Ease impact of age on stress related complications in pregnancy

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ABSTRACT

Age brings a lot of complications like high blood pressure, diabetes and high cholesterol and due to reduced physical activity among women, these risks are higher. When women tend to postpone the pregnancy due to various social, cultural, personal and economic reasons, the risk of complications during childbirth also increases. Though there may be a number of reasons for each woman to postpone the pregnancy, the outcomes will represent a risk for the woman as well as the health of the baby. Stress is a major cause of disorders and complications like diabetes, hypertension, stroke etc. in normal people. Pregnant women undergo a lot of stress during the pregnancy duration and it also affects the fetes. As the age progresses, the stress related complications like high blood pressure, diabetes and high cholesterol increase the risk of complications during the pregnancy and delivery leading to other complications like birth defects. The paper discusses a model for connecting the age and stress related risks during pregnancy and for predicting the risk prone age which can create complications like ceasarian sections, hypertension and gestational diabetes. The results show that as the age of the mother increases, the pregnancy and delivery become more complicated.

Keywords: Age related complications, Stress related complications, Gestational diabetes, Prediction model, Hypertension.

1. INTRODUCTION

Pregnancy, in itself can present a lot of complications in health of the mother and the baby. In addition to the stress of being pregnant, there are many other reasons a woman can become stressful during the pregnancy, leading to many other complications in her health as well as the baby's health. Some of the socio economic and cultural reasons have been known to make it difficult for a woman to come out of the stressful life thus leading to the complications and postnatal health deterioration for the woman and the baby. Recently work place stress adds to that thus increasing the complications.

Women are to be physically and emotionally ready for the pregnancy to avoid stress. Working women are facing a lot of stress due to the necessity for them to balance their career and family and pregnancy becomes another source of stress for them. But added to this, women recently have started to postpone their pregnancy to a later age, which is the effect of the trend towards women wanting to have sustainable careers. More reasons like lack of family support for childcare, lack of mentorship for the women, social and cultural shifts like the nuclear families, inflexible work policies and economic uncertainty add to the uncertainty of having a family as well as a career. In western countries couples tend to think about the advantages of late pregnancy in terms of their career and economic sustainability. However, they have very scarce knowledge about the risks associated with it. As the age increases, the ability to conceive may reduce and this creates a lot of stress in the women's mind. With age, the process of delivery becomes complicated and this knowledge also creates a lot of stress during the pregnancy. This

paper describes the risks associated with having late pregnancy, especially the stress-based complications and the impact on the delivery.

Recently it has been of interest for researchers as well as the common people to study how stress affects the people and what health complications occur due to long exposure to stress. The way stress is received by older adults is different for stressful events at home, mainly in the way they perceive it and on how it increases and affects in older aged adults (above 60), comparing to young ones less than the age of 36. It has been proven that older adults are better in predicting stress at home rather than younger adults, which maybe caused to various multi-cultural causes. But, even though they have better anticipating skills, when it comes to coordination and management, older adults are not as good and have proved of attaining an abnormal or increase in levels of stress. It has also been proven that women react more negatively to stress at older age than at the younger age. When the added stress of being pregnant adds to the already increasing vulnerability of being aged, the affect is higher and it will lead to pregnancy and delivery complications, resulting in possible complications for the baby too.

2. LITERATURE SURVEY

About two decades ago, the women considered getting pregnant by the age of 20 as normal and the medical and the social support required to undergo the pregnancy and the post pregnancy activities also acknowledged the fact. But recently women are more interested in establishing a career due to various reasons and the social environment has also evolved in such a way that having babies at a later age is considered normal. However, the biological complications that may occur when the women postpone their pregnancies is a matter of concern discussed in many medical forums though the women lack awareness on them. It can even lead to sterility in some couples and also can lead to greater generation gaps. Thus, the political and social environment should completely support the pregnancy at desired age in order to overcome the above difficulties (Bellieni, 2016).

