Heart Disease Diagnostic Analysis

INDRODUCTION

Health is real wealth in the pandemic time we all realized the brute effects of covid-19 on all irrespective of any status. You are required to analyze this health and medical data for better future preparation.

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
import plotly.express as px
```

In [2]:
```
# Read the File
df=pd.read_csv('processed_cleveland.csv')
df
```

Out[2]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num
0	63	1	1	145	233	1	2	150	0	2.3	3	0	6	0
1	67	1	4	160	286	0	2	108	1	1.5	2	3	3	2
2	67	1	4	120	229	0	2	129	1	2.6	2	2	7	1
3	37	1	3	130	250	0	0	187	0	3.5	3	0	3	0
4	41	0	2	130	204	0	2	172	0	1.4	1	0	3	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
298	45	1	1	110	264	0	0	132	0	1.2	2	0	7	1
299	68	1	4	144	193	1	0	141	0	3.4	2	2	7	2
300	57	1	4	130	131	0	0	115	1	1.2	2	1	7	3
301	57	0	2	130	236	0	2	174	0	0.0	2	1	3	1
302	38	1	3	138	175	0	0	173	0	0.0	1	?	3	0

303 rows × 14 columns

In [3]:
```
# Show all the Columns presnt in the dataset
df.columns
```

Out[3]:
```
Index(['age', 'sex', 'cp', 'trestbps', 'chol', 'fbs', 'restecg', 'thalach',
       'exang', 'oldpeak', 'slope', 'ca', 'thal', 'num'],
      dtype='object')
```

There are Fourteen Features in this dataset

age: age in years

sex: sex (1 = male; 0 = female)

cp: chest pain type

Value 1: typical angina Value 2: atypical angina Value 3: non-anginal pain Value 4: asymptomatic

trestbps: resting blood pressure (in mm Hg on admission to the hospital)

chol: serum cholestoral in mg/dl

fbs: fasting blood sugar > 120 mg/dl (1 = true; 0 = false)

restecg: resting electrocardiographic results Value 0: normal Value 1: having ST-T wave abnormality (T wave inversions and/or ST elevation or depression of > 0.05 mV) Value 2: showing probable or definite left ventricular hypertrophy by Estes' criteria

thalach: maximum heart rate achieved

exang: exercise induced angina (1 = yes; 0 = no)

oldpeak: ST depression induced by exercise relative to rest

slope: the slope of the peak exercise ST segment Value 1: upsloping Value 2: flat Value 3: downsloping

ca: number of major vessels (0-3) colored by flourosopy (for calcification of vessels)

thal: results of nuclear stress test (3 = normal; 6 = fixed defect; 7 = reversable defect)

num: Heart disease Value 0: NO Value 1: Yes

In [4]:
```
#find the missing values
df.isnull().sum()
```

Out[4]:
```
age         0
sex         0
cp          0
trestbps    0
chol        0
fbs         0
restecg     0
thalach     0
exang       0
oldpeak     0
slope       0
ca          0
thal        0
num         0
dtype: int64
```

There is no missing value .

In [5]:
```
df.dtypes
```

Out[5]:
```
age           int64
sex           int64
cp            int64
trestbps      int64
chol          int64
fbs           int64
restecg       int64
thalach       int64
exang         int64
oldpeak     float64
slope         int64
ca           object
thal         object
num           int64
dtype: object
```

In [6]:
```
df.groupby('num').size()
```

Out[6]:
```
num
0    164
1     55
2     36
3     35
4     13
dtype: int64
```

In [7]:
```
#Changing the variable
df['num']=df['num'].replace([2,3,4],1)
```

In [8]:
```
df.groupby('num').size()
```

Out[8]:
```
num
0    164
1    139
dtype: int64
```

In [9]:
```
#Converting numberical variable into categorical
def heart_disease(row):
    if row==0:
        return 'Absence'
    elif row==1:
        return 'Presence'
```

In [10]:
```
df['heart_disease'] = df['num'].apply(heart_disease)
df.head()
```

Out[10]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num	heart_
0	63	1	1	145	233	1	2	150	0	2.3	3	0	6	0	A
1	67	1	4	160	286	0	2	108	1	1.5	2	3	3	1	P
2	67	1	4	120	229	0	2	129	1	2.6	2	2	7	1	P
3	37	1	3	130	250	0	0	187	0	3.5	3	0	3	0	A
4	41	0	2	130	204	0	2	172	0	1.4	1	0	3	0	A

In [11]:
```
df.columns
```

Out[11]:
```
Index(['age', 'sex', 'cp', 'trestbps', 'chol', 'fbs', 'restecg', 'thalach',
       'exang', 'oldpeak', 'slope', 'ca', 'thal', 'num', 'heart_disease'],
      dtype='object')
```

In [12]:
```
heart_name=df.heart_disease.value_counts().index
heart_name
```

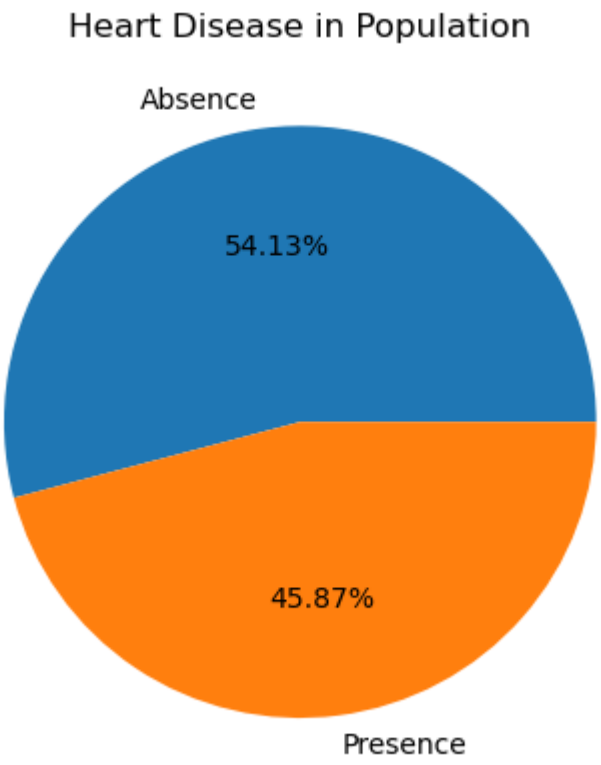
Out[12]:
```
Index(['Absence', 'Presence'], dtype='object')
```

In [13]:
```
heart_Val=df.heart_disease.value_counts().values
heart_Val
```

Out[13]:
```
array([164, 139], dtype=int64)
```

In [14]:
```
#Creating Pie chart proportion of patients with and without heart disease
plt.pie(heart_Val,labels=heart_name,autopct='%1.2f%%')
plt.title('Heart Disease in Population')
```

Out[14]:
```
Text(0.5, 1.0, 'Heart Disease in Population')
```



The People having Heart Disease Absence are 54.13%. The People Having Heart Disease Presence are 45.87%.

In [15]:
```
#Coverting the numercial Variable into Catogerical
def Gender(row):
    if row==0:
        return 'Female'
    elif row==1:
        return 'Male'
```

In [16]:
```
df['Gender'] = df['sex'].apply(Gender)
df.head()
```

Out[16]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num	heart_
0	63	1	1	145	233	1	2	150	0	2.3	3	0	6	0	A
1	67	1	4	160	286	0	2	108	1	1.5	2	3	3	1	P
2	67	1	4	120	229	0	2	129	1	2.6	2	2	7	1	P
3	37	1	3	130	250	0	0	187	0	3.5	3	0	3	0	A
4	41	0	2	130	204	0	2	172	0	1.4	1	0	3	0	A

In [17]:
```
Gender_name=df.Gender.value_counts().index
Gender_name
```

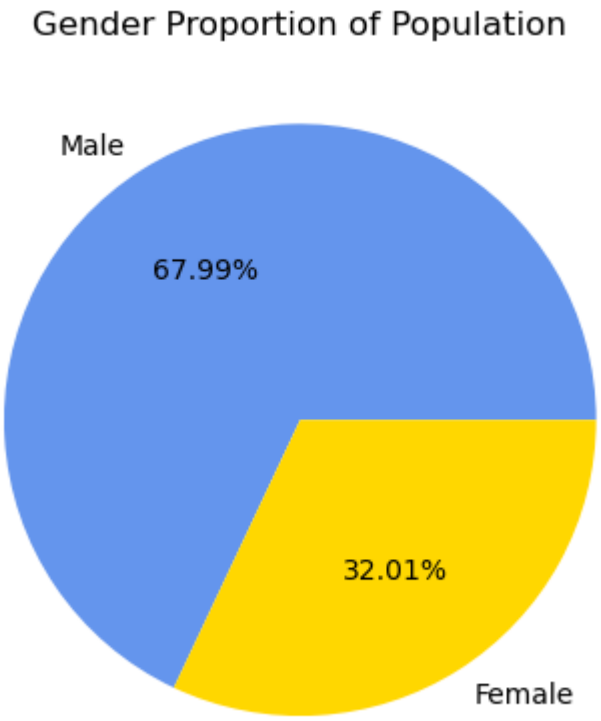
Out[17]:
```
Index(['Male', 'Female'], dtype='object')
```

In [18]:
```
Gender_val=df.Gender.value_counts().values
Gender_val
```

Out[18]:
```
array([206,  97], dtype=int64)
```

In [19]:
```
#Creating Pie chart gender propertion of the Patients
plt.pie(Gender_val,labels=Gender_name,autopct='%1.2f%%',colors=[ 'cornflowerblue', 'g
plt.title('Gender Proportion of Population')
```

Out[19]:
```
Text(0.5, 1.0, 'Gender Proportion of Population')
```



The number of the Male are 67.99%. The number of the Female are 32.01%.

In [20]:
```
#Coverting the numercial Variable into Catogerical
def Chest_Pain(row):
    if row==1:
        return 'typical angina'
    if row==2:
        return 'atypical angina'
    if row==3:
        return 'non-anginal'
    elif row==4:
        return 'asymptomatic'
```

In [21]:
```
df['Chest_Pain'] = df['cp'].apply(Chest_Pain)
df.tail()
```

Out[21]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num	hea
298	45	1	1	110	264	0	0	132	0	1.2	2	0	7	1	
299	68	1	4	144	193	1	0	141	0	3.4	2	2	7	1	
300	57	1	4	130	131	0	0	115	1	1.2	2	1	7	1	
301	57	0	2	130	236	0	2	174	0	0.0	2	1	3	1	
302	38	1	3	138	175	0	0	173	0	0.0	1	?	3	0	

In [22]:
```
Chest_name=df.Chest_Pain.value_counts().index
Chest_name
```

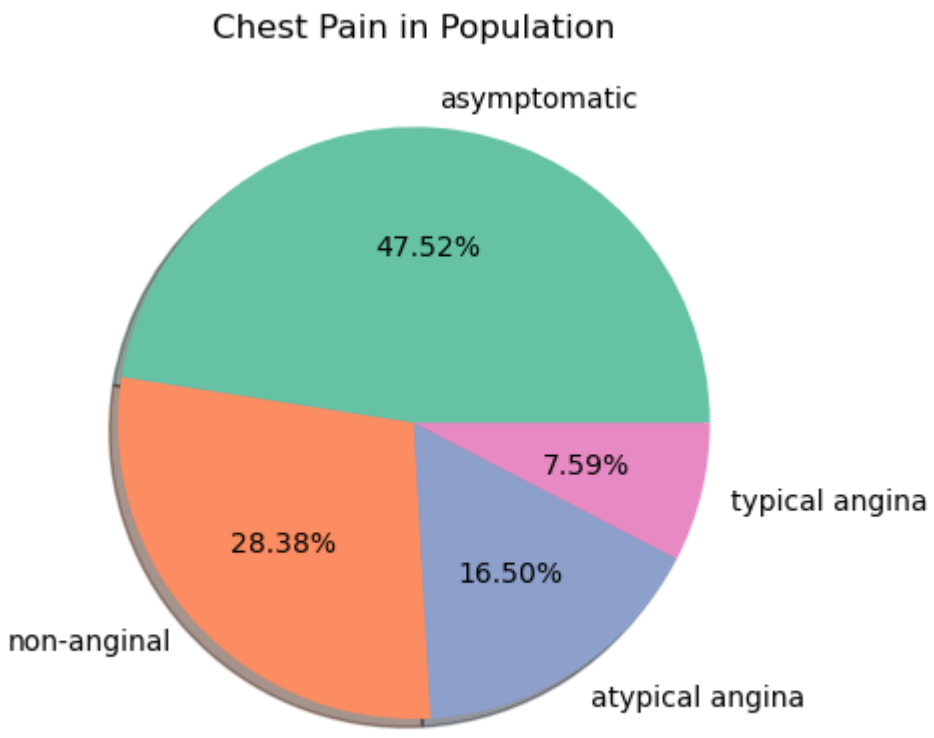
Out[22]:
```
Index(['asymptomatic', 'non-anginal', 'atypical angina', 'typical angina'], dtype='ob
ject')
```

In [23]:
```
Chest_val=df.Chest_Pain.value_counts().values
Chest_val
```

Out[23]:
```
array([144,  86,  50,  23], dtype=int64)
```

In [24]:
```
#Creating Pie chart proportion of chest pain in patient
plt.pie(Chest_val,labels=Chest_name,autopct='%1.2f%%',colors=sns.color_palette('Set2')
plt.title('Chest Pain in Population')
```

Out[24]:
```
Text(0.5, 1.0, 'Chest Pain in Population')
```



We have asymptomatic individual of 47.52% does not show any signs of illness or experience any noticeable symptoms associated with a Chest pain. We Have non-angina individual of

28.38% chest pain in people without heart disease. we have atypical angina of 16.50% chest pain caused by reduced blood flow to the heart muscle due to narrowed or blocked coronary arteries. we have typical angina of 7.59% pain is usually described as a tightness, pressure, squeezing, or burning sensation in the chest.

