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# Fetal Health Classification



## OUTLINE

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01

## Data Background

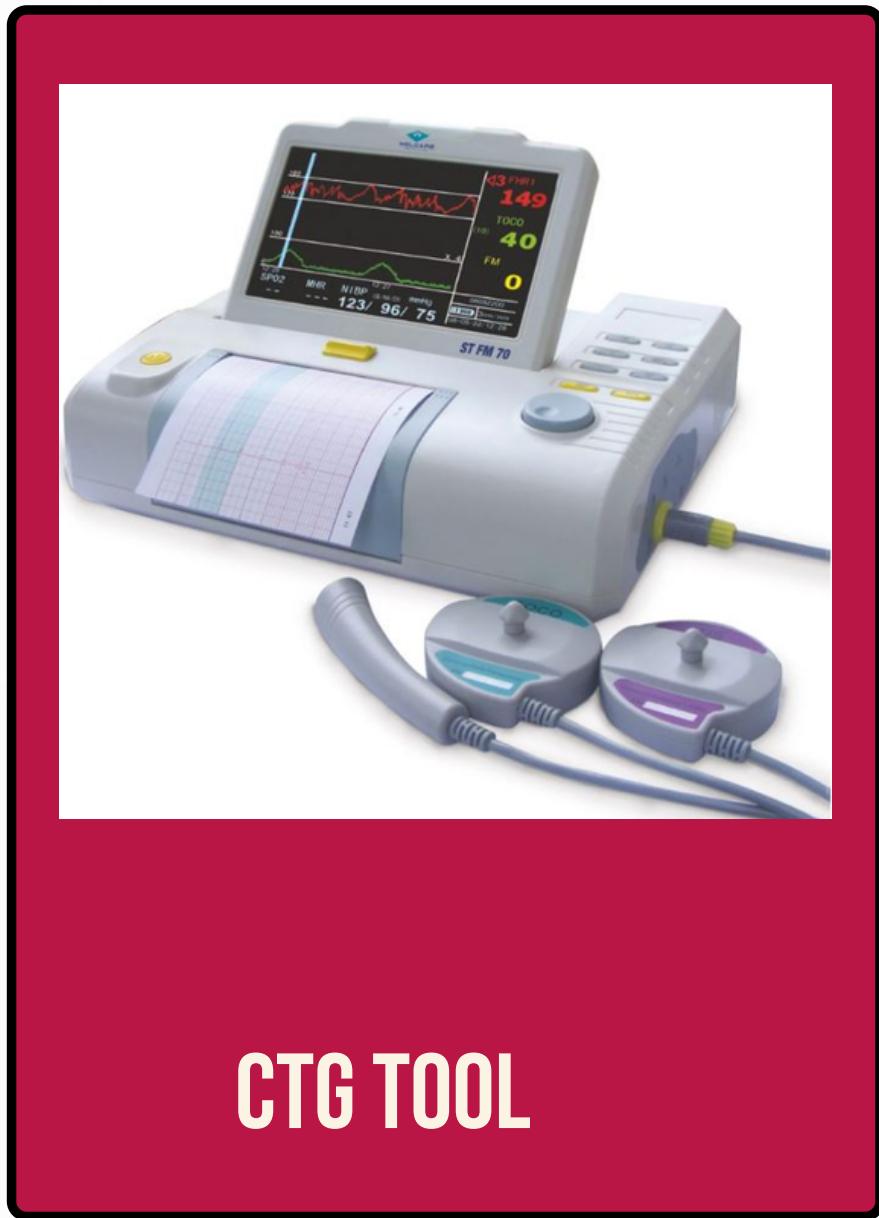
# CTG

## / CARDIOTOCOGRAPHY

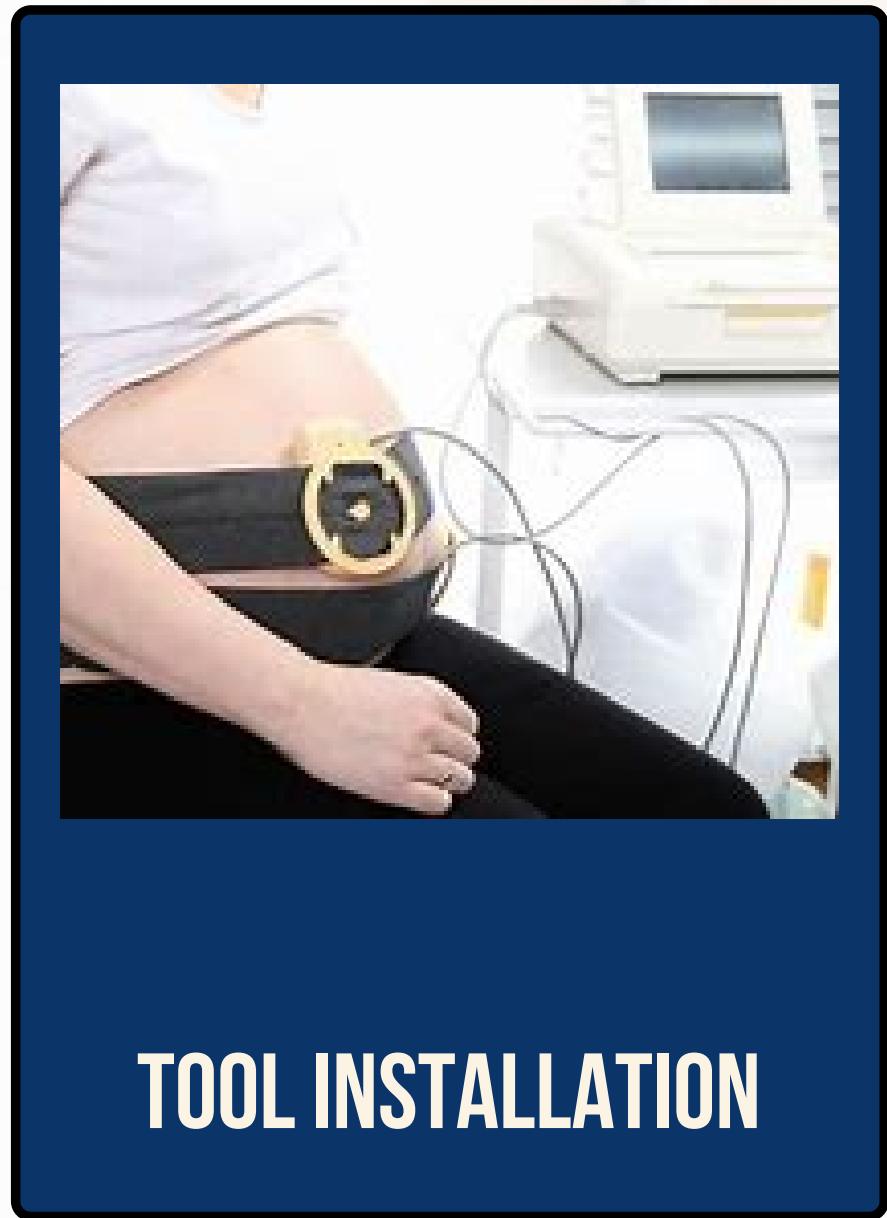
The dataset includes **fetal health classifications** determined by obstetricians using CTG equipment.

One of the causes of the high infant mortality rate is **hypoxia** experienced by the fetus. This is **avoidable**, as **CTG** can be used to monitor **the activity and heart rate of the fetus** as well as **uterine contractions**.

Monitoring is recommended when **more than 28 weeks pregnant** or in the **3rd trimester**.



CTG TOOL



TOOL INSTALLATION



02

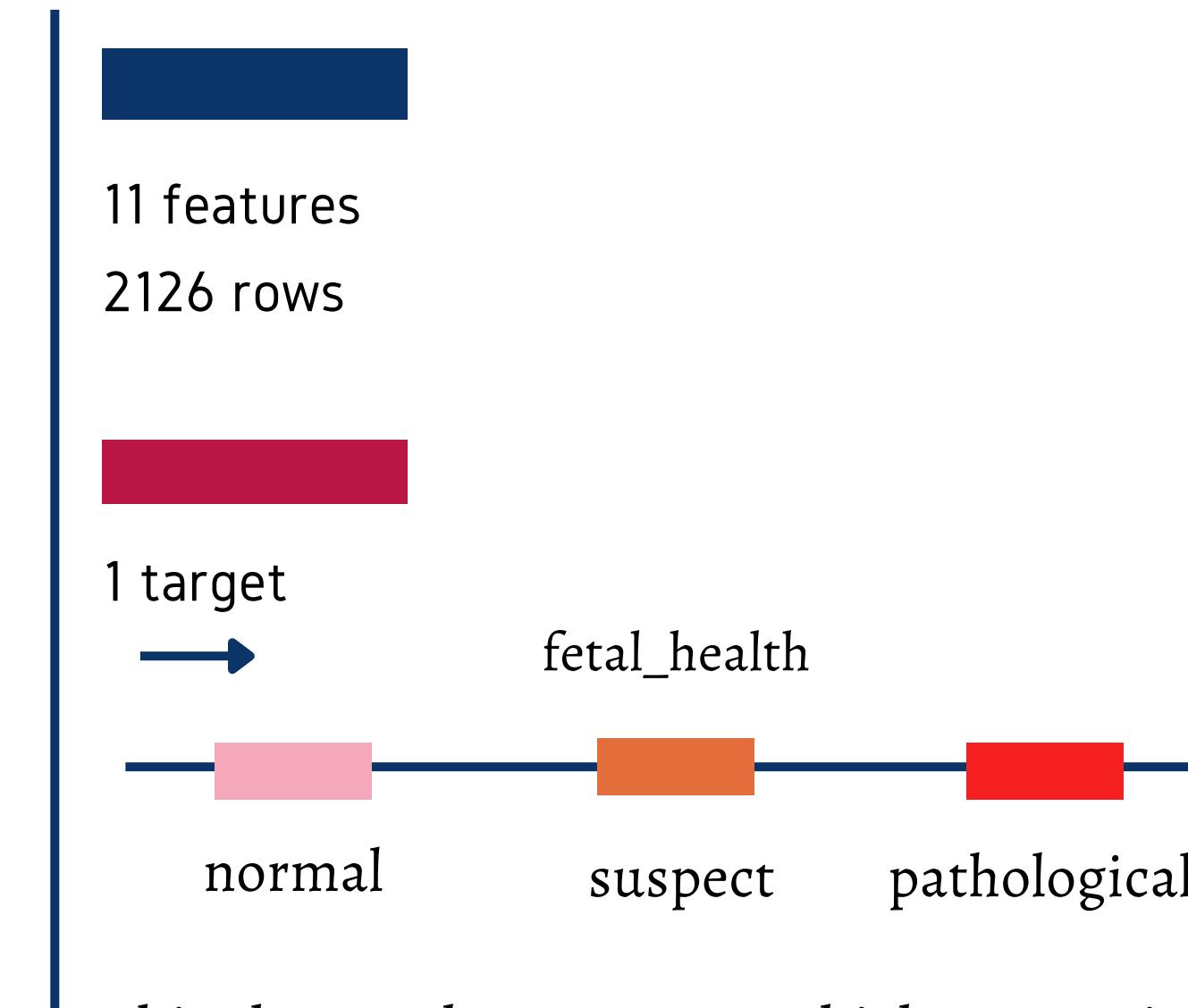
## Data Understanding and Analysis



# DATASET INFORMATION

## Numerical

- baseline\_FHR
- accelerations
- fetal\_movement
- uterine\_contraction
- light\_decelerations
- severe\_decelerations
- prolonged\_decelerations .
- percentage\_STV
- mean\_STV
- percentage\_LTV
- mean\_LTV



This dataset has a target which means it includes Supervised Learning with a classification category.