Further studies tend to prove that there have been repeated assessments and measures to relate the stress, anxiety and other wellbeing characteristics affecting women's behavior, especially women in the low income bracket of the society, in early and late pregnancy and it has been established that these have a connection towards variables of prenatality, intrapartum, and neonatal complications. The most important discriminating factors for prenatal complications are state anxiety and total functional social support. The factors for neonatal complications were negative lifeevents and the lack of presence of support in mentoring them (Zachariah, 2009). Analyzing these factors brings out many peripheral parameters for the onset of stress for the pregnant women, especially when the women postpone the process of having

babies due to many reasons. Recently a study by the Centers for Disease Control and Prevention has listed the data on the age and pregnancy and the 2016 data shows an increase in the number of women having babies after their age of 30 higher than the number of women having their babies in their twenties (Stein and Susser, 2000).

Further analyzing, the aim of a likewise study was to discover whether perceived maternal stress was in link with the occurrence of pregnancy complications. A batch study of pregnant women was conducted and proved that maternally perceived stress before 20 weeks of gestation is associated with pregnancy complications (Roy-Matton et al., 2011). Another problematic situation encountered was hassles, pregnancy-specific stress, and state anxiety faced by pregnant woman during pregnancy. Hassles were found to be stably consistent throughout the pregnancy. Women reported significantly higher pregnancy-specific stress in the first and third trimester of pregnancy. The occurrence of a gestational complication during pregnancy was related to higher pregnancy-specific stress in the third trimester (Da Costa et al., 1999).

The average age at which the women are having their first baby can be an important factor in determining the health of the mother and the baby as well as the complications that may occur later. Stress hormones have a special flow effect in brain as the age increases. A paper discusses and examines the connection between maternal age and morbidity which arises during labor complications. There are numerous findings which point out the need for pregnant woman to have a high awareness of the risks in ageing (Cavazos-Rehg et al., 2015). Some of the risks the women will have to face if they postpone motherhood are explained here.

Decline in fertility is an important risk since the likelihood of pregnancy becomes lesser and lesser as the women age (Federation CECOS et al., 1982). Lampinen et al. (2009) has held a strong discussion on the women's age and its relation to pregnancy in which pregnancies of women over 35 years of age and the risks associated with pregnancy were reviewed. The paper considered the articles, scientific journals relevant to the above objective and concluded advanced maternal age is associated with pregnancy-related risks. It also evidently concluded that both men and women lack knowledge on the facts and risks of prolonged pregnancy (Lampinen et al., 2009). A study conducted by Centres d'Etude et de Conservation du SpermeHumain (CECOS) shows that the conception rate declines as the age increases. The study was conducted with 2193 women divided into 4 age groups from 25 years to 35 and older. A decrease in the conception rate was proved to be a function of the woman's age. The probability of success of conception was recorded as an average 73% for the women under 30 and average 54% for women above 30 years of age.

One theory has used multiple logistic regression to find an analysis between specific pregnancy complications and posttraumatic stress disorder. After controlling for

demographic and psychosocial factors, there has been an evidential data proving that pregnant women with posttraumatic stress disorder might be at higher risk for certain conditions. It was recommended that assessment and following a treatment for undiagnosed posttraumatic stress might be warranted for women with those obstetric complications. Continuous treatment of traumatic stress symptoms might improve pregnancy morbidity and maternal mental health (Forray et al., 2009). Another theory similarly suggests the prevalence of post traumatic stress disorder (PTSD) in pregnant women with a prior pregnancy-related complication is considerable and the most common one being miscarriage. These findings provide additional evidence that pregnancy complications can be experienced as traumatic and as such lead to partial PTSD or full symptoms (Seng et al., 2001).