In [25]:
```
#Coverting the numercial Variable into Catogerical
def Fasting_blood_sugar(row):
    if row==0:
        return 'False'
    elif row==1:
        return 'True'
```

In [26]:
```
df['Fasting_blood_sugar']=df['fbs'].apply(Fasting_blood_sugar)
df.head()
```

Out[26]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num	heart_
0	63	1	1	145	233	1	2	150	0	2.3	3	0	6	0	A
1	67	1	4	160	286	0	2	108	1	1.5	2	3	3	1	P
2	67	1	4	120	229	0	2	129	1	2.6	2	2	7	1	P
3	37	1	3	130	250	0	0	187	0	3.5	3	0	3	0	A
4	41	0	2	130	204	0	2	172	0	1.4	1	0	3	0	A

In [27]:
```
fbs_name=df.Fasting_blood_sugar.value_counts().index
fbs_name
```

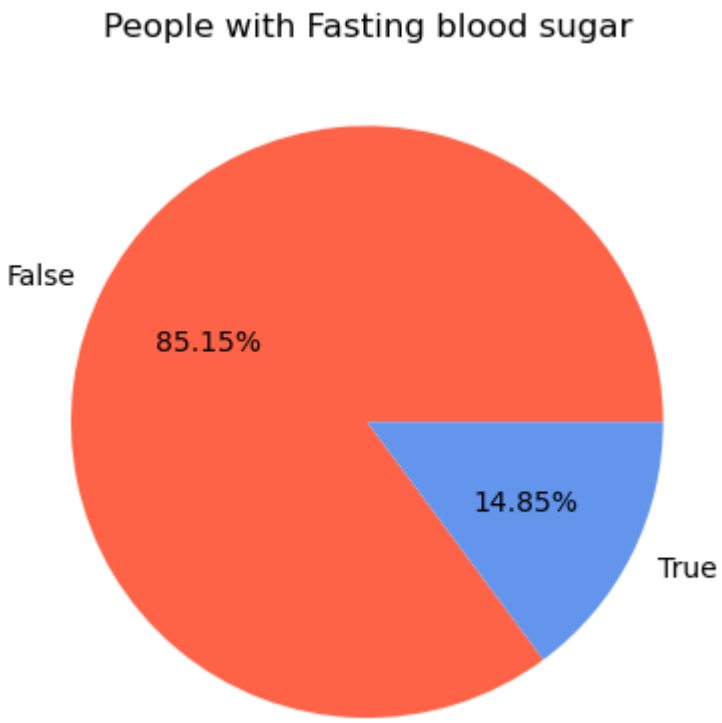
Out[27]:
```
Index(['False', 'True'], dtype='object')
```

In [28]:
```
fbs_val=df.Fasting_blood_sugar.value_counts().values
fbs_val
```

Out[28]:
```
array([258,  45], dtype=int64)
```

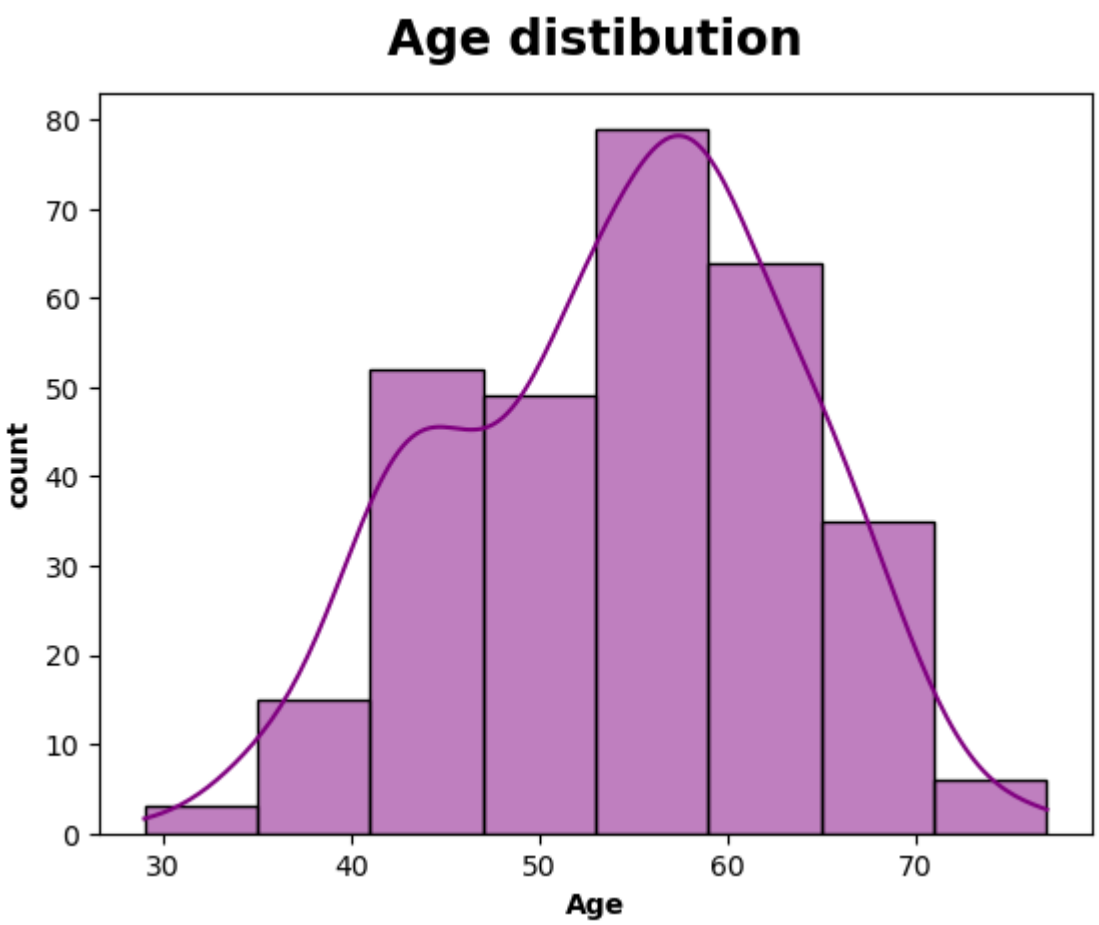
In [29]:
```
#Creating Pie chart proportion of patients with Fasting blood Sugar
plt.pie(fbs_val,labels=fbs_name,autopct='%1.2f%%',colors=['tomato', 'cornflowerblue',
plt.title('People with Fasting blood sugar')
```

Out[29]:
```
Text(0.5, 1.0, 'People with Fasting blood sugar')
```



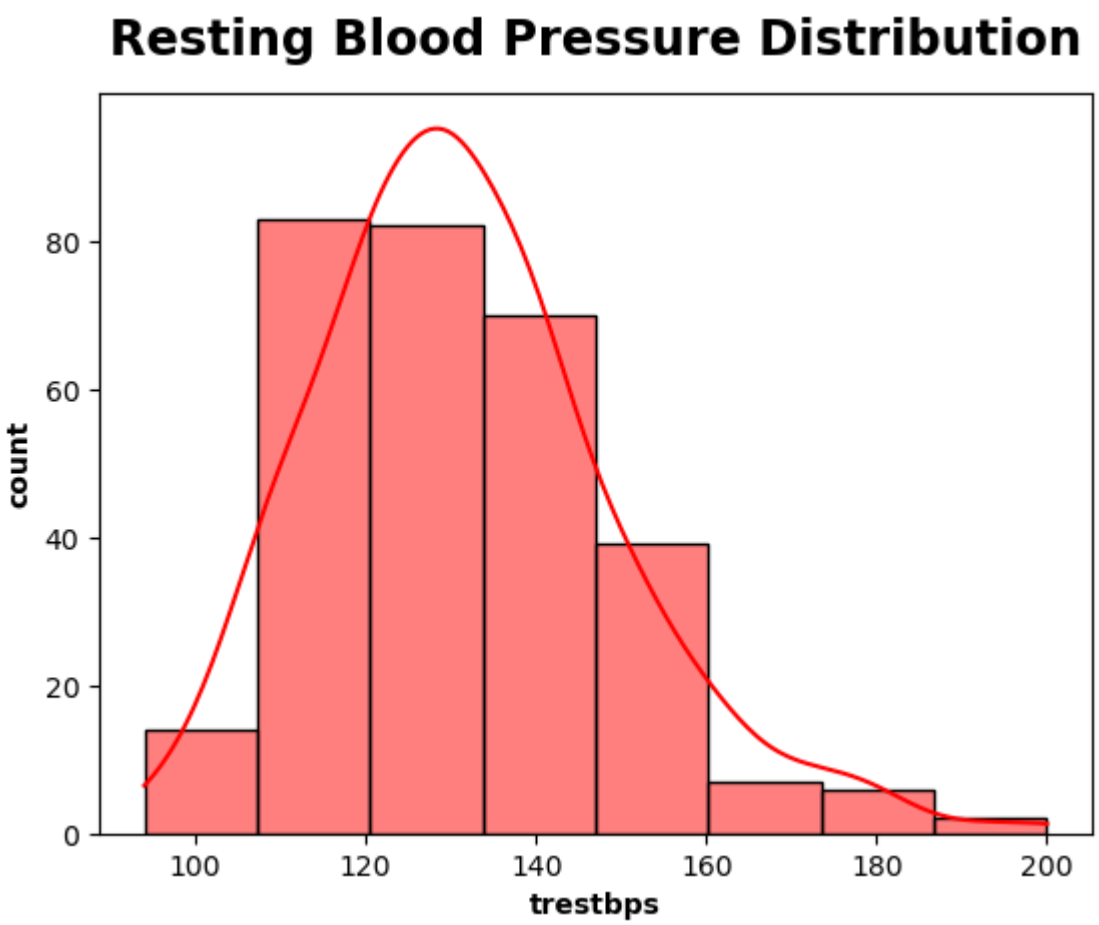
The people with not fasting blood sugar are 85.15% they do not have Fasting blood sugar which is less than 120 mg/dl The people are fasting with blood sugar are 14.85%. which is greater than 120 mg/dl blood sugar levels is crucial as high blood sugar can contribute to inflammation, endothelial dysfunction, and an increased risk of cardiovascular events.

In [30]:
```
# Age dirtribution in heart disease
Age_dis=sns.histplot(data=df ,x='age',bins=8,kde=True,color='purple')
Age_dis.set_xlabel('Age',fontweight='bold')
Age_dis.set_ylabel('count',fontweight='bold')
Age_dis.set_title('Age distibution',fontweight='heavy',size='xx-large',y=1.03)
plt.show()
```



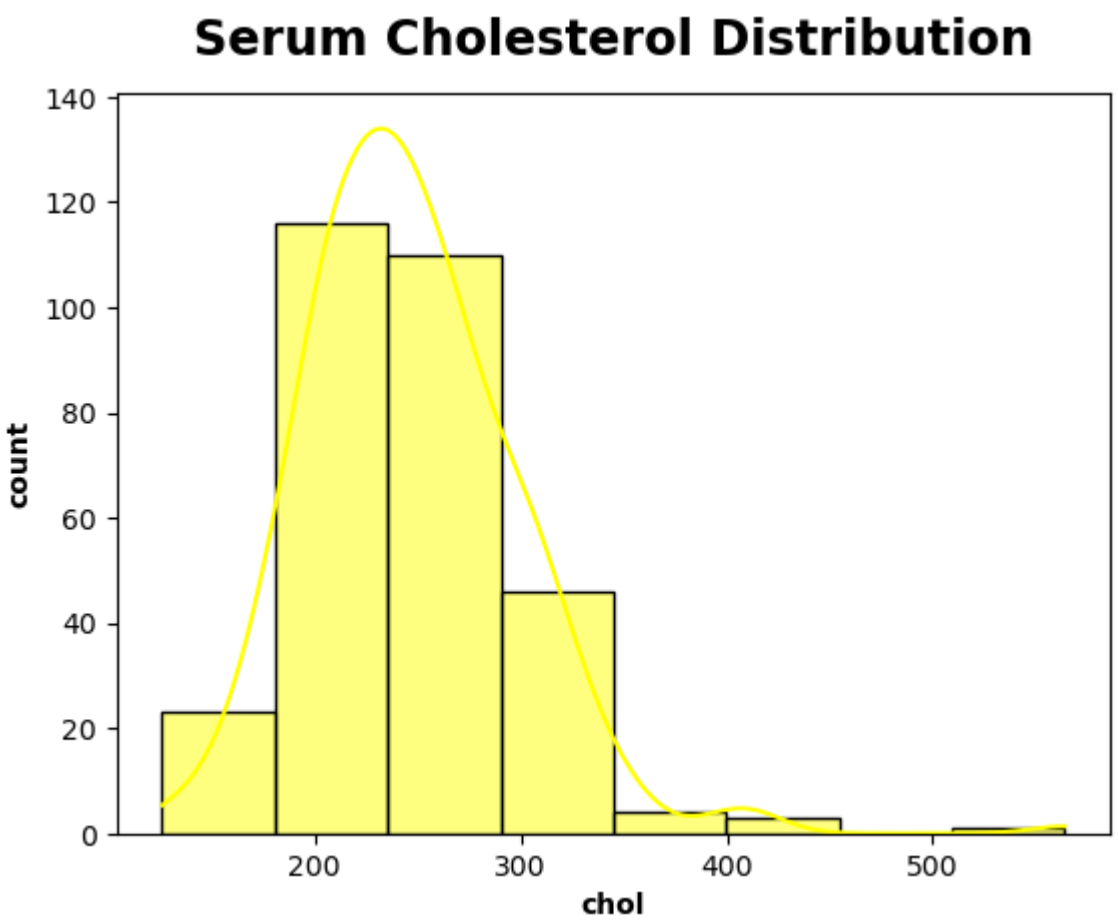
The potential age groups of 51-65 that are more prone to heart disease.

In [31]:
```
#Resting blood pressure Distribution
res_dis=sns.histplot(data=df ,x='trestbps',bins=8,kde=True,color='red')
res_dis.set_xlabel('trestbps',fontweight='bold')
res_dis.set_ylabel('count',fontweight='bold')
res_dis.set_title('Resting Blood Pressure Distribution',fontweight='heavy',size='xx-la
plt.show()
```



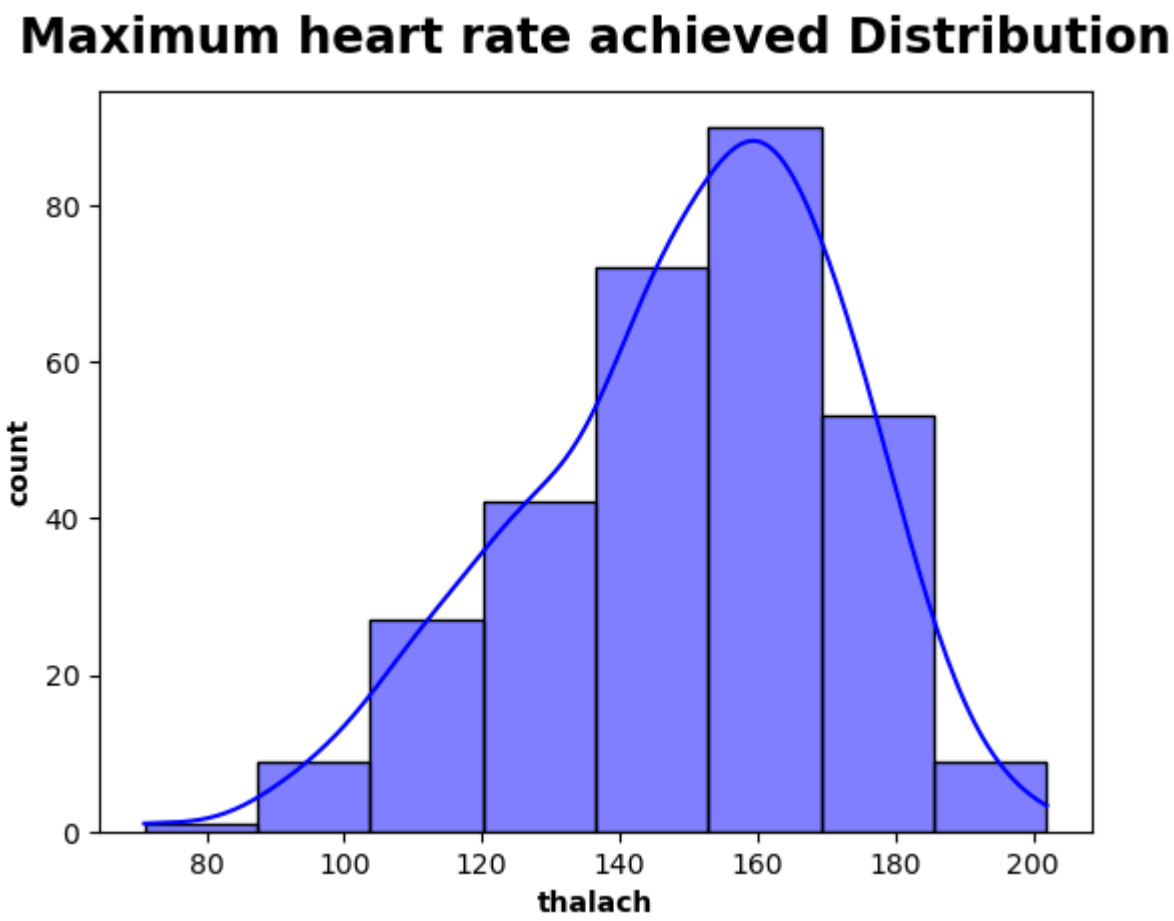
The Resting blood pressure in heart disease more likely 110-140 mm hg

In [32]:
```
# Serum Cholesterol Distribution
ser_dis=sns.histplot(data=df ,x='chol',bins=8,kde=True,color='yellow')
ser_dis.set_xlabel('chol',fontweight='bold')
ser_dis.set_ylabel('count',fontweight='bold')
ser_dis.set_title('Serum Cholesterol Distribution',fontweight='heavy',size='xx-large',
plt.show()
```



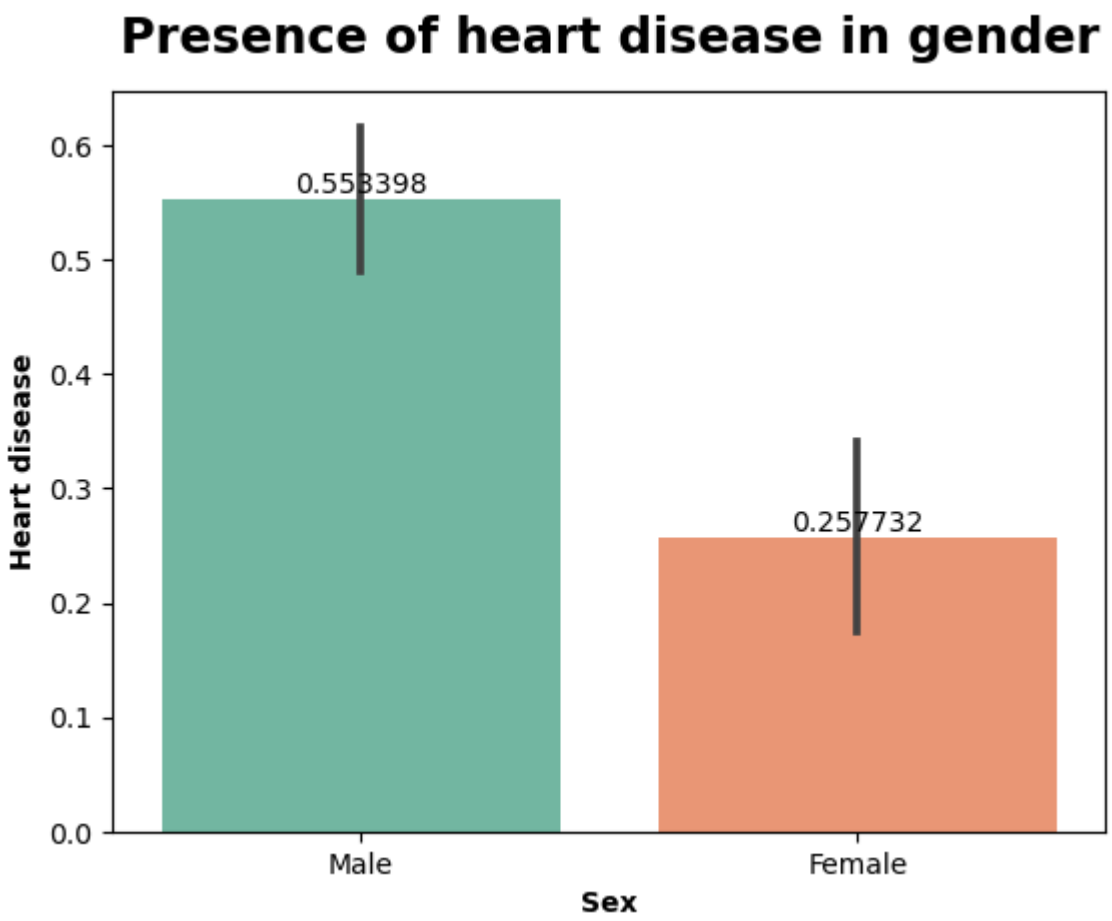
The serum Cholesterol in heart disease more likely 200-300 mg/dl

In [33]:
```
# maximum heart rate achieved distribution
ser_dis=sns.histplot(data=df ,x='thalach',bins=8,kde=True,color='blue')
ser_dis.set_xlabel('thalach',fontweight='bold')
ser_dis.set_ylabel('count',fontweight='bold')
ser_dis.set_title('Maximum heart rate achieved Distribution',fontweight='heavy',size='
plt.show()
```



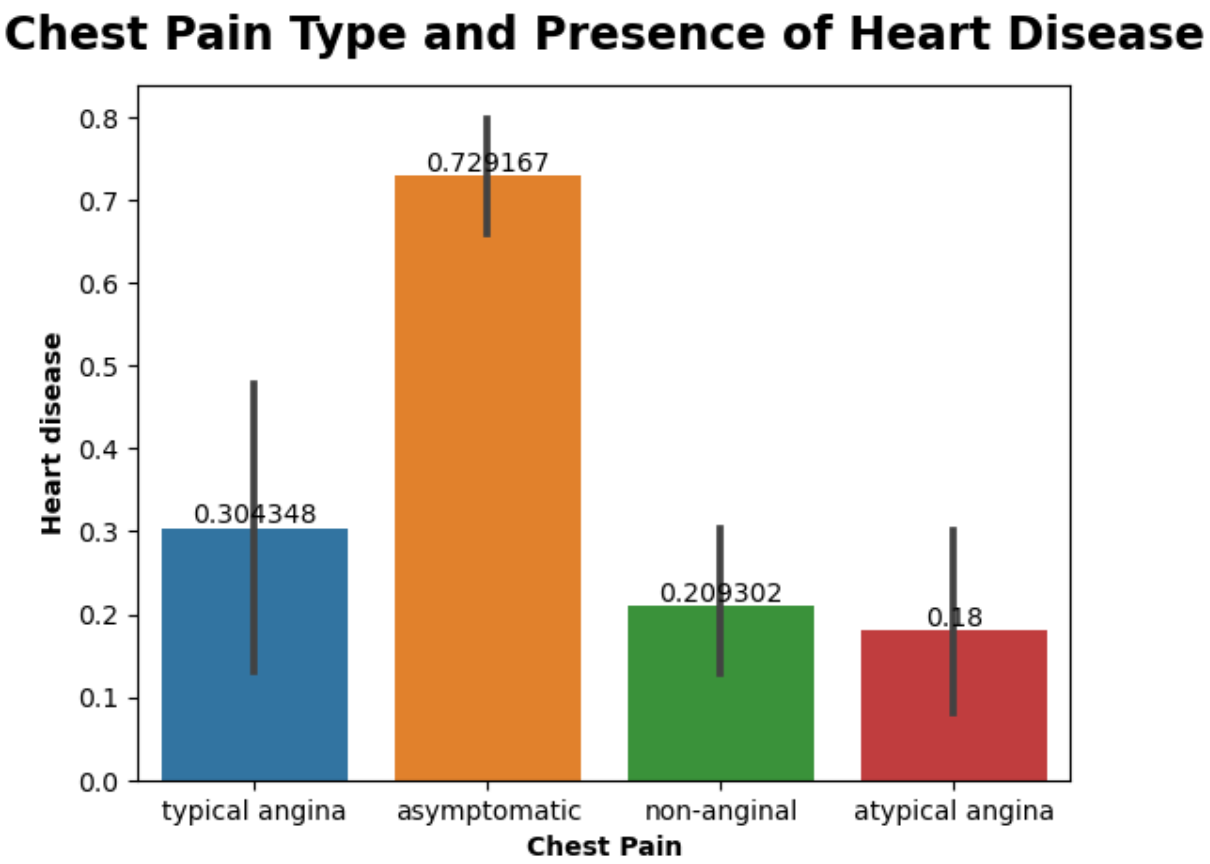
The maximum Heart rate achieved in heart disease is 140-180

In [34]:
```
# Barplot in Presence of heart disease in gender
Presence=sns.barplot(data=df ,x='Gender',y='num',palette="Set2")
Presence.set_xlabel('Sex',fontweight='bold')
Presence.set_ylabel('Heart disease',fontweight='bold')
Presence.set_title('Presence of heart disease in gender',fontweight='heavy',size='xx-l
Presence.bar_label(Presence.containers[0])
plt.show()
```



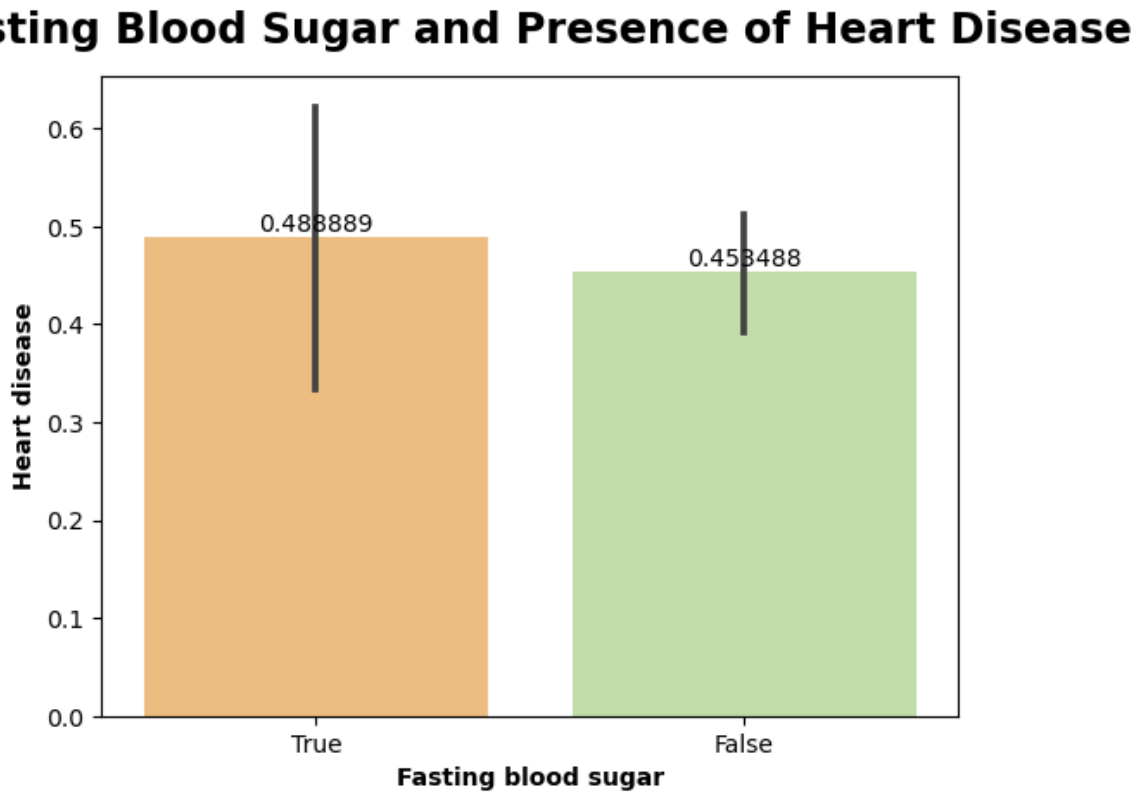
We can see that Male has high prone to heart disease .

In [35]:
```
#Bar plot of Chest Pain Type and Presence of Heart Disease
Presence=sns.barplot(data=df ,x='Chest_Pain',y='num')
Presence.set_xlabel('Chest Pain',fontweight='bold')
Presence.set_ylabel('Heart disease',fontweight='bold')
Presence.set_title('Chest Pain Type and Presence of Heart Disease',fontweight='heavy',
Presence.bar_label(Presence.containers[0])

plt.show()
```



The asymptomatic type of the chest pain is highly present in heart disease

In [36]:
```
#Bar plot of Fasting Blood Sugar and Presence of Heart Disease
Presence=sns.barplot(data=df ,x='Fasting_blood_sugar',y='num',palette="Spectral")
Presence.set_xlabel('Fasting blood sugar',fontweight='bold')
Presence.set_ylabel('Heart disease',fontweight='bold')
Presence.set_title('Fasting Blood Sugar and Presence of Heart Disease',fontweight='hea
Presence.bar_label(Presence.containers[0])

plt.show()
```



The Fasting blood sugar is more high in heart Disease .

In [37]:
```
df.head()
```

Out[37]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num	heart_
0	63	1	1	145	233	1	2	150	0	2.3	3	0	6	0	A
1	67	1	4	160	286	0	2	108	1	1.5	2	3	3	1	P
2	67	1	4	120	229	0	2	129	1	2.6	2	2	7	1	P
3	37	1	3	130	250	0	0	187	0	3.5	3	0	3	0	A
4	41	0	2	130	204	0	2	172	0	1.4	1	0	3	0	A

In [38]:
```
df['thal']=df['thal'].replace("?",'7')
```

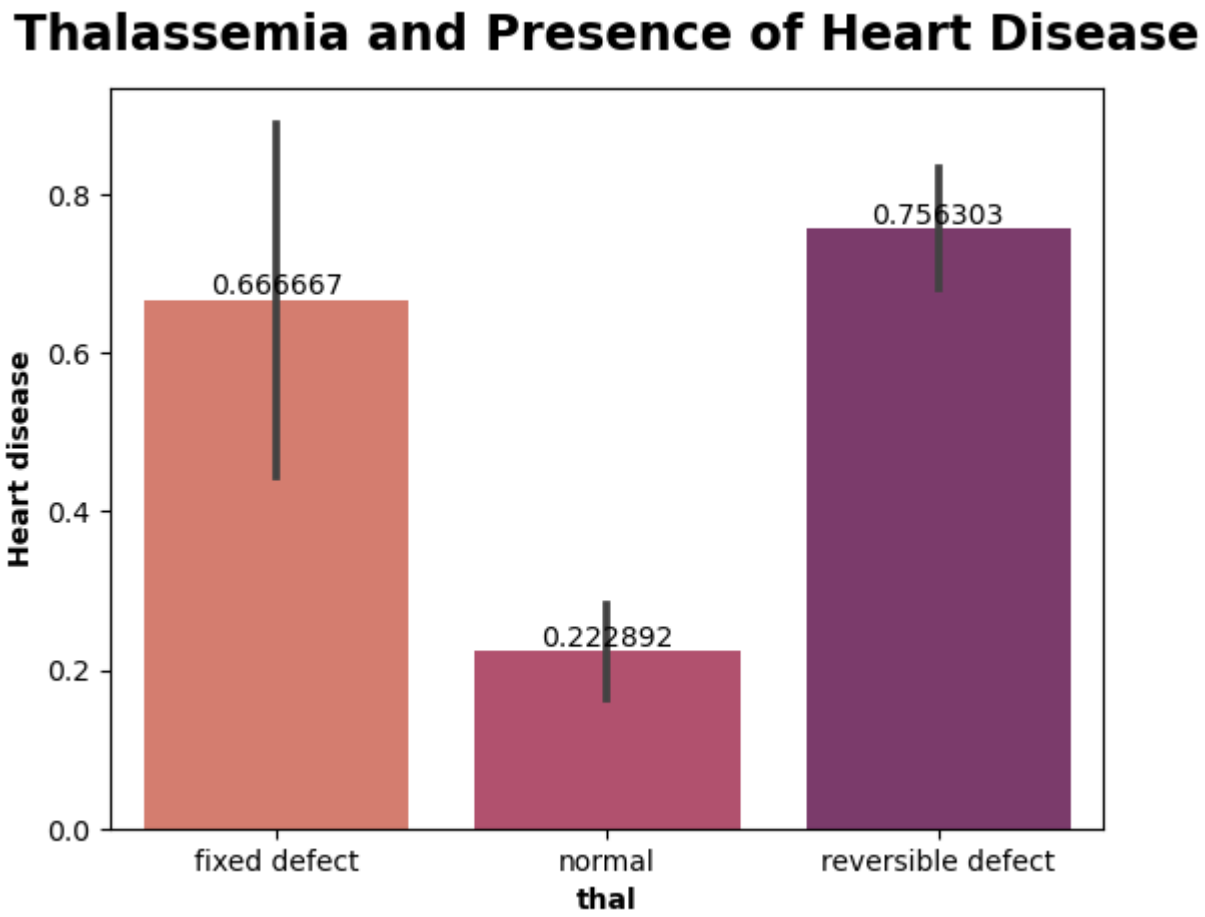
In [39]:
```
def Thal_mai(number):
    replacements = {'3': 'normal', '6': 'fixed defect', '7': 'reversible defect'}
    if number in replacements:
        return replacements[number]
    else:
        return number
```

In [40]:
```
df['Thal_mai']=df['thal'].apply(Thal_mai)
df.head()
```

Out[40]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num	heart_
0	63	1	1	145	233	1	2	150	0	2.3	3	0	6	0	A
1	67	1	4	160	286	0	2	108	1	1.5	2	3	3	1	P
2	67	1	4	120	229	0	2	129	1	2.6	2	2	7	1	P
3	37	1	3	130	250	0	0	187	0	3.5	3	0	3	0	A
4	41	0	2	130	204	0	2	172	0	1.4	1	0	3	0	A

In [41]:
```
#Bar plot of Thalassemia and Presence of Heart Disease
Presence=sns.barplot(data=df ,x='Thal_mai',y='num',palette="flare")
Presence.set_xlabel('thal',fontweight='bold')
Presence.set_ylabel('Heart disease',fontweight='bold')
Presence.set_title('Thalassemia and Presence of Heart Disease',fontweight='heavy',size
Presence.bar_label(Presence.containers[0])

plt.show()
```



The Thalassemia and Presence of Heart Disease is more high in reversible defect

In [42]:
```
# Calculate the correlation matrix
numerical_columns = ['age', 'trestbps', 'chol', 'thalach', 'oldpeak']
```

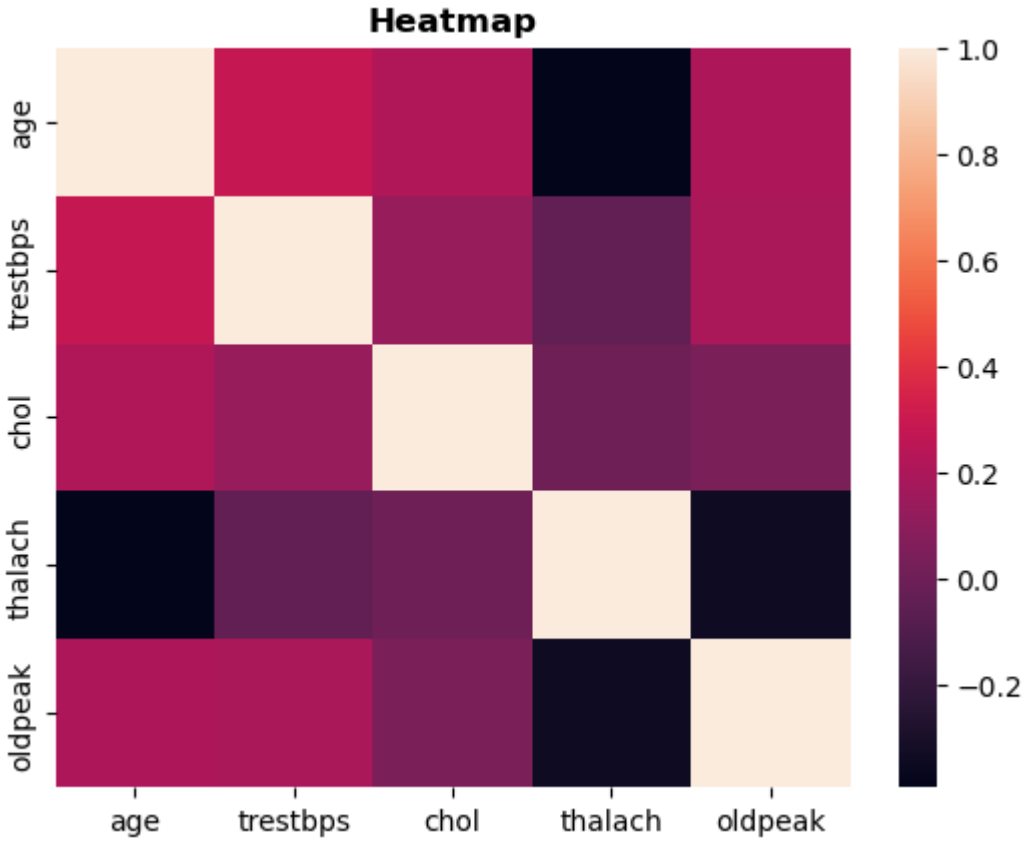
```
correlation_matrix = df[numerical_columns].corr()
correlation_matrix.style.background_gradient(cmap='summer')
```

Out[42]:

	age	trestbps	chol	thalach	oldpeak
age	1.000000	0.284946	0.208950	-0.393806	0.203805
trestbps	0.284946	1.000000	0.130120	-0.045351	0.189171
chol	0.208950	0.130120	1.000000	-0.003432	0.046564
thalach	-0.393806	-0.045351	-0.003432	1.000000	-0.343085
oldpeak	0.203805	0.189171	0.046564	-0.343085	1.000000

In [43]:

```
#Heatmap corelation between feature

heat=sns.heatmap(data=correlation_matrix)
heat.set_title('Heatmap',fontweight='bold')
plt.show()
```



Age and Maximum Heart Rate (thalach): There is a negative correlation (-0.39) between age and maximum heart rate achieved (thalach). As age increases, the maximum heart rate achieved tends to decrease.

Age and Resting Blood Pressure (trestbps): There is a positive correlation (0.28) between age and resting blood pressure (trestbps). As age increases, the resting blood pressure tends to be higher.

Age and Serum Cholesterol Level (chol): There is a positive correlation (0.21) between age and serum cholesterol level (chol). As age increases, the serum cholesterol level tends to be higher.

Maximum Heart Rate (thalach) and Oldpeak: There is a negative correlation (-0.34) between maximum heart rate achieved (thalach) and the ST depression induced by exercise relative to rest (oldpeak). As the maximum heart rate achieved increases, the ST depression tends to decrease.

In [44]:
```
df.head()
```

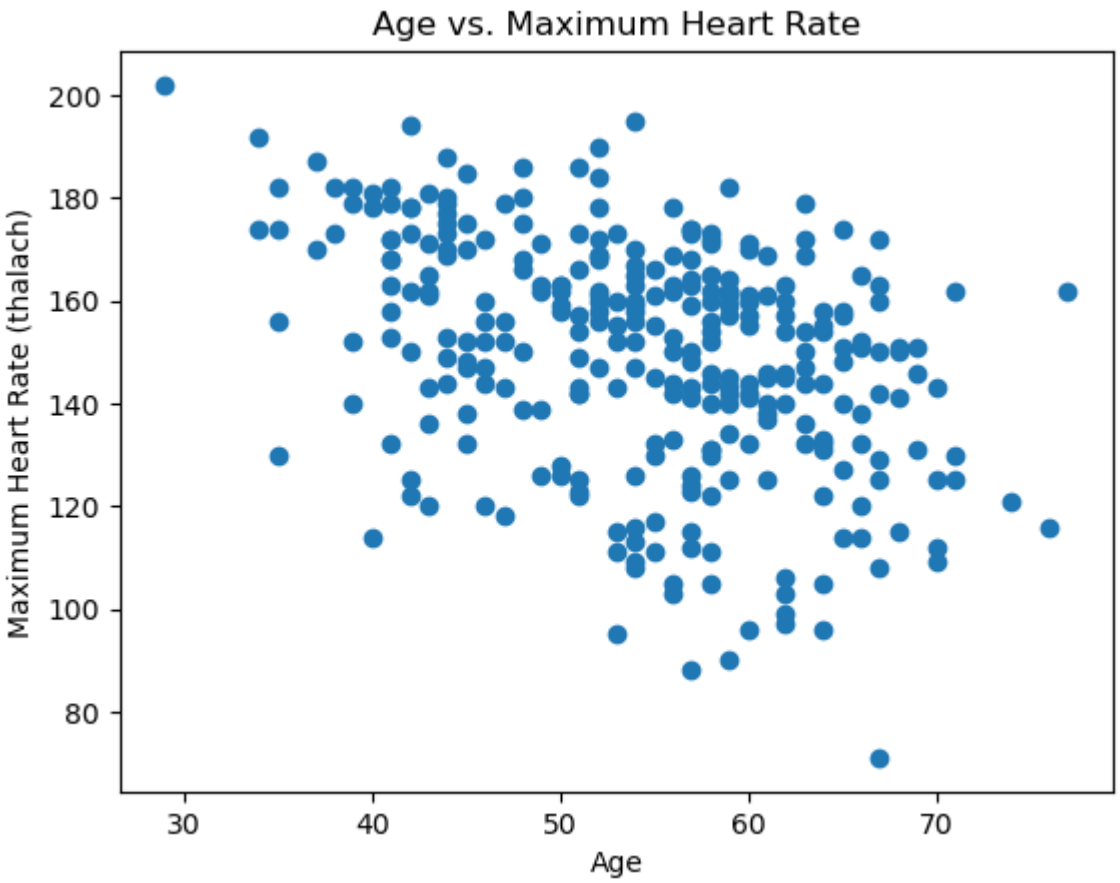
Out[44]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num	heart_
0	63	1	1	145	233	1	2	150	0	2.3	3	0	6	0	A
1	67	1	4	160	286	0	2	108	1	1.5	2	3	3	1	P
2	67	1	4	120	229	0	2	129	1	2.6	2	2	7	1	P
3	37	1	3	130	250	0	0	187	0	3.5	3	0	3	0	A
4	41	0	2	130	204	0	2	172	0	1.4	1	0	3	0	A

In [45]:
```
plot_data = df.groupby(['age', 'Chest_Pain', 'trestbps', 'chol', 'fbs', 'restecg', 'th

fig = px.line(plot_data, x='age', y='Gender', color='Chest_Pain')
fig.update_layout(
    title_text='Heart Disease Risk Factors',
    height=500, width=1000)
fig.show()
```

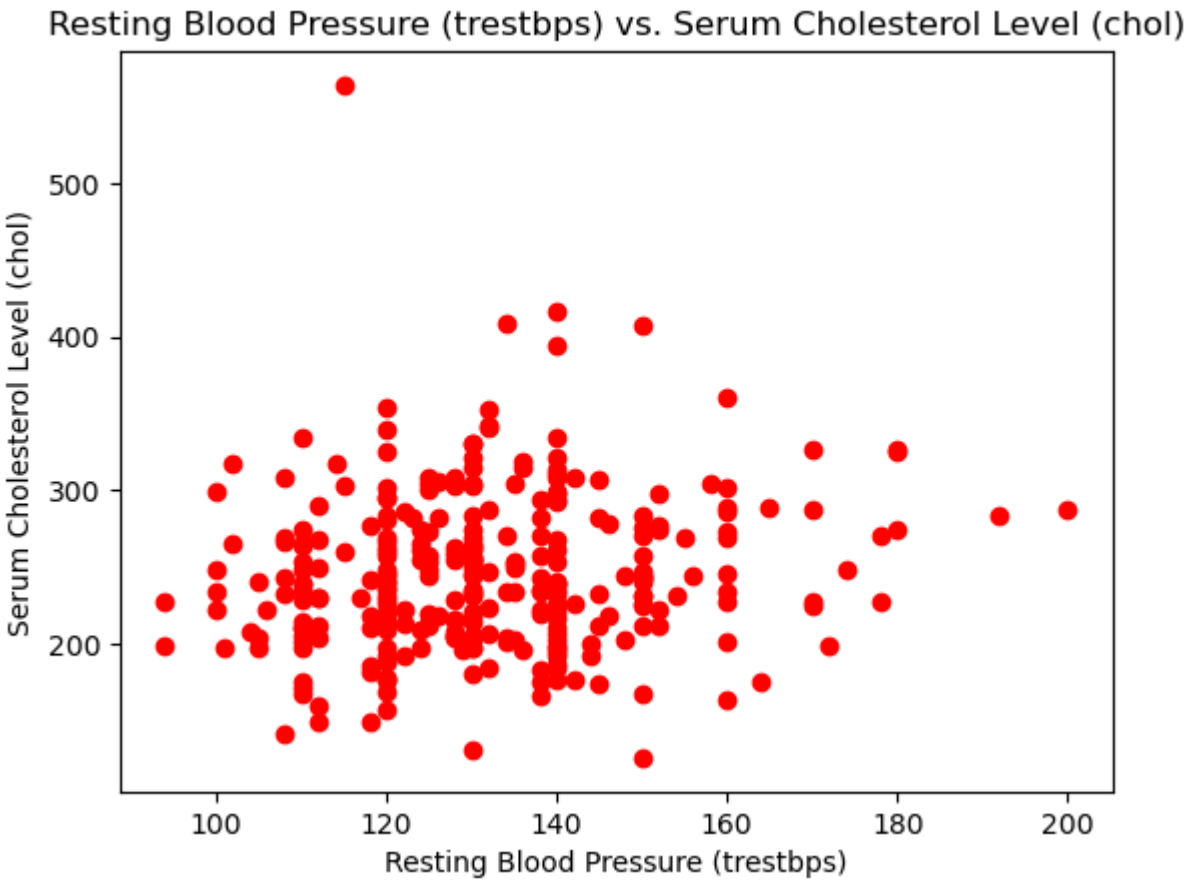
The Youngest age is 29 male with the chest Pain type atypical angina. The oldest age is 77 male with the chest pain type asymptomatic.

In [46]:
```
# Scatter plot Age vs. Maximum Heart Rate (thalach)
x = df['age']
y = df['thalach']
plt.scatter(x, y)
plt.xlabel('Age')
plt.ylabel('Maximum Heart Rate (thalach)')
plt.title('Age vs. Maximum Heart Rate')
plt.show()
```



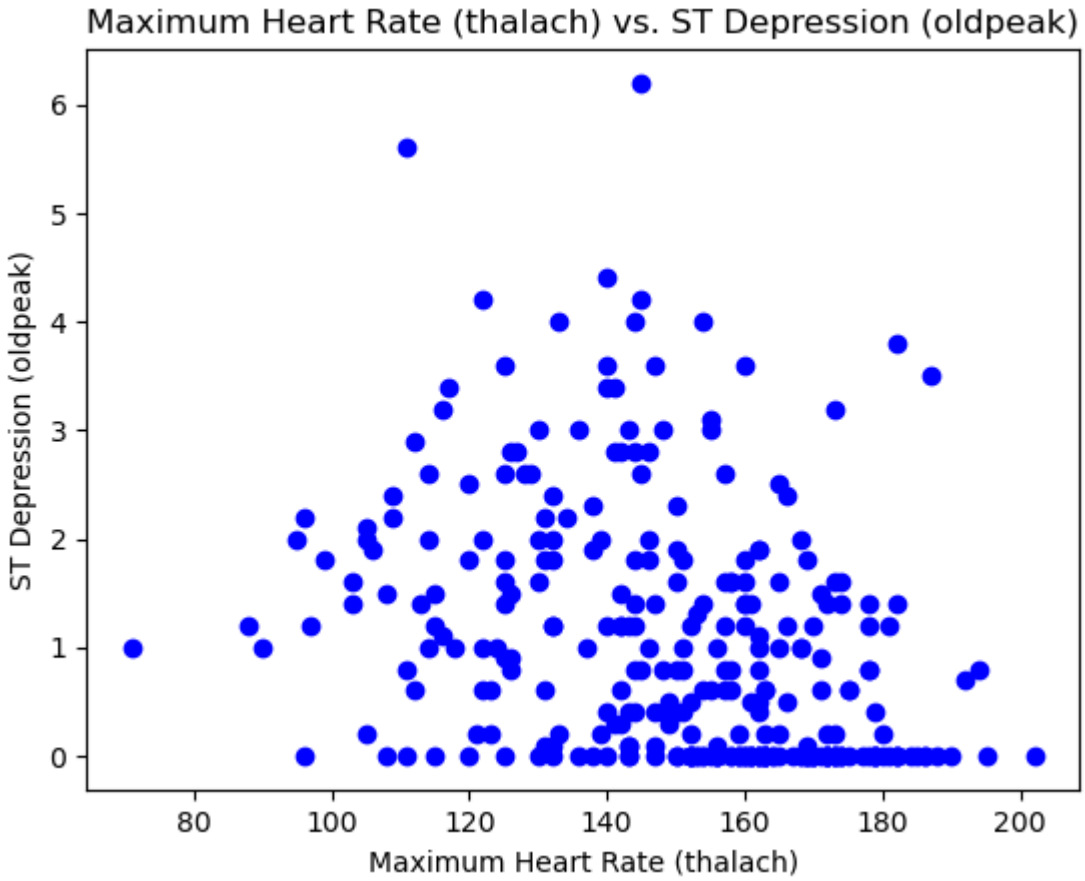
The lowest heart rate is 80-100 in the Age range of 55-70 The highest heart rateis 160-200 in the Age range of 30-45

In [47]:
```
#  Scatterplot Resting Blood Pressure (trestbps) vs. Serum Cholesterol Level (chol)
x = df['trestbps']
y = df['chol']
plt.scatter(x, y,color='red')
plt.xlabel('Resting Blood Pressure (trestbps)')
plt.ylabel('Serum Cholesterol Level (chol)')
plt.title('Resting Blood Pressure (trestbps) vs. Serum Cholesterol Level (chol)')
plt.show()
```



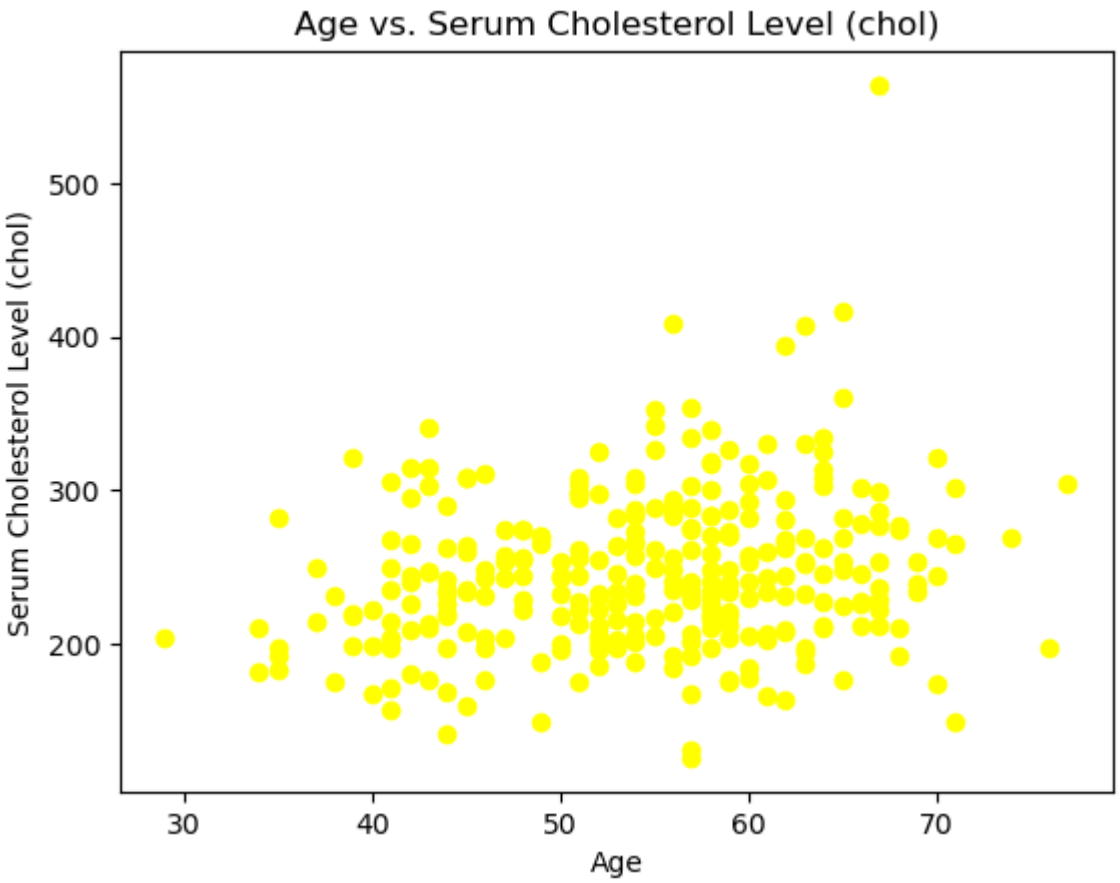
The highest cholersterrol level between 500-600 mg/dl with the Resting blood Pressure between 100-120 mm hg The lowest cholersterrol level between 100-200 mg/dl with the Resting blood Pressure between 100-160 mm hg

In [48]:
```
# Scatterplot Maximum Heart Rate (thalach) vs. ST Depression (oldpeak)
x = df['thalach']
y = df['oldpeak']
plt.scatter(x, y,color='blue')
plt.xlabel('Maximum Heart Rate (thalach)')
plt.ylabel('ST Depression (oldpeak)')
plt.title('Maximum Heart Rate (thalach) vs. ST Depression (oldpeak)')
plt.show()
```



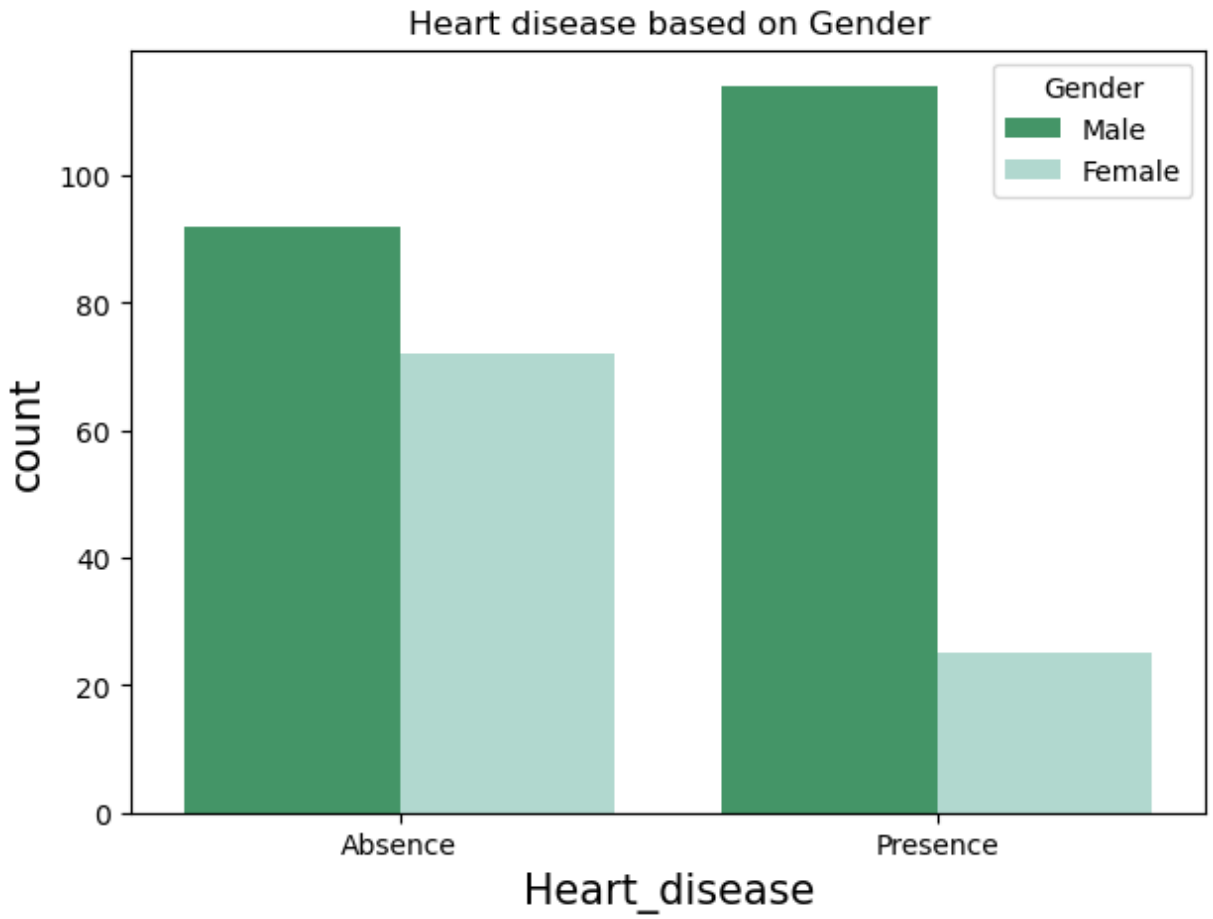
The ST depression is 0 with the maximum heart rate of 100-200 The ST depression is 5-6 with the maximum heart rate of 100-160

In [49]:
```
#Scatter plot Age vs. Serum Cholesterol Level (chol)
x = df['age']
y = df['chol']
plt.scatter(x, y,color='yellow')
plt.xlabel('Age')
plt.ylabel('Serum Cholesterol Level (chol)')
plt.title('Age vs. Serum Cholesterol Level (chol)')
plt.show()
```

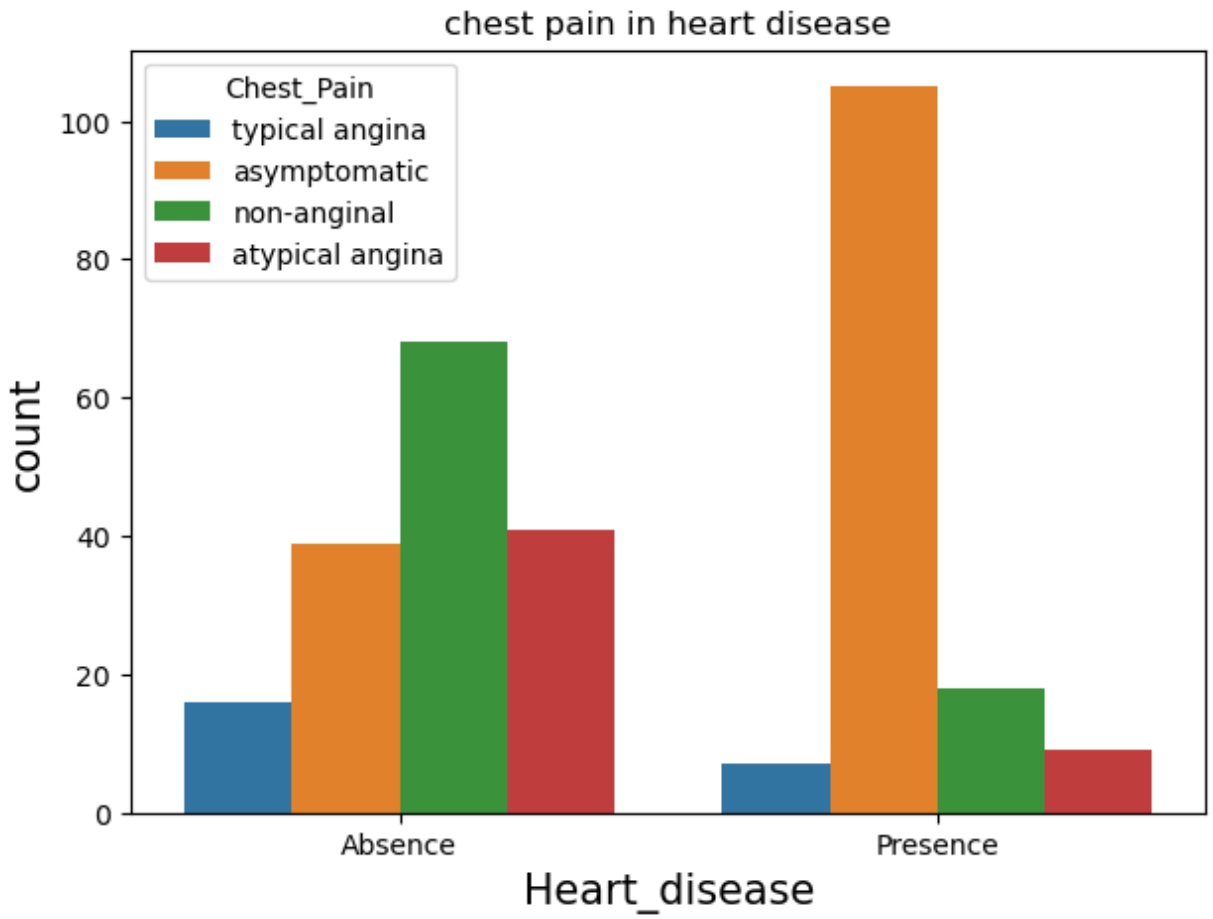


The sernum cholestrol level is high 300-500 mg/dl in the age range of 50-70 The sernum cholestrol level is low 100-200 mg/dl in the age range of 40-70

In [50]:
```
# Count plot Based on heart disease in Gender
plt.figure(figsize=(7,5))
sns.countplot(x=df['heart_disease'],hue='Gender',data=df,palette='BuGn_r')
plt.xlabel('Heart_disease',fontsize=15)
plt.ylabel('count',fontsize=15)
plt.title('Heart disease based on Gender')
plt.show()
```

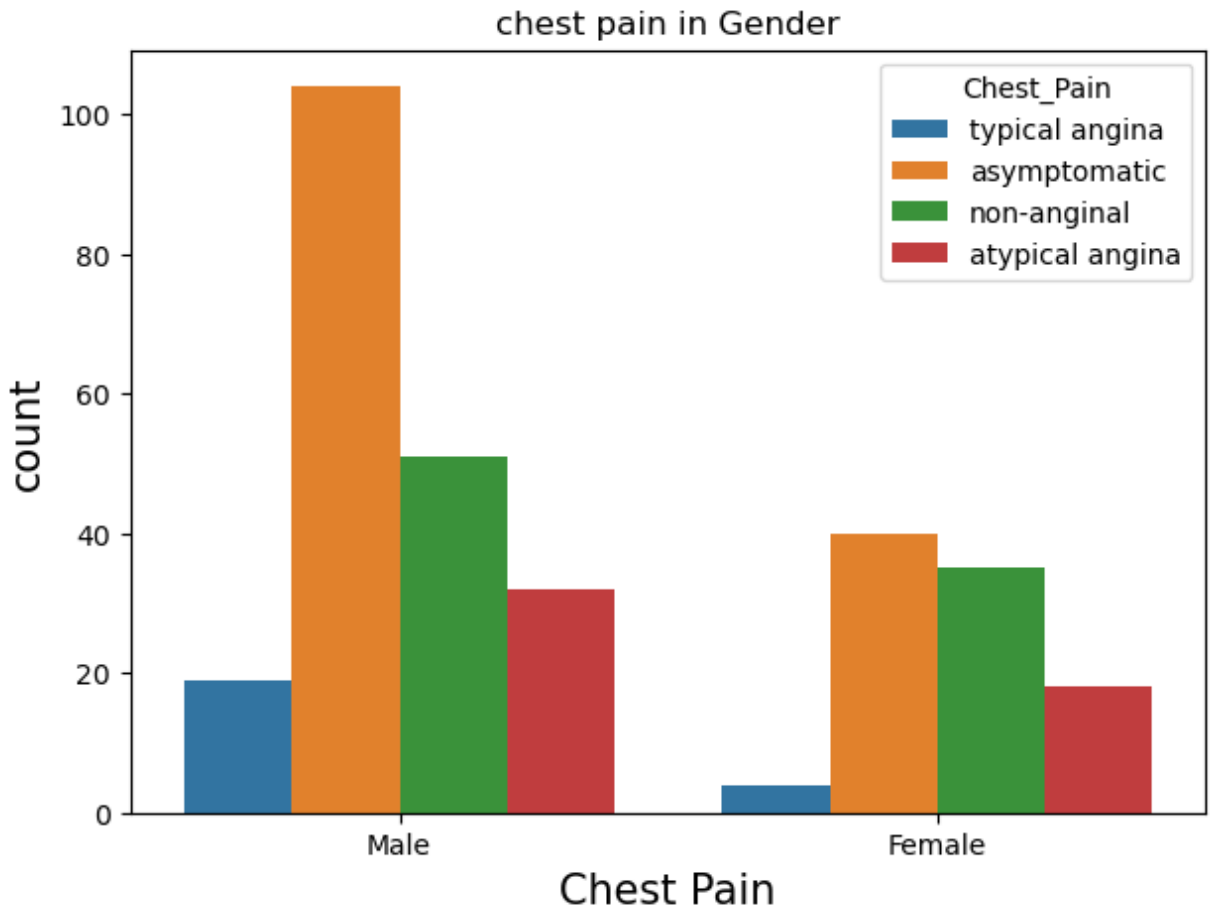


In [51]:
```
# Count plot Based on chest pain in heart disease
plt.figure(figsize=(7,5))
sns.countplot(x=df['heart_disease'],hue='Chest_Pain',data=df)
plt.xlabel('Heart_disease',fontsize=15)
plt.ylabel('count',fontsize=15)
plt.title('chest pain in heart disease')
plt.show()
```



The chest pain experience in the heart disease is more likly asymptomatic. Asymptomatic means there are no symptoms. You are considered asymptomatic if you: Have recovered from an illness or condition and no longer have symptoms of that illness or condition.

In [52]:
```
# Count plot Based on chest pain in gender
plt.figure(figsize=(7,5))
sns.countplot(x=df['Gender'],hue='Chest_Pain',data=df)
plt.xlabel('Chest Pain',fontsize=15)
plt.ylabel('count',fontsize=15)
plt.title('chest pain in Gender')
plt.show()
```



The asymptomatic chest pain is occurs mostly in male.

In [53]:
```
df.head()
```

Out[53]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num	heart_
0	63	1	1	145	233	1	2	150	0	2.3	3	0	6	0	A
1	67	1	4	160	286	0	2	108	1	1.5	2	3	3	1	P
2	67	1	4	120	229	0	2	129	1	2.6	2	2	7	1	P
3	37	1	3	130	250	0	0	187	0	3.5	3	0	3	0	A
4	41	0	2	130	204	0	2	172	0	1.4	1	0	3	0	A

In [54]:
```
#converting numercial variable into catogerical
def angina(row):
    if row==1:
        return 'yes'
    elif row==0:
        return 'no'
```

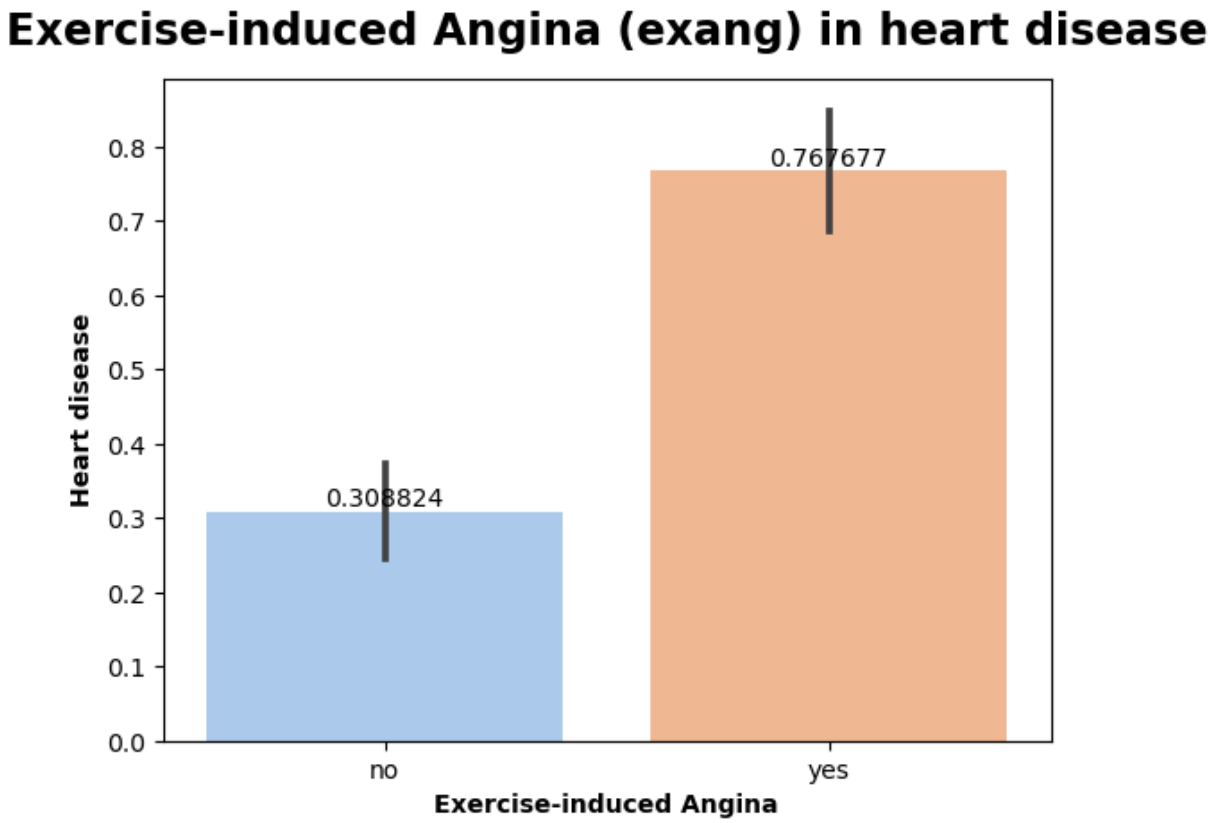
In [55]:
```
df['angina']=df['exang'].apply(angina)
df.tail()
```

Out[55]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num	hea
298	45	1	1	110	264	0	0	132	0	1.2	2	0	7	1	
299	68	1	4	144	193	1	0	141	0	3.4	2	2	7	1	
300	57	1	4	130	131	0	0	115	1	1.2	2	1	7	1	
301	57	0	2	130	236	0	2	174	0	0.0	2	1	3	1	
302	38	1	3	138	175	0	0	173	0	0.0	1	?	3	0	

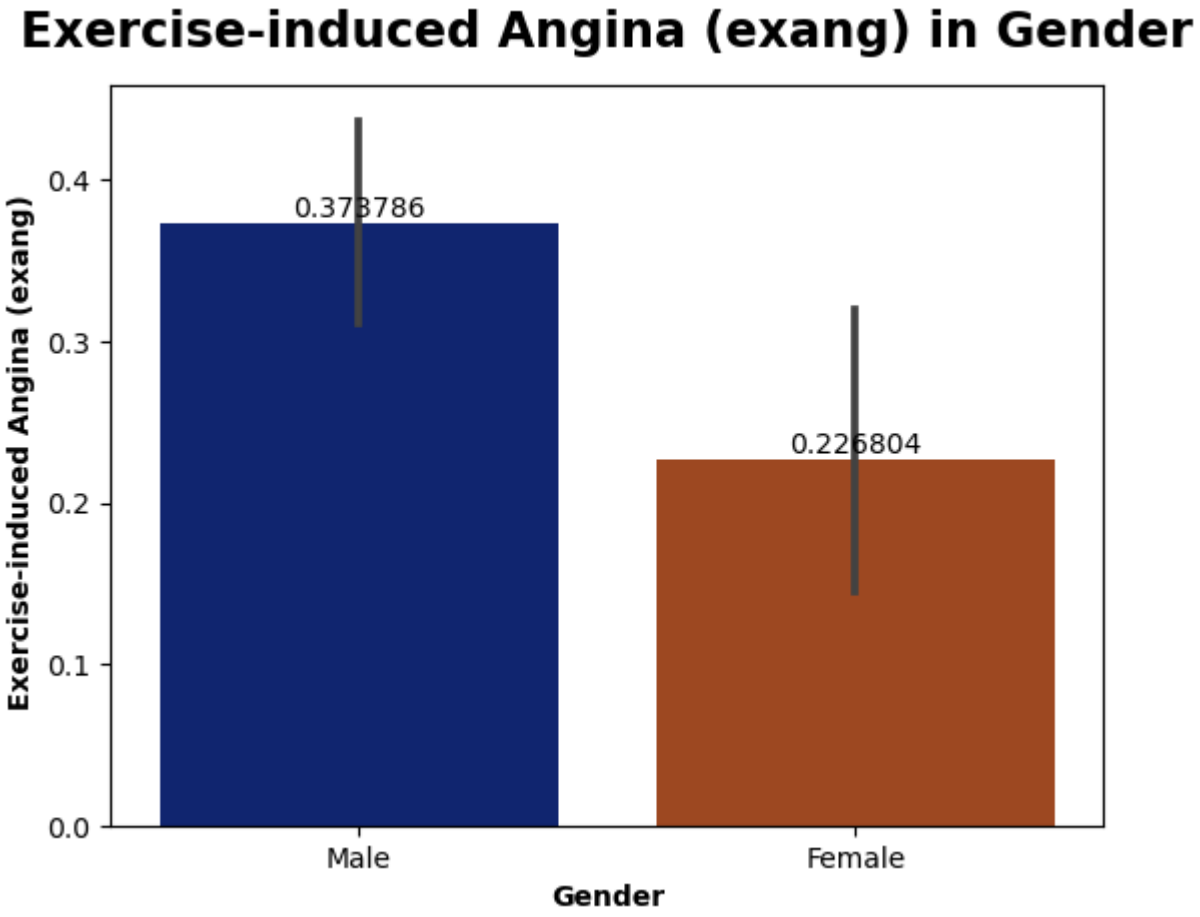
In [56]:

```
# barplot based on Exercise-induced Angina (exang) in heart disease :
Presence=sns.barplot(data=df ,x='angina',y='num',palette='pastel')
Presence.set_xlabel('Exercise-induced Angina',fontweight='bold')
Presence.set_ylabel('Heart disease',fontweight='bold')
Presence.set_title('Exercise-induced Angina (exang) in heart disease',fontweight='heav
Presence.bar_label(Presence.containers[0])
plt.show()
```



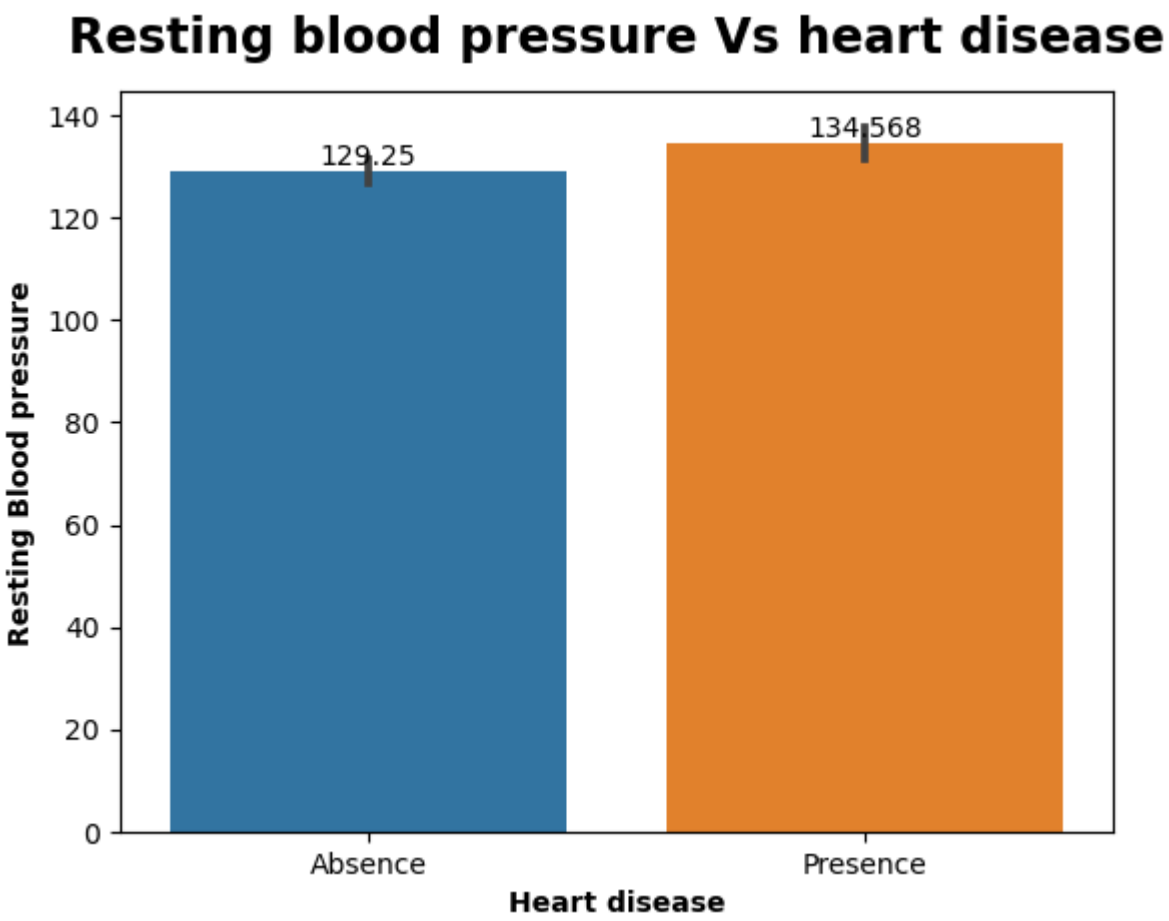
exang is the exercise induced angina which record pain and no pain when there is a heart disease That translates into chest pain or tightness — called angina — when those patients exercise or experience emotional stress, because their body is trying to pump more blood, but can't do so effectively through such a restricted space. When patients rest, though, the pain goes away.

In [57]:
```
# Barplot in Exercise-induced Angina (exang) in Gender

Presence=sns.barplot(data=df ,x='Gender',y='exang',palette='dark')
Presence.set_xlabel('Gender',fontweight='bold')
Presence.set_ylabel(' Exercise-induced Angina (exang)',fontweight='bold')
Presence.set_title('Exercise-induced Angina (exang) in Gender',fontweight='heavy',size
Presence.bar_label(Presence.containers[0])

plt.show()
```



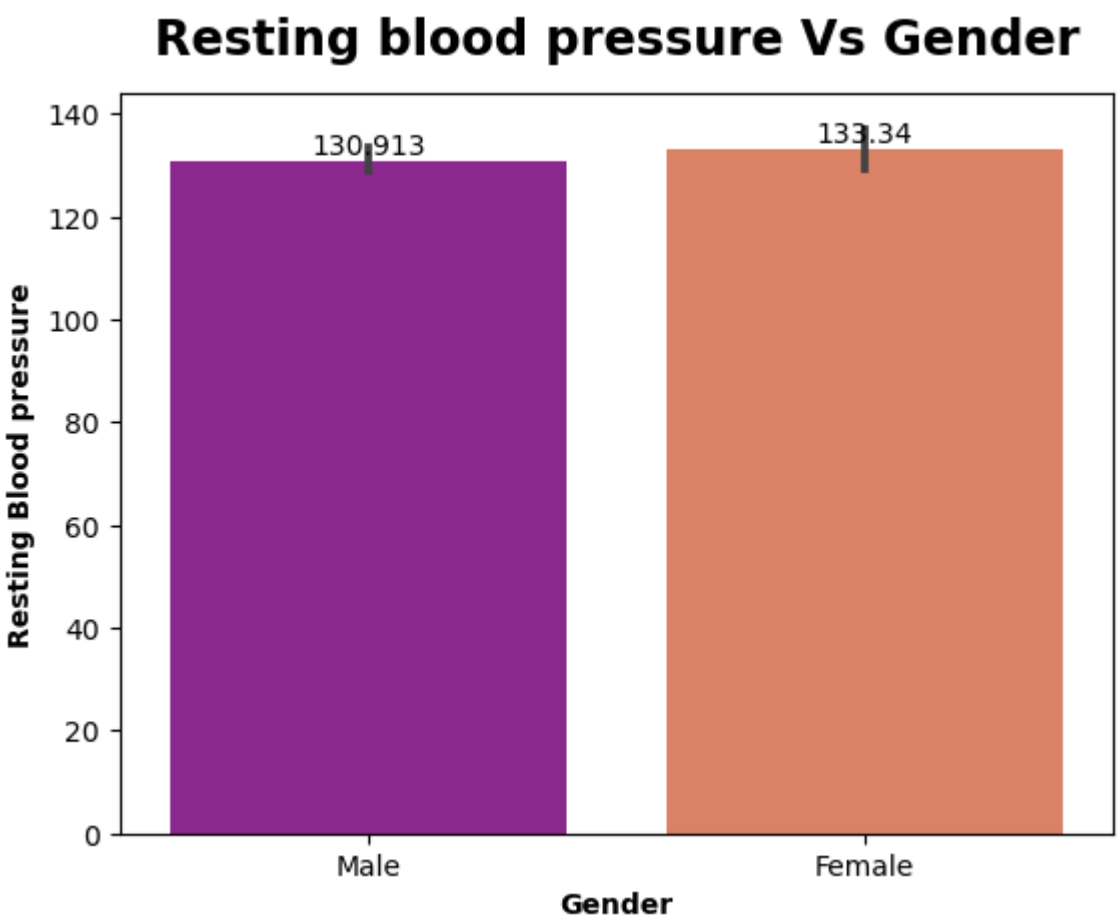
The exercise induced angina is high in male that least when those patients exercise or experience emotional stress.

In [58]:
```
# barplot on resting blood pressure Vs heart disease
Presence=sns.barplot(data=df ,x='heart_disease',y='trestbps')
Presence.set_xlabel('Heart disease',fontweight='bold')
Presence.set_ylabel('Resting Blood pressure',fontweight='bold')
Presence.set_title('Resting blood pressure Vs heart disease',fontweight='heavy',size='
Presence.bar_label(Presence.containers[0])

plt.show()
```



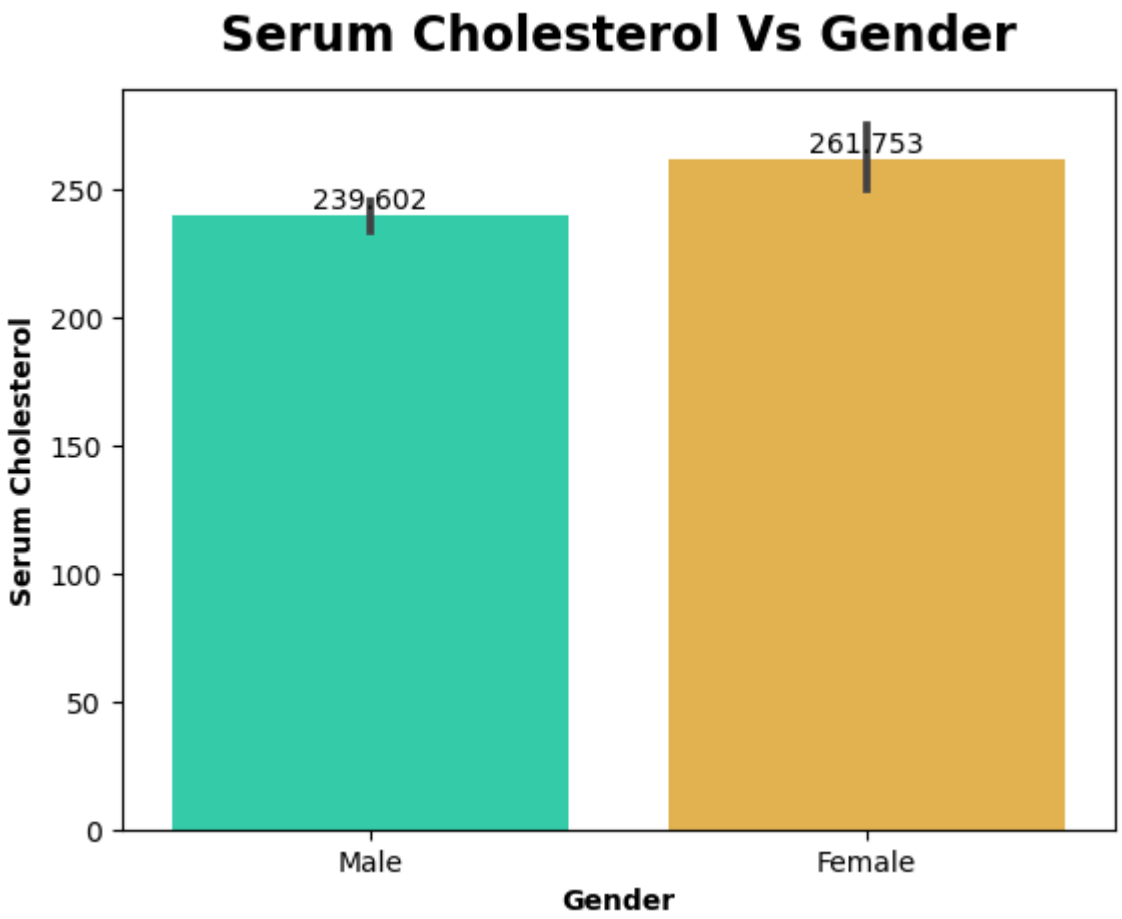
The blood pressure is more high in heart disease.

In [59]:
```
# barplot on resting blood pressure Vs Gender
Presence=sns.barplot(data=df ,x='Gender',y='trestbps',palette='plasma')
Presence.set_xlabel('Gender',fontweight='bold')
Presence.set_ylabel('Resting Blood pressure',fontweight='bold')
Presence.set_title('Resting blood pressure Vs Gender',fontweight='heavy',size='xx-larg
Presence.bar_label(Presence.containers[0])
plt.show()
```



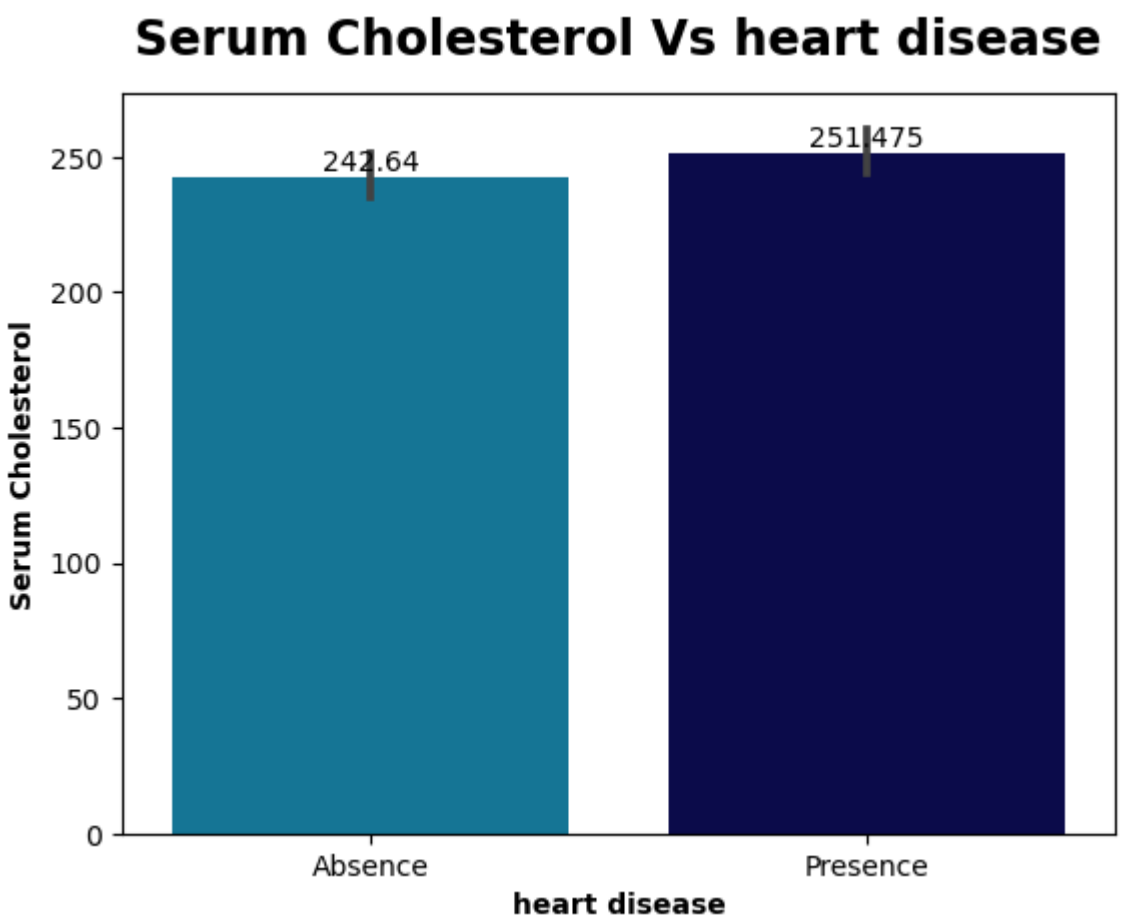
The blood pressure is most equal in male and female.

In [60]:
```
# barplot on Serum Cholesterol Vs Gender
Presence=sns.barplot(data=df ,x='Gender',y='chol',palette='turbo')
Presence.set_xlabel('Gender',fontweight='bold')
Presence.set_ylabel('Serum Cholesterol',fontweight='bold')
Presence.set_title('Serum Cholesterol Vs Gender',fontweight='heavy',size='xx-large',y=
Presence.bar_label(Presence.containers[0])

plt.show()
```



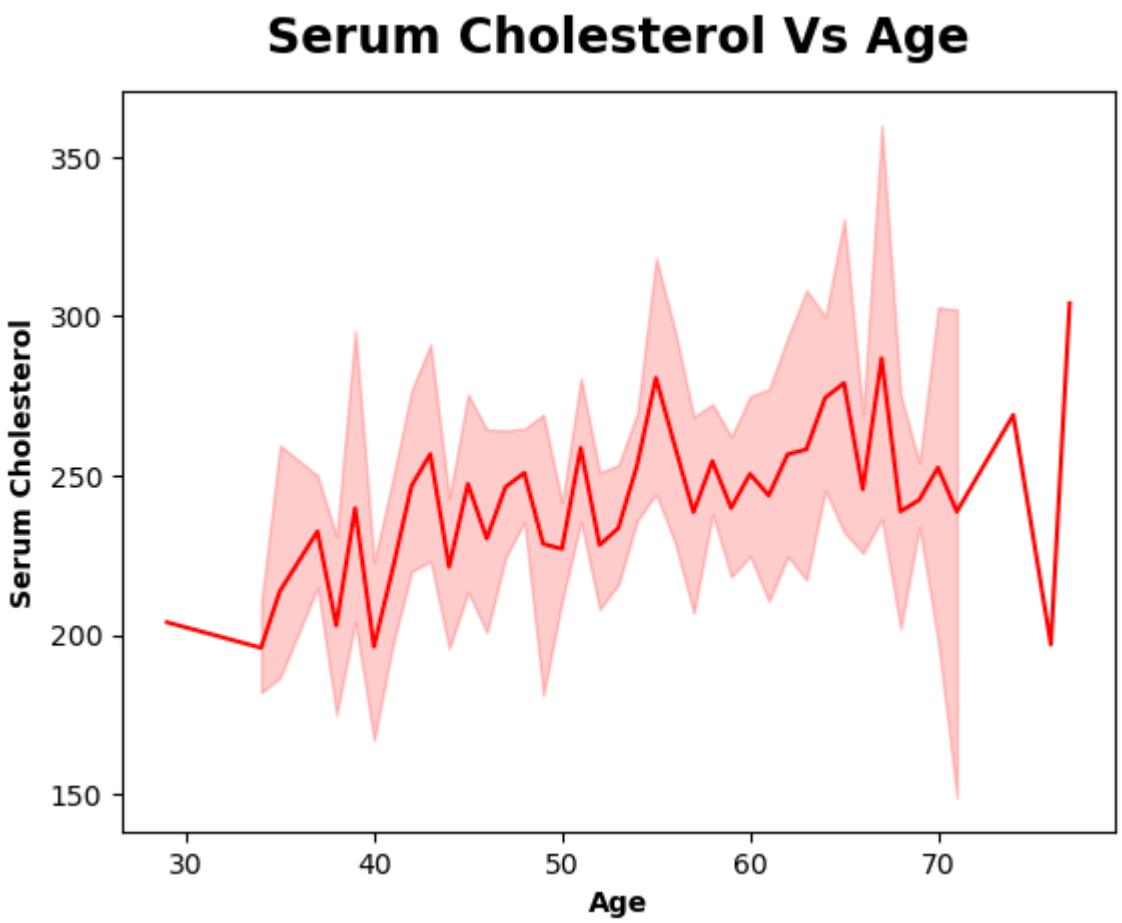
The cholesterol level is high in female as compared to male

In [61]:
```
# barplot on Serum Cholesterol Vs heart disease
Presence=sns.barplot(data=df ,x='heart_disease',y='chol',palette='ocean_r')
Presence.set_xlabel('heart disease',fontweight='bold')
Presence.set_ylabel('Serum Cholesterol',fontweight='bold')
Presence.set_title('Serum Cholesterol Vs heart disease',fontweight='heavy',size='xx-la
Presence.bar_label(Presence.containers[0])
plt.show()
```



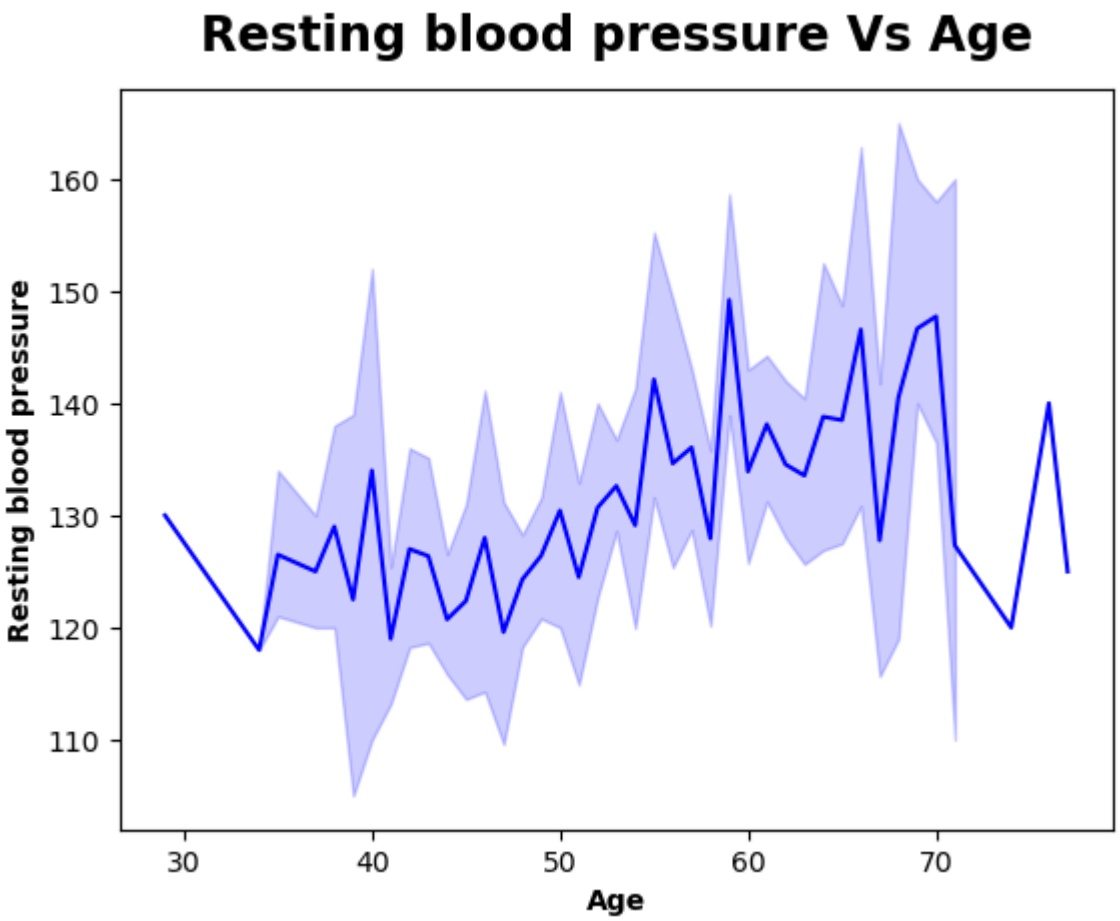
The Cholesterol is highly risk factor which can lead to heart disease.

In [62]:
```
# lineplot on Serum Cholesterol Vs Age
Presence=sns.lineplot(data=df ,x='age',y='chol',color='r')
Presence.set_xlabel('Age',fontweight='bold')
Presence.set_ylabel('Serum Cholesterol',fontweight='bold')
Presence.set_title('Serum Cholesterol Vs Age',fontweight='heavy',size='xx-large',y=1.0
plt.show()
```



The cholesterol level is increase at the age of 50-60 and then continue the same pattern

In [63]:
```
# lineplot on Resting blood pressure Vs Age
Presence=sns.lineplot(data=df ,x='age',y='trestbps',color='b')
Presence.set_xlabel('Age',fontweight='bold')
Presence.set_ylabel('Resting blood pressure',fontweight='bold')
Presence.set_title('Resting blood pressure Vs Age',fontweight='heavy',size='xx-large',
plt.show()
```

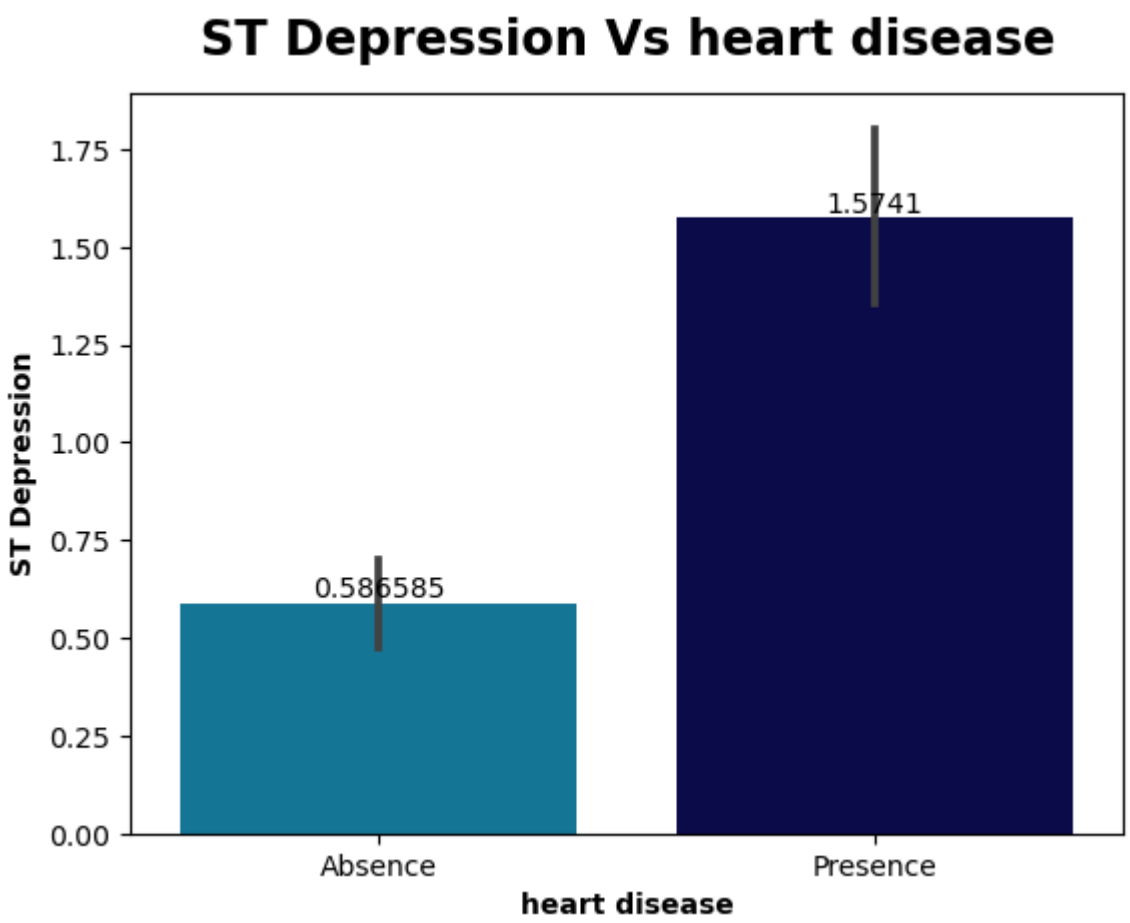


The blood pressure is increase at the age of 50-65 and then continue the same pattern.

In [64]:
```
# lineplot on ST depression Vs Age
Presence=sns.lineplot(data=df ,x='age',y='oldpeak',color='g')
Presence.set_xlabel('Age',fontweight='bold')
Presence.set_ylabel('ST depression',fontweight='bold')
Presence.set_title('ST depression Vs Age',fontweight='heavy',size='xx-large',y=1.03)
plt.show()
```

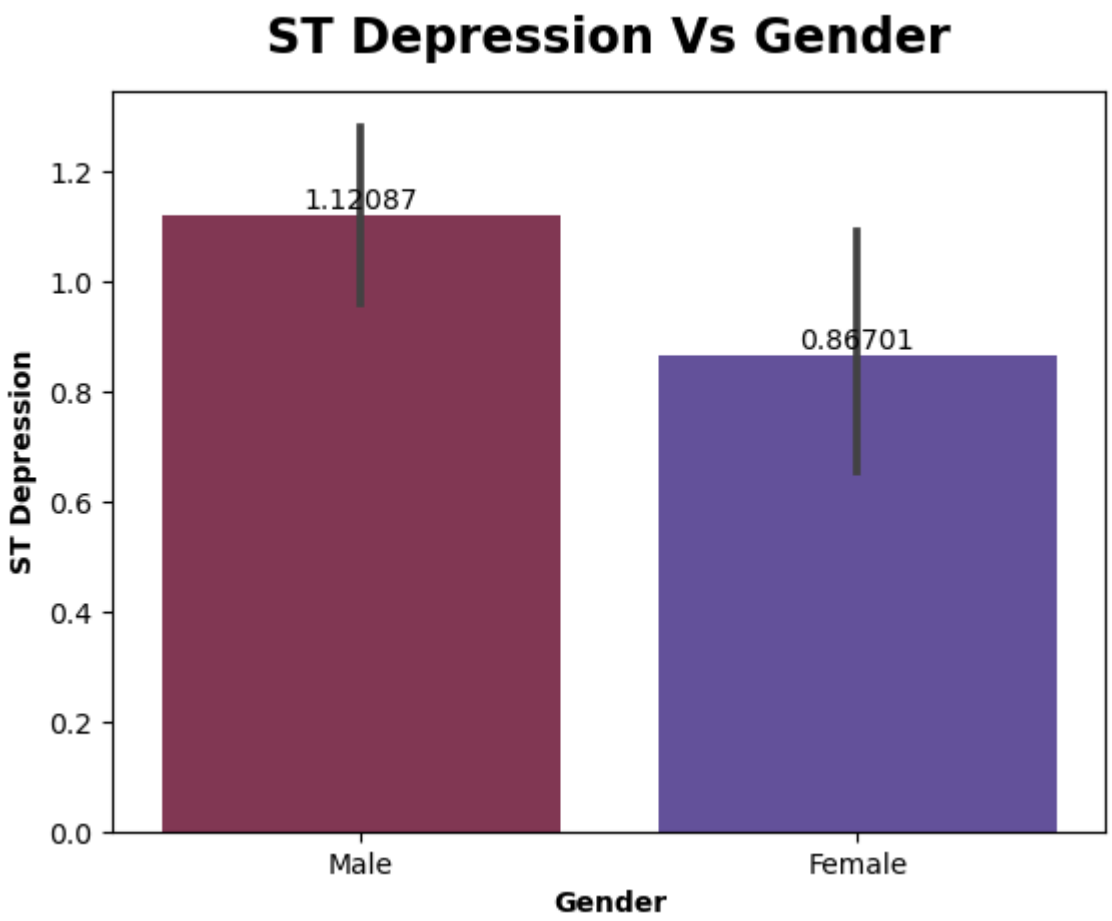
We can see that ST depression is increase suddenly at the age of 30-40. An ST depression can be an outcome of an electrocardiogram (ECG) test. It can indicate health conditions like hypokalemia, myocardial ischemia, or a side effect of medications

In [65]:
```
# barplot on ST Depression Vs heart disease
Presence=sns.barplot(data=df ,x='heart_disease',y='oldpeak',palette='ocean_r')
Presence.set_xlabel('heart disease',fontweight='bold')
Presence.set_ylabel('ST Depression',fontweight='bold')
Presence.set_title('ST Depression Vs heart disease',fontweight='heavy',size='xx-large'
Presence.bar_label(Presence.containers[0])
plt.show()
```



The ST Depression is highly present in heart disease .

