In [1]:

```
import pandas as pd
import numpy as np
from sklearn import preprocessing
import matplotlib.pyplot as plt
import seaborn as sns
sns.set(style="white")
sns.set(style="whitegrid",color_codes=True)
import warnings
warnings.simplefilter(action='ignore')
```

In [2]:

```
df=pd.read_csv(r"C:\Users\pavan\Downloads\framingham.csv")
df
```

Out[2]:

	male	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalentHyp	diabetes	totChol	sysBP	diaBP	BMI	heartRa
0	1	39	4.0	0	0.0	0.0	0	0	0	195.0	106.0	70.0	26.97	80
1	0	46	2.0	0	0.0	0.0	0	0	0	250.0	121.0	81.0	28.73	95
2	1	48	1.0	1	20.0	0.0	0	0	0	245.0	127.5	80.0	25.34	75
3	0	61	3.0	1	30.0	0.0	0	1	0	225.0	150.0	95.0	28.58	65
4	0	46	3.0	1	23.0	0.0	0	0	0	285.0	130.0	84.0	23.10	85
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
4233	1	50	1.0	1	1.0	0.0	0	1	0	313.0	179.0	92.0	25.97	66
4234	1	51	3.0	1	43.0	0.0	0	0	0	207.0	126.5	80.0	19.71	65
4235	0	48	2.0	1	20.0	NaN	0	0	0	248.0	131.0	72.0	22.00	84
4236	0	44	1.0	1	15.0	0.0	0	0	0	210.0	126.5	87.0	19.16	86
4237	0	52	2.0	0	0.0	0.0	0	0	0	269.0	133.5	83.0	21.47	80

4238 rows × 16 columns

In [3]:

```
df.head()
```

Out[3]:

	male	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalentHyp	diabetes	totChol	sysBP	diaBP	BMI	heartRate
0	1	39	4.0	0	0.0	0.0	0	0	0	195.0	106.0	70.0	26.97	80.0
1	0	46	2.0	0	0.0	0.0	0	0	0	250.0	121.0	81.0	28.73	95.0
2	1	48	1.0	1	20.0	0.0	0	0	0	245.0	127.5	80.0	25.34	75.0
3	0	61	3.0	1	30.0	0.0	0	1	0	225.0	150.0	95.0	28.58	65.0
4	0	46	3.0	1	23.0	0.0	0	0	0	285.0	130.0	84.0	23.10	85.0

In [4]:

```
df.shape
```

Out[4]:

```
(4238, 16)
```

In [5]:

```
df.describe()
```

Out[5]:

	male	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalentHyp	diabetes	totChol
count	4238.000000	4238.000000	4133.000000	4238.000000	4209.000000	4185.000000	4238.000000	4238.000000	4238.000000	4188.000000
mean	0.429212	49.584946	1.978950	0.494101	9.003089	0.029630	0.005899	0.310524	0.025720	236.721585
std	0.495022	8.572160	1.019791	0.500024	11.920094	0.169584	0.076587	0.462763	0.158316	44.590334
min	0.000000	32.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	107.000000
25%	0.000000	42.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	206.000000
50%	0.000000	49.000000	2.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	234.000000
75%	1.000000	56.000000	3.000000	1.000000	20.000000	0.000000	0.000000	1.000000	0.000000	263.000000
max	1.000000	70.000000	4.000000	1.000000	70.000000	1.000000	1.000000	1.000000	1.000000	696.000000

In [6]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4238 entries, 0 to 4237
Data columns (total 16 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   male             4238 non-null   int64  
 1   age              4238 non-null   int64  
 2   education        4133 non-null   float64
 3   currentSmoker    4238 non-null   int64  
 4   cigsPerDay       4209 non-null   float64
 5   BPMeds           4185 non-null   float64
 6   prevalentStroke  4238 non-null   int64  
 7   prevalentHyp     4238 non-null   int64  
 8   diabetes         4238 non-null   int64  
 9   totChol          4188 non-null   float64
 10  sysBP            4238 non-null   float64
 11  diaBP            4238 non-null   float64
 12  BMI              4219 non-null   float64
 13  heartRate        4237 non-null   float64
 14  glucose          3850 non-null   float64
 15  TenYearCHD       4238 non-null   int64  
dtypes: float64(9), int64(7)
memory usage: 529.9 KB
```

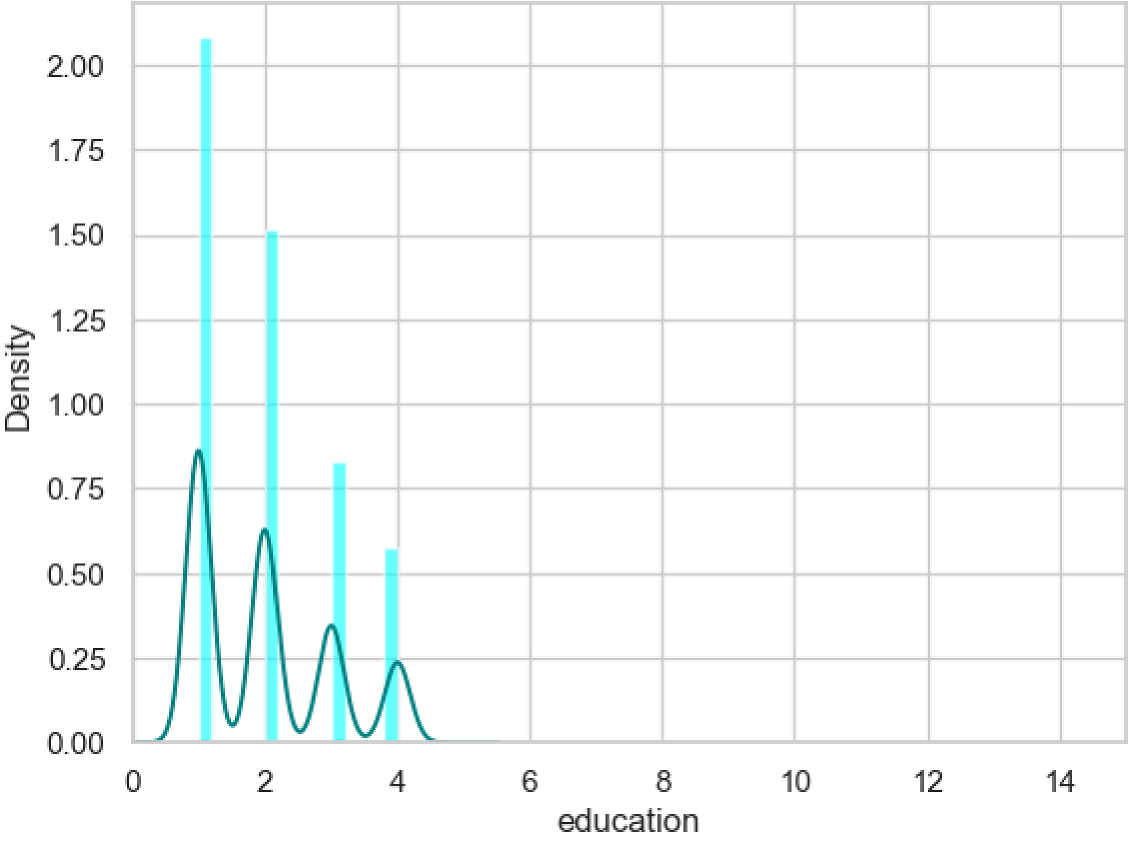
In [7]:

```
df.isnull().sum()
```

Out[7]:

```
male                 0
age                  0
education          105
currentSmoker        0
cigsPerDay          29
BPMeds              53
prevalentStroke      0
prevalentHyp         0
diabetes             0
totChol             50
sysBP                0
diaBP                0
BMI                 19
heartRate            1
glucose            388
TenYearCHD           0
dtype: int64
```

```
In [8]: ax=df["education"].hist(bins=15,density=True,stacked=True,color='cyan',alpha=0.6)
        df["education"].plot(kind='density',color='teal')
        ax.set(xlabel='education')
        plt.xlim(-0,15)
        plt.show()
```



```
In [9]: print(df["education"].mean(skipna=True))
        print(df["education"].median(skipna=True))
```

```
1.9789499153157513
2.0
```

In [10]:
```
print(df['glucose'].isnull().sum()/df.shape[0]*100)
```

```
9.155261915998112
```

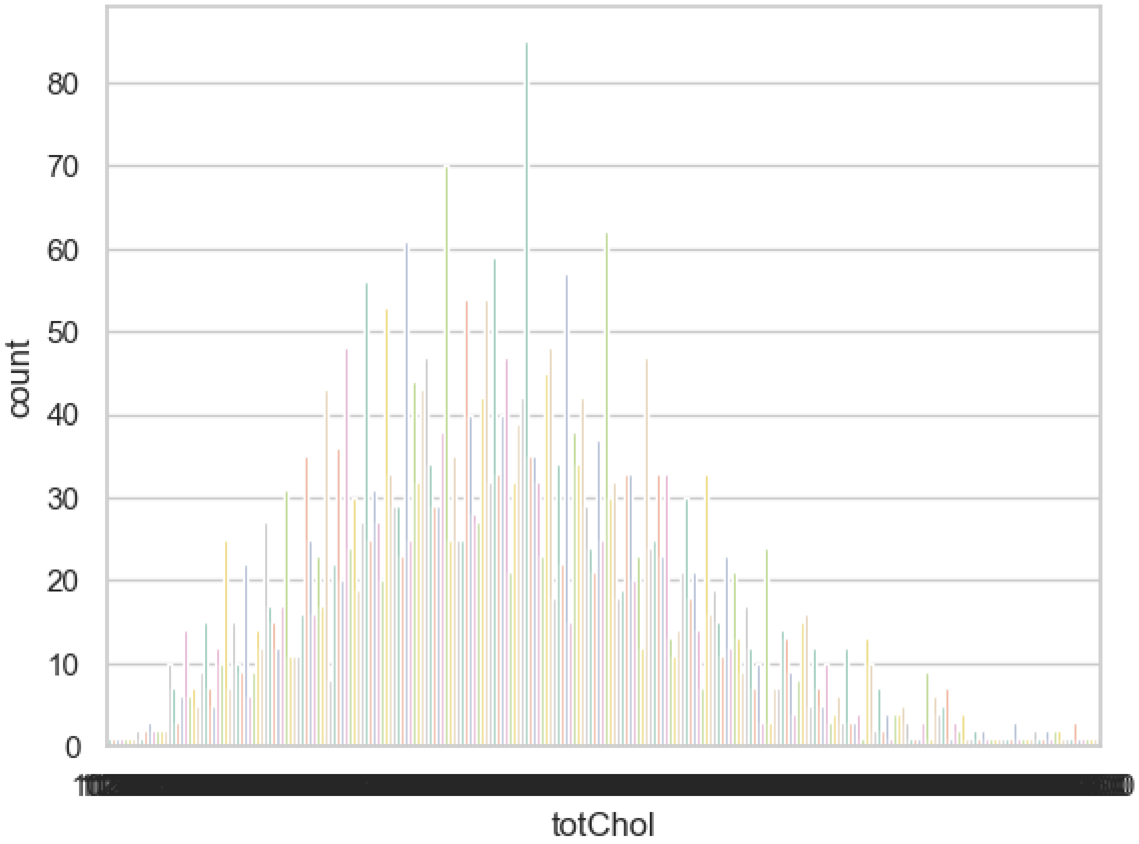
In [11]:
```
print(df['totChol'].isnull().sum()/df.shape[0]*100)
```

```
1.1798017932987257
```

In [12]:

```
print(df['totChol'].value_counts())
sns.countplot(x='totChol',data=df,palette='Set2')
plt.show()
```

```
totChol
240.0    85
220.0    70
260.0    62
210.0    61
232.0    59
         ..
392.0     1
405.0     1
359.0     1
398.0     1
119.0     1
Name: count, Length: 248, dtype: int64
```



In [13]:
```
print(df['totChol'].value_counts().idxmax())
```