In addition, conditions like stillbirth, Down syndrome and congenital anomalies are other possible risk factors in pregnancies after the age of 35 (Huang et al., 2008). The risk of stillbirth throughout the gestational periods was studied and found that the risk increases with age of the mother (Reddy and Susser, 2006). A population-based study also concludes that there is a negative impact on pregnancy outcomes with both extremes of maternal age. During the period of study, 22,933 pregnancies were observed in which multivariate analysis concluded that maternal age over 40 has an independent risk factor for preterm delivery. Pregnancy related hypertensive disorders, gestational diabetes mellitus, caesarean section, abnormal fetal presentation (Londero et al., 2019). Another study quantified the obstetric risks of adverse outcome during pregnancy in women aged 35 years and more. With 385,120 women in the three age groups of below 34 years, between 35 - 40 years and above 40 years were tested and the conclusion was that, women above 35 years of age are at increased risk of complications like stillbirth, gestational diabetes, Caesarean section (C Section) and breech delivery and premature births (Jolly et al., 2000). It is also proved that the risk of fetal loss is high when women conceive after their age of 30. When compared with women in the age group of 20 -24 years, the risk was 65% higher in the women above 40 years (Andersen et al., 2000).

However, a recent study has been conducted to find out whether the low birth weight and preterm delivery are associated with increasing age of mothers and has turned out negative results. The conclusion is that the reasons do not only depend on the age of the mother but on the behavioral aspects and life circumstances play an important role on the increase of risk (Goisis et al., 2017). Lisonkova et al. (2017) has proven how the increase in the average maternal age has a severe adverse effect on the maternal morbidity rates and that of fetal outcomes. They concluded that as age increases, the complications like renal failure and acute cardiac morbidity increase leading to serious complications and increasing mortality rates (Lisonkova et al., 2017).

On the basis of the above studies, we undertook the study concentrating on the increase in the stress based complications on account of increasing age. Osmanovic-Thunström et al. (2015) have studied how perceived stress gradually increases in older people as they age and come up with a hypothesis, also taking into consideration their physical and mental health parameters. A sample of adults above the age group of 65 was taken for the study and was assessed for various levels of perceived stress being developed amongst them. In this hypothesis they have used a 10 item perceived stress scale. For the analysis part they have used a number of mediators like health related issues. The results proved that more women than men reported a higher level of stress. The perceived stress scale (PSS) increased with age in adults, also having a link with health related factors such as multi-morbidity, cognitive decline with depressive symptoms, in the form of a linear regression model. The PSS model proved to be cross-culturally effective and was validated (Osmanovic-Thunström et al., 2015).

Agrigoroaei et al. (2017) have measured the effect of financial stress on people, apart from other aspects that could be a role playing factor for increase in stress levels. There is a contribution of financial stress on people and this aspect increases with age. In this study, it was proved that those people with actual financial stress were proved to be feeling to look older than they actually were, even though they were not (Agrigoroaei et al., 2017).

Jeon and Dunkle (2009) have undertaken a research study extending for a period of 3 continuous years among very old people above the age of 85 with an interview in every 6 months. They have used multilevel modeling analyses (MIXREG) and have determined the main causes which are related to and which provoke stress in the old adults. The daily worries, which is associated with late life depression amongst the old were found to rank top. The research was conducted using datasets with measures such as depression, stress, psychosocial resources, control variables (gender, race, education). Depression and stress increased over time among the old age, and other factors such as health, negative and positive life events and hassle had variable fluctuations in the outcomes across the 3 years (Jeon and Dunkle, 2009).

Scott et al. (2013) determined the emotional responses to everyday stressors from various age differences. According to stress and coping theory of Lazarus and Folkman, the emotional response of an individual to an event determines how it is appraised by the individual. Though this study did not take appraisal into account, the authors tested the emotional experience with respect to the age differences and found that the negative effects and positive effects are different for different ages. The age matters when it comes to negative affects – they are affected more by the recent stressors than the younger people. The positive affects do not have age differences. The study also evaluated how contextual features such as timing of exposure to stress, stressor velocity, global perceived stress and moderate age differences affect the emotional experience. Together, these results support the notion that chronic stress plays a central role in emotional experience in daily life (Scott et al., 2013).

An empirical study on the relationship between age and short-term indicators of work-related stress proves that the age might affect several processes of the stress factors at work. The author conducts both a literature review and meta-analysis of age and work-related stress. However, this relation is significantly moderated with the type of occupation and gender. Conclusively it has been proven that with increased age the stress factor associated with the person also increases (Rauschenbach et al., 2012).

Aldwin (1991) suggest that the elderly has lesser control over the environment than the adults. This lack of perceived control should have an adverse effect on how they cope up with the stressful situations. But most studies suggested that elderly differ very little from the younger ones. This contradiction was investigated with sample of 228 community residing adults. Based on the study the author concludes that neither age nor perceived controllability had direct effects on depression, but they had indirect effects through their influence on the use of coping strategies and perceived efficacy (Aldwin, 1991).

Hsu (2018) examined the association of work stress, exhaustion, well-being and related factors focusing especially on age-differences in Taiwan and the results showed that older age was related to worse self-rated health, and age showed a reverse-U-shaped relation with psychological health. The resilience of older workers could be an opportunity for the global active aging trend and interventions to support older workers in organizations would be beneficial. Older workers can face more barriers and stressors at work, such as physical strength limitations and health concerns, gaps related to using new technology and the engagement in work. Although ageism may exist in the workplace, a meta-analysis study found that perceptions regarding older workers are varied, i.e., not entirely positive or negative (Hsu, 2018).

Based on the above reviews, it was concluded that age plays a significant factor in increasing the stress levels and affecting the health of the people. Hence it was decided that in addition to the stress and stress related outcomes like gestational diabetes, hypertension, age also can be taken into account to determine the risk level of the pregnancies.
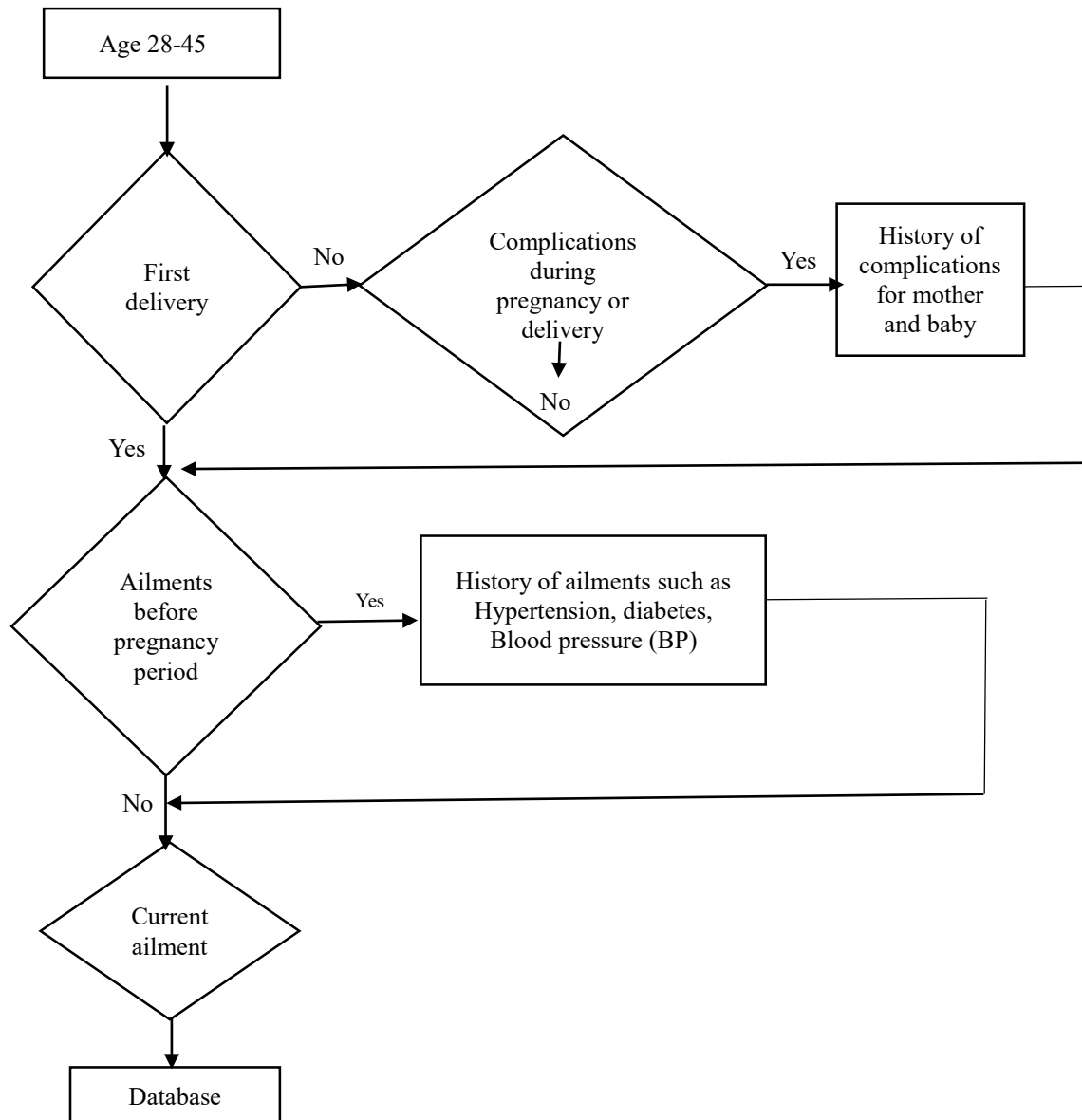
3. PROPOSED METHODOLOGY

