pregnancy it's necessary to follow a healthy diet which means eating plenty of fruits and vegetables, eat protein-rich foods, include dairy items such as milk, yoghurt. Restrict intake of high amounts of fats. Kept physically active during pregnancy by doing exercise such as walking, low impact aerobics training etc. Maintain healthy weight, limiting the caffeine intake to 200mg mg each day i.e., 0.2g. Avoid alcohol, smoking and use of illegal drugs, this will lead to long term harmful to baby.

Module 5: Gestational Diabetes

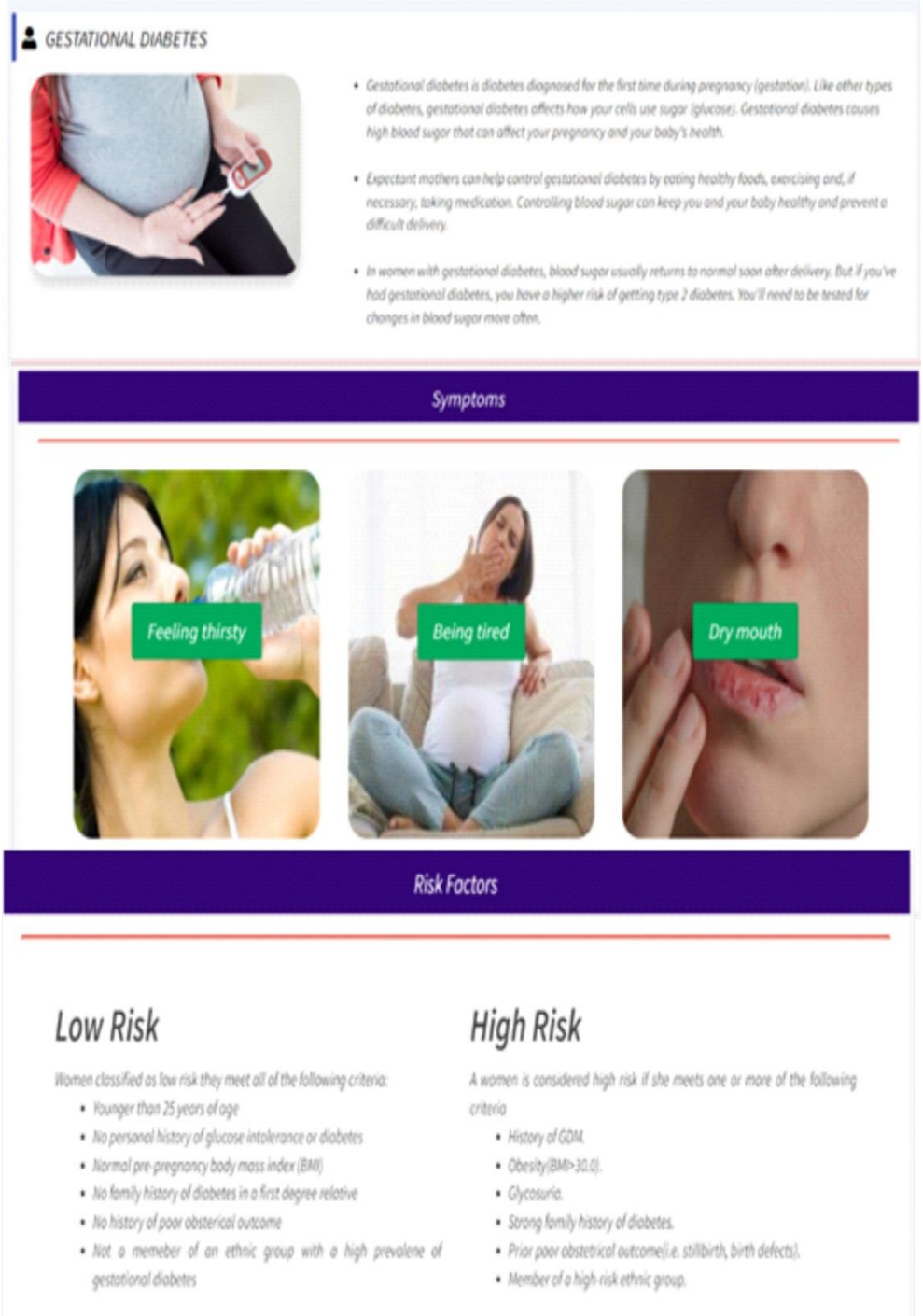


Fig 38: Gestational Diabetes, Symptoms and Risk Factors

Fig 38 shows a brief about gestational diabetes that was diabetes is diagnosed for the first-time during pregnancy. It was cause due to the high blood sugar which affect the pregnant women as well as the baby. The blood sugar usually returns to normal soon after delivery. It shows the symptoms of gestational diabetes includes

feeling thirsty, being tired and dry mouth. And also indicates two types of risk factors, low risk and high risk. Some of the risk factors were history of GDM, obesity, family history, glycosuria etc.

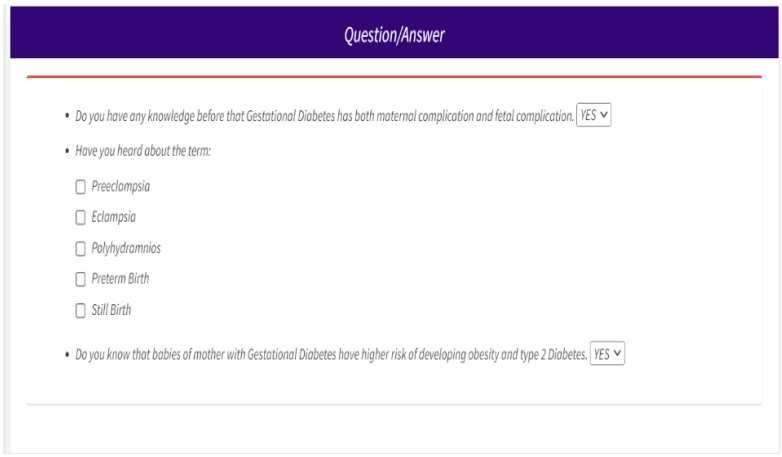


Fig 39: Questionnaire for Gestational Diabetes

The fig 39 represent a questions and answer to know the user are aware with what is gestational diabetes, complication of gestational diabetes, heard of any term related to gestational diabetes, and any higher risk of gestational diabetes.

Fig 40: Complication, Prevention and Diet for Gestational Diabetes

The above fig elaborates the complication, prevention and diet for gestational diabetes. The complication consists of maternal complication and fetal complication. Maternal complication includes preeclampsia, eclampsia, polyhydramnios etc. And fetal complication consists of stillbirth, preterm birth, low blood pressure etc.

The knowledge provided to prevent gestational diabetes were to eat healthy foods, keep active and start pregnancy in healthy weight.

Also, the fig highlights the diet for gestational diabetes which needs to be followed. Simple carbohydrates should be avoided. Select foods loaded with full of vitamins, minerals, dietary fiber and healthy carbohydrates like complex carbs. Vegetable and fruits should be intake daily. Includes dairy products because they are a great source of protein, calcium and phosphorous. Limit the use of fat particularly the saturated fat and sweet are high in fat and sugar.

Fig 41: Diet Plan for Gestational Diabetes

The above figure illustrates the diet plan of gestational diabetes. Each diet plan was provided with 2 vegetarian diet plans and 2 non-vegetarian diet plans. The diet plan consists from early morning till bed time. The diet plan includes all the four food groups.

B. EVALUATION OF THE KNOWLEDGE OF GESTATIONAL DIABETES AMONG SELECTED PREGNANT WOMEN

Demographic of Respondents

The respondent (n=54) was selected based on the purposive random sampling. The demographics of the study respondents were presented in the table.

TABLE I

DEMOGRAPHIC PROFILE OF THE SELECTED SUBJECTS

Age (Years)	Frequency	Percentage (%)
20-30	39	69.6
31-40	15	26.8
Qualification		
10 standards	22	40.7
12 standards	12	22.2
Undergraduate	16	29.6
Postgraduate	3	5.6
Professional	1	1.9
Height (cm)		
140-150	3	5.4
151-160	44	78.6
160-170	7	12.5
Weight (kg)		
40-60	35	62.5
61-80	19	33.9
Waist (cm)		
20-30	24	44.4
30-40	30	55.6
Hip (cm)		
30-40	54	100

The above table depicts the demographic data of selected subjects. Subjects have been classified into 2 groups based on their age from 20 to 40 years. The table reveals that the maximum number of subjects of 39 falls between 20-30 age group. This was followed by the least number of 15 subjects between the age of 31-40.

Regarding the educational qualification of the subjects, nearly 40.7 percent of the subjects were 10 standards. About 29.6% of the subjects were 12 standards. Followed by 22.2 percent of the subjects were undergraduate. 5.6 percent of the subjects were post graduate and lastly 1.9 percent of the subjects were professionals.

With concern to the height 76.6 percent of subjects were between the 151-150 cm. 12.5 percent of the subjects were between the height 160-170 cm. Followed by the least number 5.4 percent of the subjects between 140-150 cm of height.

As far as their weight is concerned, 62.5 percent of the subjects were between the weight of 40-60 kg. Followed by 33.9 percent of subjects were 61-80 kg of weight.

Among the 54 respondents, the majority of the subjects 55.6 percent waist size falls between 30-40 cm and least number of subjects 44.4 percent waist size were between 20-30cm.

It was observed that 100 percent of the subject's hip sizes were between 30-40 cm.

Pregnancy weeks

The Pregnancy weeks of the selected pregnant women is depicted in the figure below and discussed.

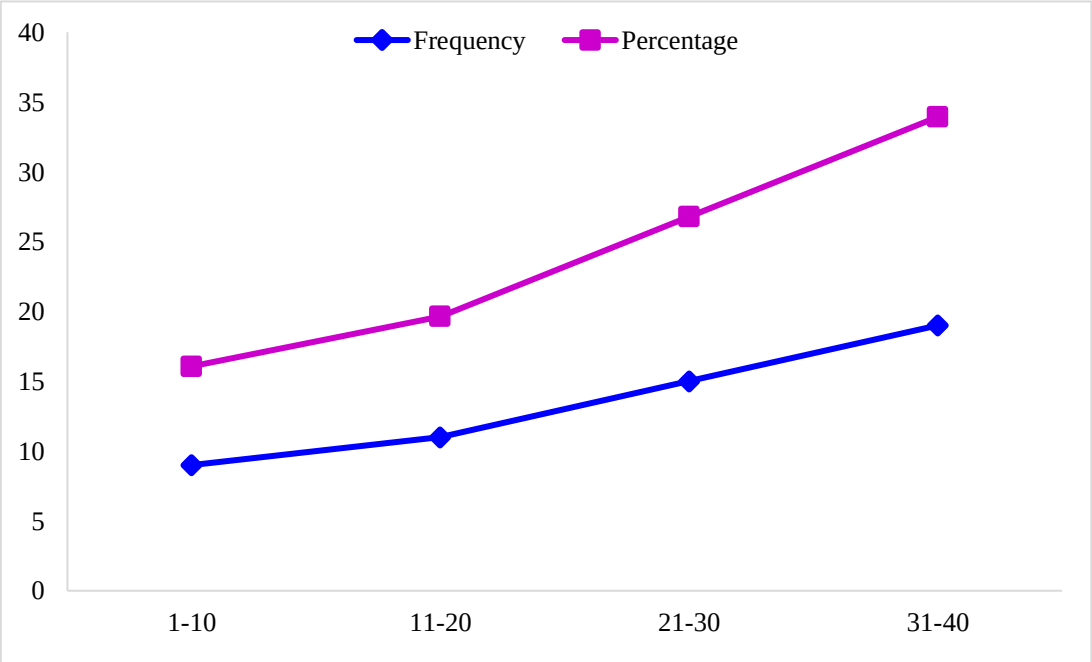


Fig 42: Pregnancy Weeks of the Selected Subjects

From the above figure it was shown that 33.9 percent of the selected pregnant women were between the pregnancy weeks of 31-40 respectively. Followed by 26.8 percent pregnant women between 21-30 weeks of pregnancy. Furthermore 19.6% of the women between 11-12 weeks of pregnancy, and the least subjects of 16.1percent between the weeks of 1-10.

According to Aldadhli (2005), insulin secretion increases during early pregnancy, but insulin sensitivity remains constant, decreases, or even increases. As a result, GDM normally appears in the late second trimester and disappears almost immediately after birth.

Dietary Pattern

Dietary pattern of the selected pregnant women is given in Figure and discussed below.

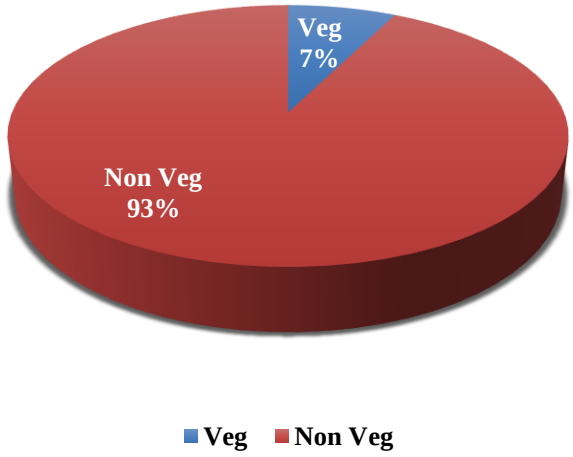


Fig 43: Food intake Pattern of the Selected Subjects

The above figure indicates that 93 percent of the selected pregnant women were non-vegetarian respectively. Furthermore, 7.1 percent of the of the selected pregnant women were found to be vegetarian.

According to Zadeh *et. al.,* (2020) states that a sensible, vegetable, and Mediterranean dietary pattern with high whole grain, fruits, vegetables, and low-fatdairy intake reduced the risk of GDM.

BMI (Body Mass Index)

The height and weight of the selected pregnant women were collected. The BMI was calculated and the subjects were categorised for their body weight composition. The observation table are elaborate below.

The cut-offs used for gestational weight gain below the IOM guidelines were as follows: for underweight women (BMI < 18.5 kg/m^2), for normal-weight women (BMI 18.5 to 24.99 kg/m^2), for overweight women (BMI 25 to 29.99 kg/m^2), and for obese women (BMI > 30 kg/m^2)

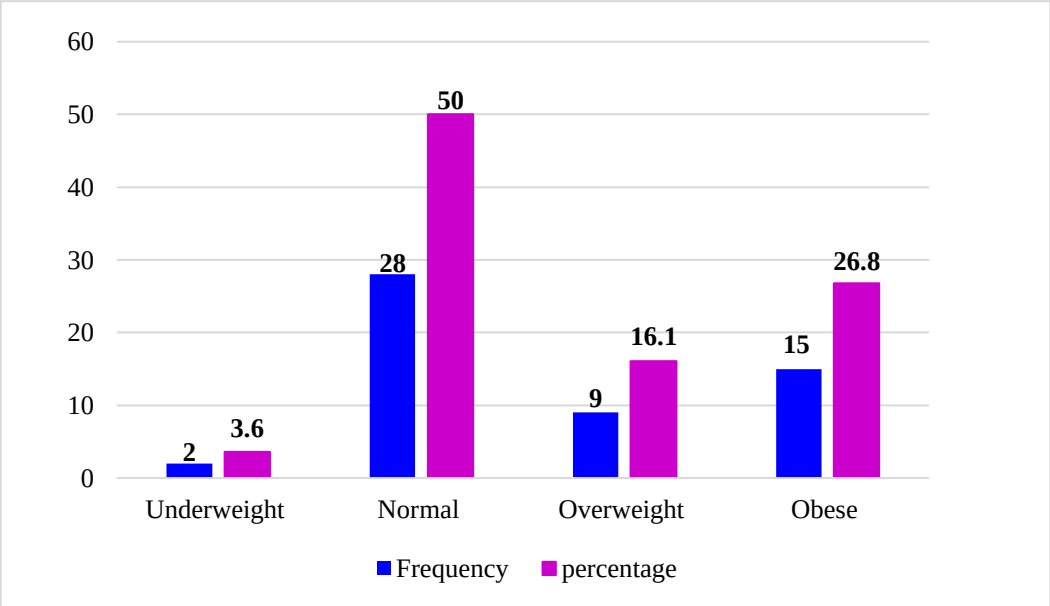


Fig 44: BMI of the Selected Subjects

It was clear from the above figure that 50 percentage of the selected pregnant women were found to be normal body weight composition. Further it was also observed that 26.8 and 16.1 percent of selected pregnant women were found to be obese and overweight respectively. Lastly 3.6 percent of the selected women were underweighted.

Recipe's Collection of the 24 hrs Diet Recall

The figure 44 illustrates the 24 hrs diet recall consumed by the selected pregnant women. Among the 54 selected pregnant women 17 were from Coimbatore, and 37 pregnant women were from Manipur. The 24 hrs diet recall presented in the above figure consist of Early morning, Breakfast, Drinks, Lunch/Dinner, Fruits and Snacks. Among the 17 subjects from Coimbatore most of the women consumed Milk and Millet porridge in early morning, dosa, idli, upma, chutney which are the main dish of South Indian were consumed in breakfast, for lunch and dinner majority of them prefer dosa, rice, idli, sambar, rasam, chutney's, curd, non-veg curry, veg curry, colour rice, tomato rice etc. As for the fruit and drinks they prefer all types of fruit and drinks like fruit juices and snacks items like vada

Furthermore, among the 37 subjects from Manipur, most of the pregnant women goes for poori, matar dal fry, roti, bakery items (cakes, cookies, donut, puff etc), with milk tea, black tea, milk, sometimes boiled egg. As for the lunch and dinner they usually consumed rice in both lunch and dinner along with that some of the side

dishes were consumed which include boiled vegetable curry (kangsoi) or chutney (Eromba) or mixed vegetable dry fry or non-veg curry or cabbage, cauliflower curry or, boiled vegetables, fried egg, dal fry, fried fish. As for the fruits they go for banana, apple, mango, and snacks items like mix veg chutney (Singju), fried rice, pakora.

Fig 45: Recipe's Collection of the 24 Hours Diet Recall

The Knowledge of GDM

The knowledge of GDM by the selected pregnant women for managing the GDM among the expectant mother

TABLE II

SELECTED SUBJECTS' KNOWLEDGE OF GDM

Knowledge	**n=54**			
	Yes	**%**	**No**	**%**
GDM	4	7.1	50	89.3
Complication	2	3.6	52	92.9
Preeclampsia	2	3.6	52	92.9
Eclampsia	2	3.6	52	92.9
Polyhydramnios	-	-	54	100
Preterm birth	3	5.4	51	91.1
Stillbirth	3	5.4	51	91.1
Higher risk	3	5.4	51	91.1

It was observed from the above table that among the 54 selected subjects only 7.1 percent of the subjects are aware about gestational diabetes and 89.3 percent of the subjects are not aware.

Furthermore, 92.9 percent of the subjects don't have the idea that GDM has both maternal and fetal complication, only 3.6 percent of the subjects have the idea of GDM complication. 92.9 percent, 92.9 percent, 100 percent, 91.1 percent and 91.1 percent of the pregnant women haven't heard about the term preeclampsia, eclampsia, polyhydramnios, preterm birth and stillbirth.

Lastly 91.1 percent of the subjects don't know that babies with gestational diabetes have a greater chance of developing obesity and type 2 diabetes.

TABLE III

RELATIONSHIP BETWEEN QUALIFICATION AND SELECTED SUBJECTS' KNOWLEDGE OF HIGHER RISK OF GDM

	Selected Subjects' knowledge of higher risk of GDM					
		Yes	**No**	**Total**	**X^2**	**P Value**
Qualification	10 standards	0	22	22	20.965[a]	0.000
	12 standards	0	13	13		
	B. Sc	2	13	15		
	Master	0	3	3		
	Professional	1	0	1		
	Total	**3**	**51**	**54**		

Table indicates that there was a significant ($p<0.05$) relationship between the qualification and selected subjects knowledge of higher risk of GDM (X^2 (4) = 20.965, $P<0.05$). Majority of the selected subjects don't have the knowledge of GDM as well as the higher risk of GDM and only 2 with B. Sc qualification and 1 professional qualification selected subjects have the knowledge of GDM and also the higher risk.

Over 75% of rural women were unaware of GDM's long-term consequences, and 56% were unaware that GDM could lead to the development of T2DM in the future. GDM is poorly understood by pregnant women, especially in rural areas. (Bhavadharani*et. al.,* 2017)

TABLE IV

RELATIONSHIP BETWEEN QUALIFICATION AND SELECTED SUBJECTS' KNOWLEDGE ON COMPLICATION OF GDM

	Selected subjects' knowledge on complication of GDM					
		Yes	**No**	**Total**	**X^2**	**P Value**
Qualification	10 standards	0	22	22	5.400[a]	0.249
	12 standards	0	13	13		
	B. Sc	2	13	15		
	Master	0	3	3		
	Professional	0	1	1		
	Total	**2**	**52**	**54**		

The above table highlighted a significant (P<0.05) association between the qualification and knowledge of complication of GDM (X^2 (4) = 5.400[a], P< 0.05). This indicates that majority of the selected subjects don't have the knowledge of complication of GDM and only 2 respondents have the knowledge of GDM complication

TABLE V

ASSOCIATION BETWEEN SELECTED SUBJECTS' KNOWLEDGE ON GDM WITH PREECLAMPSIA, ECLAMPSIA, POLYHYDRAMNIOS, PRETERM BIRTH, STILLBIRTH

	Selected subjects' knowledge on GDM					
		Yes	**No**	**Total**	**X^2**	**P Value**
Preeclampsia	Yes	1	1	2	5.493[a]	0.019
	No	3	49	52		
	Total	4	50	54		
Eclampsia	Yes	1	1	2	5.493[a]	0.019
	No	3	49	52		
	Total	4	50	54		
Polyhydramnios	Yes	0	0	0	0	0
	No	4	50	54		
	Total	4	50	54		
Preterm birth	Yes	2	1	3	16.264[a]	0.000
	No	2	49	51		
	Total	4	50	54		
Stillbirth	Yes	2	1	3	16.264[a]	0.000
	No	2	49	51		
	Total	4	50	54		

From the above table it was illustrated that there was a significant (p<0.05) relationship between the selected subject's knowledge of GDM and the term preeclampsia, eclampsia, polyhydramnios, preterm birth, stillbirth. This indicates that most of the selected subjects don't have the knowledge of preeclampsia, eclampsia, eclampsia, polyhydramnios, preterm birth & stillbirth.

According to study done Islam *et. al.,* (2017) show that 19.6 percent had very poor knowledge, 60.7 percent had poor knowledge, 17.8 percent had average knowledge, 1.9 percent had good knowledge and no excellent knowledge.

TABLE VI

SELECTED SUBJECTS' BMI (BODY MASS INDEX) AND WHR (WAIST HIP RATIO)

	r_p value	**P value**	**N**
BMI VS WHR of the respondent	-0.120	0.032	54

The above table VI highlighted a negative significant difference ($p<0.05$) association between BMI & WHR of the selected subjects. This indicates that respondent who had normal body mass index (BMI) does not have normal waist hip ratio (WHR).

The risks of GDM were higher in obese by BMI or WHR. Increased WHR and BMI in early pregnancy are associated with GDM. (Basraon *et. al.,* 2016)

C. Evaluation of the Web Application (Students, Dietitian, Computer professionals, Pregnant Women)

TABLE VII

SELECTED SUBJECTS' SATISFACTION ABOUT THE NUTRITIONAL ASSESSMENT RESULT WITH CLINICAL ASSESSMENT, DESIGNATION, NUTRIENTS CALCULATIONS & NUTRIENT COMPARISON

Nutritional assessment result	**r_P value**	**P value**
Clinical assessment	0.132*	0.041
Designation	0.303*	0.028
Nutrient calculations	0.529**	0.000
Nutrient comparison	0.432*	0.005

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

From the above table, it elaborates a positively significant (p=0.041) association between the nutritional assessment result of the selected subjects with the clinical assessment by the respondent of about 13 percent, with the designation of 30 percent respondent (p=0.028), 52 percent of subjects with nutrients

calculations(p=0.000) and nutrients comparison with 43 percent of the subjects (p=0.005). This indicates that respondent who felt satisfied with the nutritional assessment result also felt easy with the clinical assessment, nutrients calculations and nutrients comparison.

TABLE VIII

SELECTED SUBJECTS' SATISFACTION ABOUT CLINICAL ASSESSMENT WITH DESIGNATION, NUTRIENT CALCULATION & NUTRIENT COMPARISON

Clinical Assessment	r_P value	P Value
Designation	-0.98*	0.042
Nutrient calculations	-0.59*	0.037
Nutrient comparison	0.57*	0.005

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

From the table, it was observed a negatively significant (p=-0.042) association between the clinical assessment of the selected subjects and designation of about 98 percent and (p=0.037) with the nutrient calculations of 59 percent of the selected subjects, this indicates that the subjects based on the designation and nutrients calculations does not felt easy to assess the clinical assessment. Positive significant (p=0.037) selected subjects association between the clinical assessment and nutrient comparison, indicates that those c who felt easy with the clinical assessment felt satisfied with the nutrient comparison.

TABLE IX

SELECTED SUBJECTS' SATISFACTION BASED ON DESIGNATION WITH NUTRIENT CALCULATION & NUTRIENT COMPARISON

Designation	$r_P$value	P value
Nutrient calculations	0.175*	0.028
Nutrient comparison	0.277*	0.048

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

The above table IX shows that there was a positively significant (p=0.028) association between the designation and the nutrients calculations of the respondent of about 17 percent and (p=0.048) between the designations and nutrients comparison of

the respondent. This indicates that based on the designation subjects felt satisfied with both the nutrient calculations and nutrient comparison.

The use of image-based dietary records was well-received by participants, with the majority ready to utilise the practise again. This would also be a valuable and practical method for dietitians in research or practise settings. (Ashman *et. al.,* 2017)

TABLE X

SELECTED SUBJECTS' SATISFACTION ABOUT NUTRIENT CALCULATIONS WITH NUTRIENT COMPARISON

	r_P value	**P Value**
Nutrient calculations Vs Nutrient comparison	0.663**	0.000

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

It was observed from the table X that there was a positively significant (p=0.000) association between the nutrient calculations and nutrients comparison of the respondent about 66 percent. This indicates that selected subjects who felt satisfied with the nutrient calculations of the diet consumed also felt satisfied with the nutrient comparison.

TABLE XI

SELECTED SUBJECTS' SATISFACTION ABOUT FUNCTIONALITY OF THE WEB APPLICATION WITH LEARNING, USER-FRIENDLY, EXPECTATION, EXHAUSTING & RECOMMENDATION

Functionality	**r_P value**	**P Value**
Learning	-0.424*	0.006
Friendly	-0.260*	0.010
Expectation	-0.424*	0.006
Exhausting	0.314*	0.048
Recommendation	0.114*	0.045

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

From the table XI, a negatively significant (p=0.006) association between the functionality and learning of the selected subjects of about 42 percent, (p=0.010) association between functionality and friendly of the respondent of about 26 percent, and (p=0.006) association between the functionality and expectation of the subjects of

about 42 percent. This indicates that respondents who felt satisfied with the functionality of the web application does felt the same satisfaction with the learning, user-friendly and expectation of the web application. On the other hand there shows a positive significant (p=0.048) association between the functionality and exhausting of the subjects of about 31 percent and (p=0.045) functionality and recommendation of the subjects of about 11 percent. Which indicates that subjects who felt satisfied with the functionality also felt replenish and felt satisfied to recommend the web application to their colleague.

Acceptability, feasibility, usefulness, and satisfaction were generally favourable in the Cartar *et al.*, (2019) study, both with the mobile app being evaluated and with the care it was designed to support on a mobile phone apps for clinical decision support in pregnancy.

TABLE XII

SELECTED SUBJECTS' SATISFACTION ABOUT LEARNING TOPIC OF THE WEB APPLICATION WITH USER-FRIENDLY, EXHAUSTING & RECOMMENDATION

Learning	**r_P value**	**P value**
Friendly	-0.37*	0.022
Exhausting	0.61*	0.001
Recommendation	0.145*	0.037

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

The above table depict that there was negatively significant (p=0.022) association between the learning and user friendly of the subjects of about 37 percent. This indicates that the respondent who felt satisfied with the learning topic of the web application does not felt user-friendly with the web application. Whereas there was positively significant (p=0.001) and (p=0.037) association between the learning and exhausting use of the web application and between learning and recommendation of the web application of the subjects of about 61 percent and 14 percent. This indicates that the subjects who felt very satisfied with the learning topic also felt replenish to use the web application and also satisfied enough to recommend to others.

TABLE XIII

SELECTED SUBJECTS' SATISFACTION TO THE USER-FRIENDLY OF THE WEB APPLICATION WITH EXPECTATION, EXHAUSTING & RECOMMENDATION

Friendly	r_P value	P Value
Expectation	-0.37*	0.022
Exhausting	0.87*	0.005

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

From the above table there was negatively significant (p=0.022) association between the user friendly and expectation of the web application of the subjects of about 37 percent and (p=0.005) between the user friendly and recommendation of the respondent of about 23 percent. This indicates that respondent who felt friendly with web application does satisfied with their expectation and recommendation of the web application. On the other hand, there show a positive significant (p=0.008) association between the user friendly and exhausting of the web of subjects about 87 percent, which indicates that subjects who felt user friendly also felt replenish to use the web application.

TABLE XIV

SELECTED SUBJECTS' SATISFACTION ABOUT EXPECTATION OF THE WEB APPLICATION WITH EXHAUSTING AND RECOMMENDATION

Expectation	r_P value	P Value
Exhausting	0.61*	0.011
Recommendation	0.145*	0.003

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

The above table shows that there was positively significant (p=0.011) association between expectation and exhausting of the web application of the subjects of about 61 percent. Also (p=0.003) between the expectation and recommendation of the subjects of about 14 percent. This indicates that respondent who felt satisfied with their expectation for the web application also felt satisfied with the replenish and recommendation for the web application.

TABLE XV

SELECTED SUBJECTS' SATISFACTION ABOUT THE VIDEOS WITH INSTRUCTION, TIMINGS AND RATINGS

Videos	r_P value	P Value
Instruction	-0.46**	0.000
Timing	0.466*	0.002
Ratings	0.60*	0.012

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

From the table there was negative significant (p=0.000) association between videos and instruction of the subjects of about 40 percent. This shows that respondent who felt satisfied with the videos does not felt satisfied with the instruction. Whereas there shows positive significant (p=0.002) and (p=0.012) association between the videos with timing and ratings with the subjects of 46 percent and 60 percent, which indicates that the subjects who felt satisfied with the videos also felt satisfied with the timings and ratings of the web applications.

TABLE XVI

SELECTED SUBJECTS' SATISFACTION ABOUT THE INSTRUCTION WITH TIMINGS AND RATINGS

Instruction	r_P value	P Value
Timing	0.424*	0.006
Ratings	-0.164*	0.011

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

From the above table it was observed that there was positive significant (p=0.006) association between the instruction and timings of the respondent of about 42 percent. Which depicts that subject who felt satisfied with the instruction also felt satisfied with the timings. On the other hand, there was negatively significant (p=0.011) between the instruction and ratings of subjects of about 16 percent which indicate even though they felt satisfied with the instruction they felt unsatisfied with their ratings on web application.

Written cues were the most prevalent way for applications to give exercise instruction, followed by videos, spoken cues, and finally graphics or still photographs to depict the exercise. (Hayman *et. al.*, 2022)

TABLE XVII

SELECTED SUBJECTS' SATISFACTION ABOUT THE TIMING WITH RATINGS

	r_P value	P Value
Timing Vs Ratings	0.114*	0.042

***r_p- Spearman's correlation** ***Correlation is significant at the 0.01 level (2-tailed)**

The tables shows that there was positive significant (p=0.042) association between the timings and ratings of the subjects of about 11 percent, this indicate that those respondents who felt satisfied with the timings also felt satisfied with the ratings for the web applications.

TABLE XVIII

DIFFERENCE BETWEEN SELECTED SUBJECTS' RESPONSE ON NUTRIENT CALCULATIONS WITH DIETARY SURVEY AND GESTATIONAL DIABETES

Variable		Mean	Standard deviation	f	P value
Dietary	Very satisfied	2.0000**	.00000	20.805	0.000
	Satisfied	1.9444**	.23570		
	Average	1.2500	.50000		
	Total	1.9000	.30382		
Gestational diabetes	Very satisfied	1.8889*	.32338	4.102	0.025
	Satisfied	1.7222*	.46089		
	Average	1.2500	.50000		
	Total	1.7500	.43853		

***The mean difference is significant at the 0.05 level**

From the above table XVII, it was highlighted that there was a significant difference between (p<0.05) the nutrient calculation with the ratings of the dietary survey and information regarding gestational diabetes. When comparing with the nutrient calculation it was clear that most of the respondents were very satisfied and satisfied with the dietary survey and gestational diabetes.

TABLE XIX

DIFFERENCE BETWEEN SELECTED SUBJECTS' RESPONSES ON NUTRIENT COMPARISON WITH VIDEOS, TIMING, ANTHROPOMETRY, CLINICAL ASSESSMENT, EXERCISE AND DIET

Variable		Mean	SD	f	P-value
Videos	Very satisfied	1.0769*	.27735	3.043	0.060
	Satisfied	1.0400*	.20000		
	Average	1.5000	.70711		
	Total	1.0750	.26675		
Timing	Very satisfied	1.0769**	.27735	10.793	0.000
	Satisfied	1.0800**	.27689		
	Average	2.0000	.00000		
	Total	1.1250	.33493		
Anthropometry	Very satisfied	1.9231*	.27735	6.444	0.004
	Satisfied	1.8400*	.37417		
	Average	1.0000	.00000		
	Total	1.8250	.38481		
Clinical assessment	Very satisfied	2.0000*	.00000	12.158	0.000
	Satisfied	1.8800*	.33166		
	Average	1.0000	.00000		
	Total	1.8750	.33493		
Exercise	Very satisfied	1.9231*	.27735	5.034	0.012
	Satisfied	1.7600*	.43589		
	Average	1.0000	.00000		
	Total	1.7750	.42290		
Diet	Very satisfied	2.0000**	.00000	9.580	0.000
	Satisfied	1.8400**	.37417		
	Average	1.0000	.00000		
	Total	1.8500	.36162		

***The mean difference is significant at the 0.05 level**

The above table XIX elaborates that there was a significant difference between ($p<0.05$) the nutrients comparison with the video's presentation, timing to perform the exercise for pregnancy, anthropometry measurement, clinical assessment, exercise

information and diet provided. When comparing with the nutrients comparison it was shown that most of the respondents were very satisfied and satisfied with the videos, timing, anthropometry, clinical assessment, exercise, and diet.

TABLE XX

DIFFERENCE BETWEEN SELECTED SUBJECTS' RESPONSES ON NUTRITIONAL ASSESSMENT RESULT WITH WAIST HIP RATIO(WHR), TIMING, ANTHROPOMETRY, CLINICAL ASSESSMENT AND DIET

Variable		Mean	SD	f	P value
WHR	Very satisfied	1.0000*	.00000	1.841	0.013
	Satisfied	1.0000*	.00000		
	Average	1.3333	.57735		
	Total	1.0250	.15811		
Timing	Very satisfied	1.1111*	.33333	5.217	0.010
	Satisfied	1.0714*	.26227		
	Average	1.6667	.57735		
	Total	1.1250	.33493		
Anthropometry	Very satisfied	1.8889*	.33333	2.936	0.016
	Satisfied	1.8571*	.35635		
	Average	1.3333	.57735		
	Total	1.8250	.38481		
Clinical assessment	Very satisfied	2.0000*	.00000	5.695	0.012
	Satisfied	1.8929*	.31497		
	Average	1.3333	.57735		
	Total	1.8750	.33493		
Diet	Very satisfied	1.8889*	.33333	3.783	0.032
	Satisfied	1.8929*	.31497		
	Average	1.3333	.57735		
	Total	1.8500	.36162		

***The mean difference is significant at the 0.05 level**

It was observed from the above table XX that there was a significant difference between ($p<0.05$) the nutritional assessment result with the waist hip ratio value, timing provided for the exercise, anthropometry, clinical assessment and diet provided for the pregnant women. This indicates that when comparing the nutritional

assessment result most of the respondents were very satisfied and satisfied with the waist hip ratio (WHR), timing, anthropometry, clinical assessment and diet.

TABLE XXI

ASSOCIATION OF RATINGS AND KNOWLEDGE OF GESTATIONAL DIABETES MELLITUS, SYMPTOMS, RISK FACTOR, PREVENTION, DIET, AND MENU PLAN

	Ratings							
		5	**4**	**3**	**2**	**Total**	**X^2**	**P value**
GDM	Yes	18	19	1	1	39	1.134	0.032
	No	1	0	0	0	1		
	Total	19	19	1	1	40		
Symptoms	Yes	18	19	1	1	39	1.134	0.032
	No	1	0	0	0	1		
	Total	19	19	1	1	40		
Risk Factor	Yes	18	19	1	1	39	1.134	0.32
	No	1	0	0	0	1		
	Total	19	19	1	1	40		
Prevention	Yes	18	19	1	1	39	1.134	0.32
	No	1	0	0	0	1		
	Total	19	19	1	1	40		
Diet	Yes	18	19	1	1	39	1.134	0.32
	No	1	0	0	0	1		
	Total	19	19	1	1	40		
Menu Plan	Yes	18	19	1	1	39	1.134	0.32
	No	1	0	0	0	1		
	Total	19	19	1	1	40		

*****[$X^2(3) = 1.134$, $P<0.05$]

From the above table it shows the relationship between ratings with GDM, symptoms, risk factor, prevention, diet and menu plan. The majority of the subjects of 19 numbers felt clear knowledge of GDM, symptoms, risk factors, prevention, diet and menu plan gave the ratings of 4. Followed by 18 subjects with the ratings of 5.

Least number of 1 subject each who felt clear knowledge of GDM, symptoms, risk factor, prevention, diet, menu plan was not provided, gave the rating of 3 and 2.

TABLE XXII

ASSOCIATION OF RATINGS AND COMPLICATIONS OF GDM OF THE RESPONDENT

		Ratings						
		5	**4**	**3**	**2**	**Total**	**X^2**	**P value**
Complication	Yes	18	19	1	0	38	20.055[a]	0.000
	No	1	0	0	1	2		
	Total	19	19	1	1	40		

***[X^2(3) =20.055[a], P<0.001]**

The above table highlighted the relationship between the ratings and complications of GDM of the selected subjects. The majority of 19 subjects felt that it gives clear information about GDM complications in the web application gave the rating of 4. Least number of 1 subject felt that it adds less information about gestational diabetes in the application gave the rating of 3. None of the subjects gave ratings of 1 of the complication.

TABLE XXIII

ASSOCIATION OF DESIGNATION WITH GDM, SYMPTOMS, RISK FACTOR, PREVENTION, DIET, MENU PLAN OF RESPONDENT

	Designation							
		Students	**Dietitian**	**Computer Professional**	**Pregnant Women**	**Total**	**X^2**	**P value**
GDM	Yes	10	10	10	9	39	3.077[a]	0.013
	No	0	0	0	1	1		
	Total	10	10	10	10	40		
Symptoms	Yes	10	10	10	9	39	3.077[a]	0.013
	No	0	0	0	1	1		
	Total	10	10	9	10	40		
Risk factor	Yes	10	10	10	9	39	3.077[a]	0.013
	No	0	0	0	1	1		
	Total	10	10	9	10	40		
Prevention	Yes	10	10	10	9	39	3.077[a]	0.013
	No	0	0	0	1	1		
	Total	10	10	9	10	40		
Diet	Yes	10	10	10	9	39	3.077[a]	0.013
	No	0	0	0	1	1		
	Total	10	10	9	10	40		
Menu plan	Yes	10	10	10	9	39	3.077[a]	0.013
	No	0	0	0	1	1		
	Total	10	10	9	10	40		

***[X^2 (3) =3.077[a], P<0.05]**

The above table highlighted the association between the designation with GDM, symptoms, risk factor, prevention, diet, menu plan. It indicates that a maximum number of 10 respondents from each designation felt that the knowledge of GDM, symptoms, risk factor, prevention, diet and menu plan was clearly provided in the web application. And the least number of 1 subjects (pregnant women) felt the web application does not provide clear information about GDM, symptoms, risk factors, prevention, diet, menu plan.

The Mother system, according to Varnfied et al. (2021), has the potential to considerably benefit pregnant women by allowing for speedier treatments while also eliminating unnecessary trips to GDM prenatal clinic

TABLE XXIV

ASSOCIATION OF DESIGNATION AND COMPLICATION OF GDM

	Designation							
		Students	**Dietitian**	**Computer Professional**	**Pregnant Women**	**Total**	**X^2**	**P value**
Complication	Yes	10	10	9	9	38	2.105^a	0.031
	No	0	0	1	1	2		
	Total	10	10	10	10	40		

***[X^2 (3) =2.105^a, P<0.05]**

The above table elaborates the association between the designation with complication of GDM. It indicates that a maximum number of 10 subjects each from student, dietitian and computer professionals felt that the knowledge of GDM complication was clearly provided in the web application. And the least number of 1 subject from pregnant women felt the web application does not provide clear information about GDM complication.

TABLE XXV

RESPONDENT SATISFACTION ON NORMAL HEIGHT AND WEIGHT WITH PREGNANCY WEIGHT GAIN CALCULATION, PREGNANCY WEIGHT DISTRIBUTION, PREGNANCY BELLY SIZE CHART

Variable	Mean	SD	t	P value
Pregnancy weight gain calculation	1.0500	.22072	30.087	.000
Normal height and weight	1.1000	.30382	22.898	.000
Pregnancy weight distribution	1.0750	.26675	25.488	.000
Pregnancy belly size chart	1.0500	.22072	30.087	.000

From the above table it was observed that there was a positively significant which indicates that when comparing with the subject's satisfaction on pregnancy weight gain calculation, pregnancy weight distribution and pregnancy belly size chart is higher than the respondent satisfaction on normal height and weight.

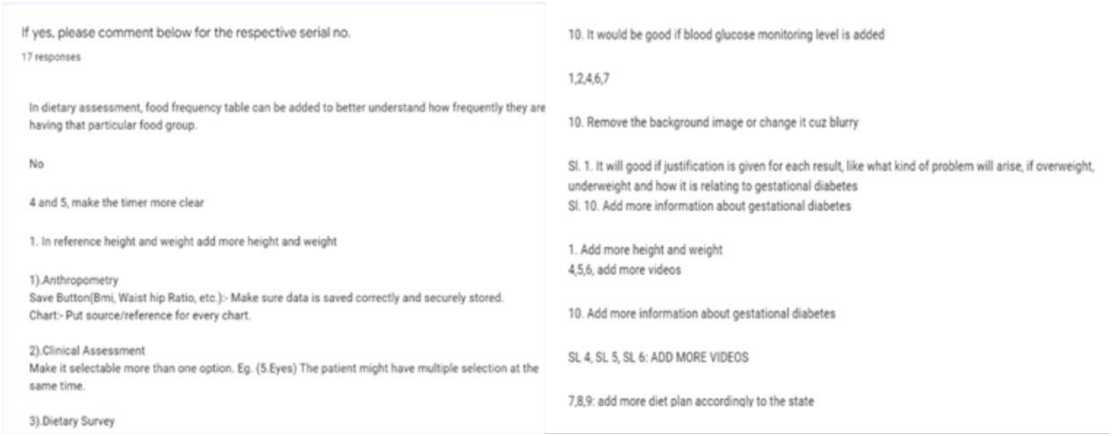


Fig 46: Screenshot of the Respondent Suggestion on the Improvement of the Web Application

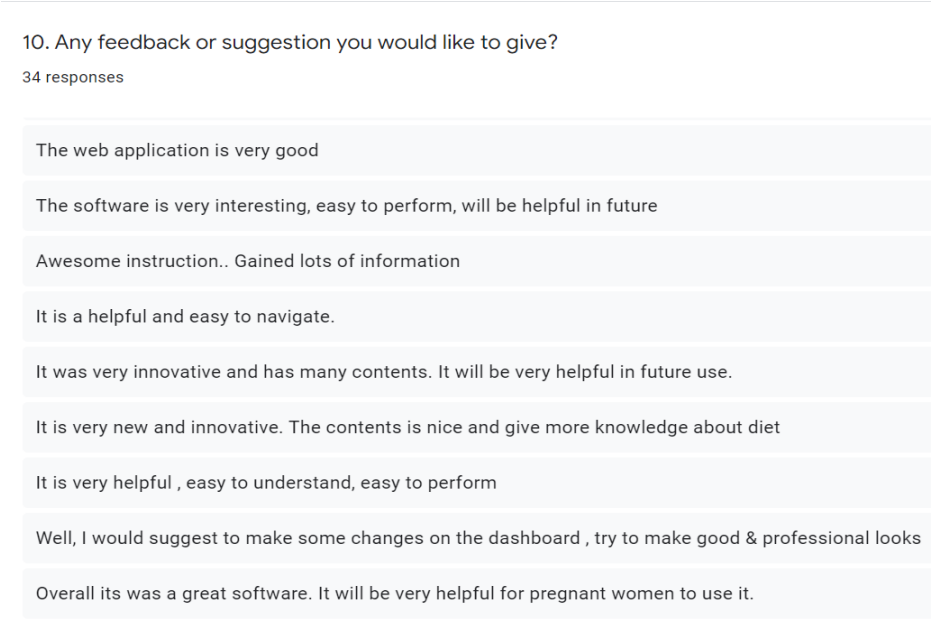


Fig 47: Screenshot of Respondent Feedback on the Web Application

D. Awareness to manage gestational diabetes among expectants mothers.

Fig 47: Awareness and data collection session in Women's Health Clinic, Coimbatore

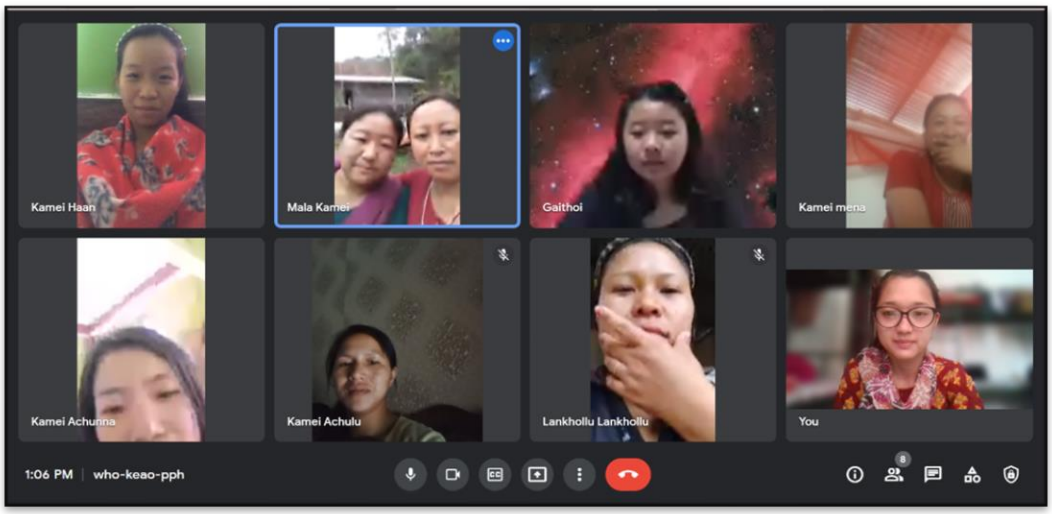


Fig 48: Screenshot of Awareness Session through Google Meet

SUMMARY & CONCLUSION

V. SUMMARY AND CONCLUSION

The goal of the study was to educate pregnant women about healthy pregnancy and how to control gestational diabetes via a web application. Since gestational diabetes mellitus is now a well-known health problem that is spreading over the globe, The female population requires immediate attention in terms of health education. Electronic media, such as the internet, have become more accessible and convenient as modern technology has advanced. When it comes to web applications, they allow topic content such as texts, videos, and audio to be clearly displayed on the internet.

Instead of relying on face-to-face and paper techniques, young women in their reproductive years are increasingly using the internet, social media, and smartphone apps to obtain health information. The current era has ushered in a trend of using mobile health to reach out to women. Mobile health could also be beneficial to young expectant women. Maintaining a healthy lifestyle while pregnant has advantages for both mothers and newborns.

In the past, when technology was lacking, pregnant women had to rely on midwives, doctors, friends, or relatives for pregnancy-related information. However, the development of mobile health interventions has a number of advantages, including low cost, simple access to health information, outreach to lower socioeconomic groups, and fewer hospital visits.

The study was designed with the following objectives, to developed a web application for expectant mothers, to educate and encourage expectant mothers to lead a healthy lifestyle with the help of the developed web application and lastly to find out impact using the web application.

The foremost step in the development of the web application was charting out an effective plan followed by reviewing and synthesizing various materials. The next step was developing the web using software developing text, videos, voice, picture and adjusting the font size and color, screen size, color of the screen etc.

A developed web application consists of 5 module which contains all the necessary information regarding: Module 1- Nutritional assessment like

Anthropometry measurement for women which include BMI calculations based on IOM guidelines, WHR, Pregnancy weight gain calculations; Clinical assessment; Dietary survey which includes 24 hours diet recall, nutrient calculations using ICFT books (2017), nutrients comparison according to Recommended Allowances (2020).

There was also nutritional assessment which will give all the result which include BMI value, WHR value, Clinical assessment result and calorie calculations, if exceeds exercise is recommended; Module 2- Exercise, yoga and meditation that can be performed during pregnancy providing related youtube videos, instructing and timings to perform; Module 3 - Diet for pregnancy which includes foods to included, foods to be avoided, model menu plan for both vegetarian and non-vegetarian based on South Indian cuisines for all the three trimester, Module 4 - Healthy pregnancy tips; Module 5 - Gestational diabetes which consists of symptoms, complication, risk factors, prevention, diet for GDM and menu plan for GDM which includes both vegetarian and non-vegeterian diet plan.

Using the web application data was collected for 54 pregnant women from Coimbatore, Tamil Nadu and Imphal, Manipur to evaluate the knowledge of gestational diabetes that was carried out through online and offline. To evaluate questionnaire were made which include the subjects profile details, 24 hrs diet recall in order to find out their commonly consumed foods items and knowledge about GDM and related term. Also 40 Responses, 10 respondents each from students, dietitian, computer professionals and pregnant women were collected to find out the applicability of the web application for wider use. The questionnaire includes whether they are satisfied with all the 5 module and also it to give comments if any improvement needed in the web application. Lastly awareness to the expectant mothers with the developed app through online and offline was also done. Keeping all these aspects the current research was carried out.

The salient features are:

1. **Development of the web application to manage gestational diabetes among expectant mother's**
    - The "Registration" icon would enable the user to register and then "Log in" page enables the user to view the web application. A click on the submit button will take to the home screen or dashboard.
    - The user needs to fill in their details such as First name, last name, role selection whether they are admin or user, email, mobile number, occupation, food category whether they are vegetarian or non-vegetarian, qualification, age, address and password. After registering "Log in" is also provided to secure their data. On completion of registration process, they will access to home screen.
    - The Home page of the web application has five modules. A click on each module will take the user to the respective module namely Module 1: "Nutritional Assessment", Module 2: "Exercise, Yoga, Meditation, Module" 3: "Diet for pregnancy" Module 4: "Healthy Pregnancy", Module 5: "Gestational Diabetes".
    - The first module "Nutritional assessment" was conceptualized to know the nutritional status of pregnant women. Thus, the screen was developed with 4 sections namely Anthropometry, Clinical assessment, dietary survey. Under section 1 Anthropometry another 6 sub section is divided namely , "BMI" were the user will enter height(cm) and weight(kg) and will automatically calculate the result, "Waist Hip Ratio" were waist(cm) and hip(cm) will enter and result value will be automatically shown, "Pregnancy weight gain calculations" were the user has to enter the height(cm), weight(kg) and their pregnancy weeks and then min-max wight to be gain during the particular weeks will be shown and also for the whole weeks of pregnancy, "Pregnancy belly size chart", "Normal height and weight references for women", and "Pregnancy weight gain distributors".
    - Section 2 "Clinical assessment" which involves assessing the nutritional status by checking sign and symptoms of any related nutrient deficiency on the body. The user has to select if they have any sign and symptoms for general appearance, subcutaneous fat, muscle mass, skeleton, teeth and tongue,

gastrointestinal, cardiovascular, endocrine, neurologic, hair, skin, mouth, eyes, neck, extremities was given.

- Section 3 is the dietary survey of the user which consists of 24 hours diet recall, nutrients calculations, nutrient comparison. The user has to enter what they ate then automatically the nutrients will be calculated based on the IFCT book (2017) and then nutrient comparison of the actual intake and RDA will be provided.
- Section 4 is the "Nutritional assessment result" after filling all the above details the result for all the 3 sections will be provided - BMI value, Clinical data, Total Nutrition, and Total calorie.
- Module 2 "Exercise, Yoga, Meditation" was designed to stay fit and healthy during pregnancy by doing the given exercise, yoga and meditation. Clicking on these different categories of exercise, yoga and meditation will be shown for three trimesters of pregnancy. This will be included youtube videos, instructions, and timing to perform.
- Module 3 "Diet for pregnancy" was conceptualized to elaborate on the diet to be included and avoided during the 3 trimesters of pregnancy. Information like how they have to included or avoided, how much to take, benefit of that particular food items, rich sources of food were included in this module.
- Module 4 "Healthy Pregnancy" of the web application was design with tips to have a healthy pregnancy. A click on the shown images will let the user to view in details. Tips included were - Intake of folic acid; No alcohol, smoking, or drugs; Avoid exposure to toxic substances; Maintaining and following a healthy diet; Limit caffeine intake; Eat a safe and healthy diet; Physical activity; Maintain a healthy weight; Maintaining Nutrition status; Get regular dental follow up; Prevent infections that can affects pregnancy.
- Module 5 "Gestational diabetes mellitus" was designed to aware and add knowledge the user about Gestational diabetes mellitus. In this screen information like Gestational Diabetes Mellitus, its symptoms, followed by questionnaire regarding whether they had knowledge about complication, heard any term related to GDM, and risk factors, then continued with complications, risk factors, prevention and lastly diet for GDM were provided.

Furthermore, a menu plan for Gestational Diabetes Mellitus was provided in both vegetarian and non-vegetarian menu.

2. **Evaluation of the knowledge of gestational diabetes among selected pregnant women**
    - The 54 subjects were selected based on purposive random sampling methods.
    - Among the selected 54 subjects' pregnant women 39 subjects falls between 20-30 age group. This was followed by the least number of 15 subjects between the age of 31-40.
    - Around 29.6 percent of the subjects were 12th graders. Undergraduate subjects made up 22.2 percent of the subjects. Postgraduate subjects accounted for 5.6 percent of the subjects, while professionals accounted for 1.9 percent.
    - Sixty-six points six percent of the participants were between the heights of 151 and 150 cm. 12.5 percent of the participants were between the heights of 160-170 cm and 5.4 percent were between the heights of 140-150 cm. Furthermore, 62.5 percent of the participants weighed between 40 and 60 kgs. 33.9 percent of respondents weighed between 61 and 80 kg.
    - Majority of the number with 89.3 percent of the selected subjects were non-vegetarian respectively. Furthermore, 7.1 percent of the of the selected subjects were found to be vegetarian.
    - Maximum number with 50 percentage of the selected subjects were found to be normal body weight composition. Further it was also observed that 26.8 and 16.1 percent of selected pregnant women were found to be obese and overweight respectively. Lastly 3.6 percent of the selected subjects were underweighted.
    - Among the 54 selected subjects only 7.1 percent of the subjects are aware about gestational diabetes and 89.3 percent of the subjects are not aware.
    - Selected subjects of 92.9 percent don't have the idea that GDM has both maternal and fetal complication, only 3.6 percent of the subject have the idea of GDM complication. 92.9 percent, 92.9 percent, 100 percent, 91.1 percent and 91.1 percent of the pregnant women haven't heard about the term preeclampsia, eclampsia, polyhydramnios, preterm birth and stillbirth.

- Majority of the selected subjects with 91.1 percent don't know that Obesity and type 2 diabetes are more likely in newborns with gestational diabetes.

3. **Evaluation of the web application (Students, Dietitian, Computer professionals, pregnant women)**
    - Approximately 43% of respondents were satisfied with the nutritional assessment result, found the clinical evaluation to be simple, and were pleased with the nutrition calculations and comparison.
    - The selected subjects of 66 percent felt satisfied with the nutrient calculations of the diet consumed also felt satisfied with the nutrient comparison.
    - A positive significant association between the designation and the respondent's nutrients calculations of about 17 percent and between the designations and the respondent's nutrients comparison of 27 percent, indicating that the respondent was satisfied with both the nutrient calculations and the nutrient comparison based on the designation.
    - There was a negative significant of 42 percent between respondent functionality and learning, a positive 26 percent correlation between respondent functionality and friendliness, and a 42 percent correlation between respondent functionality and expectancy. This illustrates that respondents who were satisfied with the web application's functionality were also satisfied with the web application's learning, user-friendliness, and expectations.
    - A negative correlation of roughly 37 percent between respondent learning and user friendliness, indicating that respondents who were satisfied with the learning topic of the web application did not find the web application to be user-friendly. Whereas there was a positive significant association of about 61 percent and 14 percent between learning and exhausting use of the web application, and between learning and recommendation of the web application of the respondent, indicating that the respondent who felt very satisfied with the learning topic also felt replenished to use the web application and satisfied enough to recommend to others.
    - A negative significant association between videos and instruction of the respondent of about 40 percent which shows that respondent who felt satisfied with the videos does not felt satisfied with the instruction. Whereas there shows positive significant association between the videos with timing and

ratings with the respondent of 46 percent and 60 percent, which indicates that the respondent who felt satisfied with the videos also felt satisfied with the timings and ratings of the web applications.

- There was positive significant association between the timings and ratings of the respondent of about 11 percent, this indicate that those respondents who felt satisfied with the timings also felt satisfied with the ratings for the web applications.
- The majority of the respondent of 19 numbers felt clear knowledge of GDM, symptoms, risk factors, prevention, diet and menu plan gave the ratings of 4. Followed by 18 respondents with the ratings of 5. Least number of 1 respondent each who felt clear knowledge of GDM, symptoms, risk factor, prevention, diet, menu plan was not provided, gave the rating of 3 and 2.
- A maximum number of 10 respondents from each designation felt that the knowledge of GDM, symptoms, risk factor, prevention, diet and menu plan was clearly provided in the web application. And the least number of 1 respondent (pregnant women) felt the web application does not provide clear information about GDM, symptoms, risk factors, prevention, diet, menu plan.

Conclusion

To conclude, pregnant women encounter challenges with their lifestyle during their pregnancy and are burdened with a high rate of Gestational Diabetes Mellitus. A web application that offers a secure, cost-effective, environmentally friendly, easy-to-use interface, improved learning, and positive interactions is the need of the hour. As a result, the current study "Development and Evaluation of Web Application to Manage Gestational Diabetes Mellitus Among Expectant Mother's" demonstrates that the web application will be very beneficial in the future when used by expectant mothers. The web application that was created provides a new dimension to a healthy pregnancy and self-care management of gestational diabetes mellitus. The user-friendly web tools can be used by expectant mother at home or anywhere to monitor nutritional status, assess clinical signs and symptoms, dietary management, exercise, yoga, meditation, advice for a healthy pregnancy, and gestational diabetes mellitus

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APPENDICES

APPENDIX I

THESES APPROVAL BY INSTITUTIONAL HUMAN ETHICAL COMMITTEE

(IHEC/21-22/FSMD-12)

INSTITUTIONAL HUMAN ETHICS COMMITTEE

Avinashilingam

Institute for Home Science and Higher Education for Women
(Deemed to be University under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956) Re-accredited with 'A++' Grade by NAAC.
Recognised by UGC Under Section 12 B
Coimbatore-641 043, Tamil Nadu, India

08th March 2022

To
Ms.Kamei Lanjellu Kabuini
Department of Food Service Management and Dietetics
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore – 641 043

Dear Kamei Lanjellu Kabuini,

Ref: Your proposal No. IHEC/21-22/FSMD-12 entitled "Development and Evaluation of Web Application to Manage Gestational Diabetes among Expectant Mother's" resubmitted for approval to IHEC on 02.03.2021.

The Institutional Human Ethics Committee of our University hereby grants approval to your research proposal No. IHEC/21-22/FSMD-12 entitled "Development and Evaluation of Web Application to Manage Gestational Diabetes among Expectant Mother's" resubmitted by you. The Approval number for the same is AUW/IHEC/FSMD-21-22/XPD-12.

We wish you all the best in your research endeavours.

Regards,

S. Uma Mageshwari

Dr.S.Uma Mageshwari
Member Secretary

Institutional Human Ethics Committee

APPENDEX II

THESES PLAGIARISM REPORT

DEVELOPMENT AND EVALUATION OF WEB APPLICATION TO MANAGE GESTATIONAL DIABETES AMONG EXPECTANT MOTHER'S

ORIGINALITY REPORT

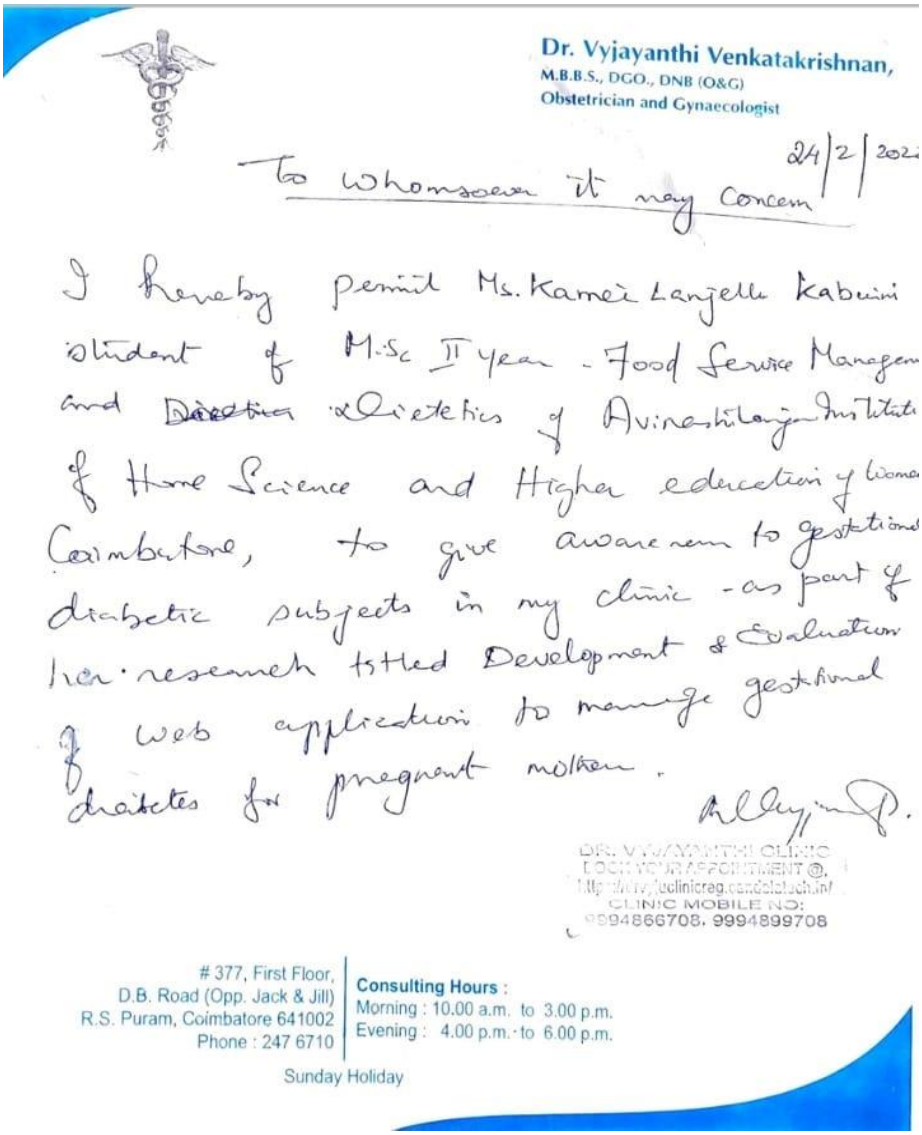
5%	3%	2%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to The British College Student Paper	1%
2	Submitted to University of Northumbria at Newcastle Student Paper	<1%
3	Chia Yook Chin, Ooi Pei Boon, Hwang Jung Shan, Teow Sin Yeang, Badariah Ahmad, Peh Suat Cheng (Eds). "Diabetes: Disarming the Silent Killer", Diabetes, 2022 Publication	<1%
4	link.springer.com Internet Source	<1%
5	Submitted to University of Wales Institute, Cardiff Student Paper	<1%
6	www.mdpi.com Internet Source	<1%
7	Submitted to National School of Business Management NSBM, Sri Lanka Student Paper	<1%
8	Submitted to Adelphi University Student Paper	<1%
9	electrophysiology.onlinejacc.org Internet Source	<1%

APPENDEX III

APPROVAL LETTERHEAD BY GYNECOLOGIST



Dr. Vyjayanthi Venkatakrishnan,
M.B.B.S., DGO., DNB (O&G)
Obstetrician and Gynaecologist

24/2/2021

To whomsoever it may Concern

I hereby permit Ms. Kamei Lanjelli Kabuini student of M.Sc II year - Food Service Management and ~~Dietetics~~ Dietetics of Avinashilingam Institute of Home Science and Higher education for Women Coimbatore, to give awareness to gestational diabetic subjects in my clinic - as part of her research titled Development & Evaluation of web application to manage gestational diabetes for pregnant women.

Dr. Vyjayanthi

DR. VYJAYANTHI CLINIC
LOCATE YOUR APPOINTMENT @
http://drvyjclinicreg.candelatech.in/
CLINIC MOBILE NO:
9994866708, 9994899708

377, First Floor,
D.B. Road (Opp. Jack & Jill)
R.S. Puram, Coimbatore 641002
Phone : 247 6710

Consulting Hours :
Morning : 10.00 a.m. to 3.00 p.m.
Evening : 4.00 p.m. to 6.00 p.m.

Sunday Holiday

APPENDIX IV

IOM weight gain recommendation for pregnancy by pre-pregnancy weight status

Weight category	IOM BMI category criteria	Asian BMI category criteria	IOM recommended weight gain
Underweight (18.5 kg/m2)	<18.5 kg/m2	<18.5 kg/m2	12.5 -18kg
Normal weight (18.5 -24.9 kg/m2)	18.5 -24.9 kg/m2	18.5 -22.9 kg/m2	11.5-16 kg
Overweight (25-29.9 kg/m2)	25.0 -29.9 kg/m2	23-24.9 kg/m2	7-11.5 kg
Obese (>30kg/m2)	>30 kg/m2	>25 kg/m2	5-9 kg

Source: IOM guidelines

APPENDIX V

Waist Hip Ratio (WHO)

Health risk	Women
Low	0.80 or lower
Moderate	0.81 – 0.85
High	0.86 or higher

Source: WHO

APPENDIX VI

FOOD EXCHANGE LIST

100 calories, 20g carbohydrates, 2g protein

S.No	Cereals	Amount	Calories
1	Corn flakes	30g (uncooked)	100
2	Oatmeal	30g (uncooked)	100
3	Rice flakes	30g (uncooked)	100
4	Dalia	30g (uncooked)	100
5	Sabudana	30g (uncooked)	100
6	Vermicelli	30g (uncooked)	100
7	Ragi	30g (uncooked)	100
8	Maize dry	30g (uncooked)	100
9	Rice	30g (uncooked)	100
10	Wheat flour	30g (uncooked)	100
11	Bread	2 slices (40g)	100
12	Chapati	1 and ¼ (44g)	100
13	Jawar roti	½ (55g)	100
14	Rice	30g (uncooked)	100
15	Sago	30g (uncooked)	100
16	Rice flakes	30g (uncooked)	100
17	Maize dry	30g (uncooked)	100
18	Poha	½ katori	100
19	Upma	½ katori	100

PULSES & LEGUMES EXCHANGE LIST

100 calories, 15 carbohydrates, 6g protein

S.No	Pulses and legumes	Amount	Calories
1	Bengal gram	30g	100
2	Bengal gram flour (Besan)	30g	100
3	Kidney beans (rajma)	30g	100
4	Cow gram (black eyed pea)	30g	100
5	Horse gram	30g	100
6	Red gram	30g	100
7	Chickpea (white kabuli chana)	30g	100
8	Moth beans	30g	100
9	Lentils	30g	100
10	Dried peas	30g	100
11	Bengal gram raosted	30g	100

FRUITS EXCHANGE LIST

50 Kcal, 10g CHO

S.No	Fruits	Amount	Calories
1	Apple	1 small (75ml)	50
2	Banana	½ medium (30ml)	50
3	Mango	1 small (90ml)	50
4	Orange	1 small (90ml)	50
5	Melon	¼ medium (270ml)	50
6	Watermelon	¼ small (175ml)	50
7	Lemon	1 medium (90ml)	50
8	Pineapple	1.5 round slices (90ml)	50
9	Strawberry	40 (105ml)	50
10	Tomato	4 mediums (240ml)	50
11	Gooseberry (Amla)	20 medium (90ml)	50
12	Grapes	20 (105 ml)	50
13	Garpefruit	½ big (150ml)	50
14	Jackfruit	3 medium cloves (90ml)	50
15	Custard apple	¼ (50ml)	50
16	Cashew fruit	2 medium (90ml)	50
17	Figs	20 (105ml)	50
18	Dates	3 (30ml)	50
19	Papaya	2 medium (120ml)	50
20	Pear	1 medium (90ml)	50
21	Plum	4 medium (120ml)	50
22	Peach	1 medium (135ml)	50
23	Sweet lime	1 medium (150ml)	50

VEGETABLES EXCHANGE LIST

50 Calories, Carbohydrates 10gm

S.No	Vegetables	Amount	Calories
1	Beetroot	75	50
2	Carrot	105	50
3	Colocasia	45	50
4	Onion (big)	90	50
5	Onion (small)	75	50
6	Potato	45	50
7	Sweet potato	30	50
8	Tapioca	30	50
9	Yam	45	50
10	Broad beans	90	50
11	Cluster beans	90	50
12	Double beans	50	50
13	Jack, tender	105	50
14	Jackfruit seeds	30	50
15	Leeks	60	50
16	Peas	45	50
17	Sambar	¼ karori (35ml)	50
18	Cooked vegetables	½ katori	50

Green leafy vegetables and other vegetables		
Bitter gourd	Drumsticks	Onion stalks

Amaranth	French beans	Pumpkin
Brussels sprouts	Mango, green	Tinda
Cabbage	Curry leaves	Tomato, green
Coriander leaves	Fenugreek leaves	
Brinjal	Mint	
Cauliflower	Spinach	

These vegetables may be used as desired carbohydrates and calories are negligible

MILK & DIARY PRODUCTS EXCHANGE LIST

50Kcal, 2.5g protein

S.No	Milk and milk products	Amount	Calories
1	Cow milk	2/3rd glass (90ml)	50
2	Buffalo milk	1/3rd glass (45 ml)	50
3	Skimmed milk	1 glass (130ml)	50
4	Skimmed milk powder	15g	50
5	Coffee + 75 ml milk	75ml	50
6	Tea + 75 ml milk	75ml	50
7	Curd	2/3rd glass (105g)	50
8	Buttermilk	3 glasses (375ml)	50
9	Cheese	1 small cube (15g)	50
10	Khoya	15g	50

NON-VEG EXCHANGE LIST

70Kcal, 10g Protein

S.No	Non-vegetarian food	Amount	Calories
1	Egg (hen)	2 numbers (60g)	100
2	Liver, sheep	1 breast (60g)	70
3	Chicken	1 breast (60g)	70
4	Mutton, muscle	3 pieces (60g)	100
5	Beef	1 slice (60g)	70
6	Pork	1 slice (60g)	70
7	Fish	1 piece (60g)	70
8	Crab	120g	70
9	Prawn	5 to 7 numbers 1	70

OILS & NUTS EXCHANGE LIST

50 Kcal, 5.5 g fat

S.No	Oils and fat product	Amount	Calories
1	Ghee (clarified butter)	1 tsp (5.5g)	50
2	Butter	1.5 tsp (7.5g)	50
3	Oil (mustard, sunflower, cottonseed, sesame, coconut, groundnut, corn)	1 tsp (5.5g)	50
4	Hydrogenated fat (vanaspati)	1 tsp (5.5 g)	50
5	Cashew nuts	10g	50
6	Almonds	7.5g	50
7	Groundnut (roasted)	10g	50
8	Pistachio	7.5g	50
9	Walnuts	7.5g	50

APPENDIX VII

CALORIE COST IN 30-MINUTES ACTIVITIES

Activities	Calories cost/30 minutes
Gym activities	
Weight lifting: General	90
Aerobics: water	120
Stretching, Hatha Yoga	120
Riders: general	150
Stair step machine: general	180
Teaching aerobics	180
Weight lifting: vigorous	180
Aerobics: low impact	165
Bicycling: moderate	210
Training and sports activities	
Billiards	75
Bowling	90
Dancing: slow	90
Volleyball: general play	90
Gymnastics: General	120
Dancing: Fast	120
Swimming: General	135
Walk/jog	180
Ice skating: General	210
Tennis: General	210
Basketball: playing a game	240
Football: General	240
Hockey: Field & ice	240
Running: 5 mph	240
Outdoor Activities	
Planting seedlings, shrubs	120
Raking Lawn	120
Sacking grass or leaves	120
Gardening: general	135
Carrying & stacking wood	150
Digging, spading dirt	150
Laying sod/crushed rock	150
Chopping & splitting wood	180
Home & Daily life activities	
Sleeping	19
Watching TV	23
Reading: sitting	34
Cooking	75
Child-care: bathing, feeding, etc	105
Food shopping: with cart	105
Playing with kids: moderate effort	120
Heavy cleaning: wash car, windows	135
Moving: household furniture	180
Moving: household furniture	210
Moving: carrying boxes	

Activities	Calories cost/30 minutes
Home repair	
Auto repair	90
Wiring and plumbing	90
Carpentry: refinish furniture	135
Lay or remove carpet/tile	135
Paint, paper, remodel: inside	135
Cleaning rain gutters	150
Paint house: outside	150
Carpentry: outside	180
Roofing	180
Occupational activities	
Computer work	41
Light office work	45
Sitting in meetings	49
Desk work	53
Sitting in class	53
Truck driving: sitting	60
Server	75
Heavy equipment operator	75
Police officer	75
Theater work	90
Welding	90
Carpentry work	105
Coaching sports	120
Construction, general	165
Coal mining	180
Forestry, general	240
Heavy tools, not power	240
Steel mill: general	240
Firefighting	360

APPENDIX VIII

REVISED RDA 2020, NIN & ICMR

S.No	Nutrients	Sedentary	Moderate	Heavy
1	Moisture	-	-	-
2	Protein			
	1ST Trimester	45.7	45.7	45.7
	2nd Trimester	54.5	54.5	54.5
	3rd Trimester	67.7	67.7	67.7
3	Fat	30g	30g	30g
4	Iron	40mg	40mg	40mg
5	Fibre	20-35g	20-35g	20-35g
6	Cho	135g	135g	135g
7	Energy	2101 kcal	2480 kcal	3070 kcal
8	Calcium	1000	1000	1000
9	Vitamin C	80	80	80
10	Vitamin A (Beta carotene)	6400	6400	6400
11	Vitamin A (Retinol)	800	800	800

Source: RDA for Indian 2020

APPENDIX IX

PROCESSED FOOD DATABASE

	Quantity	Energy (Kcal)	Protein (g)	Carbohydrate (g)	Fat (g)
Cereals					
Rice	1 Cup	333	10	66.6	2.6
Idli	1 No.	75	2.25	15	0.6
Dosa	1 No.	125	3.75	25	1
Chapathi	1 No.	80	2.4	16	0.64
Rice puttu	1 Cup	280	8.4	56	2.24
Wheat dosa	1 No.	102	3.6	20.8	0.51
Adai	1 No.	587	18	117.8	4.39
Kichedi	1 Cup	215	4	33	7
Pulao	1 Cup	180	5	29	5
Paratha	1 No.	180	4	24	4
Phulka	1 No.	85	3	18	0
Appam	1 No.	125	3.75	25	1
Upma	1 Cup	210	5	26	9
Puri	1 No.	80	2	12	3
Pulses					
Green gram sundal	1 Cup	100	6	15	0.7
Groundnut roasted	1 Cup	285	13	13	19.9
Dhal	1 Cup	160	10	25	4
Bengal gram curry	1 Cup	100	6	15	0.7
Channa masala	1 Cup	223	7.2	26.8	9.7
Dal makhani	1 Cup	278	8.4	24	16
Lemon dhal	1/2 Cup	220	10.7	29	5.3
Sprouted green gram usal	1 Cup	256	18.4	43.5	1
Vegetables					
Kootu	1 Cup	145	5	15	8
Spinach dhal	1 Cup	115	6	12	5
Sambar	1 Cup	80	4	12	2
Green leafy vegetables	1 Cup	130	2	7	10
Potato masala	1 Cup	130	2	17	2
Vegetable curry	1 Cup	108	3	18	0.2
Sauted vegetable	1 Cup	115	2	10	7
Vegetable salad	1 Cup	104	4.4	12	0.6
Mango curry	1 Cup	74	0.6	16.9	0.4
Aviyal	1 Cup	108	3	18	0.2
Snacks					
Poha		200	2	30	9
Baji	1 No.	35	1	2.1	2.75
Veg omlette	1 No.	220	7	22	12
Curd vada	1 No.	173	5.5	15.5	9.5
Masala vada	1 No.	57	2	10	3.5
Black gram vada	1 No.	167	7	21.5	5.5

	Quantity	Energy (Kcal)	Protein (g)	Carbohydrate (g)	Fat (g)
Dhal vada	1 No.	190	4	12	14
Potato bonda	1 No.	87	1.75	9.76	4.57
Samosa	1 No.	308	4.67	32.21	17.86
Biscuits	2 No.	44	0.7	7.3	1.33
Cream biscuits	2 No.	160	2	23	7
Sandwich	1 No.	98	1.5	7	7
Chutneys					
Coconut chutney	2 Tbsp	125	2	6	10
Coriander chutney	1 Tbsp	45	1	2	4
Groundnut chutney	1 Tbsp	63	3	5	3
Mint chutney	1 Tbsp	7	1	2	3
Tomato chutney	2 Tbsp	32	1	5	1
Non vegetarian					
Chicken fried rice	1 Cup	223	9	30	7
Fish curry	1 Cup	100	9	0	7
Chicken curry	1 Cup	240	21.6	0	16.8
Egg curry	1 Cup	90	6.6	0	6.6
Dried fish curry	1/2 Cup	82	17.8	0	0.67
Fish cutlets	1 No.	95	7	6	4.5
Fish fry	1 No.	110	9	3	6
Mutton curry	1 Cup	240	10	10	18

APPENDIX XX

INTERVIEW SCHEDULE TO EVALUATE THE EFFECTIVENESS OF THE SOFTWARE

Profile

- Name :
- Gender : Male/Female
- Date of birth :
- Address :
- Qualification :
- Contact no. :

1. Does the anthropometry helpful to you?

Contents	Yes	No
a. BMI		
b. Waist hip ratio		
c. Pregnancy weight gain calculation		
d. Normal height and weight reference		
e. Pregnancy weight distribution		
f. Pregnancy belly size chart		

2. Do you find any difficulty with the clinical assessment?

□ Very difficulty □ Difficult
□ Average □ Easy

3. How satisfied are you with the dietary survey?

	Very satisfied	Satisfied	Average	Unsatisfied
a. Overall contents				
b. Nutrient Calculations				
c. Exercise recommendation				

4. How satisfied are you with the nutritional assessment result?

□ Very satisfied □ Satisfied
□ Average □ Unsatisfied

5. Does the exercise, yoga, meditation provided by the web application easy for you to perform?

Contents	Yes	No
a. Videos		
b. Instruction		
c. Timing		
d. Meditation		

6. Does it add more knowledge about gestational diabetes to you?

	Yes	No
a. Overall contents		
b. Symptoms		
c. Complication		
d. Risk factors		
e. Complication		
f. Prevention		
g. Diet		
h. Menu plan		

7. What do you think about the software?

	Yes	No
a. Does it have a functionality that is difficult to understand?		
b. Does it help you to better understand a learning topic?		
c. Does it have a user-friendly interface design?		
d. Does it have a good description of its functionalities?		
e. Does it have a good interactions method that is not familiar to you?		
f. Does it performs as expected?		
g. Is it exhausting to use?		
h. Is the web application design good?		
i. Does the web application need further changes/improvements with respect to the following contents?		

8. Considering your complete experience with the web application, how likely would you be to recommend its use to a friend or colleague?

□ Excellent □ Good
□ Aerage □ Poor

9. On the scale of 5, rate the web application?

□ 1 □ 2 □ 3 □ 4 □ 5 □

10. Is there anything you think the web application could do better?

	Yes	No
1. Anthropometry		
2. Clinical assessment		
3. Dietary survey		
4. Exercise		
5. Yoga		
6. Meditation		
7. Diet for pregnancy		
8. Diet plan		
9. Healthy pregnancy		
10. Gestational diabetes		

If yes, please comment below the respective serial no.

11. Any feedback or suggestion you would like to give?

APPENDIX XI

QUESTIONNAIRE TO EVALUATE THE KNOWLEDGE ABOUT GESTATIONAL DIABETES AMONG EXPECTANT MOTHERS

Profile

- Name :
- Age :
- Address :
- Qualification
  - □ 10 standards □ 12 standards
  - □ Bachelor Degree □ Master Degree
  - □ Professional
- Occupation

1. Height (cm) :
2. Wight (kg) :
3. BMI :
4. Waist (cm) :
5. Hip (cm) :
6. Pregnancy week :
7. Are you
   □ Veg □ Non-veg
8. Give a brief on your daily food intake and also, mention the amount? (Early morning, Breakfast, Mid-morning, Lunch, Evening Snacks, Dinner, Bed-time)

9. Do you know what is gestational diabetes?
   □ Yes □ No
10. Do you know gestational diabetes has both maternal and fetal complication?
    □ Yes □ No
11. Have you heard about the term?
    - Preeclampsia
      □ Yes □ No
    - Eclampsia
      □ Yes □ No
    - Polyhydramnios
      □ Yes □ No
    - Preterm birth
      □ Yes □ No
    - Stillbirth
      □ Yes □ No
12. Do you know that babies of mother with gestational diabetes have higher risk of obesity and type 2 diabetes?
    □ Yes □ No