```
240.0
```

In [14]:
```
data=df.copy()
data["education"].fillna(df["education"].median(skipna=True),inplace=True)
data["totChol"].fillna(df["totChol"].value_counts().idxmax(),inplace=True)
data.drop('glucose',axis=1,inplace=True)
```

In [15]:
```
data.isnull().sum()
```

Out[15]:
```
male                0
age                 0
education           0
currentSmoker       0
cigsPerDay         29
BPMeds             53
prevalentStroke     0
prevalentHyp        0
diabetes            0
totChol             0
sysBP               0
diaBP               0
BMI                19
heartRate           1
TenYearCHD          0
dtype: int64
```

In [16]:
```
pd.set_option('display.max_rows',4238)
pd.set_option('display.max_columns',16)
```

In [17]:
```
pd.set_option('display.width',50)
```

In [18]:
```
print('This DataFrame has %d Rows and %d Columns'%(df.shape))
```

```
This DataFrame has 4238 Rows and 16 Columns
```

In [19]:
```
features_matrix=df.iloc[:,0:15]
```

In [20]:
```
target_vector=df.iloc[:,-2]
```

In [21]:
```
print('The Features Matrix Has %d Rows And %d Column(s)'%(features_matrix.shape))
```

```
The Features Matrix Has 4238 Rows And 15 Column(s)
```

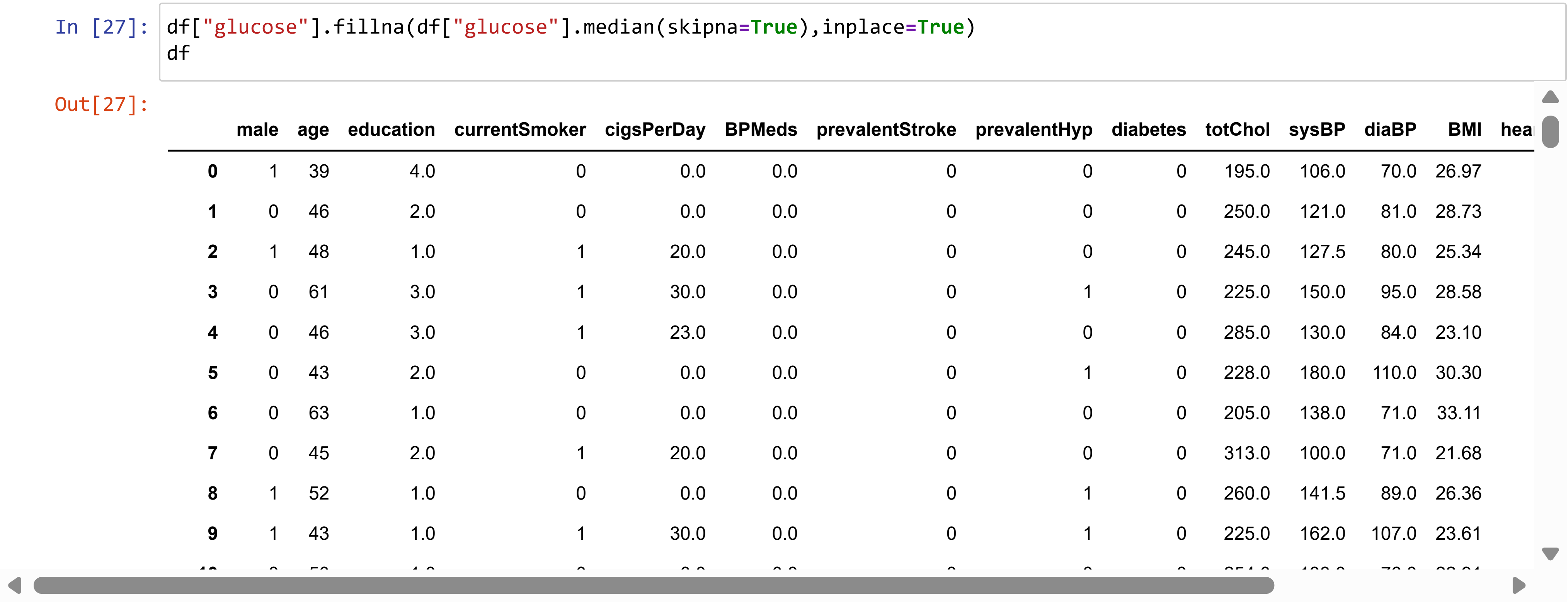
```
In [22]: print('The Target Matrix Has %d Rows And %d Column(s)'%(np.array(target_vector).reshape(-1,1).shape))

         The Target Matrix Has 4238 Rows And 1 Column(s)
```

```
In [23]: df['education'].mean()

Out[23]: 1.9789499153157513
```

```
In [24]: df['cigsPerDay'].mean()

Out[24]: 9.003088619624615
```

```
In [25]: df['heartRate'].median()

Out[25]: 75.0
```

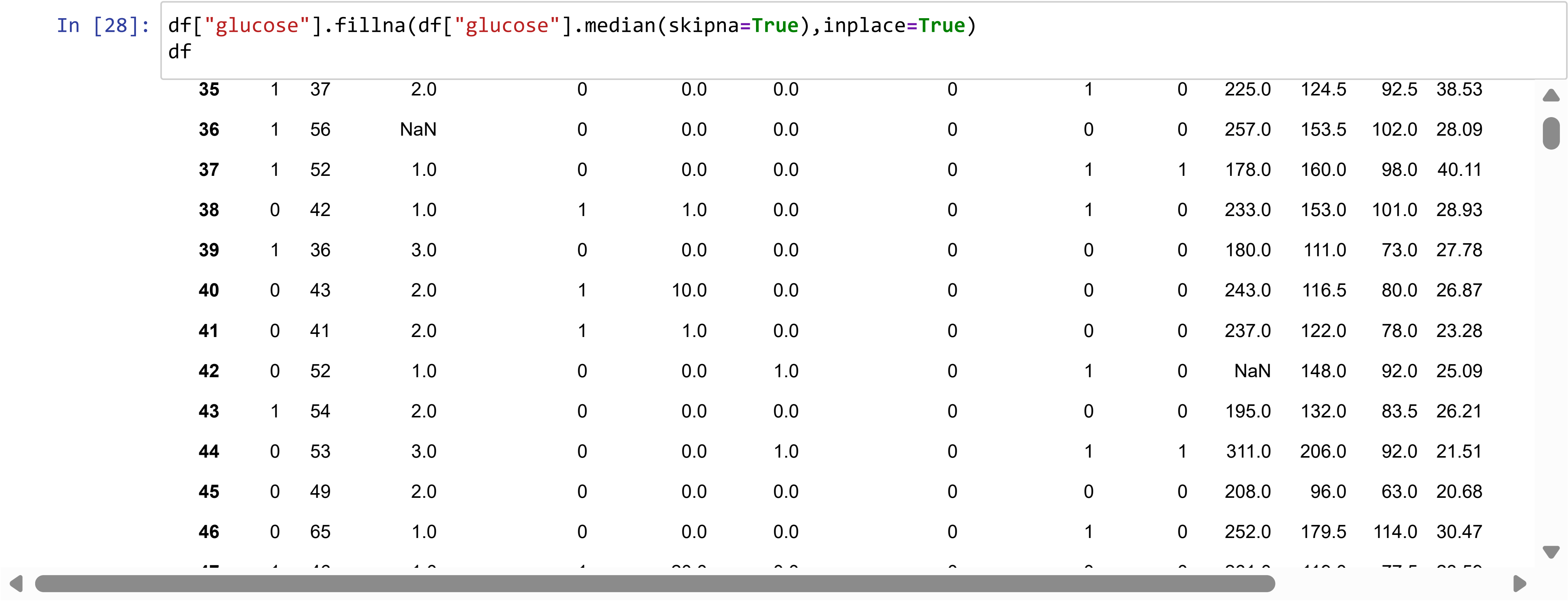
```
In [26]: df['BPMeds'].mean()

