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]:

```
da=pd.read_csv(r"C:\Users\91955\Downloads\framingham.csv")
da
```

Out[2]:

| | male | age | education | currentSmoker | cigsPerDay | BPMeds | prevalentStroke | prevalent |
|---|---|---|---|---|---|---|---|---|
| **0** | 1 | 39 | 4.0 | 0 | 0.0 | 0.0 | 0 | |
| **1** | 0 | 46 | 2.0 | 0 | 0.0 | 0.0 | 0 | |
| **2** | 1 | 48 | 1.0 | 1 | 20.0 | 0.0 | 0 | |
| **3** | 0 | 61 | 3.0 | 1 | 30.0 | 0.0 | 0 | |
| **4** | 0 | 46 | 3.0 | 1 | 23.0 | 0.0 | 0 | |
| **...** | ... | ... | ... | ... | ... | ... | ... | |
| **4233** | 1 | 50 | 1.0 | 1 | 1.0 | 0.0 | 0 | |
| **4234** | 1 | 51 | 3.0 | 1 | 43.0 | 0.0 | 0 | |
| **4235** | 0 | 48 | 2.0 | 1 | 20.0 | NaN | 0 | |
| **4236** | 0 | 44 | 1.0 | 1 | 15.0 | 0.0 | 0 | |
| **4237** | 0 | 52 | 2.0 | 0 | 0.0 | 0.0 | 0 | |

4238 rows × 16 columns

In [3]:

```
da.head()
```

Out[3]:

| | male | age | education | currentSmoker | cigsPerDay | BPMeds | prevalentStroke | prevalentHyp |
|---|---|---|---|---|---|---|---|---|
| **0** | 1 | 39 | 4.0 | 0 | 0.0 | 0.0 | 0 | 0 |
| **1** | 0 | 46 | 2.0 | 0 | 0.0 | 0.0 | 0 | 0 |
| **2** | 1 | 48 | 1.0 | 1 | 20.0 | 0.0 | 0 | 0 |
| **3** | 0 | 61 | 3.0 | 1 | 30.0 | 0.0 | 0 | 1 |
| **4** | 0 | 46 | 3.0 | 1 | 23.0 | 0.0 | 0 | 0 |

In [4]:

```
da.tail()
```

Out[4]:

| | male | age | education | currentSmoker | cigsPerDay | BPMeds | prevalentStroke | prevalent |
|---|---|---|---|---|---|---|---|---|
| **4233** | 1 | 50 | 1.0 | 1 | 1.0 | 0.0 | 0 | |
| **4234** | 1 | 51 | 3.0 | 1 | 43.0 | 0.0 | 0 | |
| **4235** | 0 | 48 | 2.0 | 1 | 20.0 | NaN | 0 | |
| **4236** | 0 | 44 | 1.0 | 1 | 15.0 | 0.0 | 0 | |
| **4237** | 0 | 52 | 2.0 | 0 | 0.0 | 0.0 | 0 | |

In [5]:

```
da.shape
```

Out[5]:

```
(4238, 16)
```

In [6]:

```
da.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]:

```
da.describe()
```

Out[7]:

| | male | age | education | currentSmoker | cigsPerDay | BPMeds | pre |
|---|---|---|---|---|---|---|---|
| **count** | 4238.000000 | 4238.000000 | 4133.000000 | 4238.000000 | 4209.000000 | 4185.000000 | |
| **mean** | 0.429212 | 49.584946 | 1.978950 | 0.494101 | 9.003089 | 0.029630 | |
| **std** | 0.495022 | 8.572160 | 1.019791 | 0.500024 | 11.920094 | 0.169584 | |
| **min** | 0.000000 | 32.000000 | 1.000000 | 0.000000 | 0.000000 | 0.000000 | |
| **25%** | 0.000000 | 42.000000 | 1.000000 | 0.000000 | 0.000000 | 0.000000 | |
| **50%** | 0.000000 | 49.000000 | 2.000000 | 0.000000 | 0.000000 | 0.000000 | |
| **75%** | 1.000000 | 56.000000 | 3.000000 | 1.000000 | 20.000000 | 0.000000 | |
| **max** | 1.000000 | 70.000000 | 4.000000 | 1.000000 | 70.000000 | 1.000000 | |

In [8]:

```
da.isnull().sum()
```

Out[8]:

```
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 [9]:

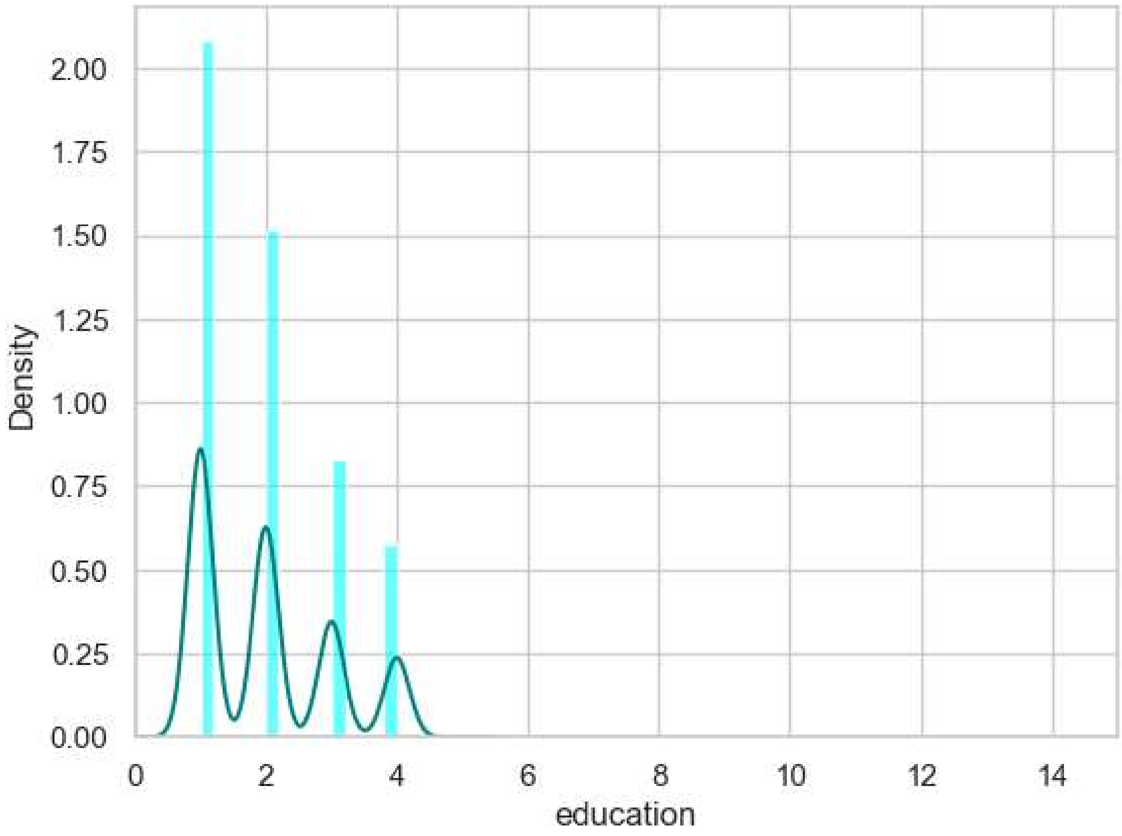
```
da.duplicated().any()
```

Out[9]:

```
False
```

In [12]:

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



In [13]:

```
print(da["education"].mean(skipna=True))
print(da["education"].median(skipna=True))
```

```
1.9789499153157513
2.0
```

In [15]:

```
print((da['glucose'].isnull().sum()/da.shape[0])*100)
```

```
9.155261915998112
```

In [16]:

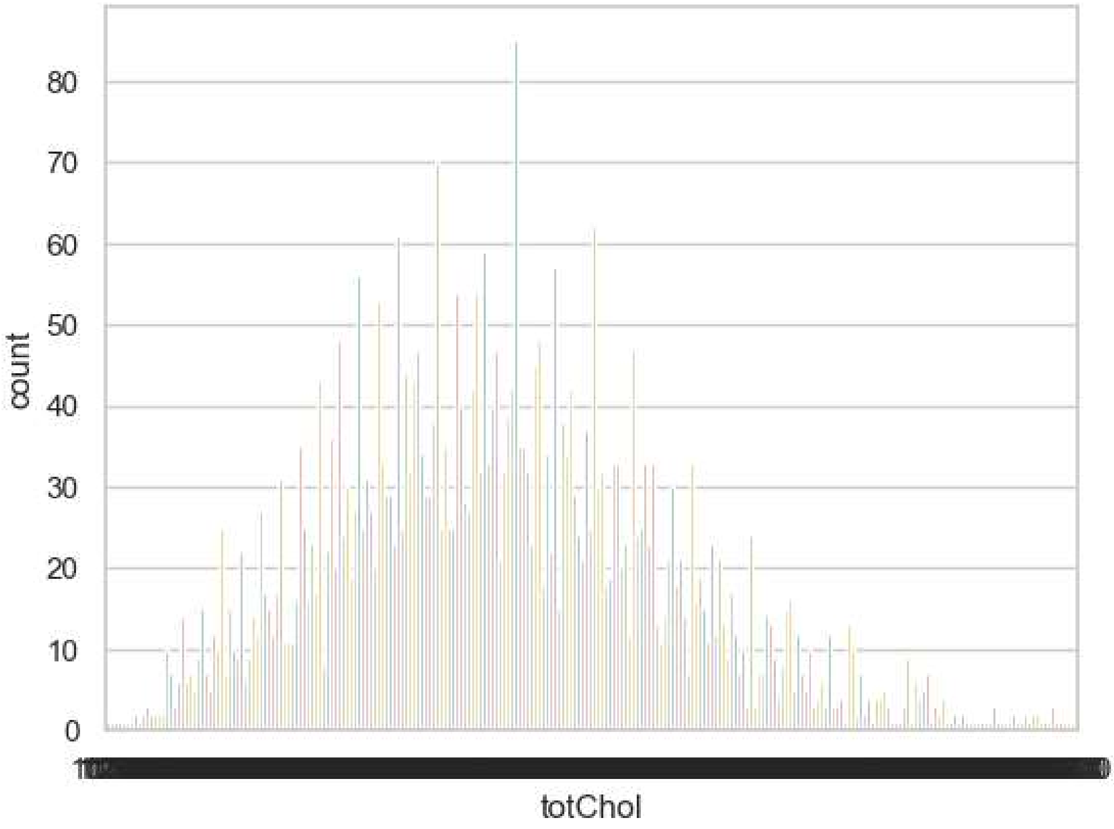
```
print((da['totChol'].isnull().sum()/da.shape[0])*100)
```

```
1.1798017932987257
```

In [17]:

```
print(da['totChol'].value_counts())
sns.countplot(x='totChol',data=da,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 [18]:

```
print(da['totChol'].value_counts().idxmax())
```

```
240.0
```

In [21]:

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

In [22]:

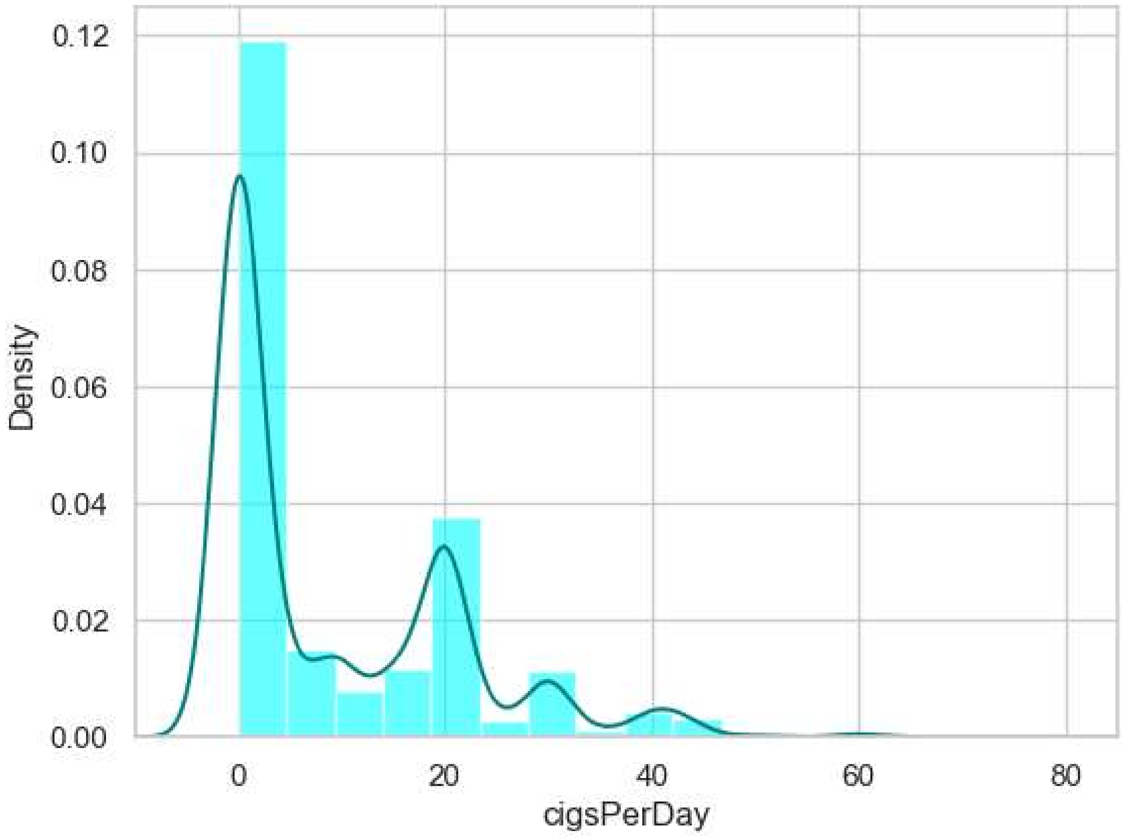
```
data.isnull().sum()
```

Out[22]:

```
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 [24]:

```
ax=da["cigsPerDay"].hist(bins=15,density=True,stacked=True,color='cyan',alpha=0.6)
da["cigsPerDay"].plot(kind='density',color='teal')
ax.set(xlabel='cigsPerDay')
plt.xlim(-10,85)
plt.show()
```



In [25]:

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

```
9.003088619624615
0.0
```

In [26]:

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

```
1.2505899008966492
```

In [27]:

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

```
0.4483246814535158
```

In [29]:

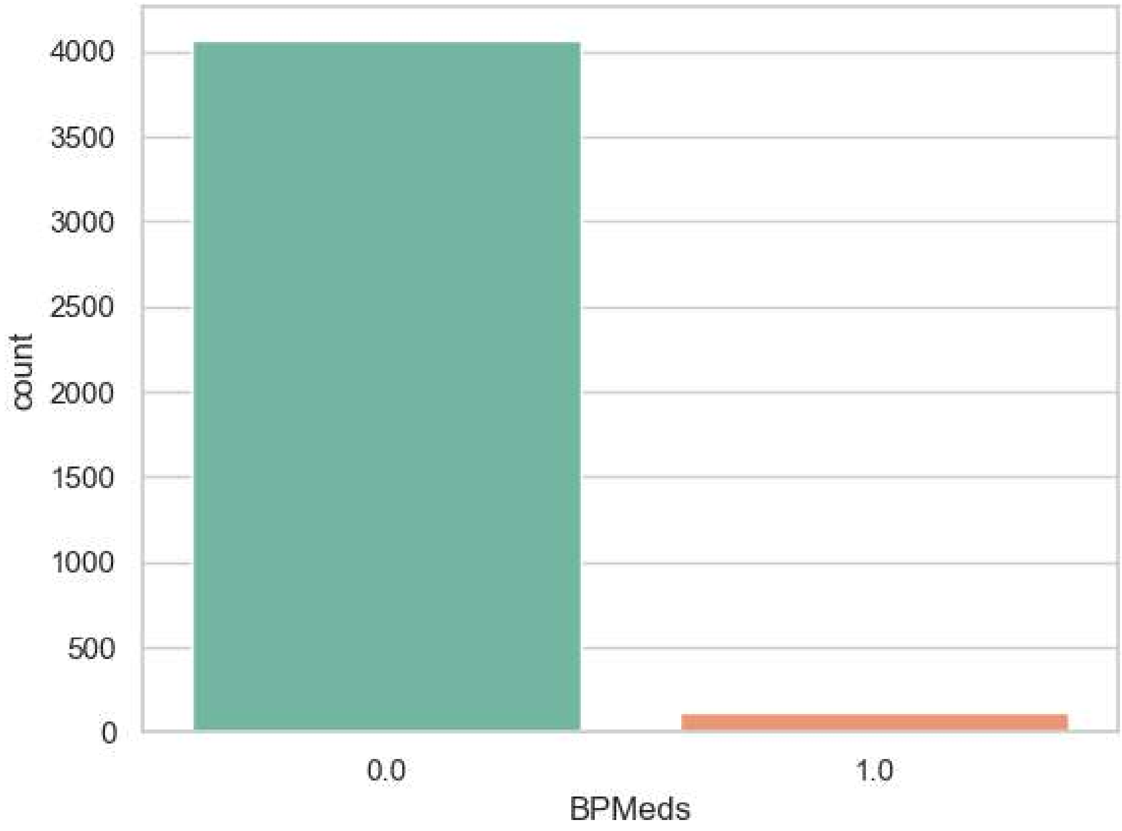
```
print((da['heartRate'].isnull().sum()/da.shape[0])*100)
```

```
0.023596035865974516
```

In [30]:

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

```
BPMeds
0.0    4061
1.0     124
Name: count, dtype: int64
```



In [31]:

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

```
75.0
```

In [33]:

```
data=da.copy()
data["cigsPerDay"].fillna(da["cigsPerDay"].median(skipna=True),inplace=True)
data["BPMeds"].fillna(da["BPMeds"].median(skipna=True),inplace=True)
data["education"].fillna(da["education"].median(skipna=True),inplace=True)
data["totChol"].fillna(da["totChol"].value_counts().idxmax(),inplace=True)
data.drop('glucose',axis=1,inplace=True)
data.drop('BMI',axis=1,inplace=True)
data.drop('heartRate',axis=1,inplace=True)
```

In [34]:

```
data.isnull().sum()
```

Out[34]:

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

In [35]:

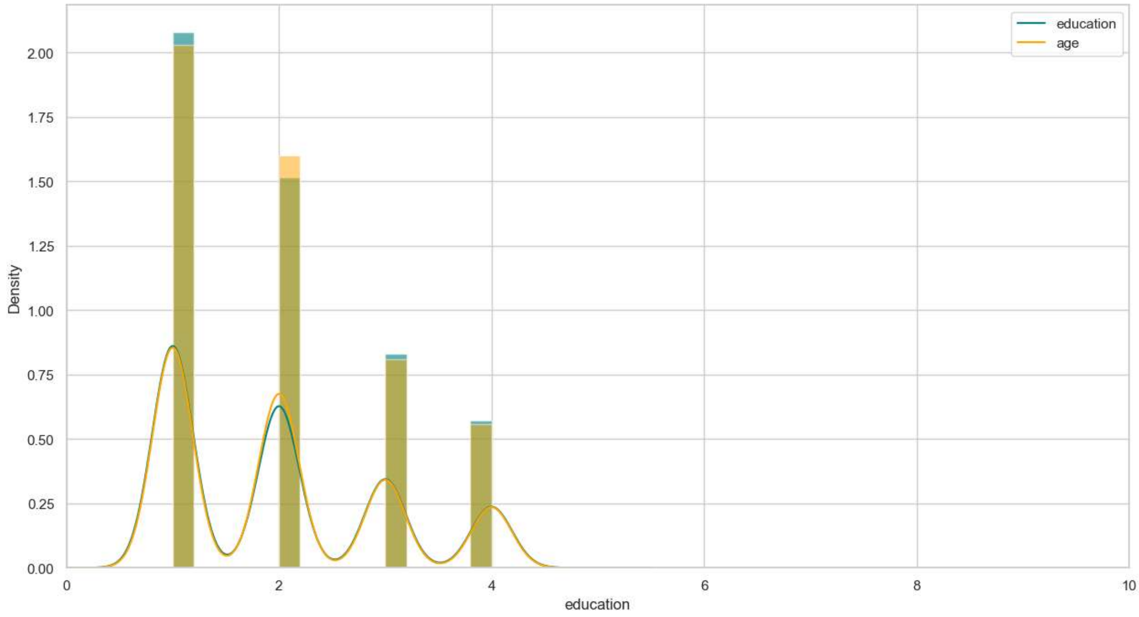
```
data.head()
```

Out[35]:

| | male | age | education | currentSmoker | cigsPerDay | BPMeds | prevalentStroke | prevalentHyp |
|---|---|---|---|---|---|---|---|---|
| **0** | 1 | 39 | 4.0 | 0 | 0.0 | 0.0 | 0 | 0 |
| **1** | 0 | 46 | 2.0 | 0 | 0.0 | 0.0 | 0 | 0 |
| **2** | 1 | 48 | 1.0 | 1 | 20.0 | 0.0 | 0 | 0 |
| **3** | 0 | 61 | 3.0 | 1 | 30.0 | 0.0 | 0 | 1 |
| **4** | 0 | 46 | 3.0 | 1 | 23.0 | 0.0 | 0 | 0 |

In [37]:

```
plt.figure(figsize=(15,8))
ax=da["education"].hist(bins=15,density=True,stacked=True,color='teal',alpha=0.6)
da["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 [38]:

```
#categorical variable for traveling alone
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 [40]:

```
#create categorical variables and drop some variables
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[40]:

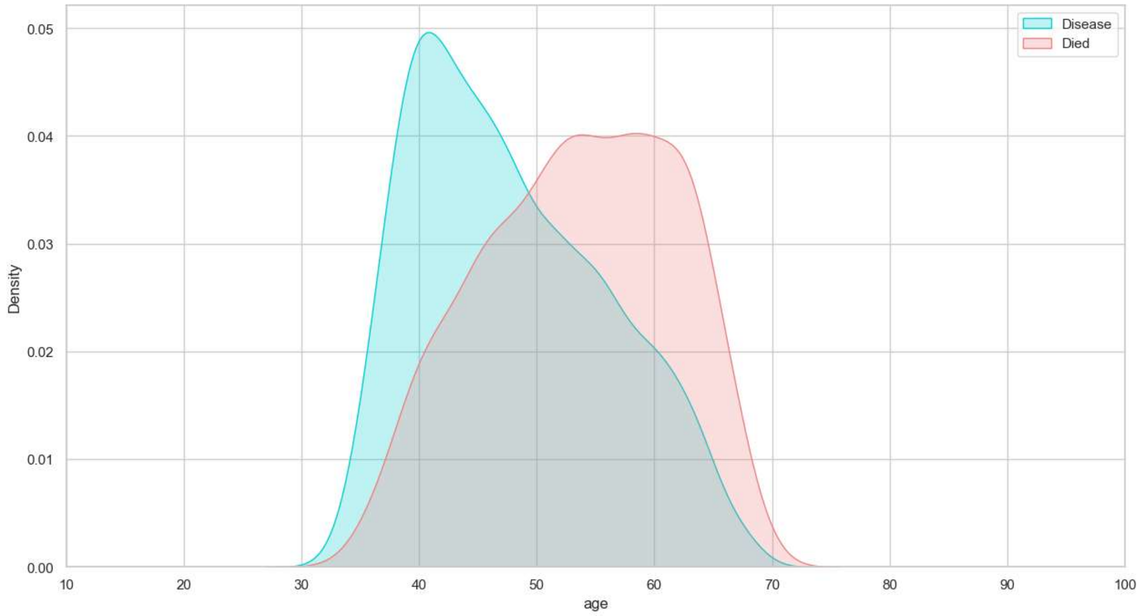
| | age | education | cigsPerDay | BPMeds | diabetes | Disease | currentSmoker_0 | currentSmoker |
|---|---|---|---|---|---|---|---|---|
| **0** | 39 | 4.0 | 0.0 | 0.0 | 0 | 1 | True | Fal |
| **1** | 46 | 2.0 | 0.0 | 0.0 | 0 | 1 | True | Fal |
| **2** | 48 | 1.0 | 20.0 | 0.0 | 0 | 1 | False | Tr |
| **3** | 61 | 3.0 | 30.0 | 0.0 | 0 | 0 | False | Tr |
| **4** | 46 | 3.0 | 23.0 | 0.0 | 0 | 1 | False | Tr |

5 rows × 490 columns

# Exploratory Data Analysis

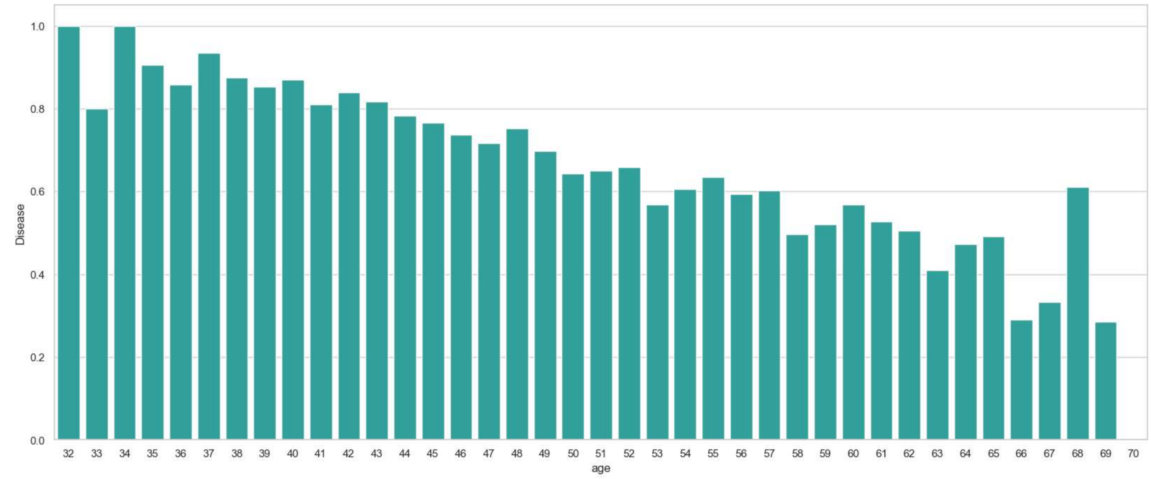
In [42]:

```
plt.figure(figsize=(15,8))
ax = sns.kdeplot(final_train["age"][final_train.Disease == 1], color="darkturquoise"
sns.kdeplot(final_train["age"][final_train.Disease == 0], color="lightcoral",shade=T
plt.legend(['Disease', 'Died'])
ax.set(xlabel='age')
plt.xlim(10,100)
plt.show()
```



In [43]:

```
plt.figure(figsize=(20,8))
avg_survival_byage = final_train[["age", "Disease"]].groupby(['age'], as_index=False
g = sns.barplot(x='age', y='Disease', data=avg_survival_byage, color="LightSeaGreen"
plt.show()
```



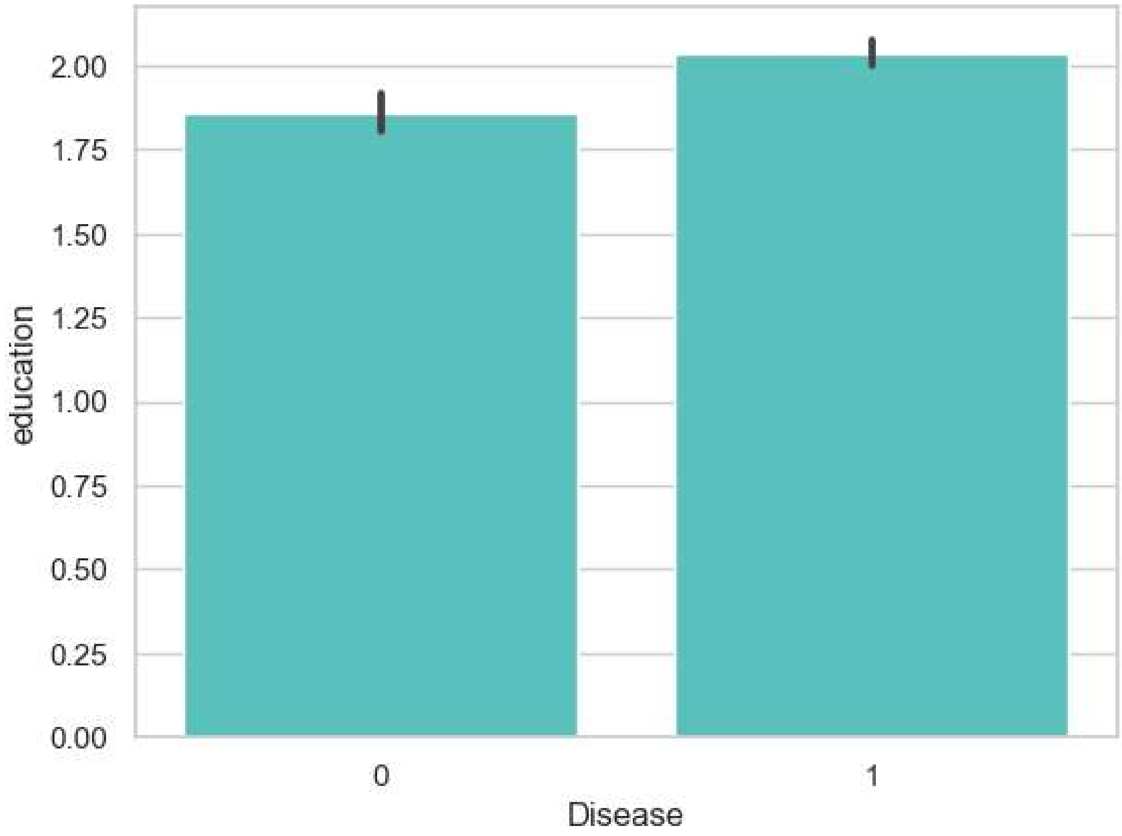
In [44]:

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

```
0       0
1       0
2       0
3       0
4       0
       ..
4233    0
4234    0
4235    0
4236    0
4237    0
Name: IsMinor, Length: 4238, dtype: int32
```

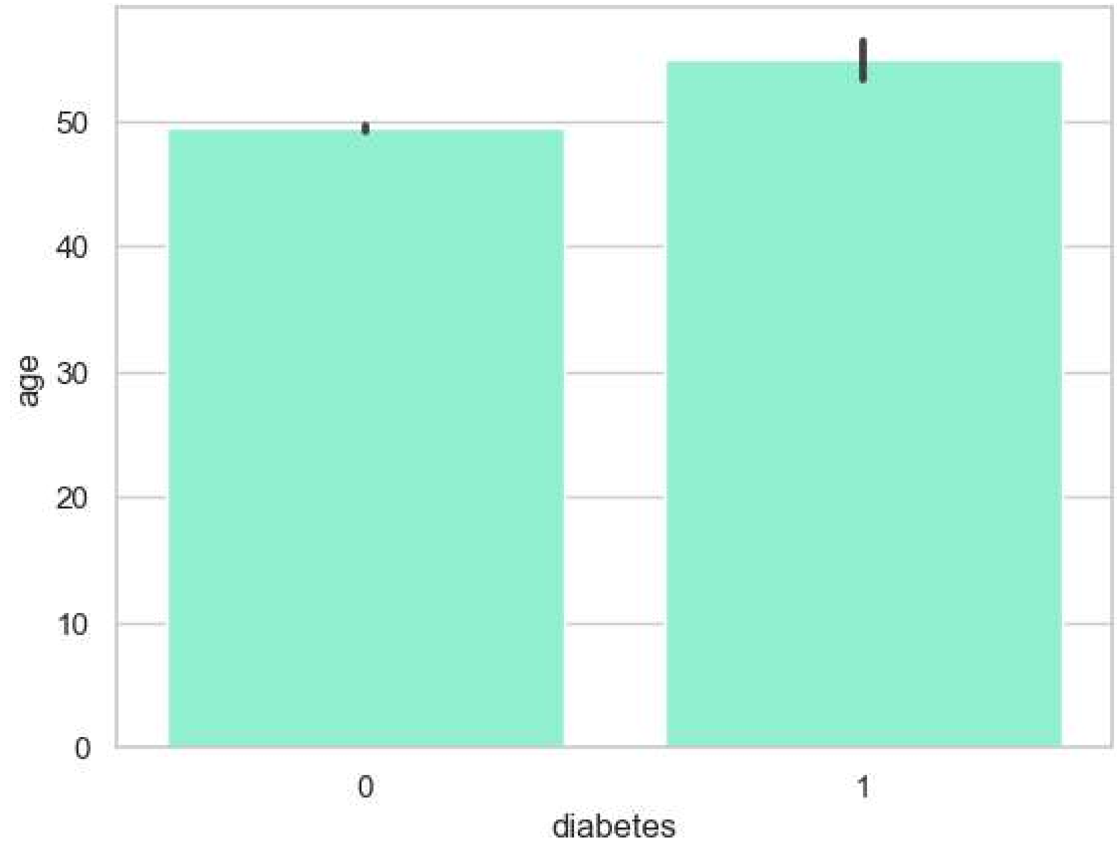
In [45]:

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



In [46]:

```
import seaborn as sns
import matplotlib.pyplot as plt
# Assuming 'train_df' is your DataFrame containing the data
sns.barplot(x='diabetes', y='age', data=da, color='aquamarine')
plt.show()
```



In [ ]:

```

```