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## QUESTION

What is the best model for predicting this data, and what is the percent accuracy?

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What variables can be used to categorize a fetus?

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## DATA CLEANSING

### Missing Value

0

There is no missing value

### Duplicate Data

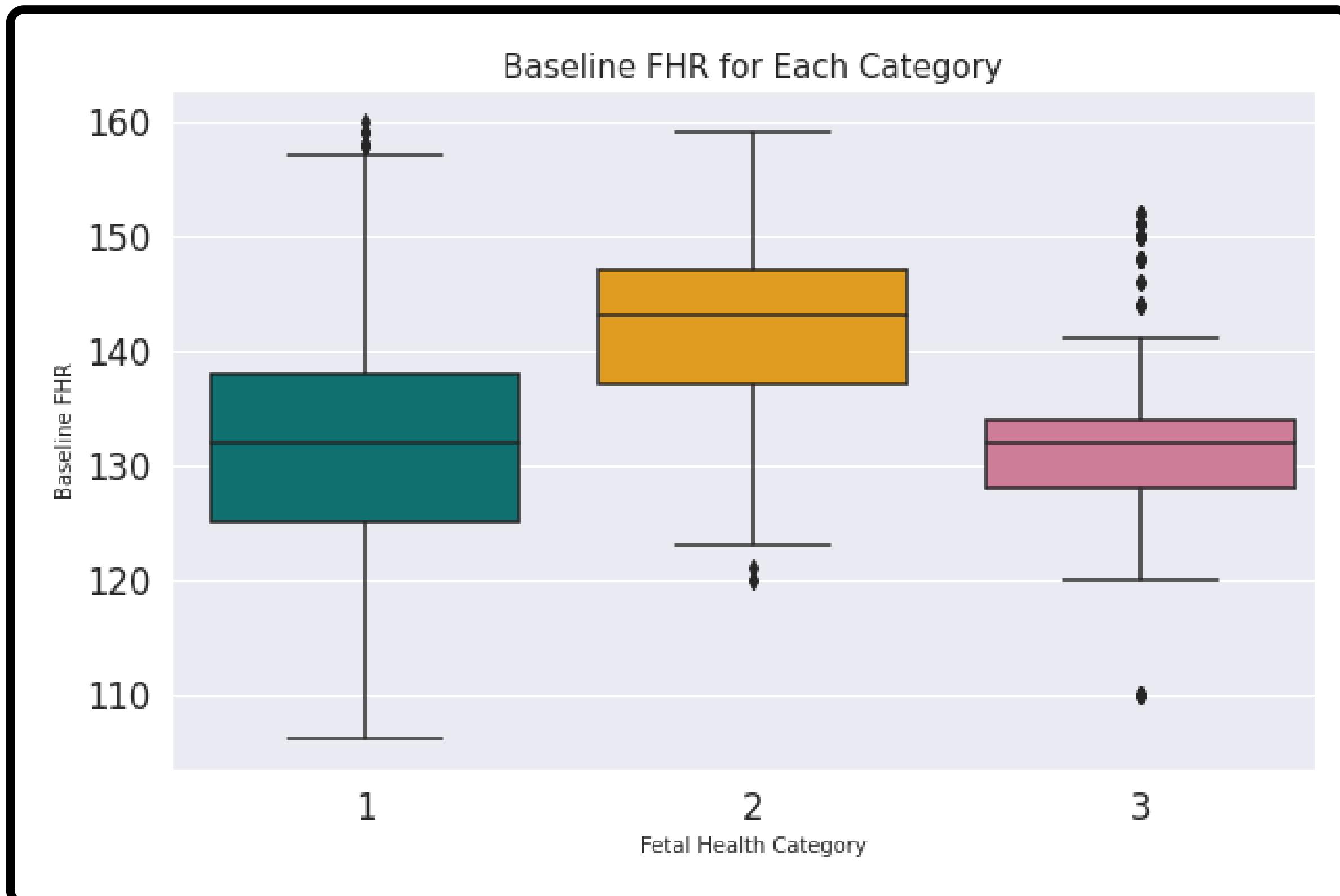
1 4

Remove duplicate data

# EXPLORATORY DATA ANALYSIS

## 1. Baseline Fetal Heart Rate

- Basic heart rate when the uterus is at rest (**per minute**).
- The suspected and pathological conditions are **the same as normal** conditions ranging from **110 - 160 bpm**.
- In conclusion, the basic fetal heart rate **doesn't provide information to determine the category of the fetus** because all fetuses are in normal condition.

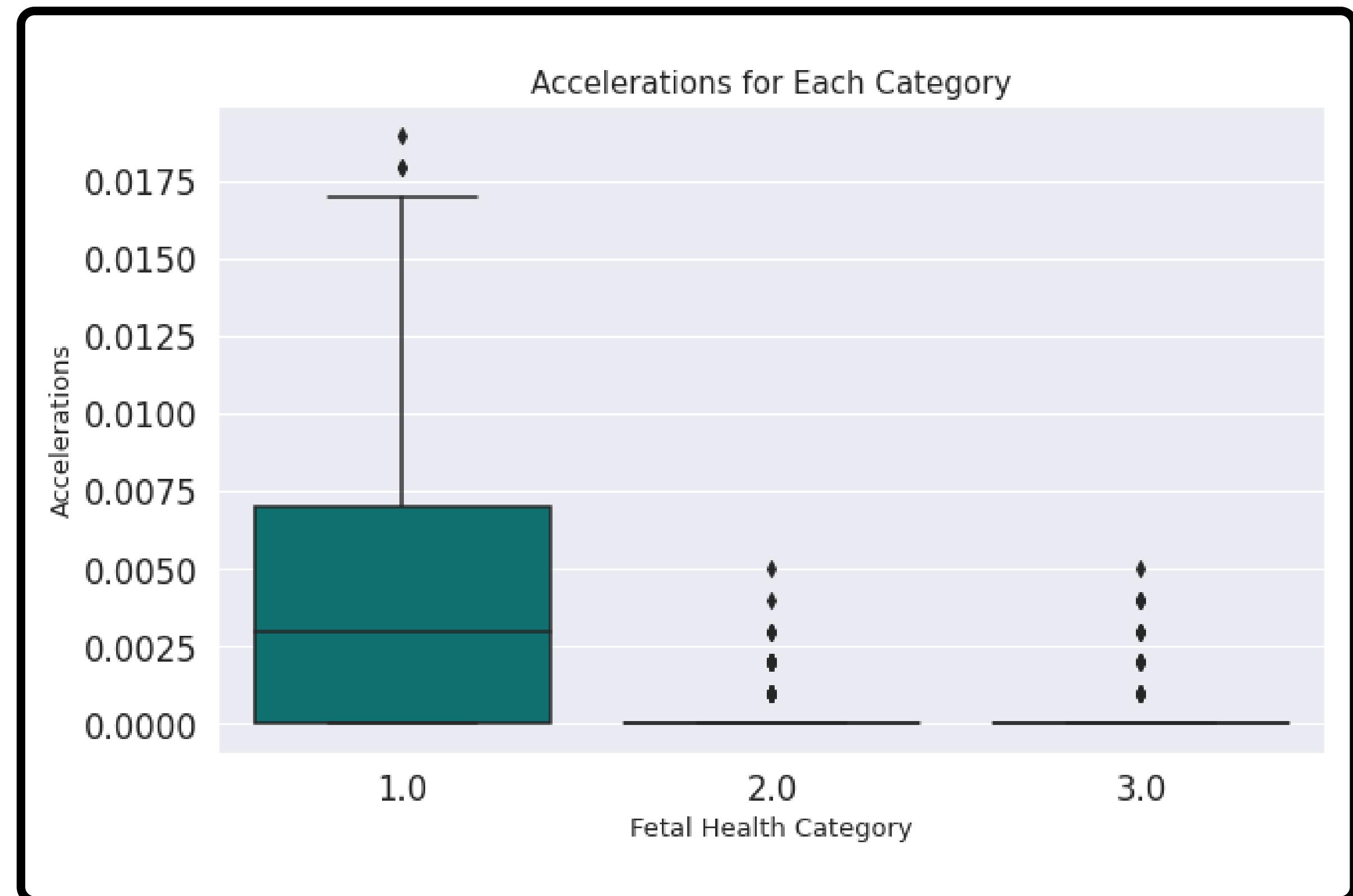


## 2. Accelerations

→ Increase in fetal heart rate  
**(per second).**

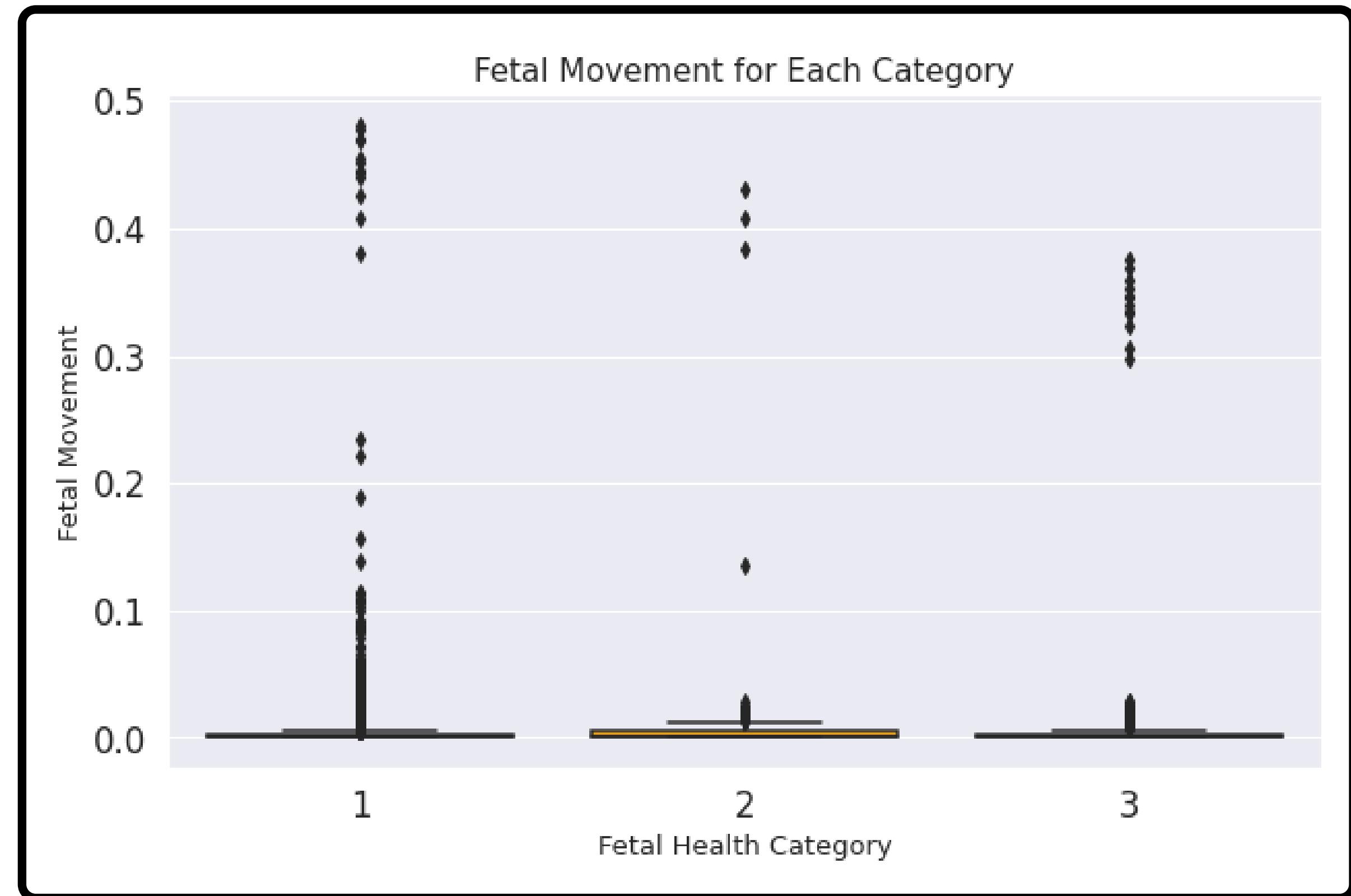
- normal (1) : **0 to 0.0175 per second.**
- suspected and pathological (2 & 3) :  
**doesn't exceed 0.0050 per second**

It can be concluded that a **healthy fetus**  
**experiences accelerations.**



### 3. Fetal Movement

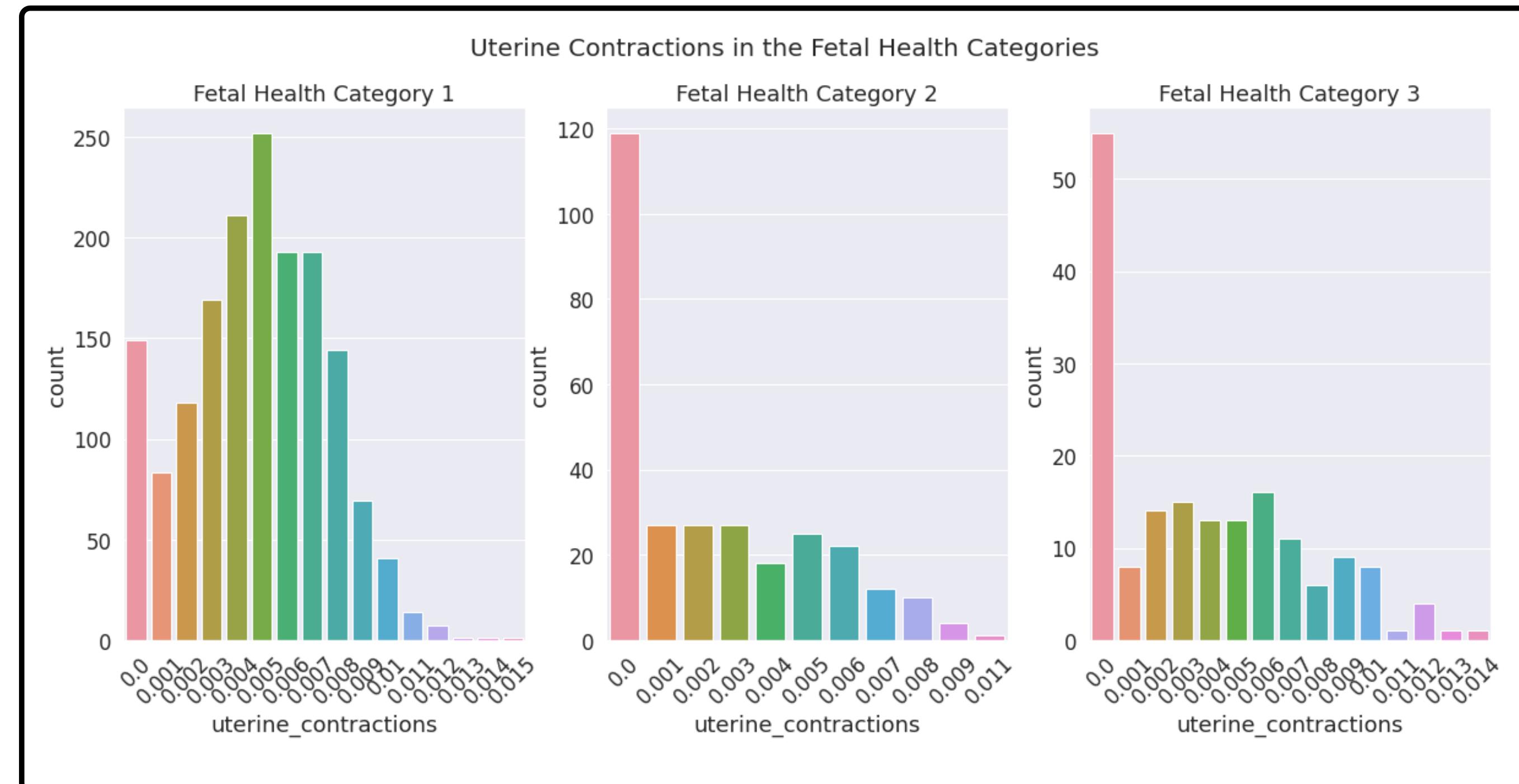
- calculation of baby kicks (per second).
- Based on the median value all categories of fetuses don't experience fetal movement.
- It can be concluded that the fetal movement can't provide information to determine the fetal category.



## 4. Uterine Contractions

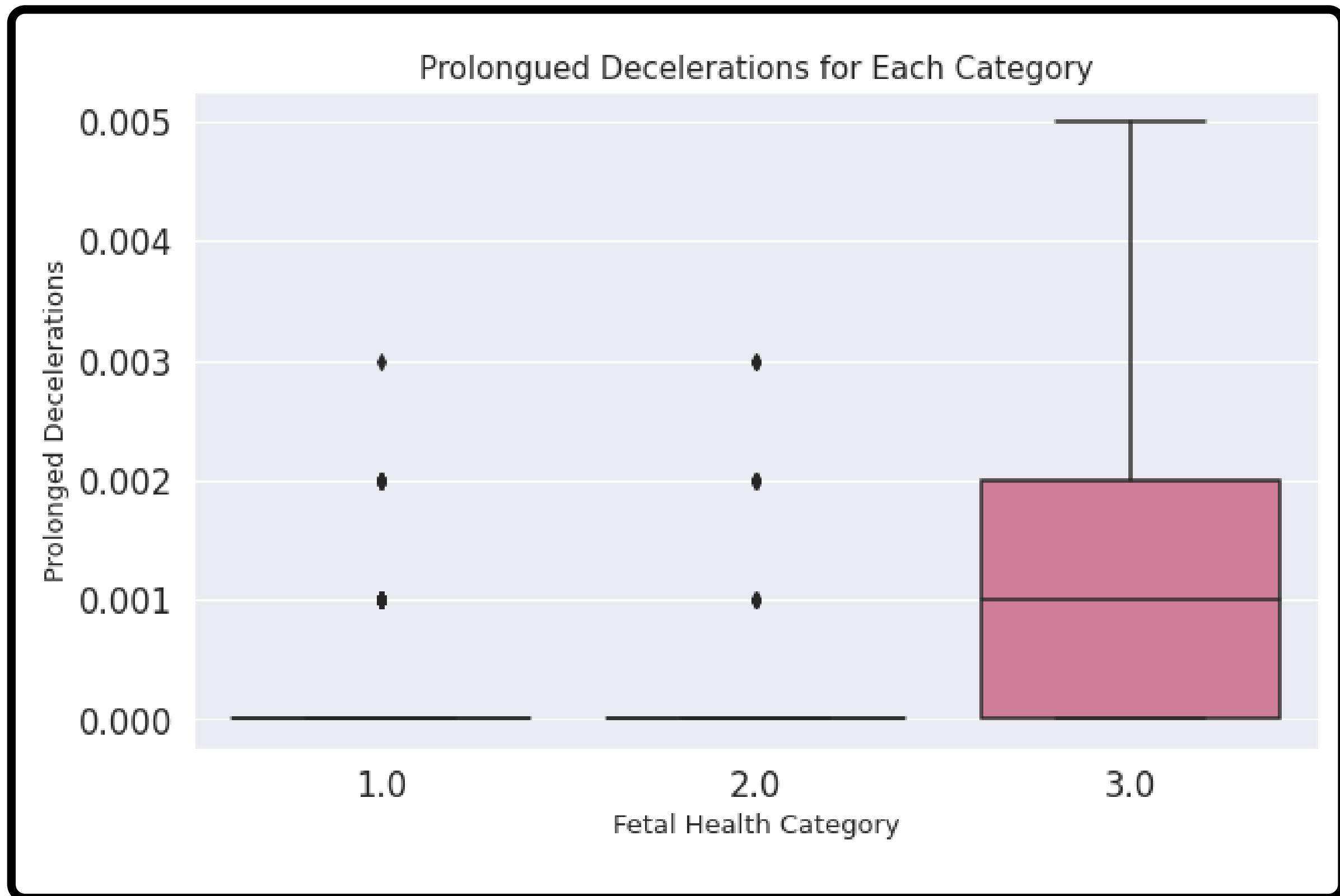
→ Fetal contractions to measure labor activity (**per second**).

- The **normal fetus** experienced uterine contractions **more frequently than suspect and pathological**.
- It can be concluded that a **healthy fetus experiences uterine contractions**.



## 5. Prolonged Decelerations

- prolonged decrease in heart rate (**per second**).
- Based on a normal fetus (1), the healthy fetus doesn't experience prolonged deceleration.



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Based on several features analyzed, it appears that **uterine contractions, accelerations, and prolonged decelerations** are determinants of fetal category.

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## Modeling and Evaluation

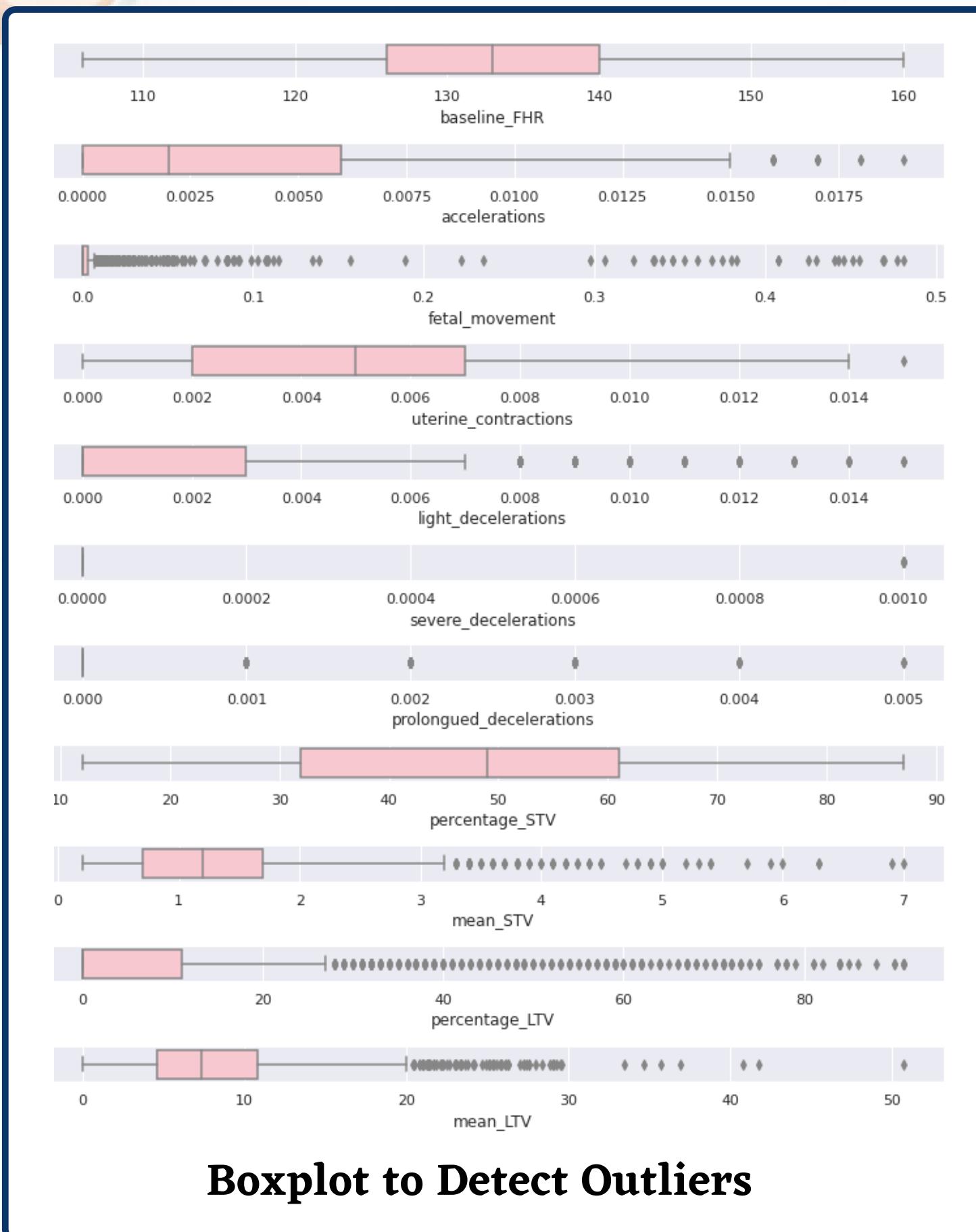
SELECTION OF MODELS

SELECTION OF MATRIX

MODELING

HYPERPARAMETER  
TUNING

FEATURE  
IMPORTANCE



## SELECTION OF MODELS

The **Boxplot** shows that the average of variables has **many outliers**. So that some models that will use are **robust models against outliers** are:

- Random Forest
- Decision Tree
- Gradient Boosting
- XGBoost

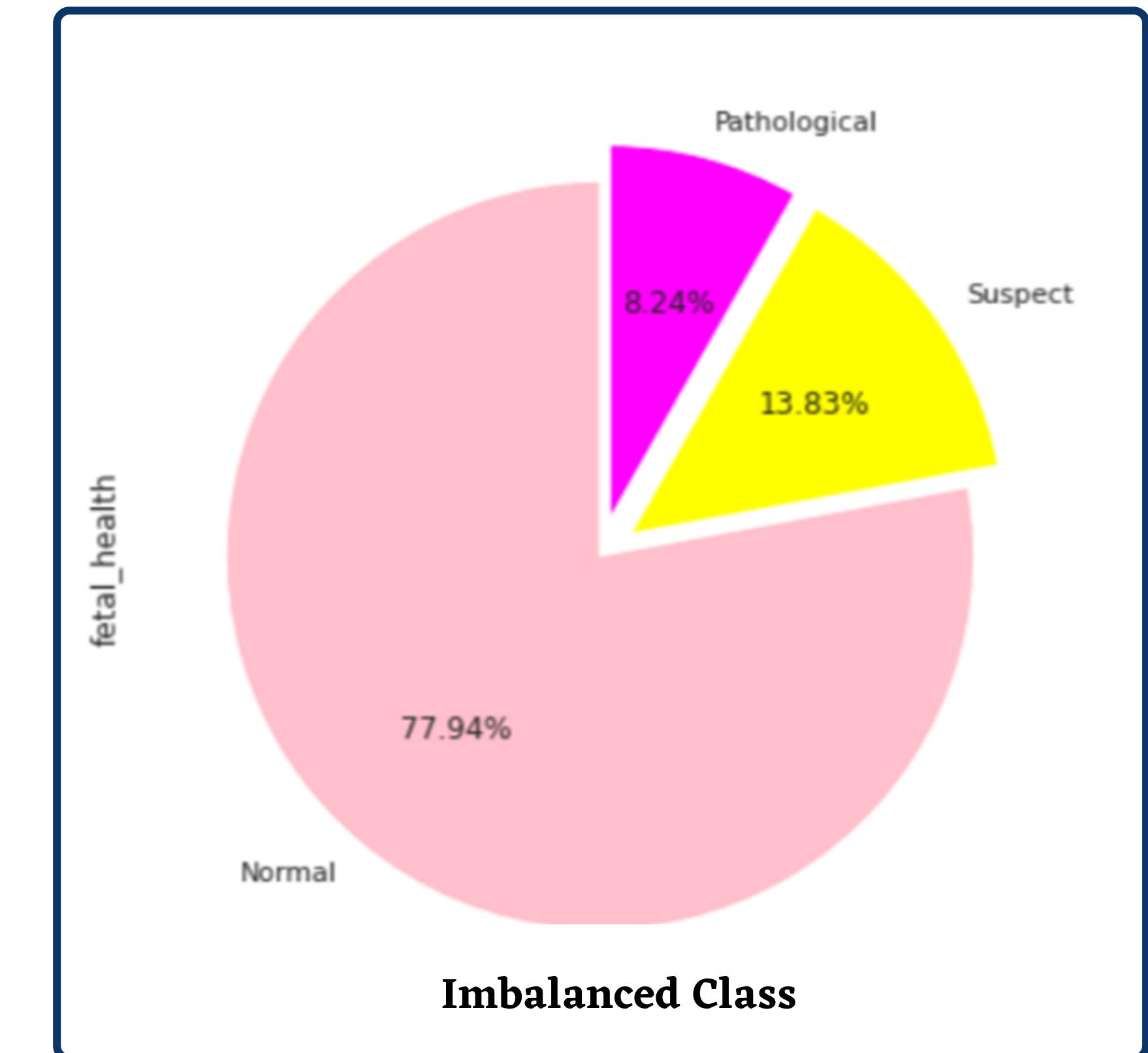
## SELECTION OF MATRIXS

### Matrix for Imbalanced class :

- AUC : classifier accuracy for imbalanced data
- Precision : predicted positive rate
- Recall : actual positive rate
- F1 Score : combination or summarizing of precision and recall.

Among the 4 matrices **to be used is the F1 score**, because:

- **Summarize precision and recall** by taking the harmonic alignment of both.
- **Minimize the false-positive and the false-negative rate.**



## MODELING

Method	F1 Score (Baseline Model)	F1 Score (Modeling)
Random Forest	0.736	0.732
Decision Tree	0.705	0.697
Gradient Boosting	0.799	0.788
XGBoost	0.775	0.779

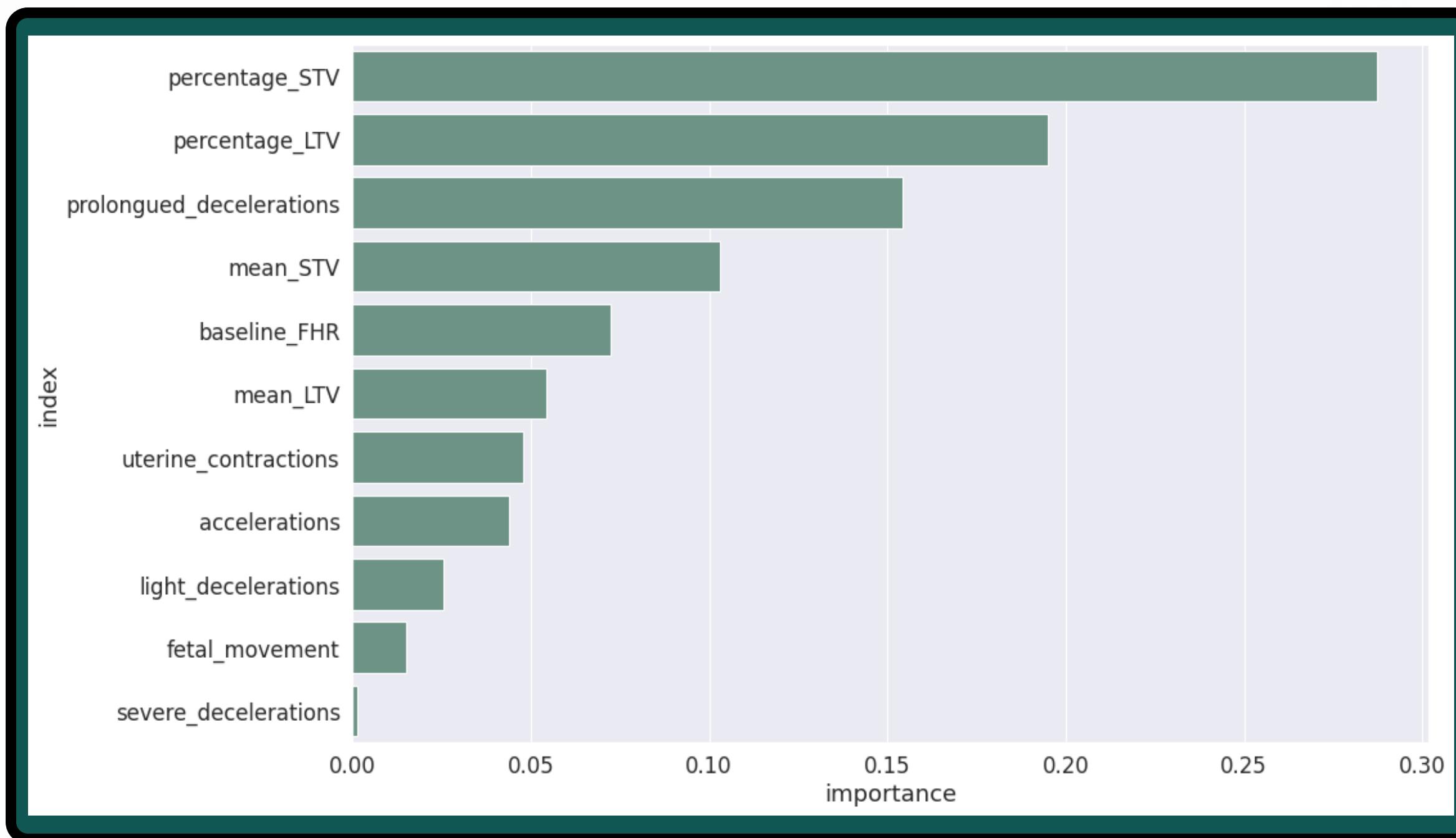
The best model after cleansing is the same as the Baseline Model, namely Gradient Boosting. Where **the baseline F1 score is slightly higher because there are 14 duplicate data.** So, **The value F1 Score after cleansing is Gradient Boosting of 78%.**

Note: Baseline model is processed before data cleansing.

## HYPERPARAMETER TUNING

Gradient Boosting	F1 Score
Baseline Model	0.799
Modeling	0.788
Hyperparameter Tuning	0.858

Hyperparameter tuning succeeded in increasing the value of F1 Score Gradient Boosting to 85%.



## FEATURE IMPORTANCE

The features with the most contributions are:

- **percentage\_STV**
- **percentage\_LTV**
- **prolonged\_decelerations**



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## Insight and Recommendation

# INSIGHT

The best model in this dataset is **Gradient Boosting** with a value **F1 Score of 85%**.

This show that, this dataset can be used as a guide for fetal well-being to avoid fetal death and other impact.

INSIGHT 1

Variables that can be used to determine the category of the fetus are :

- uterine contractions
- accelerations
- prolonged decelerations

INSIGHT 2

CTG results, in **normal fetal conditions:**

- Baseline Fetal Heart Rate : **110-160 bpm.**
- uterine contractions:  
**0 - 0.015 bps.**
- accelerations:  
**0 - 0.0175 bps.**
- There is no prolonged decelerations.

INSIGHT 3

## RECOMMENDATION

The chief obstetrician can hold meetings with managers and other important parties to disseminate the great benefits of CTG tools that can have a big impact on hospitals.

Obstetricians can socialize pregnant women patients directly or through social media to immediately check if they experience the following symptoms of fetal hypoxia:

- Reduced fetal movement.
- Decreased fetal heart rate.
- There is meconium (fetal feces) in the amniotic fluid.

The impact of fetal hypoxia is fetal death, severe brain damage, and cognitive disabilities after birth.



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**THANK YOU!**

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