Out[26]: 0.02962962962962963
```



In [27]:
```
df["glucose"].fillna(df["glucose"].median(skipna=True),inplace=True)
df
```

Out[27]:

	male	age	education	currentSmoker	cigsPerDay	BPMeds	prevalentStroke	prevalentHyp	diabetes	totChol	sysBP	diaBP	BMI	hea
0	1	39	4.0	0	0.0	0.0	0	0	0	195.0	106.0	70.0	26.97	
1	0	46	2.0	0	0.0	0.0	0	0	0	250.0	121.0	81.0	28.73	
2	1	48	1.0	1	20.0	0.0	0	0	0	245.0	127.5	80.0	25.34	
3	0	61	3.0	1	30.0	0.0	0	1	0	225.0	150.0	95.0	28.58	
4	0	46	3.0	1	23.0	0.0	0	0	0	285.0	130.0	84.0	23.10	
5	0	43	2.0	0	0.0	0.0	0	1	0	228.0	180.0	110.0	30.30	
6	0	63	1.0	0	0.0	0.0	0	0	0	205.0	138.0	71.0	33.11	
7	0	45	2.0	1	20.0	0.0	0	0	0	313.0	100.0	71.0	21.68	
8	1	52	1.0	0	0.0	0.0	0	1	0	260.0	141.5	89.0	26.36	
9	1	43	1.0	1	30.0	0.0	0	1	0	225.0	162.0	107.0	23.61	



```
In [28]: df["glucose"].fillna(df["glucose"].median(skipna=True),inplace=True)
         df
```

```
35  1  37  2.0  0   0.0  0.0  0  1  0  225.0  124.5   92.5  38.53
36  1  56  NaN  0   0.0  0.0  0  0  0  257.0  153.5  102.0  28.09
37  1  52  1.0  0   0.0  0.0  0  1  1  178.0  160.0   98.0  40.11
38  0  42  1.0  1   1.0  0.0  0  1  0  233.0  153.0  101.0  28.93
39  1  36  3.0  0   0.0  0.0  0  0  0  180.0  111.0   73.0  27.78
40  0  43  2.0  1  10.0  0.0  0  0  0  243.0  116.5   80.0  26.87
41  0  41  2.0  1   1.0  0.0  0  0  0  237.0  122.0   78.0  23.28
42  0  52  1.0  0   0.0  1.0  0  1  0    NaN  148.0   92.0  25.09
43  1  54  2.0  0   0.0  0.0  0  0  0  195.0  132.0   83.5  26.21
44  0  53  3.0  0   0.0  1.0  0  1  1  311.0  206.0   92.0  21.51
45  0  49  2.0  0   0.0  0.0  0  0  0  208.0   96.0   63.0  20.68
46  0  65  1.0  0   0.0  0.0  0  1  0  252.0  179.5  114.0  30.47
```

In [29]:
```
df.isnull().sum()
```

Out[29]:
```
male                 0
age                  0
education          105
currentSmoker        0
cigsPerDay          29
BPMeds              53
prevalentStroke      0
prevalentHyp         0
diabetes             0
totChol             50
sysBP                0
diaBP                0
BMI                 19
heartRate            1
glucose              0
TenYearCHD           0
dtype: int64
```

In [30]:
```
df['education'].fillna(df['education'].median(skipna=True),inplace=True)
```

In [31]:
```
df['totChol'].fillna(df['totChol'].median(skipna=True),inplace=True)
```

In [32]:
```
df['BMI'].fillna(df['BMI'].median(skipna=True),inplace=True)
```

In [33]:
```
df['heartRate'].fillna(df['heartRate'].median(skipna=True),inplace=True)
```

In [34]:
```
df['BPMeds'].fillna(df['BPMeds'].median(skipna=True),inplace=True)
```

In [35]:
```
df['cigsPerDay'].fillna(df['cigsPerDay'].median(skipna=True),inplace=True)
```

In [36]:

```
df.isnull().sum()
```

Out[36]:

```
male               0
age                0
education          0
currentSmoker      0
cigsPerDay         0
BPMeds             0
prevalentStroke    0
prevalentHyp       0
diabetes           0
totChol            0
sysBP              0
diaBP              0
BMI                0
heartRate          0
glucose            0
TenYearCHD         0
dtype: int64
```

In [37]:

```
df.drop('glucose',axis=1,inplace=True)
```

In [38]:

```
df.isnull().sum()
```

Out[38]:

```
male               0
age                0
education          0
currentSmoker      0
cigsPerDay         0
BPMeds             0
prevalentStroke    0
prevalentHyp       0
diabetes           0
totChol            0
sysBP              0
diaBP              0
BMI                0
heartRate          0
TenYearCHD         0
dtype: int64
```

In [39]:

```
print(df["cigsPerDay"].mean(skipna=True))
print(df["cigsPerDay"].median(skipna=True))
```

```
8.941481831052384
0.0
```

In [41]:

```
print((df['BPMeds'].isnull().sum()/df.shape[0]*100))
```

```
0.0
```

In [42]:

```
print((df['BMI'].isnull().sum()/df.shape[0]*100))
```

```
0.0
```

In [43]:

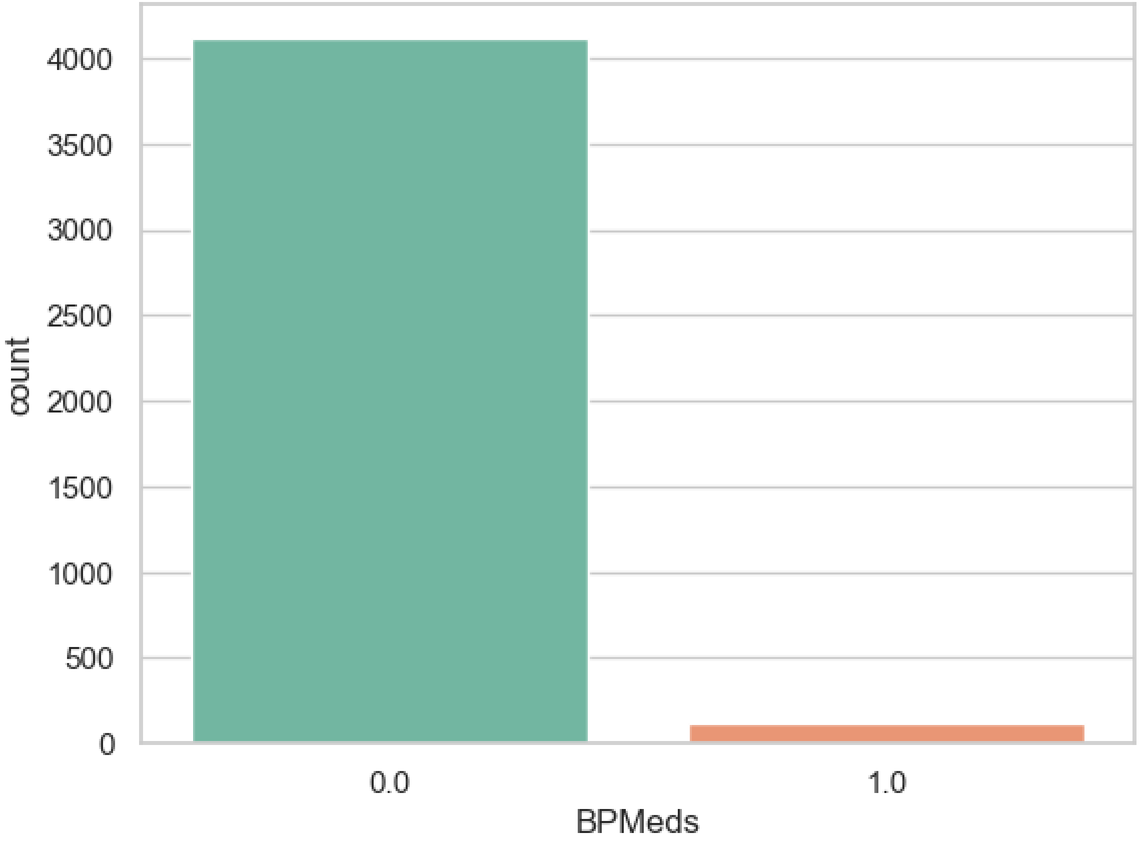
```
print((df['heartRate'].isnull().sum()/df.shape[0]*100))
```

```
0.0
```

In [44]:

```
print(df['BPMeds'].value_counts())
sns.countplot(x='BPMeds',data=df,palette='Set2')
plt.show()
```

```
BPMeds
0.0    4114
1.0     124
Name: count, dtype: int64
```



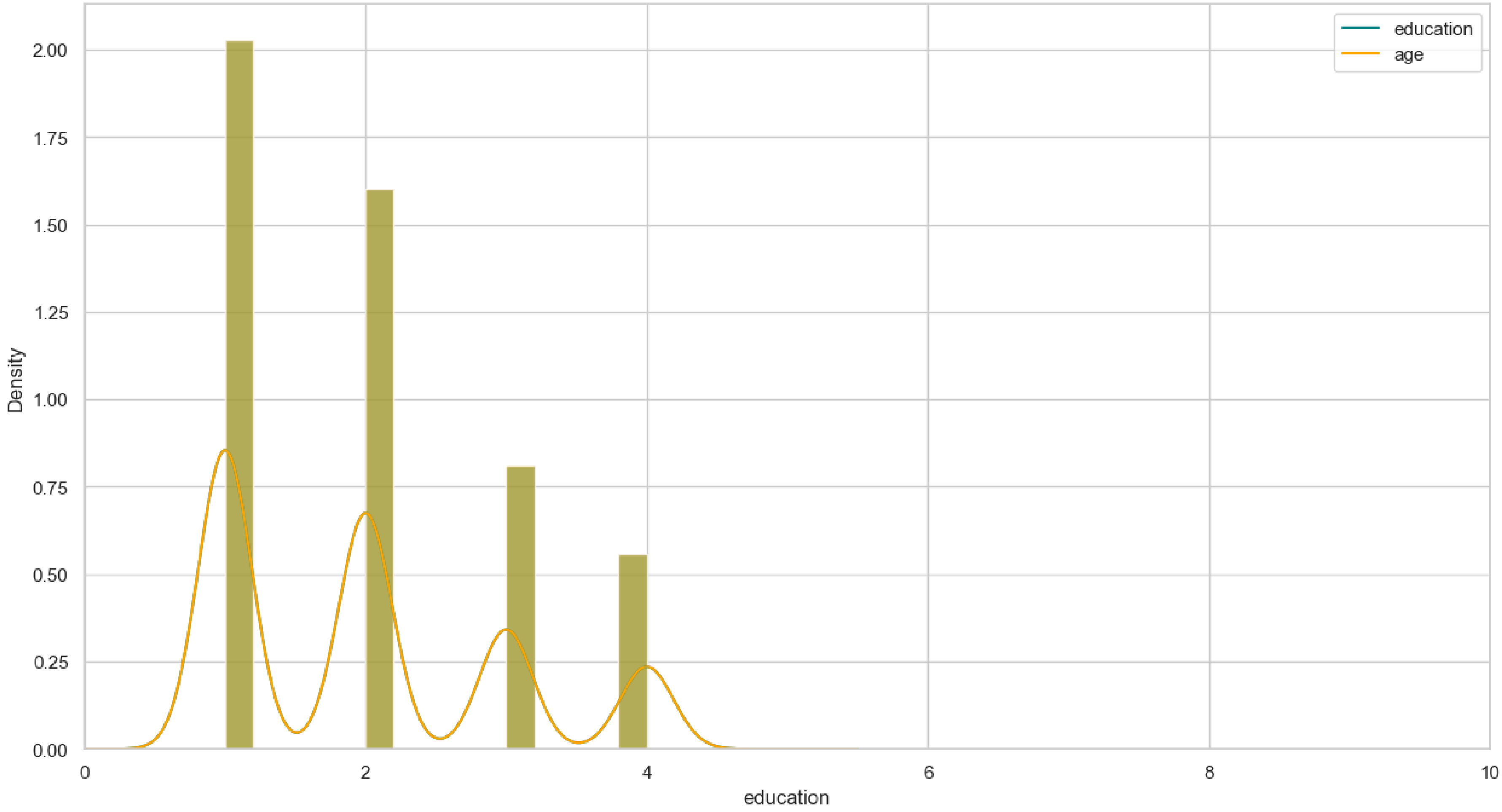
In [45]:

```
print(df['heartRate'].value_counts().idxmax())
```

```
75.0
```

In [46]:

```
plt.figure(figsize=(15,8))
ax=df["education"].hist(bins=15,density=True,stacked=True,color='teal',alpha=0.6)
df["education"].plot(kind='density',color='teal')
ax=data["education"].hist(bins=15,density=True,stacked=True,color='orange',alpha=0.5)
data["education"].plot(kind='density',color='orange')
ax.legend(["education","age"])
ax.set(xlabel='education')
plt.xlim(-0,10)
plt.show()
```



In [47]:

```
data['Disease']=np.where((data["prevalentHyp"]+data["prevalentStroke"])>0,0,1)
data.drop('prevalentHyp',axis=1,inplace=True)
data.drop('prevalentStroke',axis=1,inplace=True)
```

In [48]:

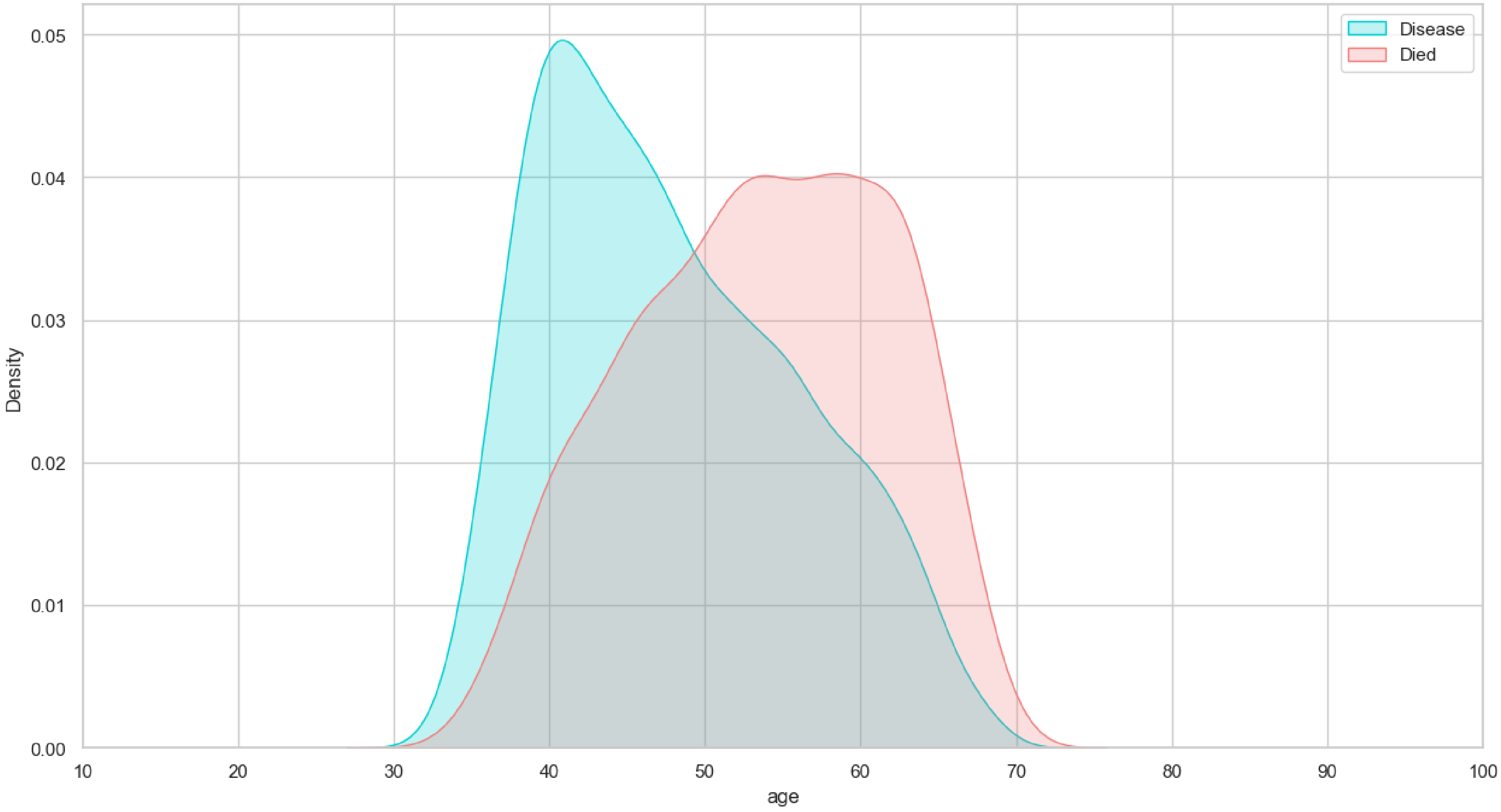
```
training=pd.get_dummies(data,columns=["currentSmoker","totChol","sysBP"])
training.drop('TenYearCHD',axis=1,inplace=True)
training.drop('male',axis=1,inplace=True)
training.drop('diaBP',axis=1,inplace=True)
final_train=training
final_train.head()
```

Out[48]:

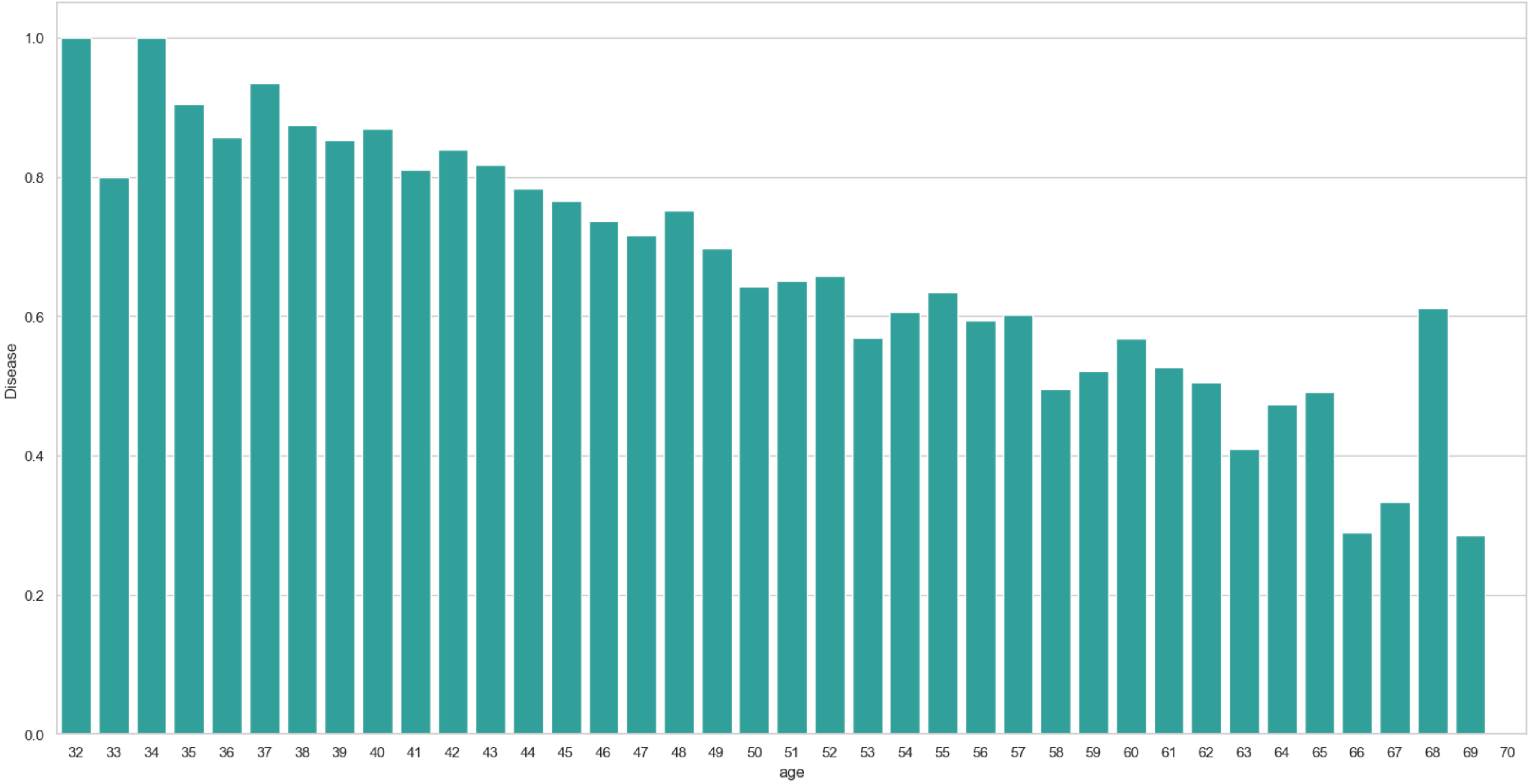
```
   age  education  cigsPerDay  BPMeds  diabetes    BMI  heartRate  Disease  ...  sysBP_220.0  sysBP_230.0  sysBP_232.0  sysBP_235.0  sysBP_2
0   39        4.0         0.0     0.0         0  26.97       80.0        1  ...        False        False        False        False        F
1   46        2.0         0.0     0.0         0  28.73       95.0        1  ...        False        False        False        False        F
2   48        1.0        20.0     0.0         0  25.34       75.0        1  ...        False        False        False        False        F
3   61        3.0        30.0     0.0         0  28.58       65.0        0  ...        False        False        False        False        F
4   46        3.0        23.0     0.0         0  23.10       85.0        1  ...        False        False        False        False        F

5 rows × 492 columns
```

In [49]:

```
plt.figure(figsize=(15,8))
ax = sns.kdeplot(final_train["age"][final_train.Disease == 1],color="darkturquoise",shade=True)
sns.kdeplot(final_train["age"][final_train.Disease == 0],color="lightcoral",shade=True)
plt.legend(['Disease','Died'])
ax.set(xlabel='age')
plt.xlim(10,100)
plt.show()
```