In [66]:
```
# barplot on ST Depression Vs gender
Presence=sns.barplot(data=df ,x='Gender',y='oldpeak',palette='twilight_r')
Presence.set_xlabel('Gender',fontweight='bold')
Presence.set_ylabel('ST Depression',fontweight='bold')
Presence.set_title('ST Depression Vs Gender',fontweight='heavy',size='xx-large',y=1.03
Presence.bar_label(Presence.containers[0])
plt.show()
```



The ST depression is more in male .

In [67]:
```
df.head()
```

Out[67]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num	heart_
0	63	1	1	145	233	1	2	150	0	2.3	3	0	6	0	A
1	67	1	4	160	286	0	2	108	1	1.5	2	3	3	1	P
2	67	1	4	120	229	0	2	129	1	2.6	2	2	7	1	P
3	37	1	3	130	250	0	0	187	0	3.5	3	0	3	0	A
4	41	0	2	130	204	0	2	172	0	1.4	1	0	3	0	A

In [68]:
```
def ST_segment(row):
    if row==1:
        return 'upsloping'
    if row==2:
        return 'flat'
    elif row==3:
        return 'downsloping'
```

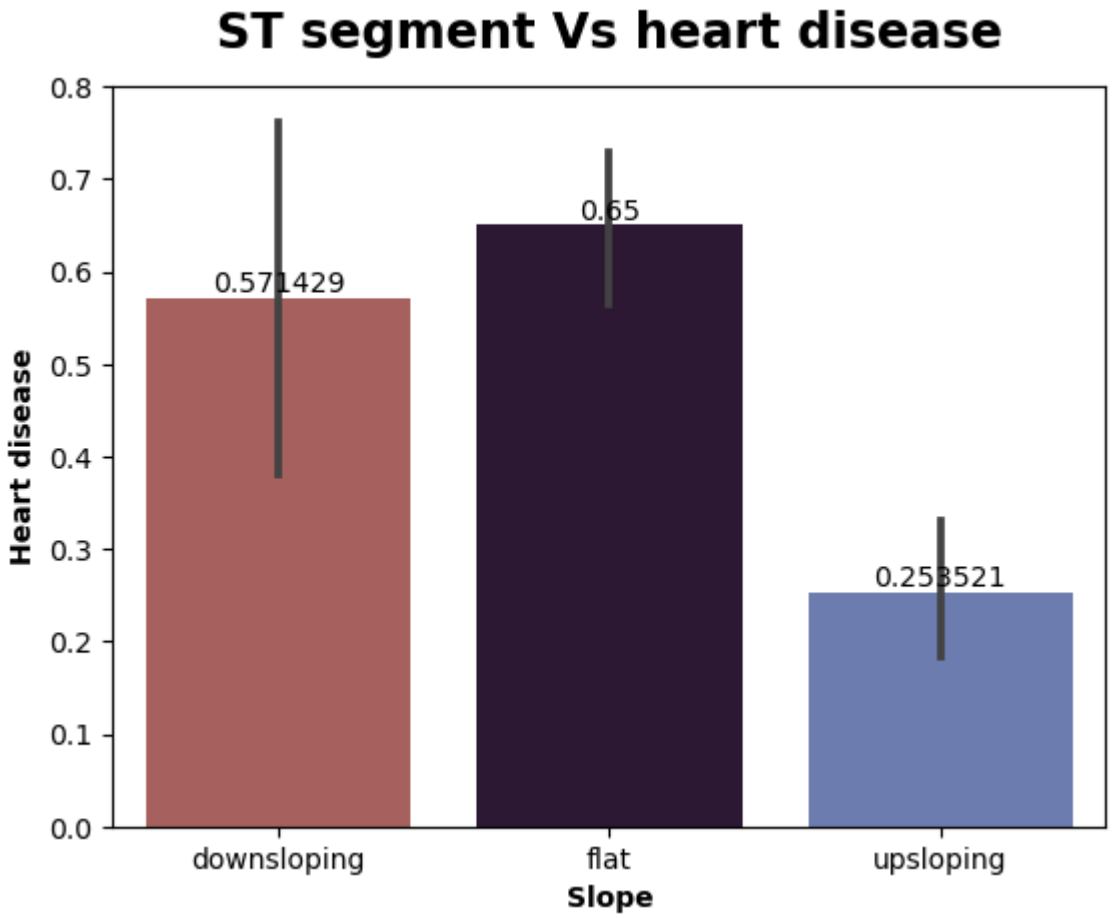
In [69]:
```
df['ST_segment']=df['slope'].apply(ST_segment)
df.head()
```

Out[69]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	...	ca	thal	num	heart_dise
0	63	1	1	145	233	1	2	150	0	2.3	...	0	6	0	Abse
1	67	1	4	160	286	0	2	108	1	1.5	...	3	3	1	Prese
2	67	1	4	120	229	0	2	129	1	2.6	...	2	7	1	Prese
3	37	1	3	130	250	0	0	187	0	3.5	...	0	3	0	Abse
4	41	0	2	130	204	0	2	172	0	1.4	...	0	3	0	Abse

5 rows × 21 columns

In [70]:
```
# barplot on ST segment Vs heart disease
Presence=sns.barplot(data=df ,x='ST_segment',y='num',palette='twilight_r')
Presence.set_xlabel('Slope',fontweight='bold')
Presence.set_ylabel('Heart disease',fontweight='bold')
Presence.set_title('ST segment Vs heart disease',fontweight='heavy',size='xx-large',y=
Presence.bar_label(Presence.containers[0])
plt.show()
```



We see that in ST segment Flat excerice is highly visible throught out heart disease The ST segment shift relative to exercise-induced increments in heart rate, the ST/heart rate slope (ST/HR slope), has been proposed as a more accurate ECG criterion for diagnosing significant coronary artery disease (CAD).

In [71]:
```
#Converting numercial value into categorical
def age_category(row):
    if row>=29 and row<40:
        return 'Young age'
    elif row>=40 and row<55:
        return 'Middle age'
    elif row>55:
        return 'Elder age'
```

In [72]:
```
df['age_category']=df['age'].apply(age_category)
df.tail()
```

Out[72]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	...	thal	num	heart_disea
298	45	1	1	110	264	0	0	132	0	1.2	...	7	1	Presen
299	68	1	4	144	193	1	0	141	0	3.4	...	7	1	Presen
300	57	1	4	130	131	0	0	115	1	1.2	...	7	1	Presen
301	57	0	2	130	236	0	2	174	0	0.0	...	3	1	Presen
302	38	1	3	138	175	0	0	173	0	0.0	...	3	0	Absen

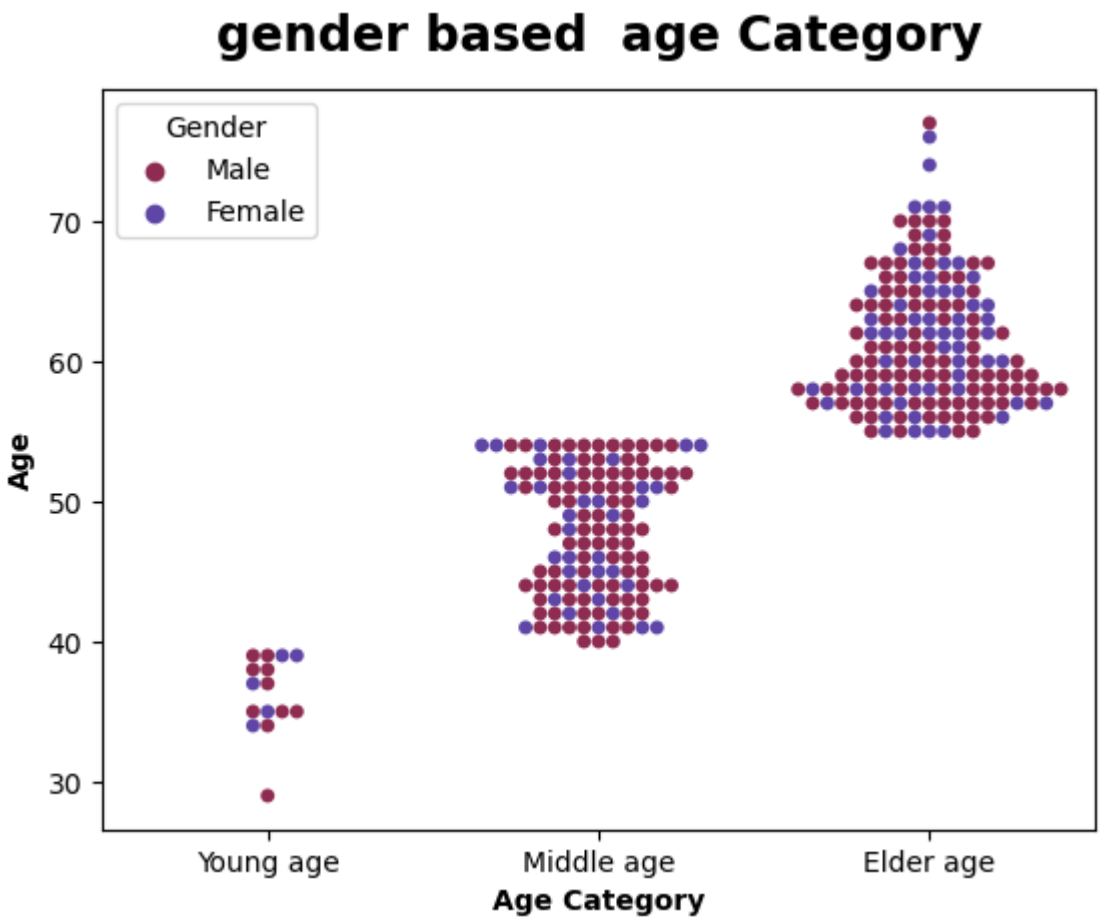
5 rows × 22 columns

In [73]:
```
df.isnull().sum()
```

Out[73]:
```
age                   0
sex                   0
cp                    0
trestbps              0
chol                  0
fbs                   0
restecg               0
thalach               0
exang                 0
oldpeak               0
slope                 0
ca                    0
thal                  0
num                   0
heart_disease         0
Gender                0
Chest_Pain            0
Fasting_blood_sugar   0
Thal_mai              0
angina                0
ST_segment            0
age_category          8
dtype: int64
```

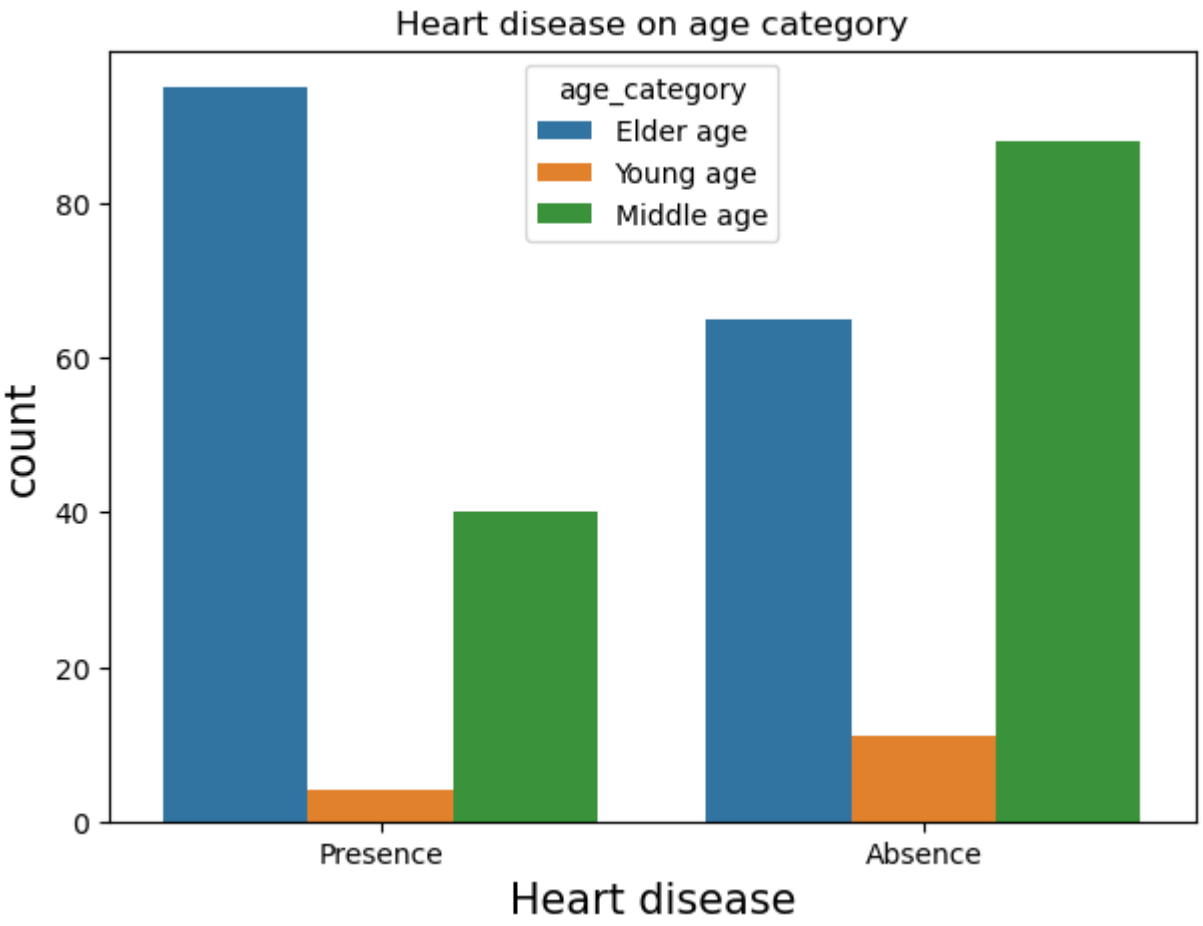
In [74]:
```
#filing null value with the mode
df['age_category'].fillna(df['age_category'].mode()[0],inplace=True)
```

In [75]:
```
#Swarm plot creation of gender based  age Category
Presence=sns.swarmplot(data=df ,x='age_category',y='age',hue='Gender',palette='twilig
Presence.set_xlabel('Age Category',fontweight='bold')
Presence.set_ylabel('Age',fontweight='bold')
Presence.set_title('gender based  age Category',fontweight='heavy',size='xx-large',y=1
plt.show()
```



In our population we found that maximum male are from middle age and most of the female are Elder age

In [76]:
```
# Count plot Based on chest pain in gender
plt.figure(figsize=(7,5))
hue_order=['Young age','Middle age','Elder age']
sns.countplot(x=df['heart_disease'],hue='age_category',data=df,order=['Presence','Abse
plt.xlabel('Heart disease',fontsize=15)
plt.ylabel('count',fontsize=15)
plt.title('Heart disease on age category')
plt.show()
```



The most of the heart disease present in the elder age and the middle age people are moslty free from thhe Heart disease .