In order to support the hypothesis of maternal age playing an important role in the pregnancy related risks, a study was conducted on the pregnancy data with maternal age and complications during the pregnancy. A quantitative analysis was done on the data to find out the frequency of occurrence of complications during delivery and the results are recorded. Further a prediction algorithm is used to predict the maternal age at which various complications are likely to happen. K – nearerst neighbours (KNN) machine learning algorithm is used to predict the maternal age and the prediction accuracy is compared with other algorithms.

KNN algorithm is a simple learning algorithm. It calculates the distance between the point A and all other points, removes the k points with the nearest point, and then counts the k points which belong to the classification. Through jupyter integrated development environment and python programming, the KNN algorithm is applied in real time. The libraries from Sklearn (specifically SKlearn.model_detection and sklearn.neighbors) were used to create the model for predicting the maternal age at which the pregnancy risk is maximum. Other packages such as numpy and pandas were used to mathematically analyze the model.

The predicting model learns from the training data set which we have collected according to Fig 1.

A machine learning model based on KNN algorithm has been developed which predicts the maternal age at which the complications occur often during labor and for the baby after delivery. In the process, the outcome considered is the maternal age and the remaining parameters are considered as the factors influencing the outcome. These were taught to the model through programming, after which the model starts predicting on the test cases to test the accuracy of the model. We can actually test the accuracy by comparing the predicted outcome (maternal age) by the model with the output of the test cases which we have hidden and uploaded to the program for the model to predict. Thus, by comparing we can give the accuracy of the prediction algorithm. The model proposed is described here.

KNN gives a better accuracy which is more than 80% using the model when kept with minimum number of neighbors in the predicting algorithm. Increasing the number of neighbors decreases the accuracy. Thus, highest accuracy is achieved with minimum neighbor in KNN algorithm. The results are recorded in the following section.

Fig 1. Flow chart for building the database

The flow chart in Fig. 3 depicts the overall methodology of the proposed model. The data set containing the percentage of the women who had several complications during pregnancy such as hypertension, gestational diabetes and complications during delivery like cesarean and prolonged labor are regularly updated year wise. The reference age around which the percentage of complications is higher is taken as the bottom-line. Every year the new data will be processed and the reference age will be updated. This updating improves the accuracy of the model. This model with increased accuracy can be used to predict the maternal age in which the complications were prone. Thus, for upcoming years these predictions can be used for providing preventive measures and special care for those women who are in that maternal age.
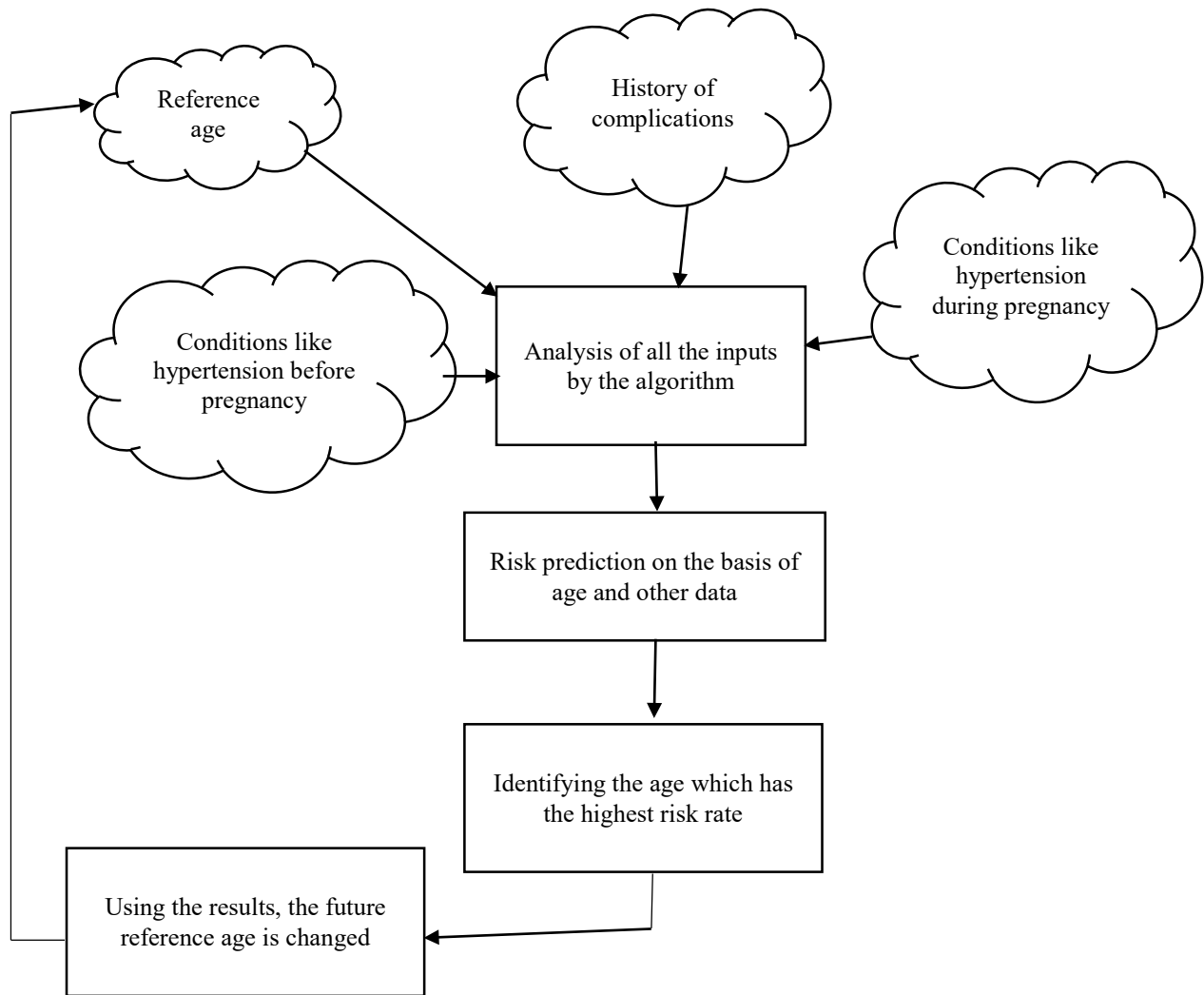
Fig 2. Model diagram for predicting the age

The exact maternal age can be identified for each complication by altering the test cases. For example, if the prediction algorithm predicts that women with maternal age of 40 are more prone to pregnancy risks based on the previous year data and current year data set, these predictions can be used for next year to prevent and even save certain women of that maternal age from the pregnancy risk. This accuracy of prediction increases over the years.

Thus, after n number of years (say 5 years or 10 years) this prediction model keeps the complete track of past 5- or 10-years data set to make a prediction and this shows the certainty of the prediction. This can be done manually by analyzing the data sets through graphs and charts. However, this model automates the process using machine learning techniques and it has more success rates than manual predictions.
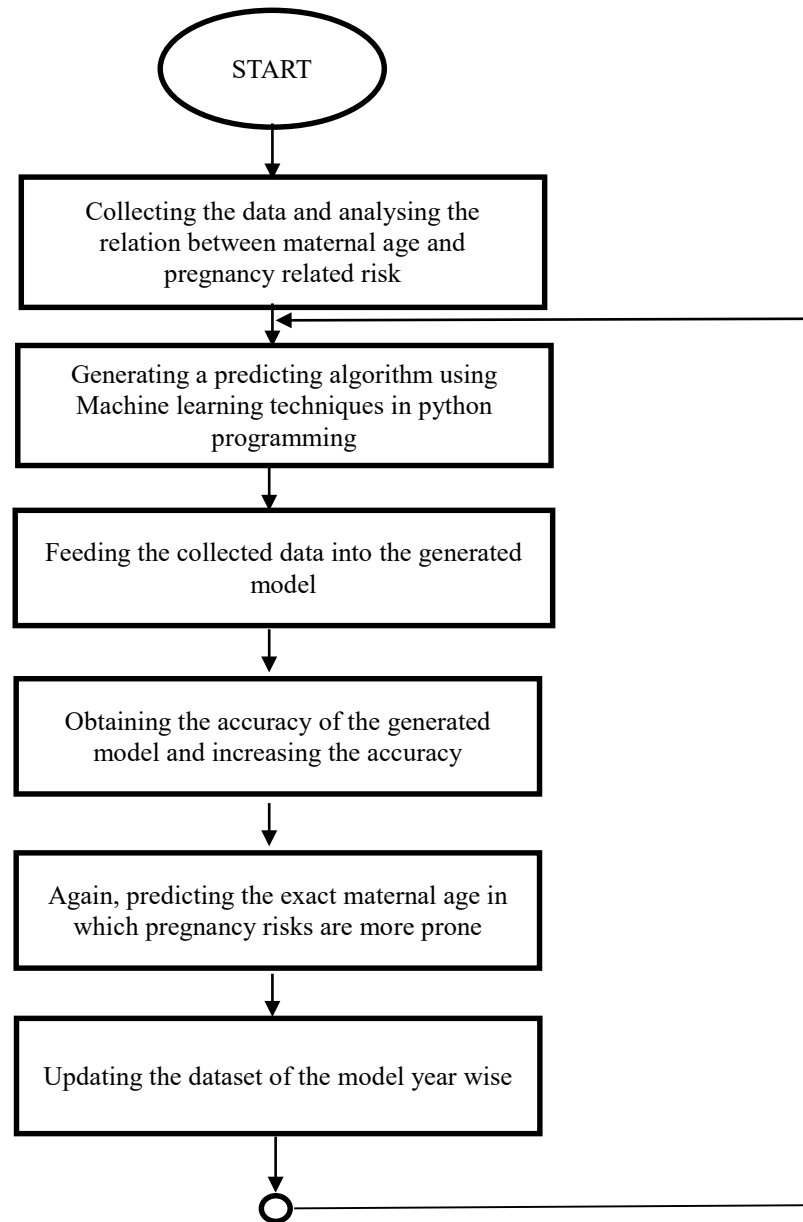
Fig 3. Methodology for the proposed model

4. RESULTS AND DISCUSSION

By analyzing the data, various results were obtained to support the hypothesis. Data are percentage of women who had undergone the listed complications below (given in colors) in the following figure. This data is sum of all cases recorded in Washington between 2003-2013.

The chart in Fig. 4 shows a clear trend of proportional increase in pregnancy risk with increase in maternal age. The horizontal axis shows the average of maternal age in the data that is used for analysis. The vertical axis shows the percentage of women who had the pregnancy complication in the taken sample of women for analysis. The number of women who had taken part in the sample for study is about 63,000 in the age category of 15-19 whose average is taken as 17 and is represented in the chart in Fig. 4. Like wise around 200,000 took part in the sample for age category 20-24 and whose average is taken as 22. Around 240,000 of maternal women of age group 25-29 took part in the study and are represented under the average of 32. Around 200,000 women participated under the maternal age group 30-35. The number of women volunteered for the maternal age group 35-39 was around 100,000 and around 25,000 and 1,500 women of maternal age 40-44 and 45 above respectively participated in the study (Lisonkova et al., 2017).
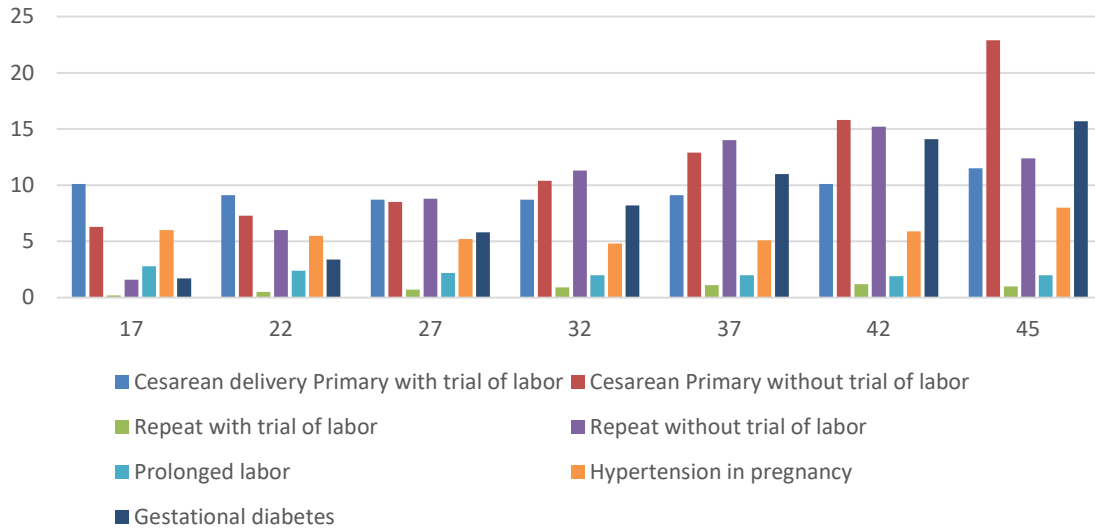
Fig. 4 Complications vs age of the women

The analysis is concentrated on the pregnancy complication such as Cesarean delivery among women, prolonged labor, hypertension in pregnancy and gestational diabetes among which the percentage of women who had cesarean increased with advanced maternal age. The number of cases with hypertension and gestational diabetes also shows a linear increase with increase in maternal age. Feeding this data into the proposed model has turned out the risk prone age band for the given data set is the maternal age of 45 with around 87.5 percent of accuracy and 42 with 37.5 percent of accuracy and 37 with 13 percent of accuracy. This will change as the data set increases every year.

Two different algorithms were used to predict the accuracy of the proposed model – KNN algorithm and decision tree which are similar in accuracy outcomes for the given dataset. However other common predicting algorithms such as Naïve Bayes and Support vector machine (SVM) provided insignificant accuracy for this particular data set.

In KNN algorithm the value which is predicted is assigned purely based on the closest neighbours. If the value of k is set to 1 then the value which is to be predicted is assigned to the class of that single nearest neighbour. The model was tested with KNN algorithm for predicting the percentage of pregnant women who has a possibility of acquiring any of the above mentioned pregnancy complications. It showed highest accuracy when the k value is assigned to 1 for this data set. When the values of k are increased the accuracy of the model decreased accordingly. This clearly shows that single nearest neighbour is the most preferable for predicting the results with this particular data set. The decreased accuracy trend can be seen from the tabulation below.

Table 1. Accuracy of prediction

K value	Accuracy in percentage
1	100
2	42.85
3	14.285

The decision tree algorithm was also tested for the above model and it was seen that the decision tree algorithm also provided significant results in prediction (for this particular data set), where the accuracy is almost 100 percent.

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