```
In [50]: plt.figure(figsize=(20,10))
         avg_survival_byage=final_train[["age","Disease"]].groupby(['age'],as_index=False).mean()
         g=sns.barplot(x='age',y='Disease',data=avg_survival_byage,color="LightSeaGreen")
         plt.show()
```



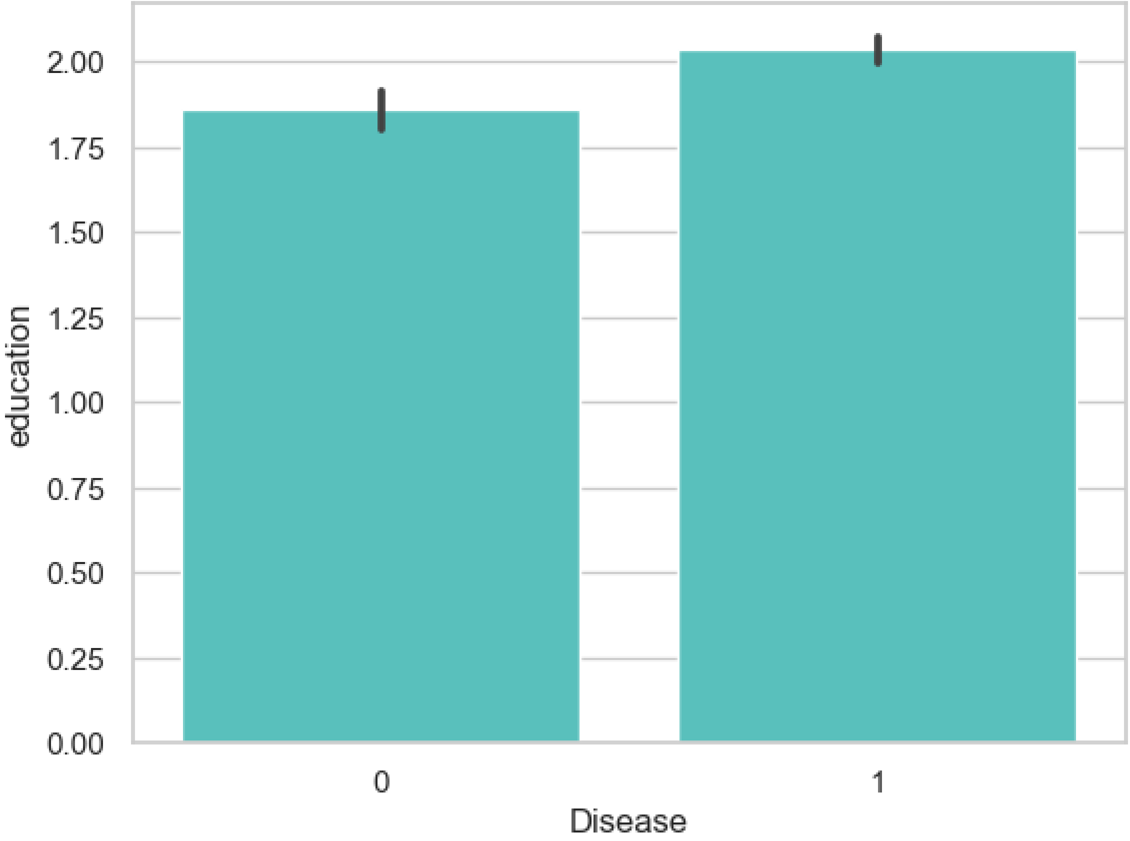
In [51]:

```
final_train['IsMinor']=np.where(final_train['age']<=16,1,0)
print(final_train['IsMinor'])
```

```
59      0
60      0
61      0
62      0
63      0
64      0
65      0
66      0
67      0
68      0
69      0
70      0
71      0
72      0
73      0
74      0
75      0
76      0
77      0
78      0
```

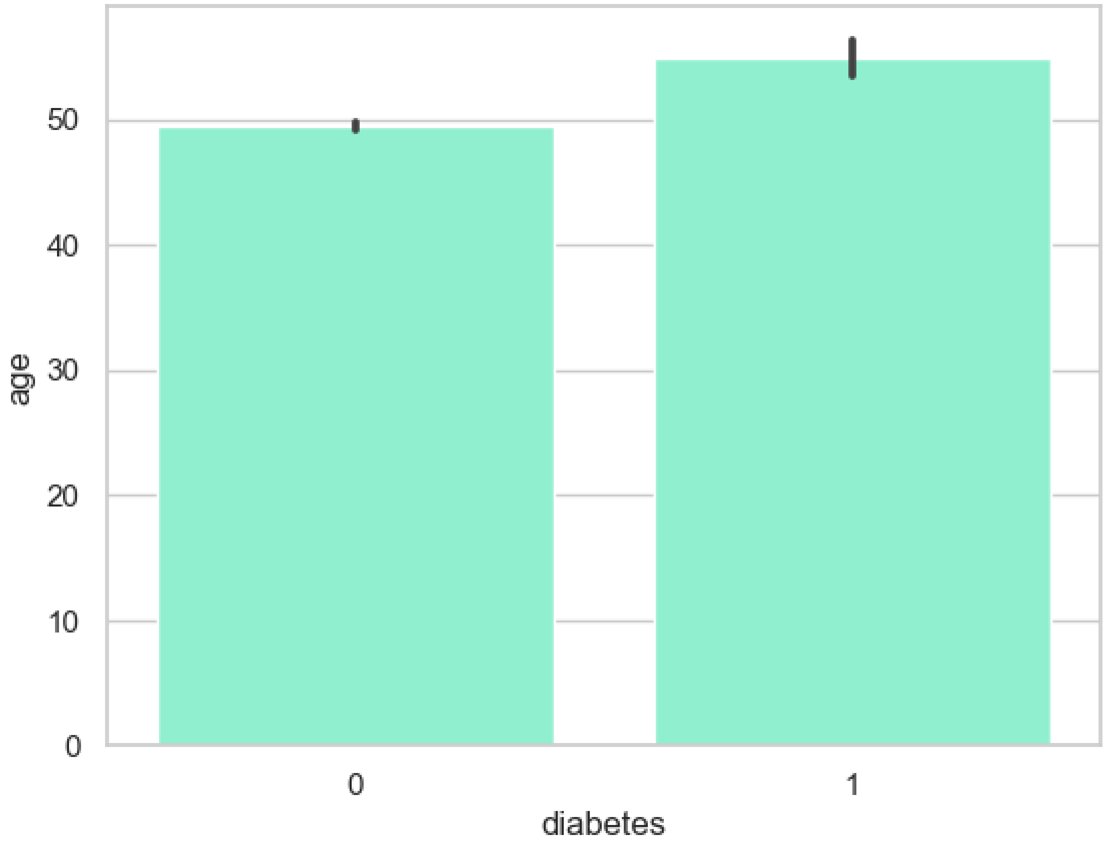
In [52]:

```
sns.barplot(x='Disease',y='education',data=final_train,color="mediumturquoise")
plt.show()
```



In [53]:

```python
import seaborn as sns
import matplotlib.pyplot as plt
sns.barplot(x='diabetes',y='age',data=df,color="aquamarine")
plt.show()
```



In [ ]: