In [1]:

```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

import seaborn as sns
import matplotlib.pyplot as plt
import scipy.stats as st
%matplotlib inline

sns.set(style="whitegrid")

import warnings
warnings.filterwarnings('ignore')
```

In [2]:

```
df = pd.read_csv(r"D:\Naresh IT\Python Introduction\Datasets\heart.csv")
```

In [4]:

```
df.head()
```

Out[4]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	ta
0	63	1	3	145	233	1	0	150	0	2.3	0	0	1	
1	37	1	2	130	250	0	1	187	0	3.5	0	0	2	
2	41	0	1	130	204	0	0	172	0	1.4	2	0	2	
3	56	1	1	120	236	0	1	178	0	0.8	2	0	2	
4	57	0	0	120	354	0	1	163	1	0.6	2	0	2	

In [6]:

```
df.shape
```

Out[6]:

```
(303, 14)
```

In [7]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 303 entries, 0 to 302
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       303 non-null    int64  
 1   sex       303 non-null    int64  
 2   cp        303 non-null    int64  
 3   trestbps  303 non-null    int64  
 4   chol      303 non-null    int64  
 5   fbs       303 non-null    int64  
 6   restecg   303 non-null    int64  
 7   thalach   303 non-null    int64  
 8   exang     303 non-null    int64  
 9   oldpeak   303 non-null    float64
 10  slope     303 non-null    int64  
 11  ca        303 non-null    int64  
 12  thal      303 non-null    int64  
 13  target    303 non-null    int64  
dtypes: float64(1), int64(13)
memory usage: 33.3 KB
```

```
In [8]: df.dtypes
```

```
Out[8]: age           int64
        sex           int64
        cp            int64
        trestbps      int64
        chol          int64
        fbs           int64
        restecg       int64
        thalach       int64
        exang         int64
        oldpeak     float64
        slope         int64
        ca            int64
        thal          int64
        target        int64
        dtype: object
```

```
In [10]: df.describe()
```

Out[10]:

	age	sex	cp	trestbps	chol	fbs	restecg
count	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000
mean	54.366337	0.683168	0.966997	131.623762	246.264026	0.148515	0.528053
std	9.082101	0.466011	1.032052	17.538143	51.830751	0.356198	0.525860
min	29.000000	0.000000	0.000000	94.000000	126.000000	0.000000	0.000000
25%	47.500000	0.000000	0.000000	120.000000	211.000000	0.000000	0.000000
50%	55.000000	1.000000	1.000000	130.000000	240.000000	0.000000	1.000000
75%	61.000000	1.000000	2.000000	140.000000	274.500000	0.000000	1.000000
max	77.000000	1.000000	3.000000	200.000000	564.000000	1.000000	2.000000

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

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

In [12]:
```
df['target'].nunique()
```

Out[12]:
```
2
```

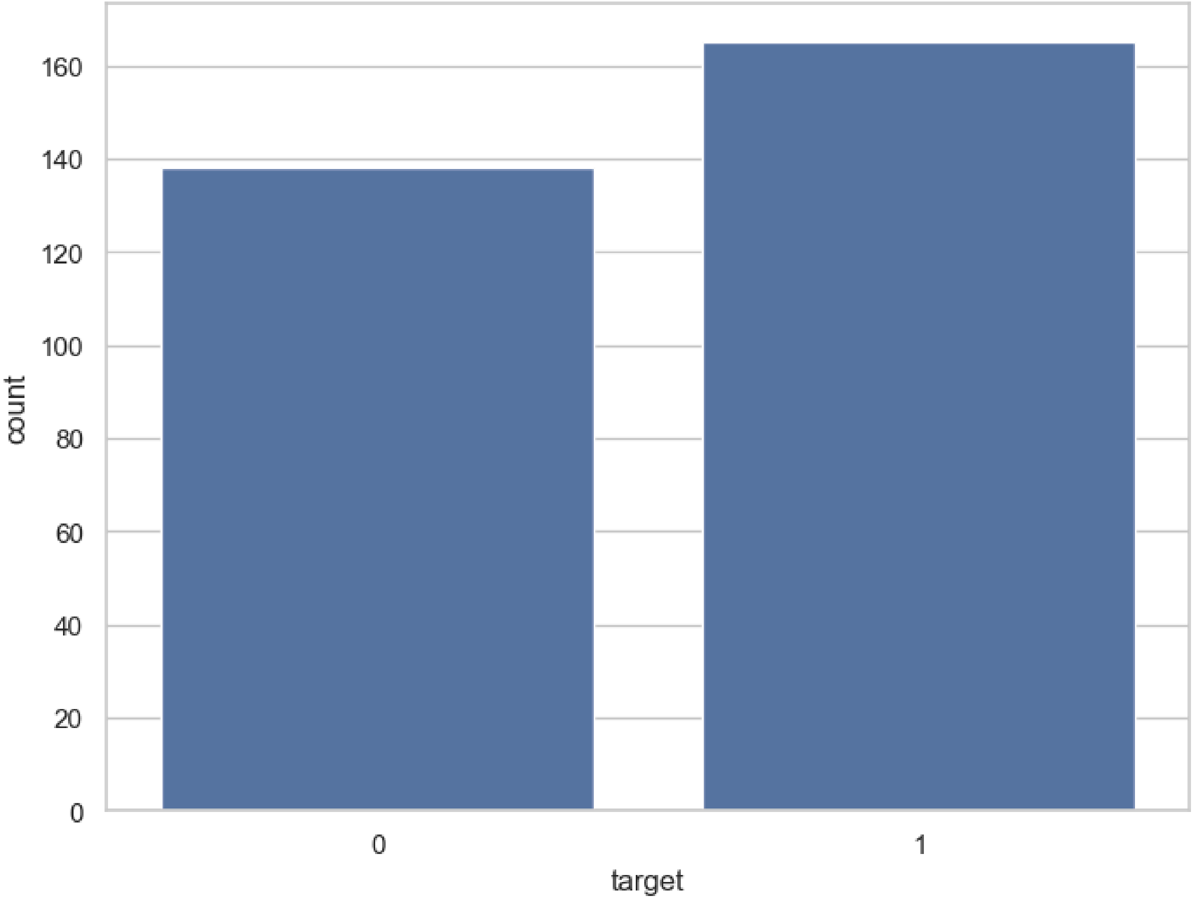
In [13]:
```
df['target'].unique()
```

Out[13]:
```
array([1, 0], dtype=int64)
```

In [14]:
```
df['target'].value_counts()
```

Out[14]:
```
target
1    165
0    138
Name: count, dtype: int64
```

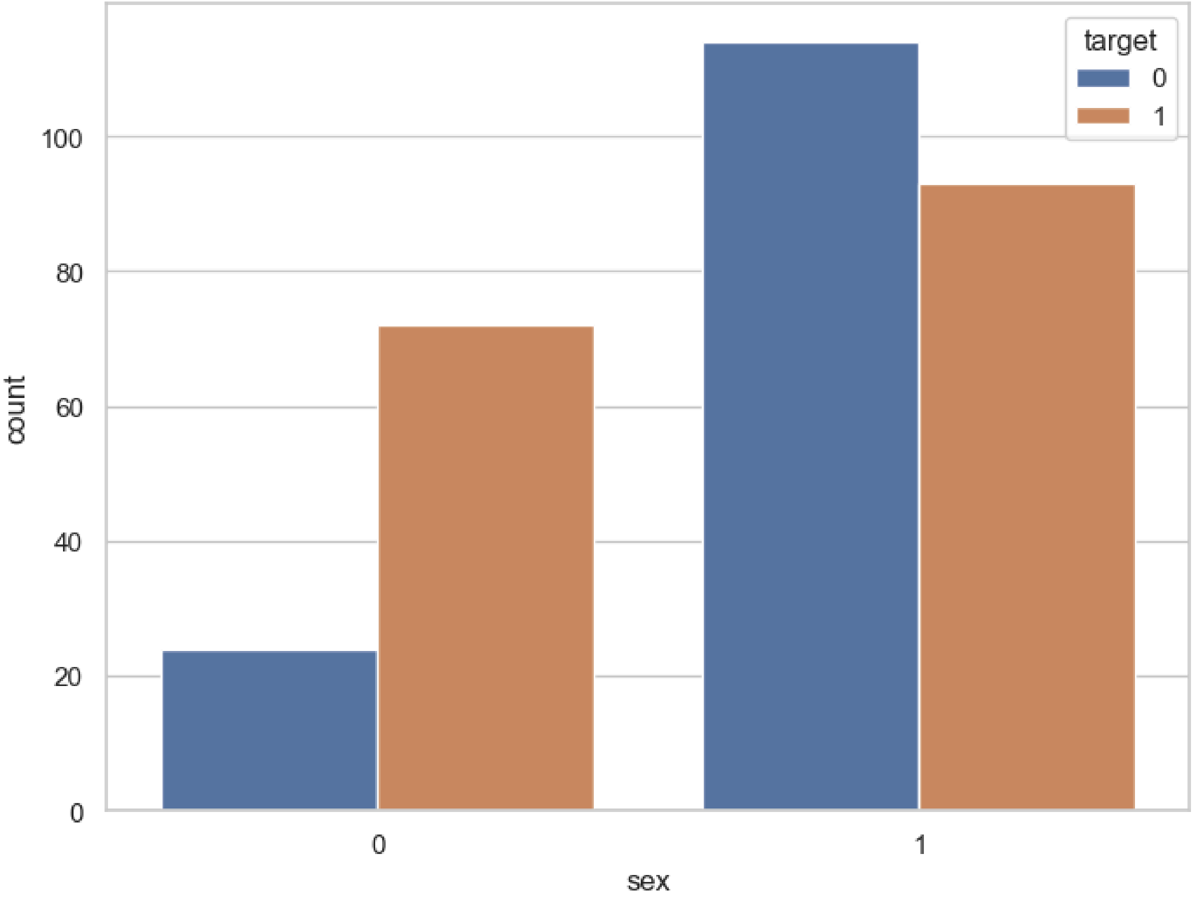
In [15]:
```
f, ax = plt.subplots(figsize=(8, 6))
ax = sns.countplot(x="target", data=df)
plt.show()
```



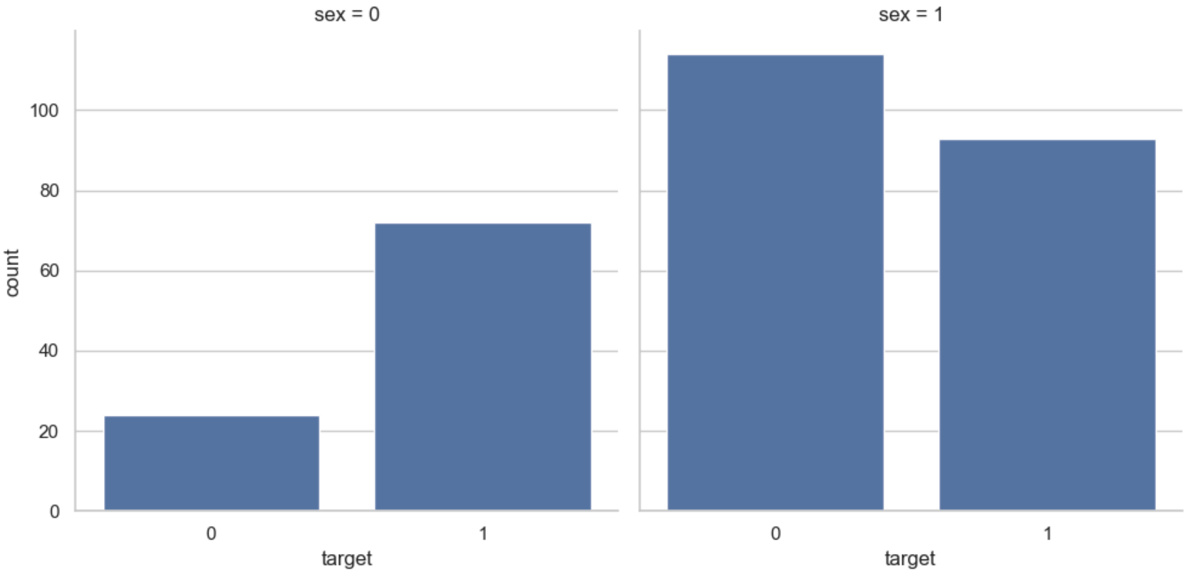
In [16]:
```
df.groupby('sex')['target'].value_counts()
```

Out[16]:
```
sex  target
0    1          72
     0          24
1    0         114
     1          93
Name: count, dtype: int64
```

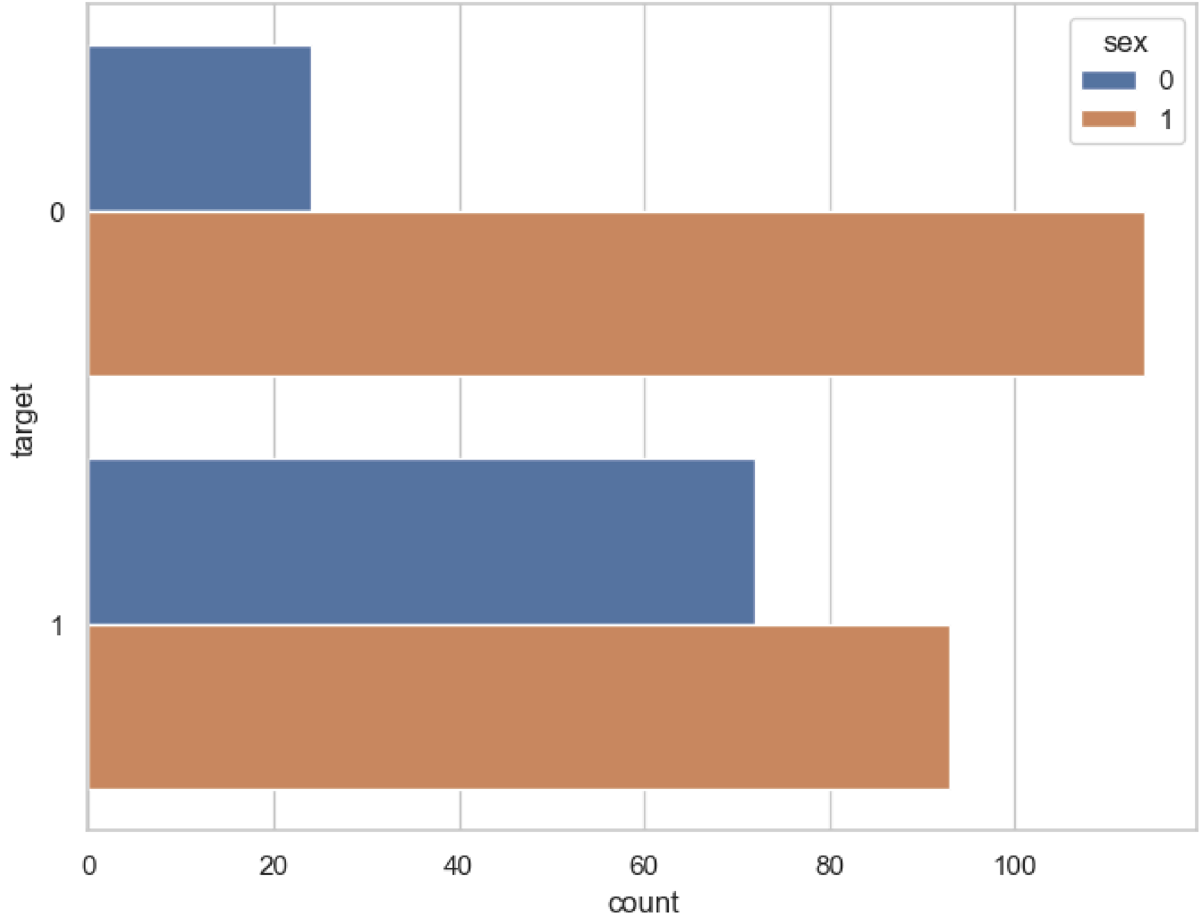
In [17]:
```
f, ax = plt.subplots(figsize=(8, 6))
ax = sns.countplot(x="sex", hue="target", data=df)
plt.show()
```



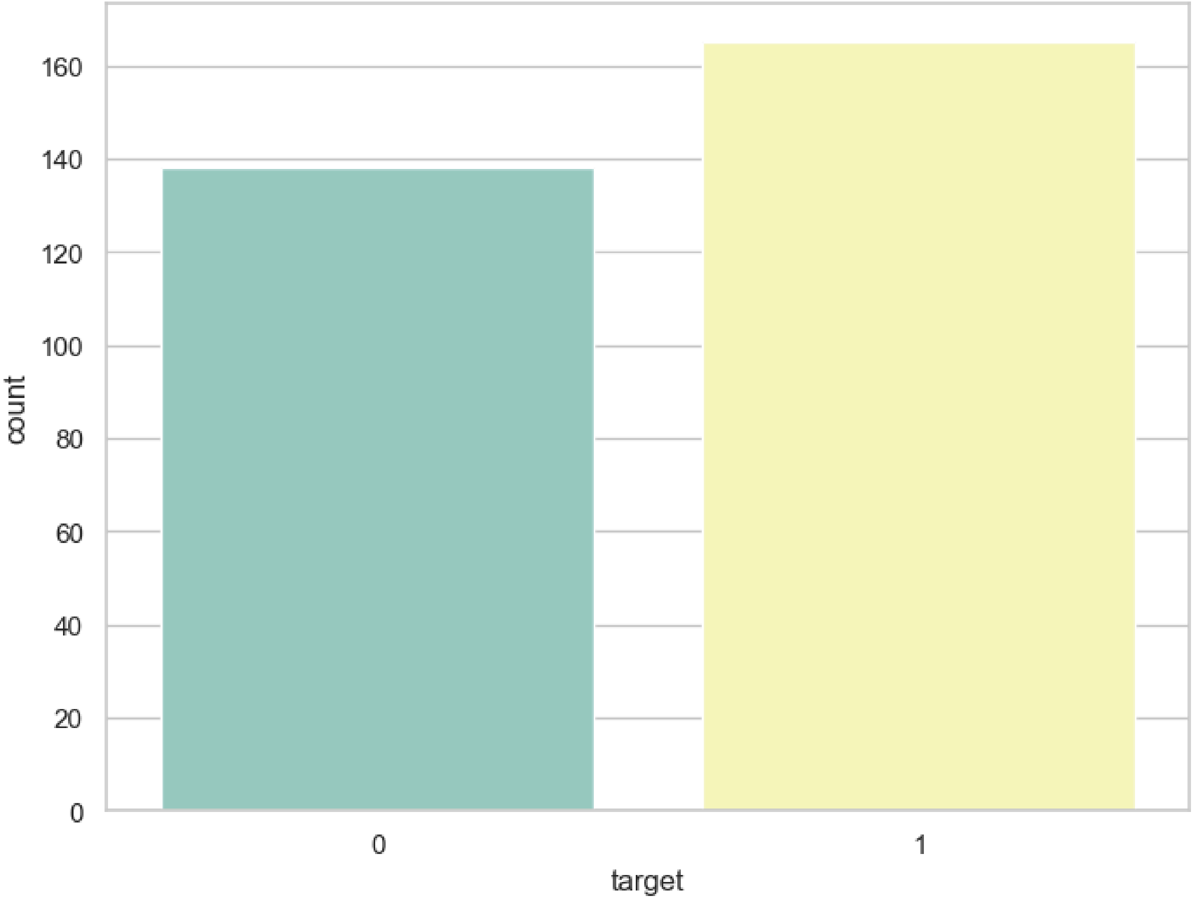
```
In [18]: ax = sns.catplot(x="target", col="sex", data=df, kind="count", height=5, aspect=1)
         plt.show()
```



```
In [19]: f, ax = plt.subplots(figsize=(8, 6))
         ax = sns.countplot(y="target", hue="sex", data=df)
         plt.show()
```

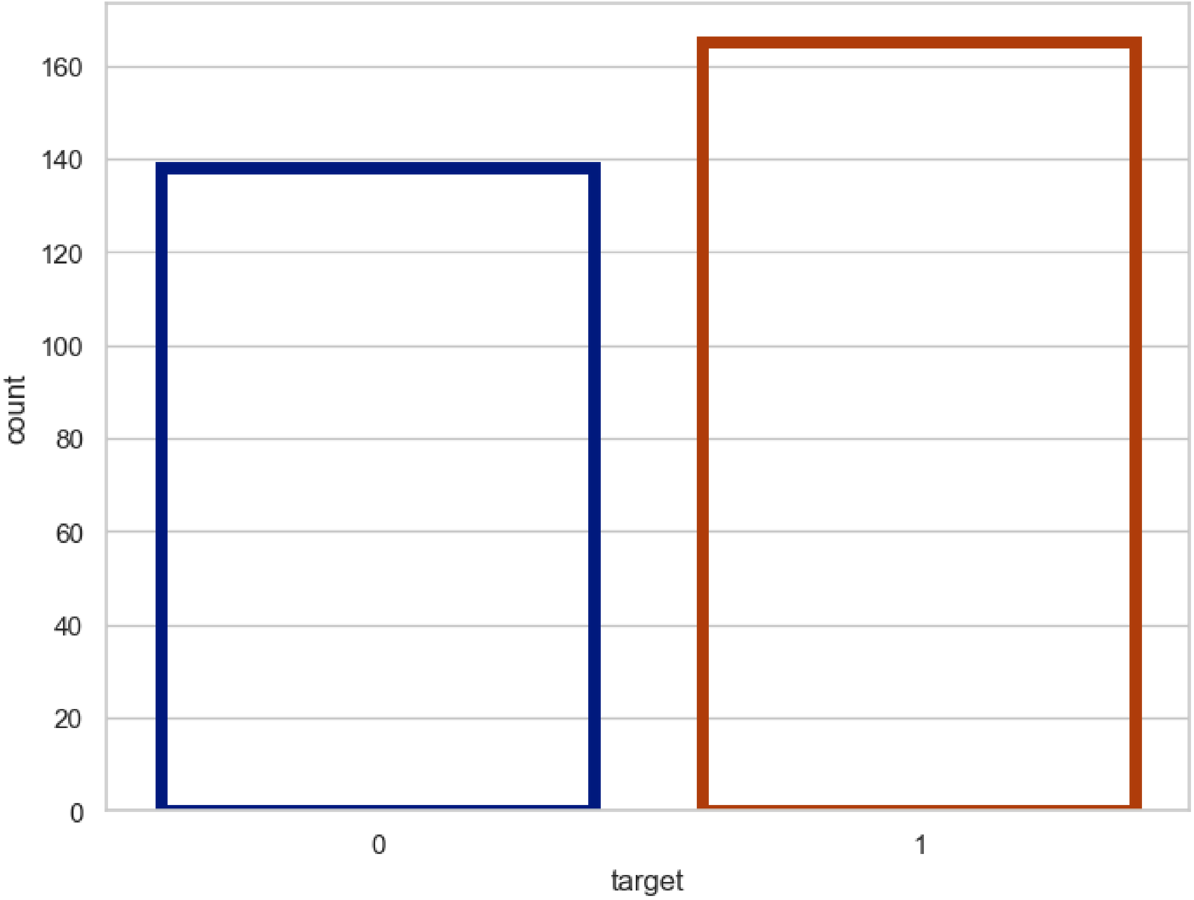


```
In [20]: f, ax = plt.subplots(figsize=(8, 6))
         ax = sns.countplot(x="target", data=df, palette="Set3")
         plt.show()
```

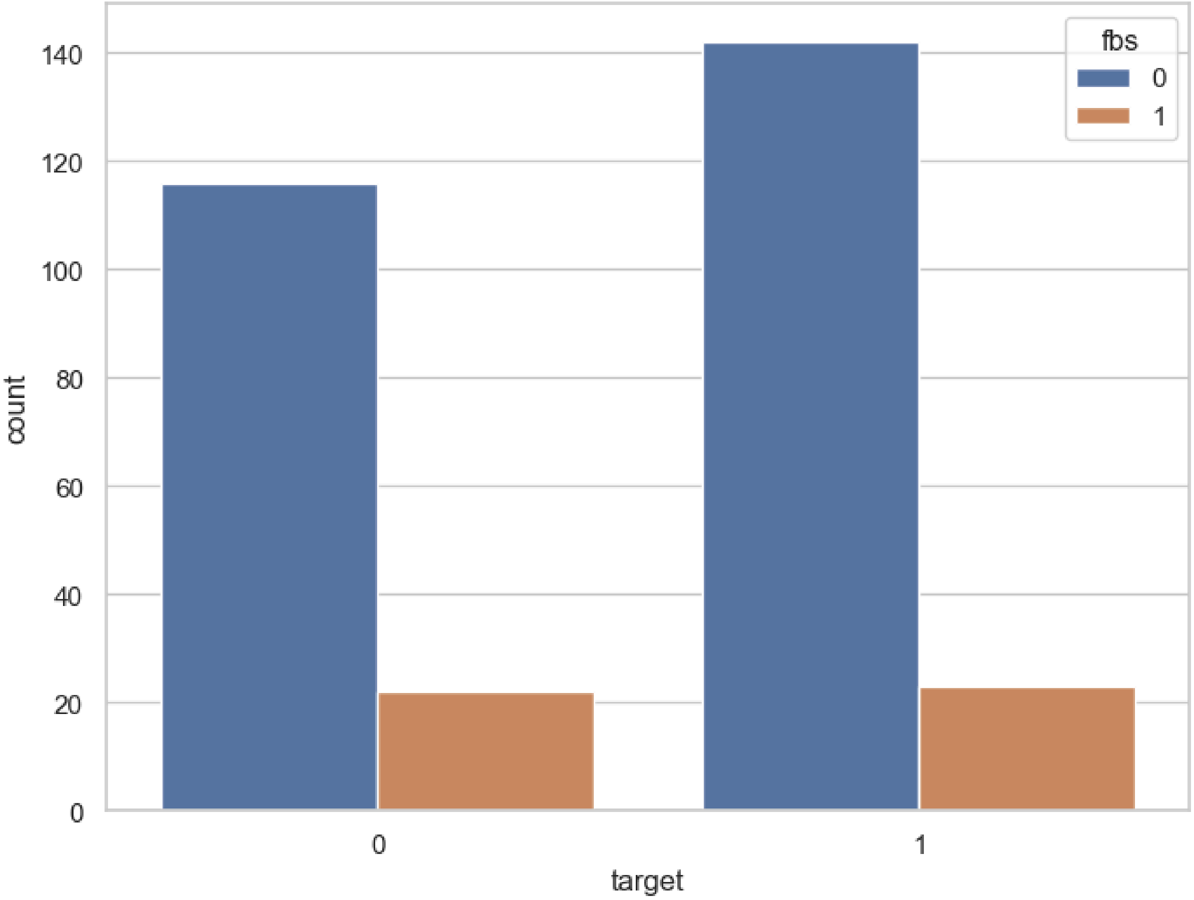


In [21]:

```
f, ax = plt.subplots(figsize=(8, 6))
ax = sns.countplot(x="target", data=df, facecolor=(0, 0, 0, 0), linewidth=5, edgeco
plt.show()
```

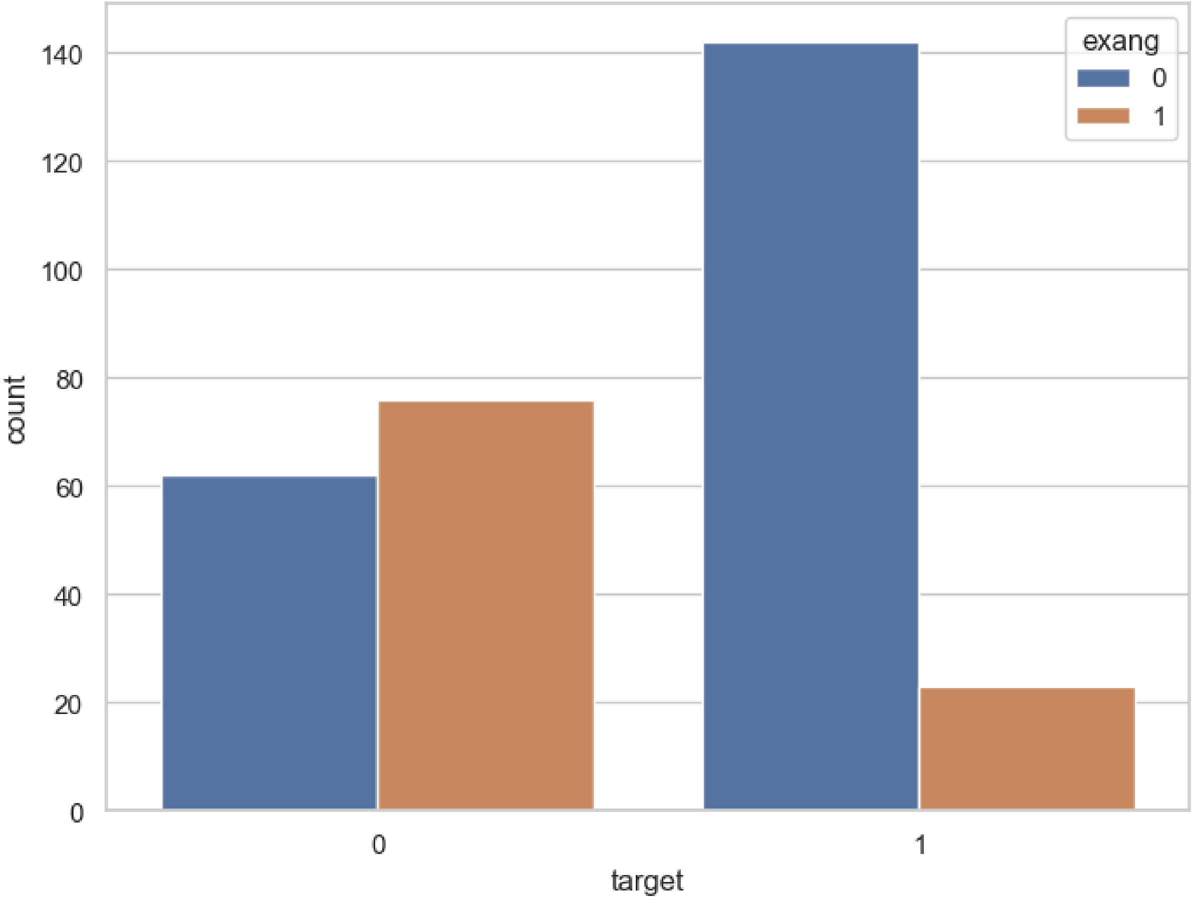


```
In [22]: f, ax = plt.subplots(figsize=(8, 6))
         ax = sns.countplot(x="target", hue="fbs", data=df)
         plt.show()
```



In [23]:

```
f, ax = plt.subplots(figsize=(8, 6))
ax = sns.countplot(x="target", hue="exang", data=df)
plt.show()
```



```
In [24]: correlation = df.corr()
```

```
In [25]: correlation['target'].sort_values(ascending=False)
```

```
Out[25]: target      1.000000
         cp          0.433798
         thalach     0.421741
         slope       0.345877
         restecg     0.137230
         fbs        -0.028046
         chol       -0.085239
         trestbps   -0.144931
         age        -0.225439
         sex        -0.280937
         thal       -0.344029
         ca         -0.391724
         oldpeak    -0.430696
         exang      -0.436757
         Name: target, dtype: float64
```

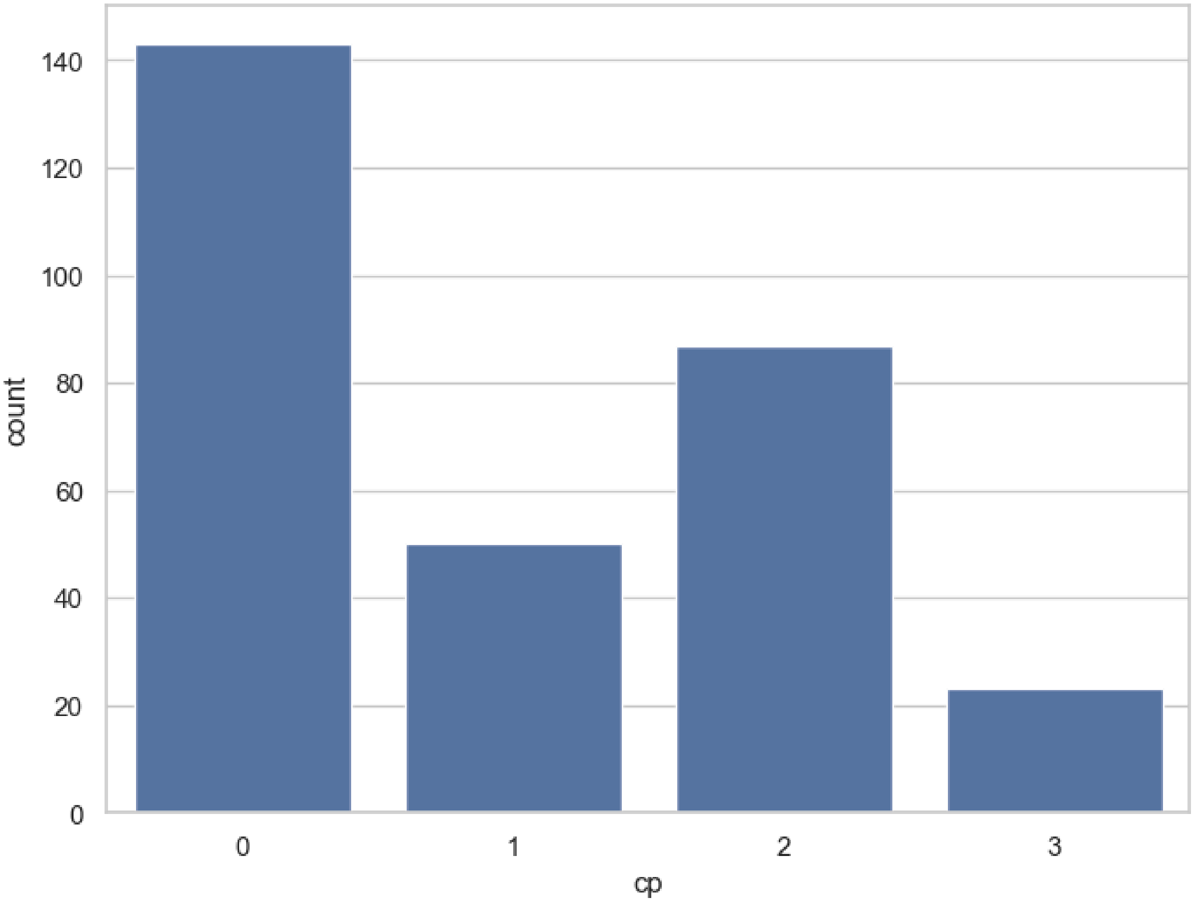
```
In [26]: df['cp'].nunique()
```

```
Out[26]: 4
```

```
In [27]: df['cp'].value_counts()
```

Out[27]:
```
cp
0    143
2     87
1     50
3     23
Name: count, dtype: int64
```

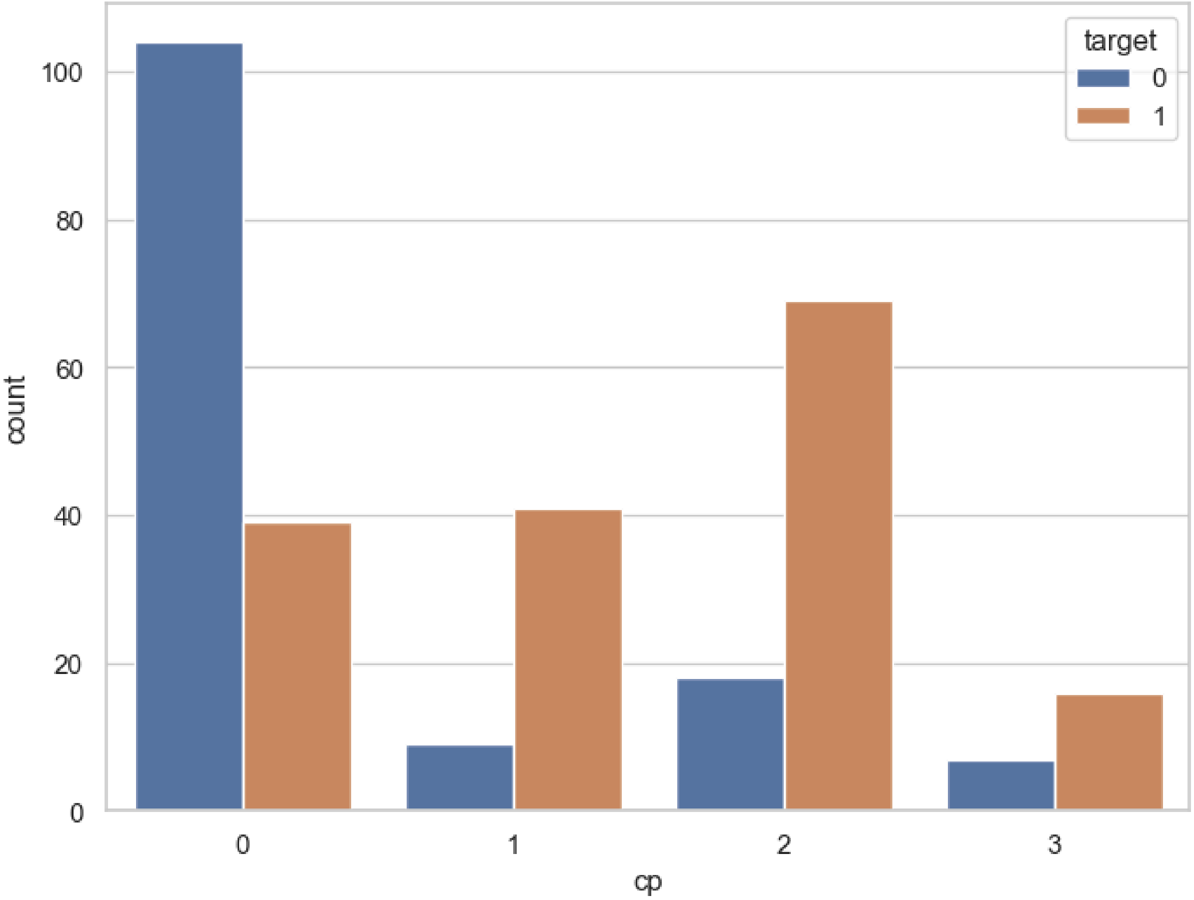
In [28]:
```
f, ax = plt.subplots(figsize=(8, 6))
ax = sns.countplot(x="cp", data=df)
plt.show()
```



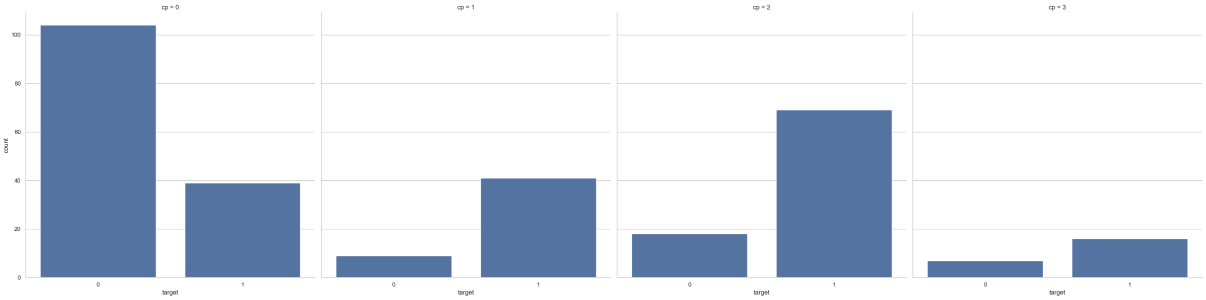
In [29]:
```
df.groupby('cp')['target'].value_counts()
```

Out[29]:
```
cp  target
0   0         104
    1          39
1   1          41
    0           9
2   1          69
    0          18
3   1          16
    0           7
Name: count, dtype: int64
```

In [30]:
```
f, ax = plt.subplots(figsize=(8, 6))
ax = sns.countplot(x="cp", hue="target", data=df)
plt.show()
```



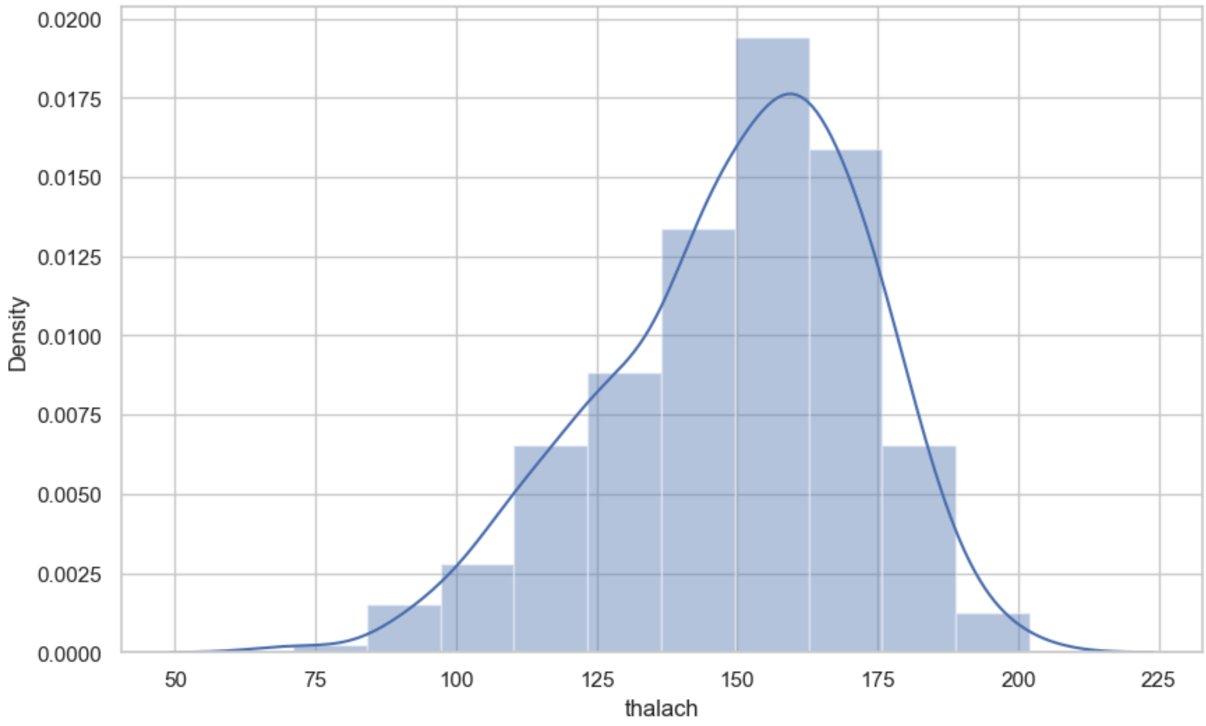
```
In [31]: ax = sns.catplot(x="target", col="cp", data=df, kind="count", height=8, aspect=1)
         plt.show()
```



```
In [32]: df['thalach'].nunique()
```

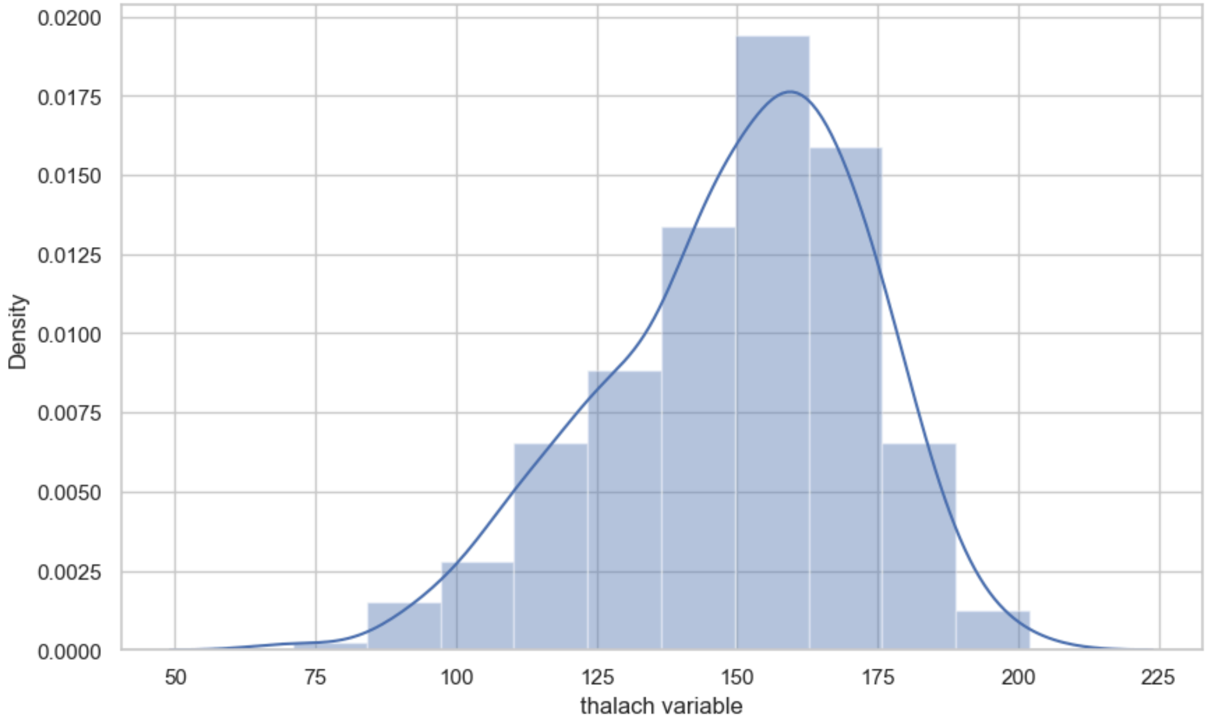
```
Out[32]: 91
```

```
In [33]: f, ax = plt.subplots(figsize=(10,6))
         x = df['thalach']
         ax = sns.distplot(x, bins=10)
         plt.show()
```



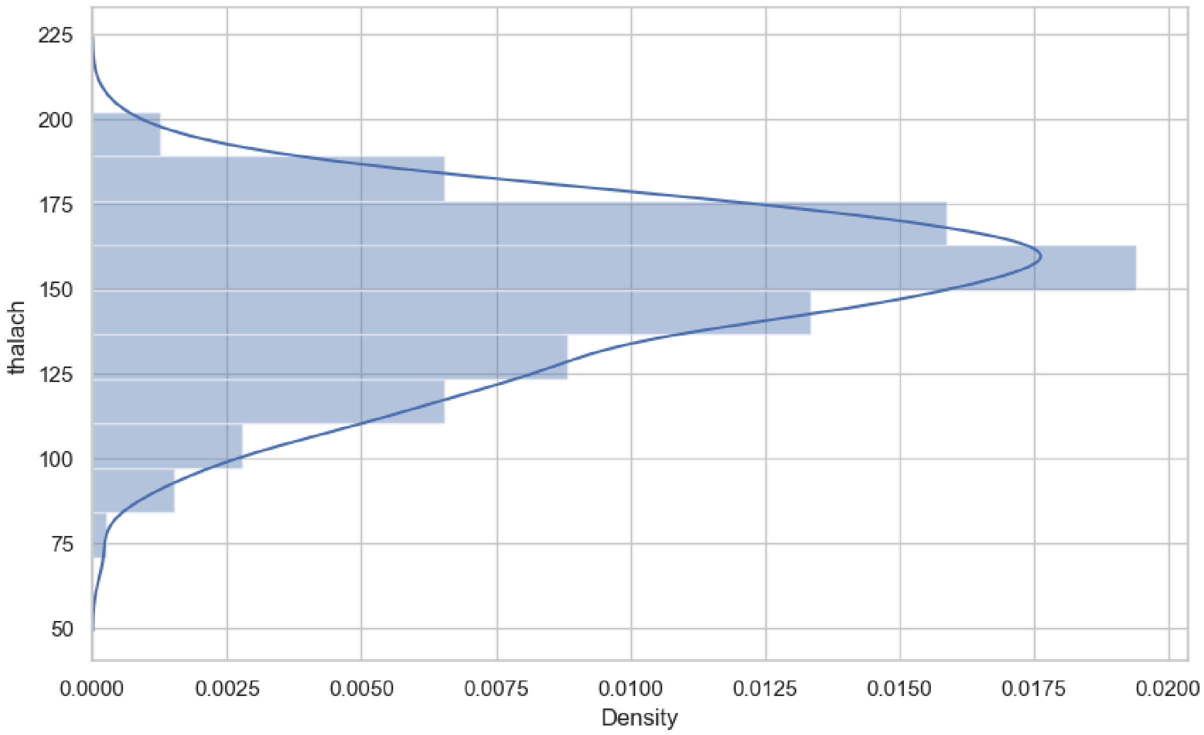
In [34]:

```
f, ax = plt.subplots(figsize=(10,6))
x = df['thalach']
x = pd.Series(x, name="thalach variable")
ax = sns.distplot(x, bins=10)
plt.show()
```

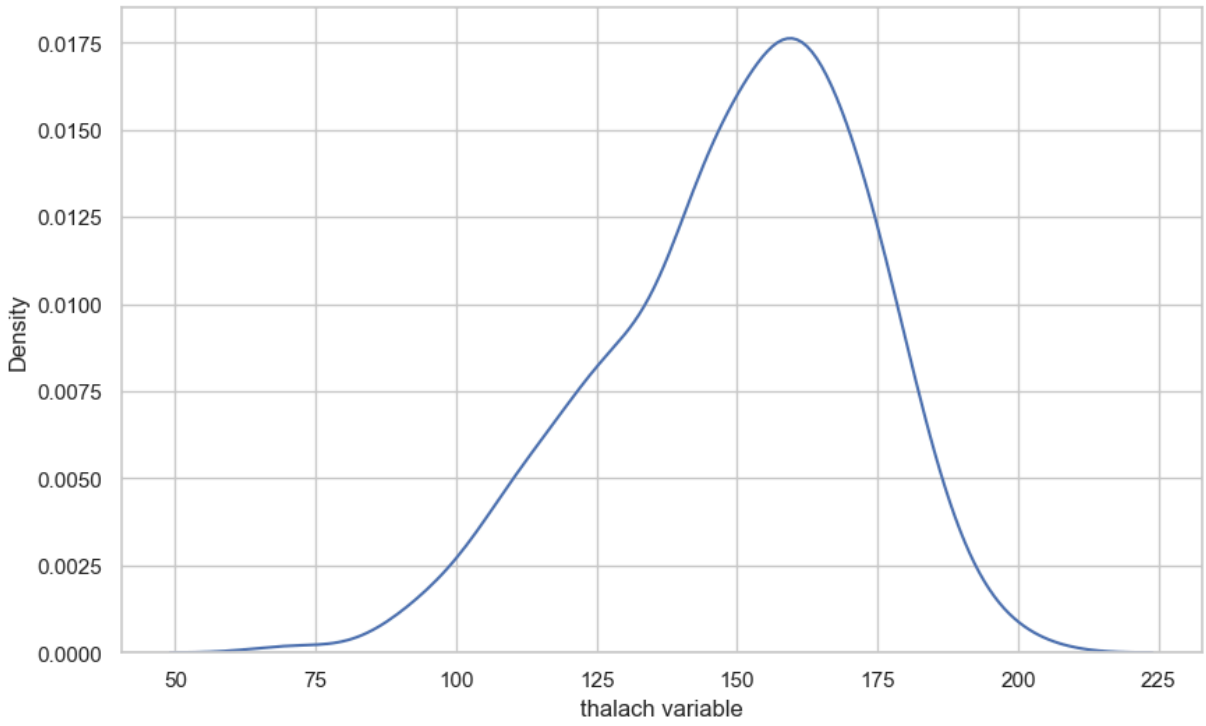


In [35]:

```
f, ax = plt.subplots(figsize=(10,6))
x = df['thalach']
ax = sns.distplot(x, bins=10, vertical=True)
plt.show()
```

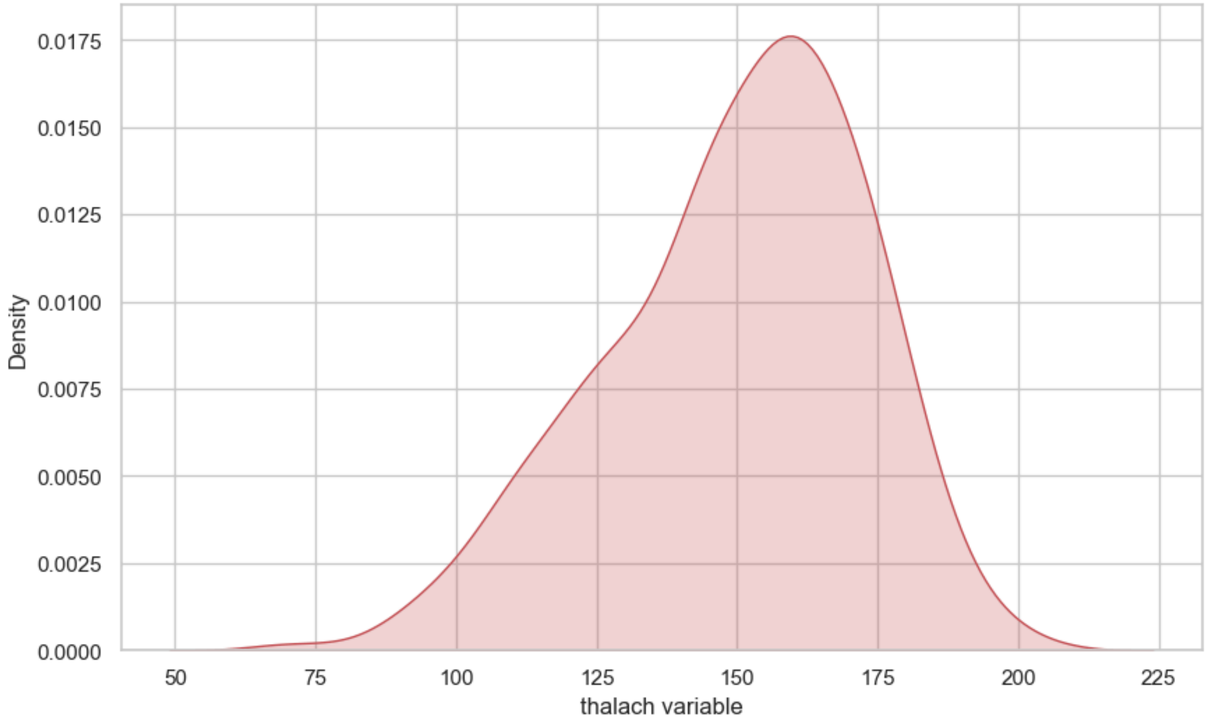


In [36]:
```
f, ax = plt.subplots(figsize=(10,6))
x = df['thalach']
x = pd.Series(x, name="thalach variable")
ax = sns.kdeplot(x)
plt.show()
```



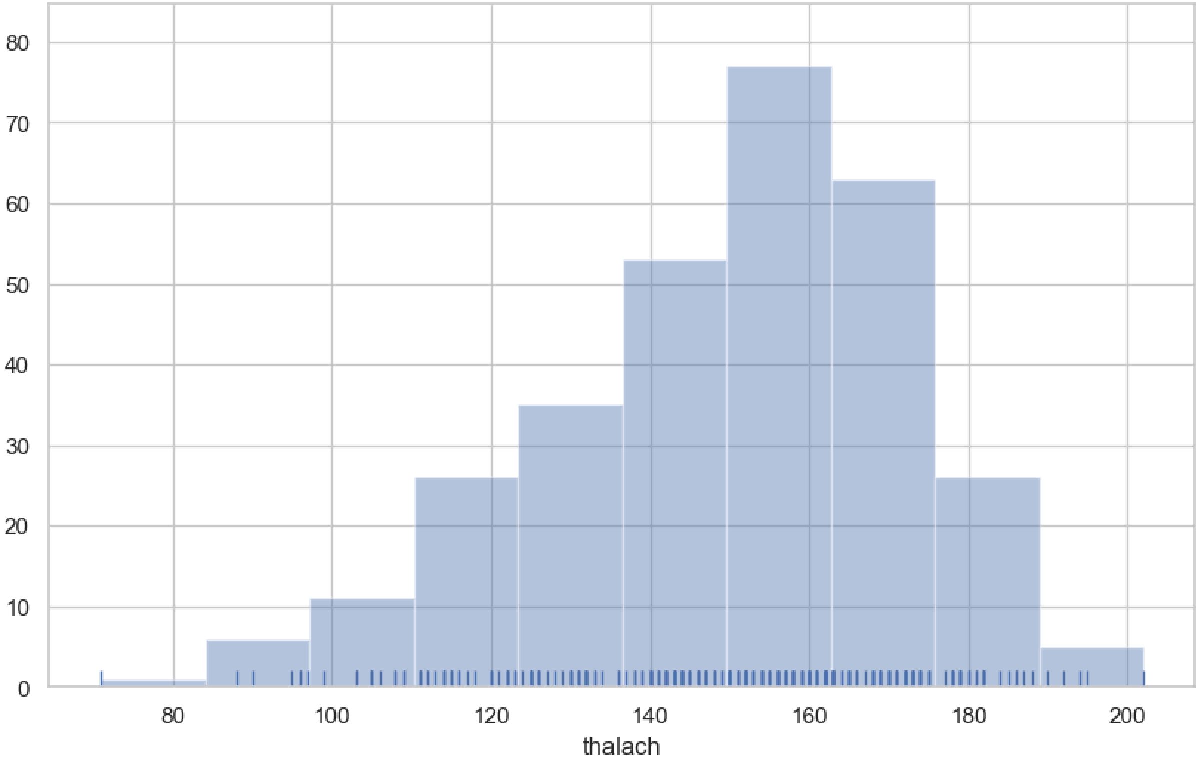
In [37]:
```
f, ax = plt.subplots(figsize=(10,6))
x = df['thalach']
x = pd.Series(x, name="thalach variable")
```

```
ax = sns.kdeplot(x, shade=True, color='r')
plt.show()
```



In [38]:

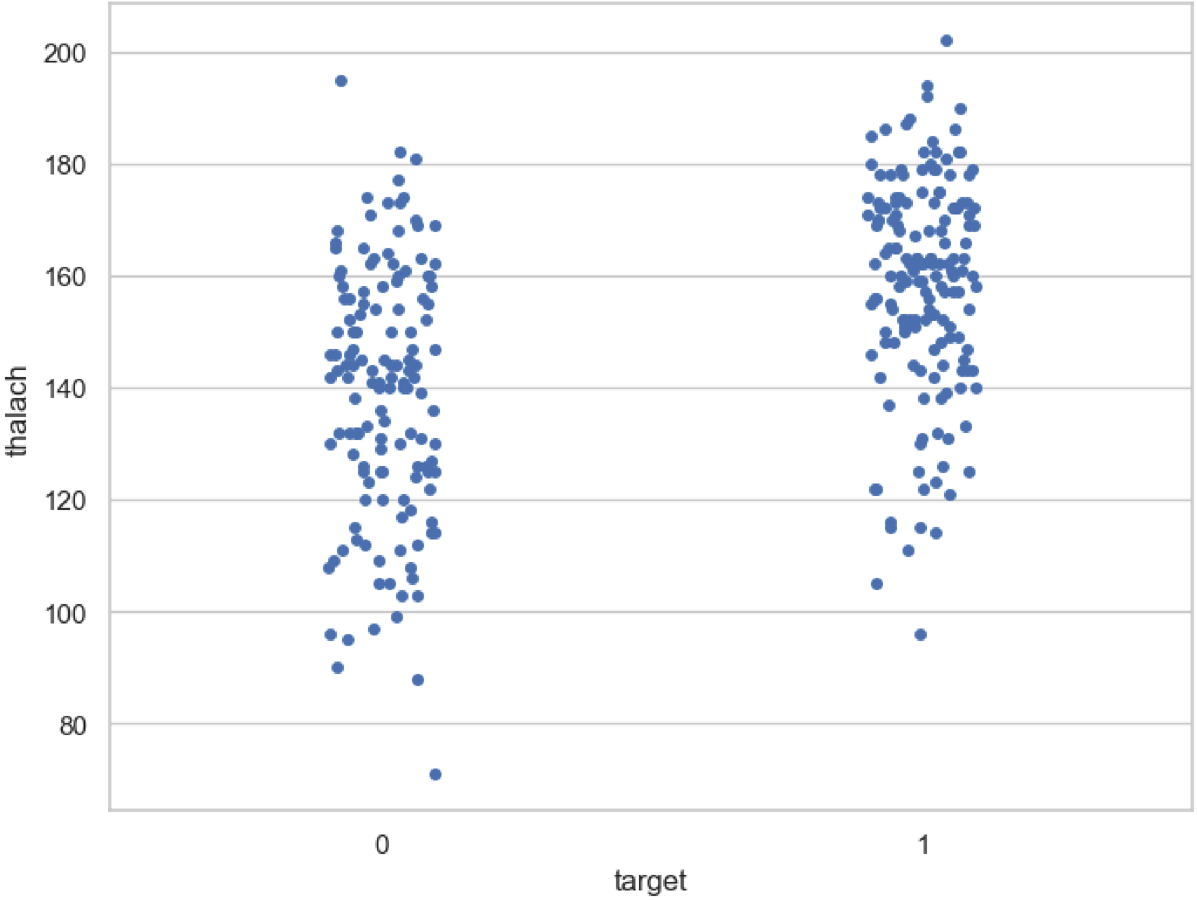
```
f, ax = plt.subplots(figsize=(10,6))
x = df['thalach']
ax = sns.distplot(x, kde=False, rug=True, bins=10)
plt.show()
```



In [39]:

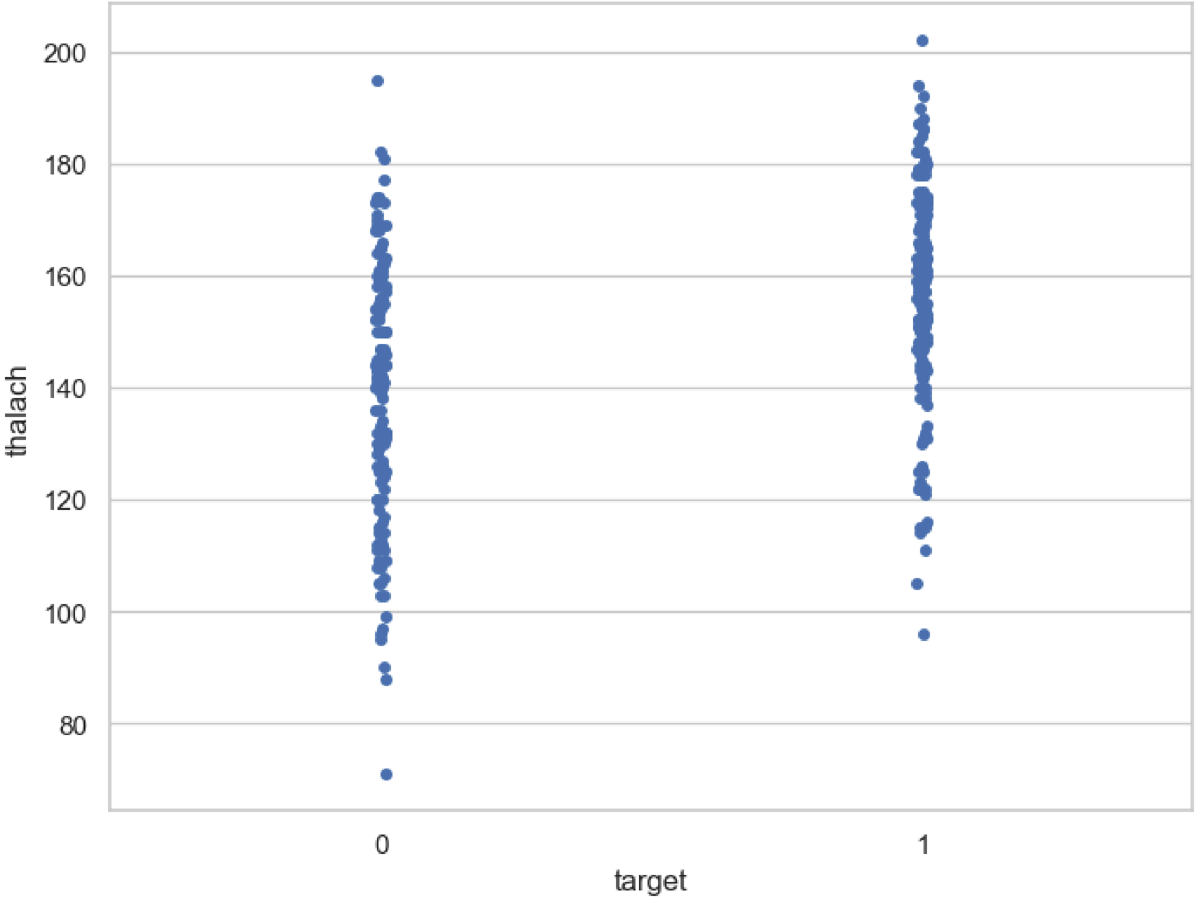
```
f, ax = plt.subplots(figsize=(8, 6))
sns.stripplot(x="target", y="thalach", data=df)
```

```
plt.show()
```

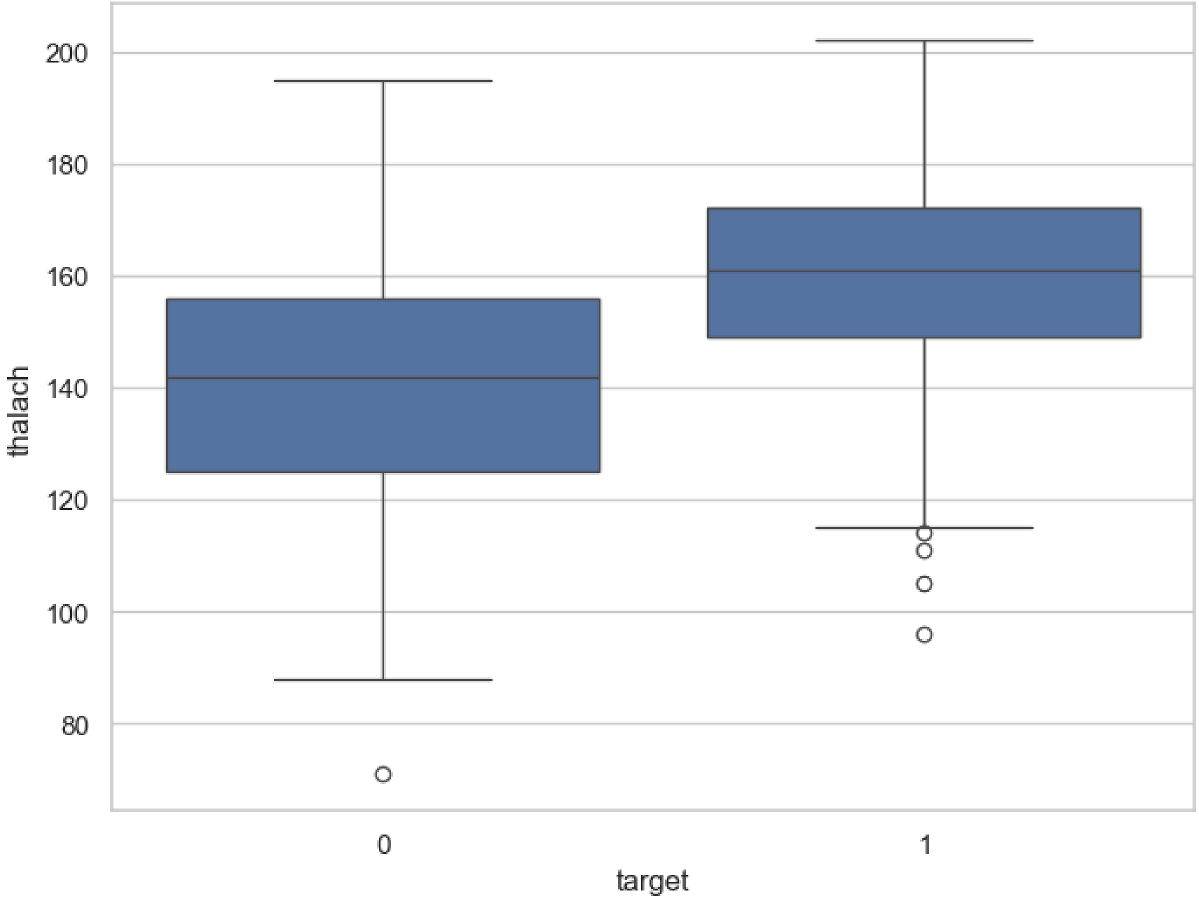


In [40]:

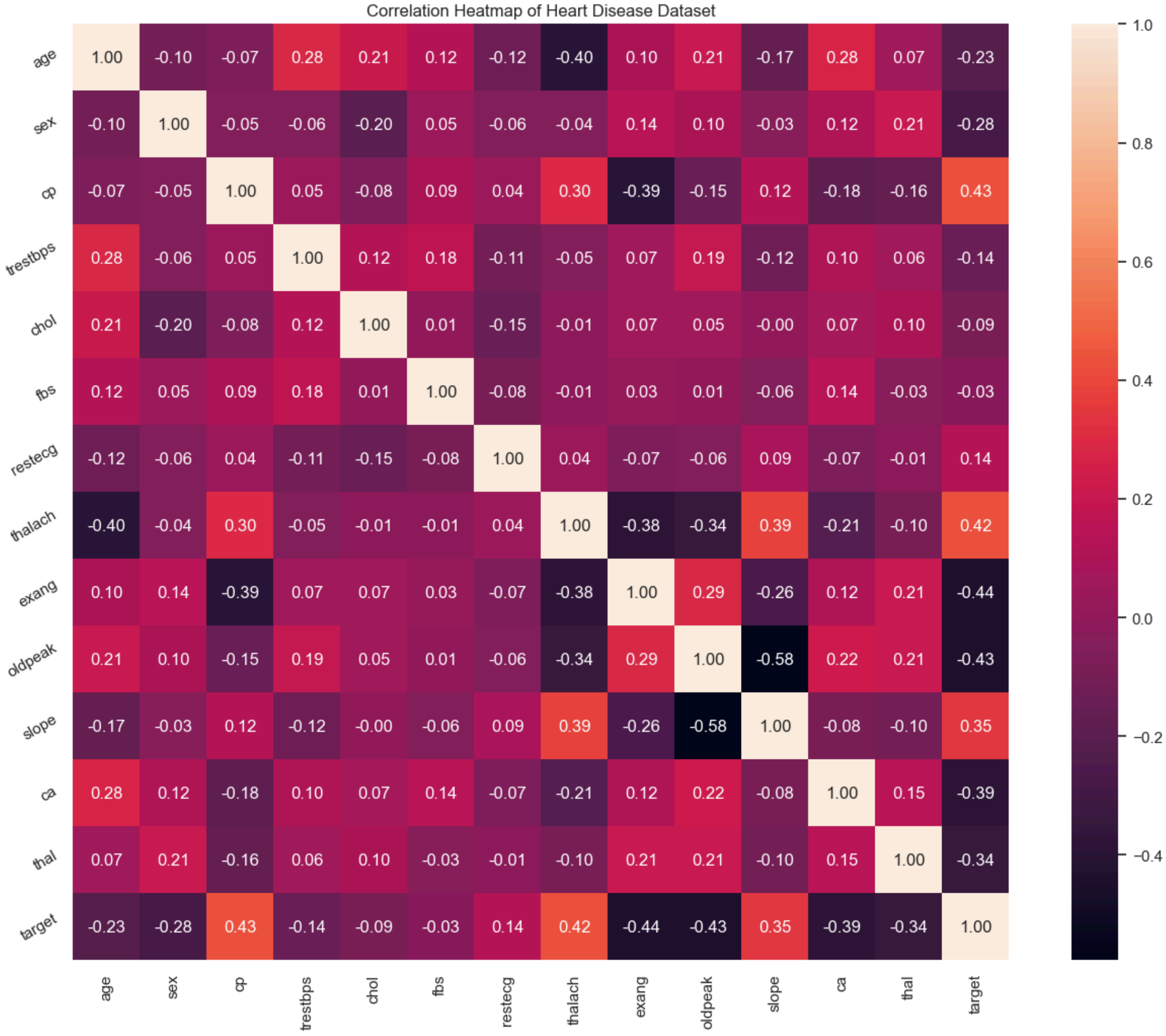
```
f, ax = plt.subplots(figsize=(8, 6))
sns.stripplot(x="target", y="thalach", data=df, jitter = 0.01)
plt.show()
```



In [41]:
```
f, ax = plt.subplots(figsize=(8, 6))
sns.boxplot(x="target", y="thalach", data=df)
plt.show()
```

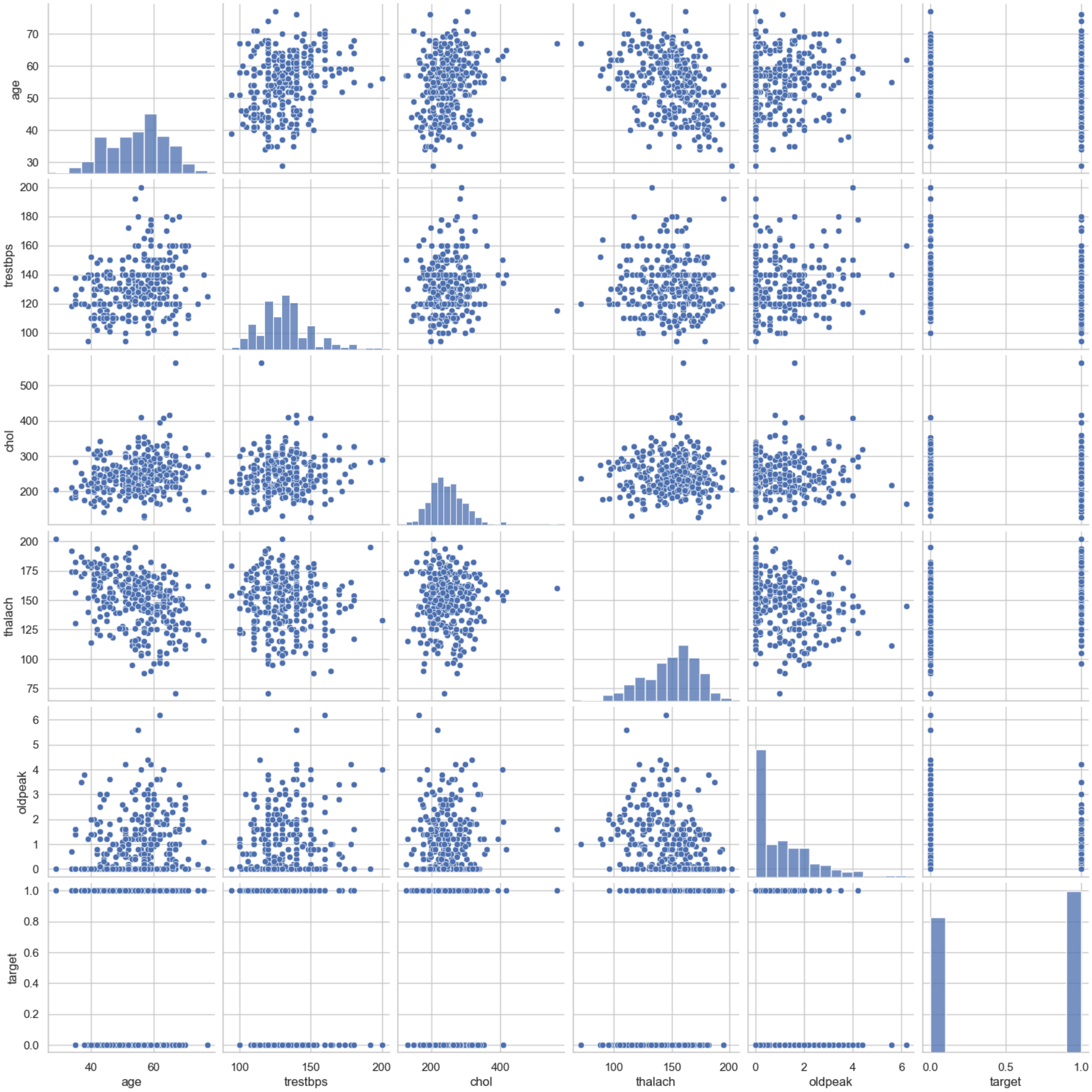


In [42]:
```
plt.figure(figsize=(16,12))
plt.title('Correlation Heatmap of Heart Disease Dataset')
a = sns.heatmap(correlation, square=True, annot=True, fmt='.2f', linecolor='white')
a.set_xticklabels(a.get_xticklabels(), rotation=90)
a.set_yticklabels(a.get_yticklabels(), rotation=30)
plt.show()
```



In [43]:

```
num_var = ['age', 'trestbps', 'chol', 'thalach', 'oldpeak', 'target' ]
sns.pairplot(df[num_var], kind='scatter', diag_kind='hist')
plt.show()
```



In [44]:
```
df['age'].nunique()
```

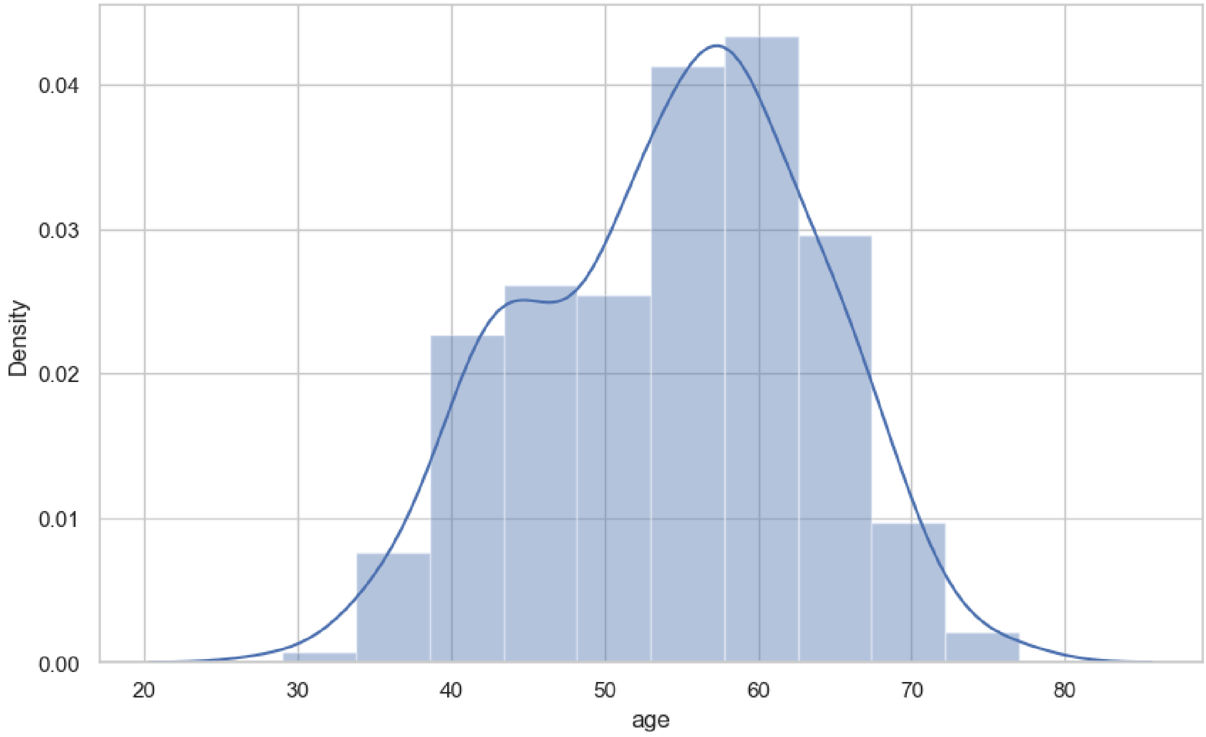
Out[44]:
```
41
```

In [45]:
```
df['age'].describe()
```

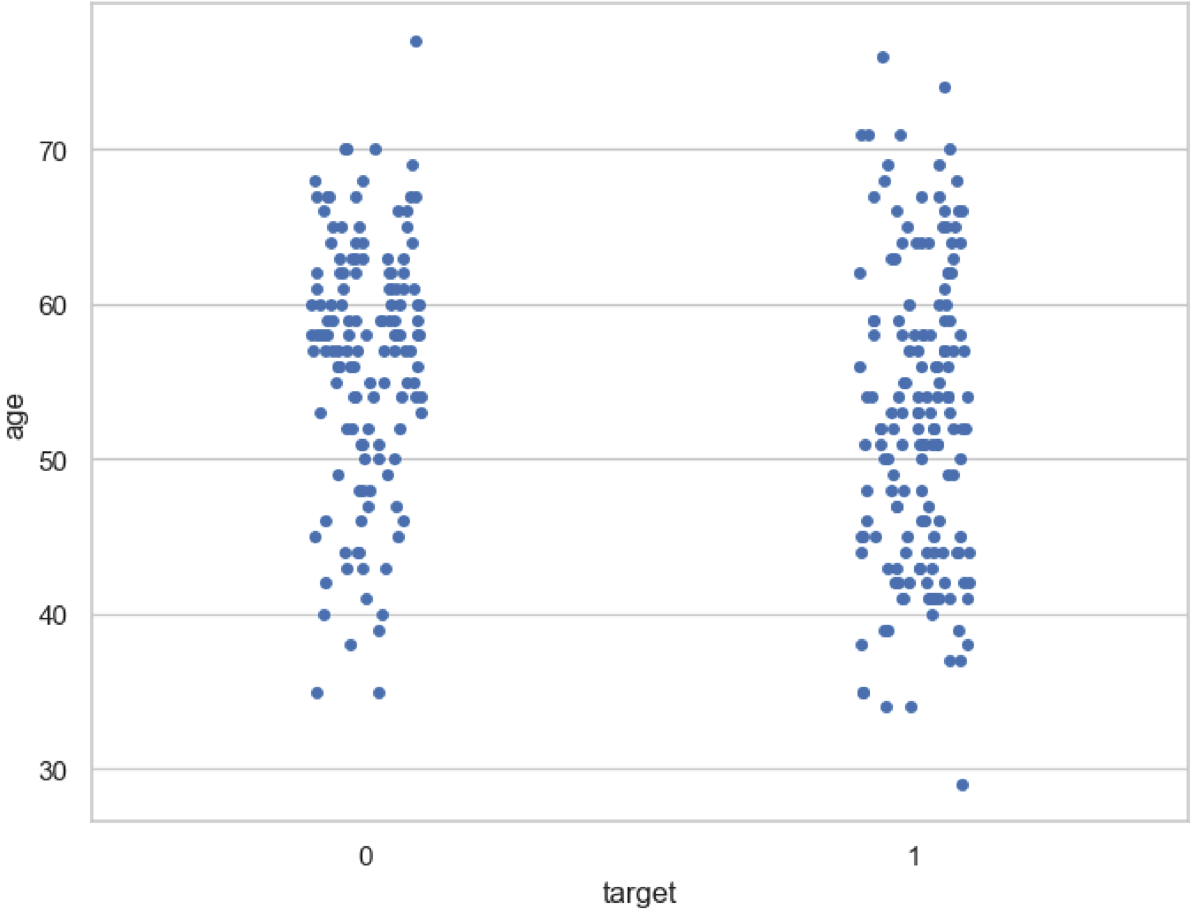
Out[45]:
```
count    303.000000
mean      54.366337
std        9.082101
min       29.000000
25%       47.500000
50%       55.000000
75%       61.000000
max       77.000000
Name: age, dtype: float64
```

In [46]:
```
f, ax = plt.subplots(figsize=(10,6))
x = df['age']
```

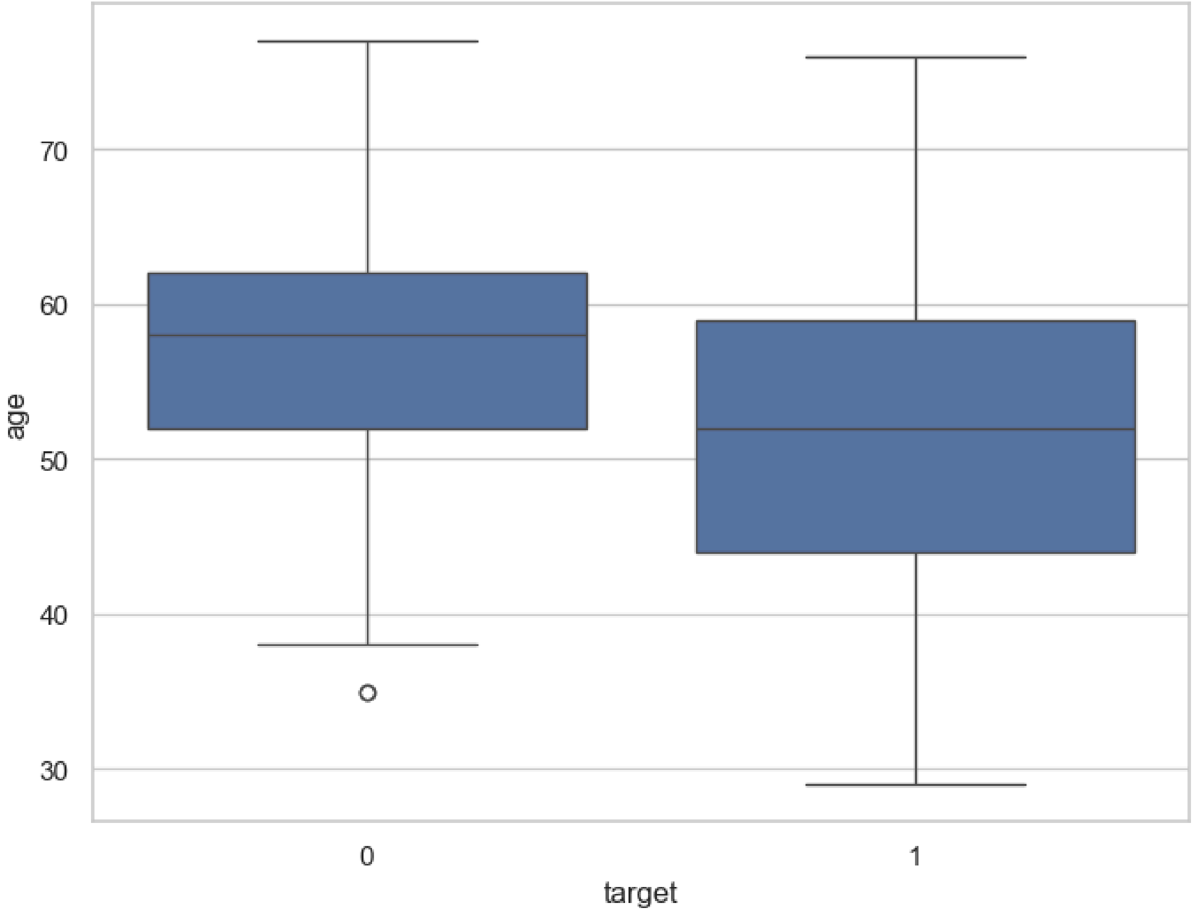
```
ax = sns.distplot(x, bins=10)
plt.show()
```



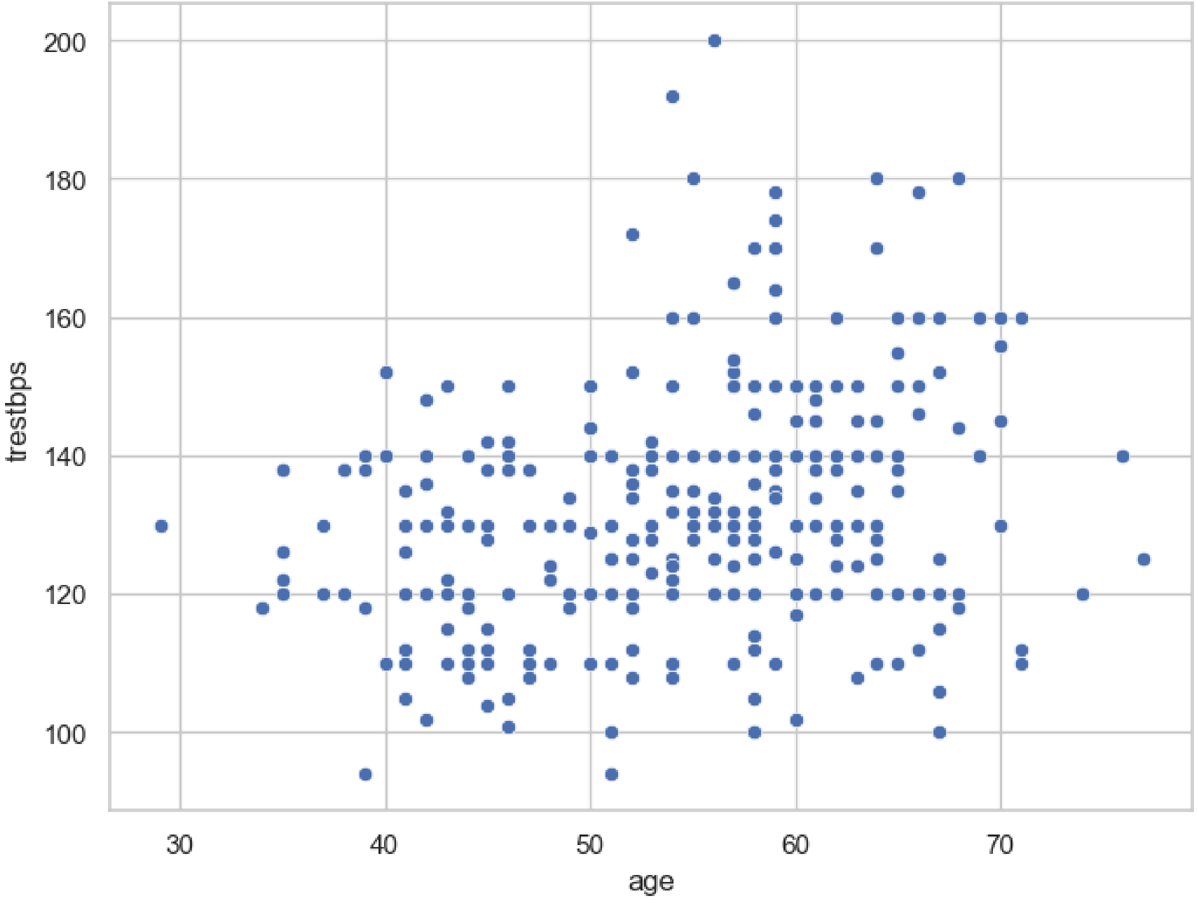
In [47]:
```
f, ax = plt.subplots(figsize=(8, 6))
sns.stripplot(x="target", y="age", data=df)
plt.show()
```



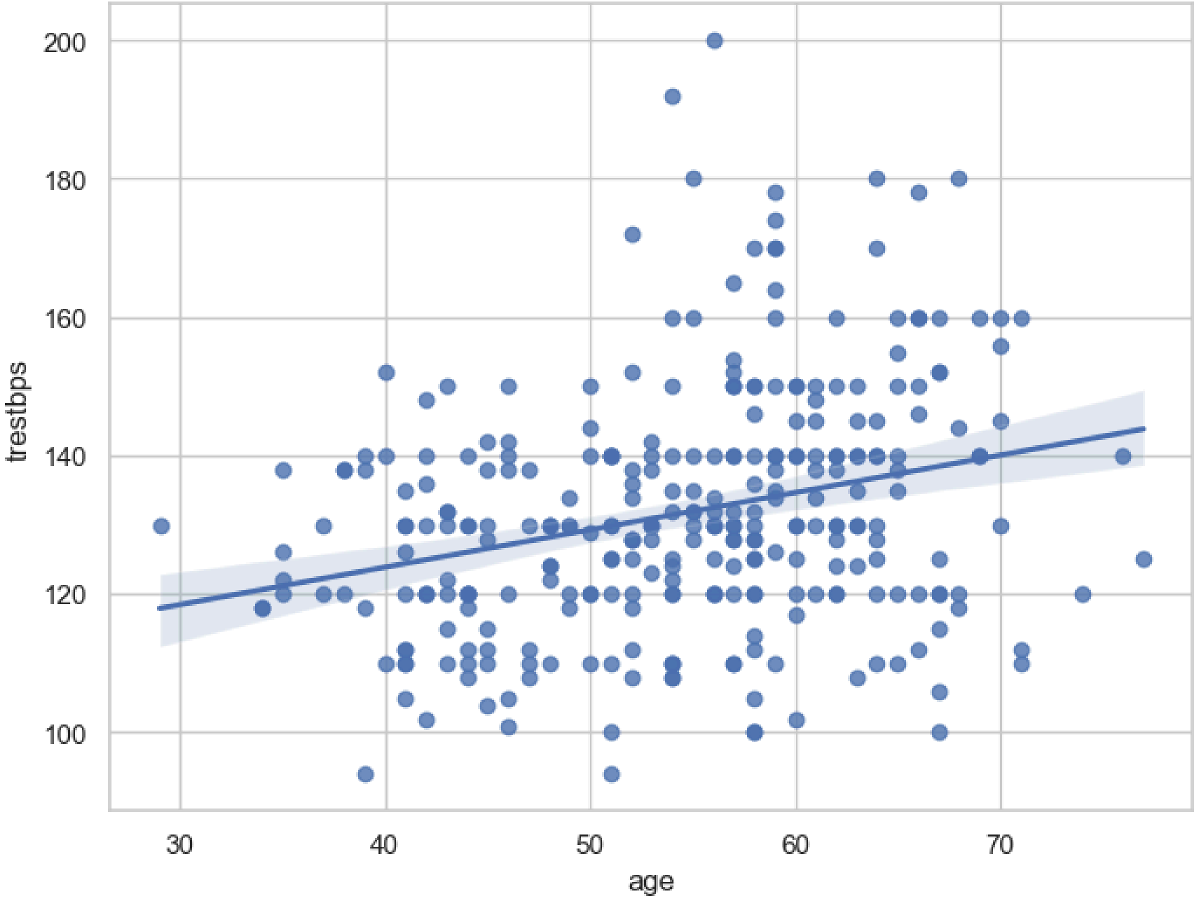
In [48]:
```
f, ax = plt.subplots(figsize=(8, 6))
sns.boxplot(x="target", y="age", data=df)
plt.show()
```



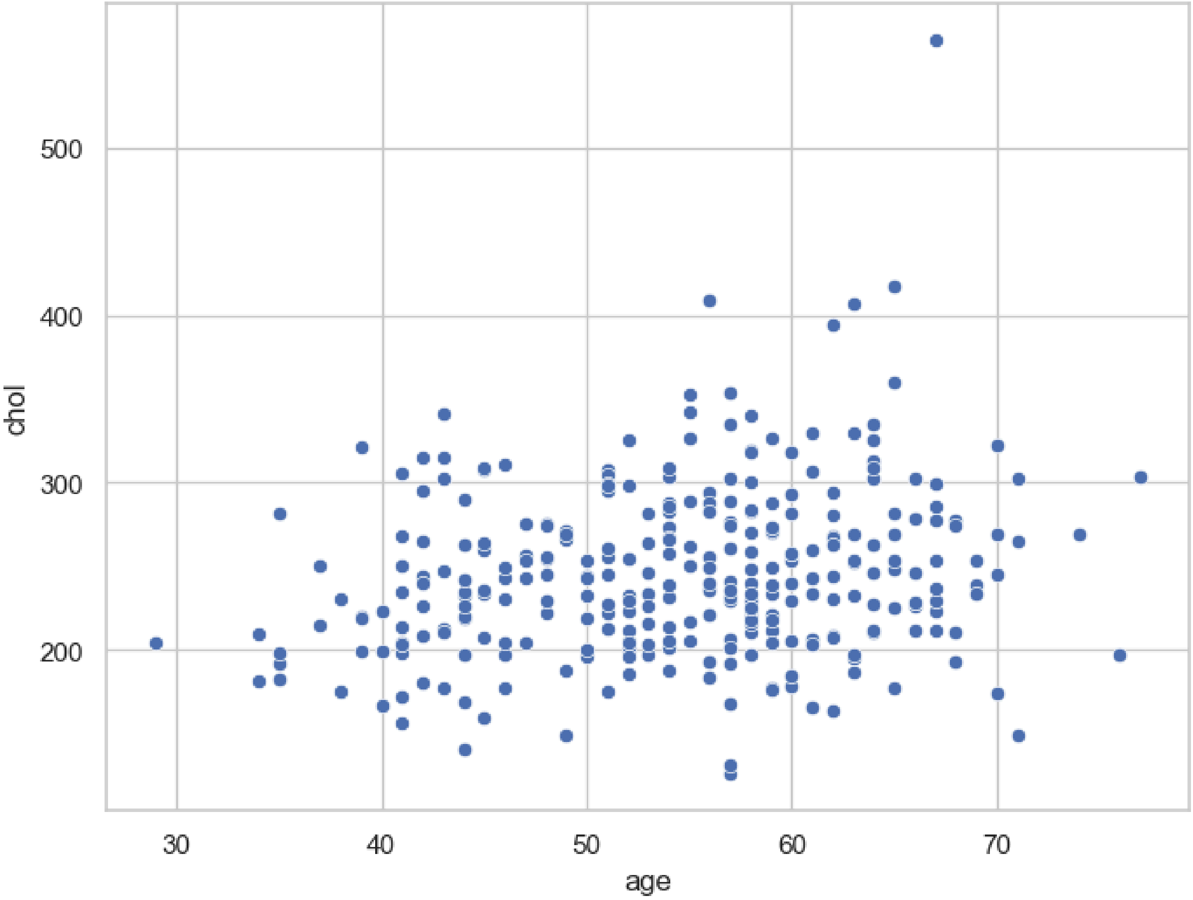
In [49]:
```
f, ax = plt.subplots(figsize=(8, 6))
ax = sns.scatterplot(x="age", y="trestbps", data=df)
plt.show()
```



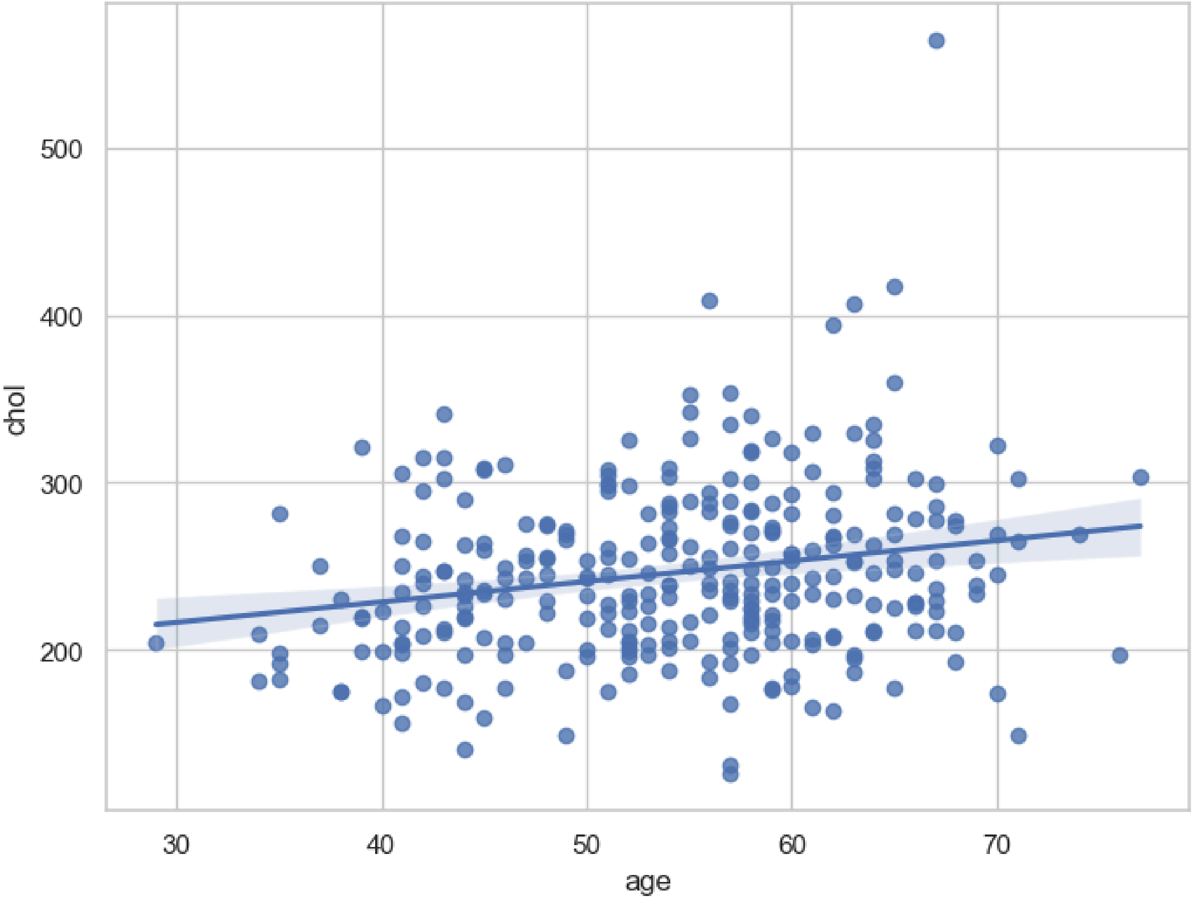
```
In [50]: f, ax = plt.subplots(figsize=(8, 6))
         ax = sns.regplot(x="age", y="trestbps", data=df)
         plt.show()
```



In [51]:
```
f, ax = plt.subplots(figsize=(8, 6))
ax = sns.scatterplot(x="age", y="chol", data=df)
plt.show()
```

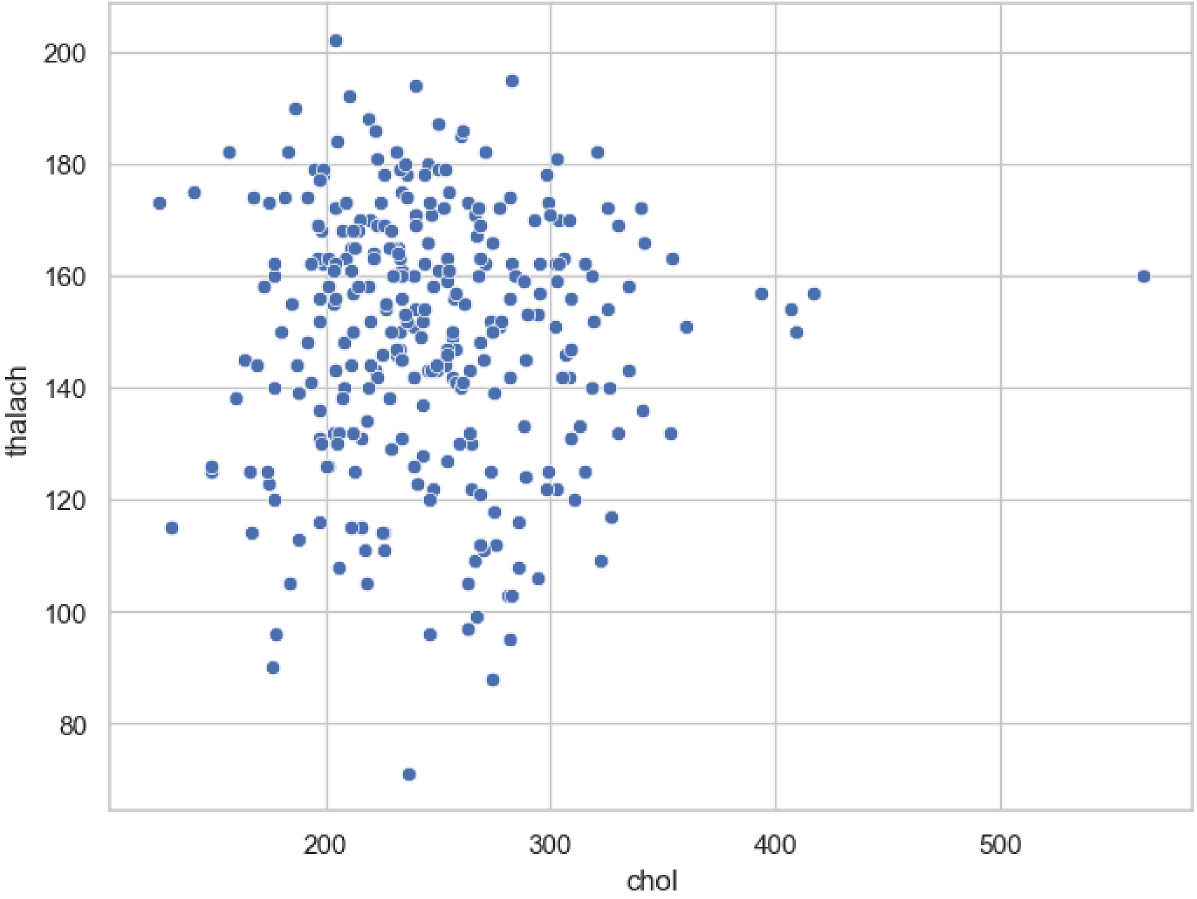


```
In [52]: f, ax = plt.subplots(figsize=(8, 6))
         ax = sns.regplot(x="age", y="chol", data=df)
         plt.show()
```

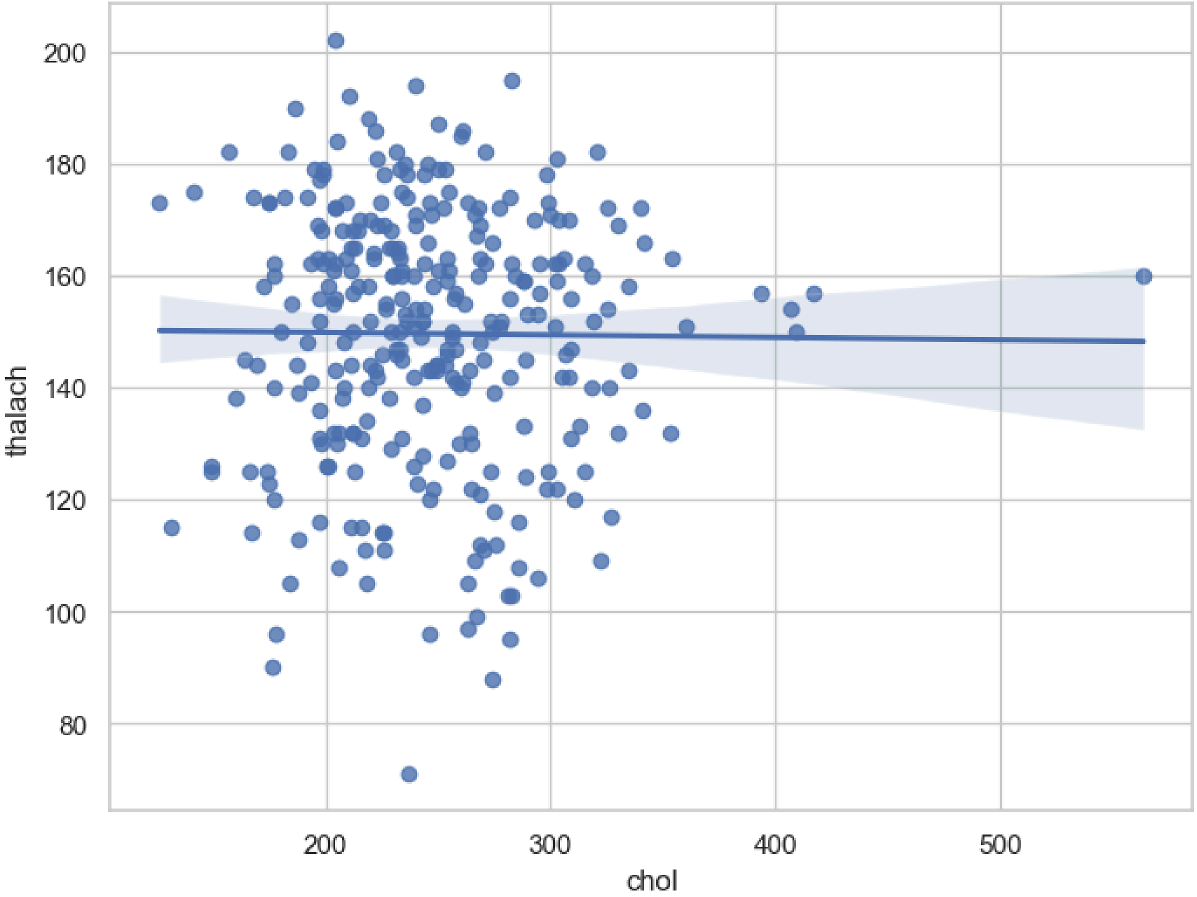


In [53]:

```
f, ax = plt.subplots(figsize=(8, 6))
ax = sns.scatterplot(x="chol", y = "thalach", data=df)
plt.show()
```



In [54]:
```
f, ax = plt.subplots(figsize=(8, 6))
ax = sns.regplot(x="chol", y="thalach", data=df)
plt.show()
```



In [55]:
```
df.isnull().sum()
```

Out[55]:
```
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
target      0
dtype: int64
```

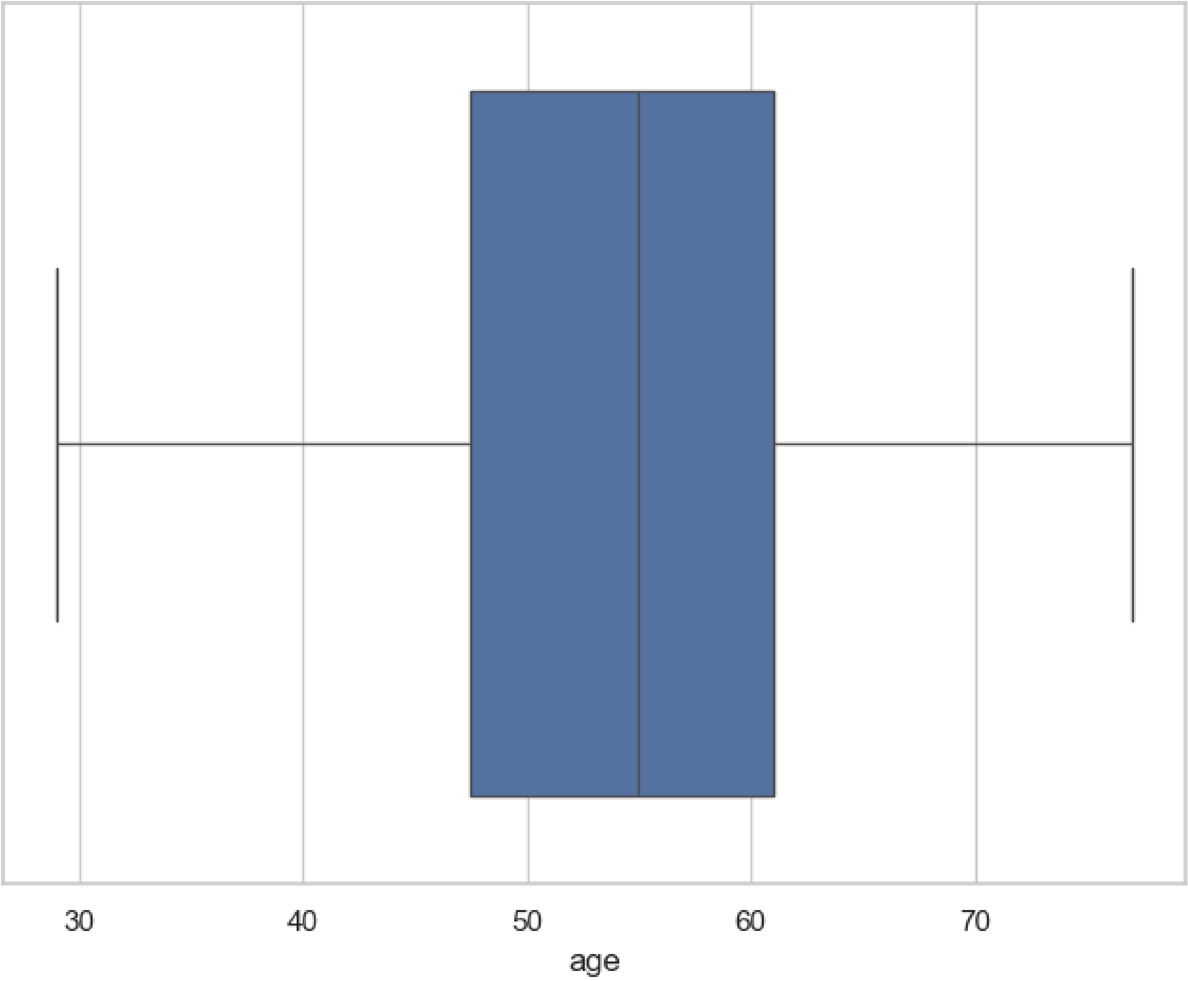
In [56]:
```
assert pd.notnull(df).all().all()
```

In [57]:
```
assert (df >= 0).all().all()
```

In [58]:
```
df['age'].describe()
```

```
Out[58]: count    303.000000
         mean      54.366337
         std        9.082101
         min       29.000000
         25%       47.500000
         50%       55.000000
         75%       61.000000
         max       77.000000
         Name: age, dtype: float64
```

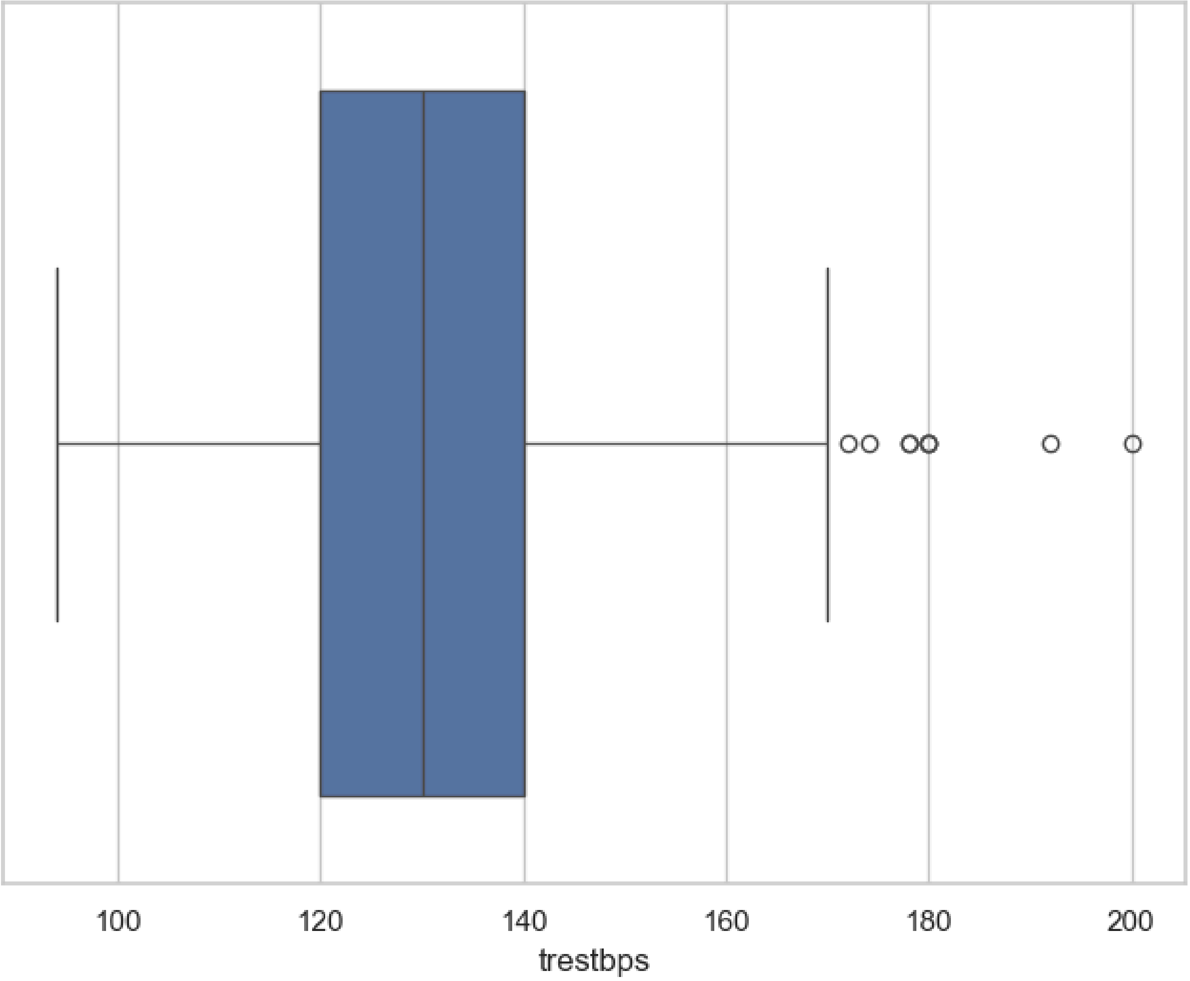
```
In [59]: f, ax = plt.subplots(figsize=(8, 6))
         sns.boxplot(x=df["age"])
         plt.show()
```



```
In [60]: df['trestbps'].describe()
```

```
Out[60]: count    303.000000
         mean     131.623762
         std       17.538143
         min       94.000000
         25%      120.000000
         50%      130.000000
         75%      140.000000
         max      200.000000
         Name: trestbps, dtype: float64
```

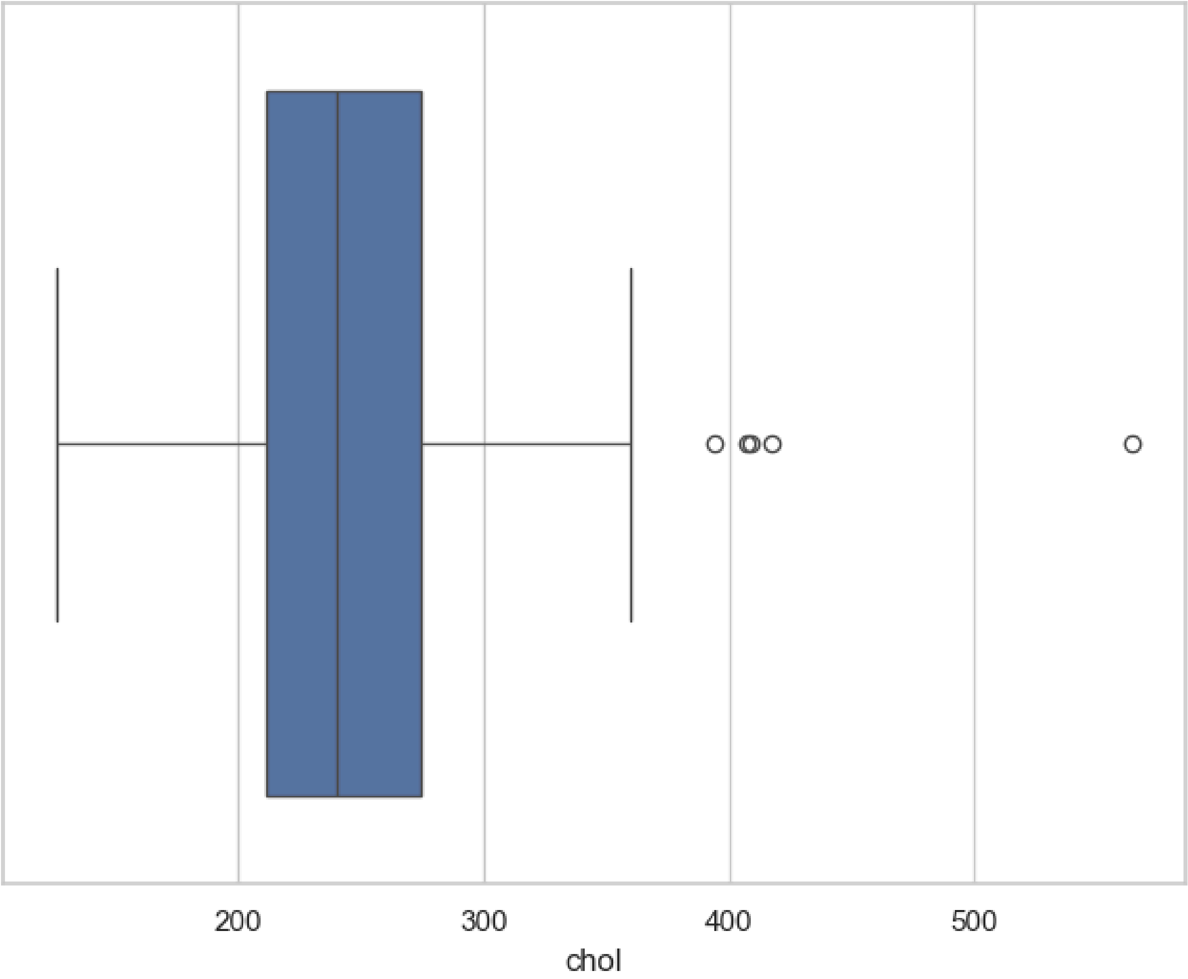
In [61]:
```
f, ax = plt.subplots(figsize=(8, 6))
sns.boxplot(x=df["trestbps"])
plt.show()
```



In [62]:
```
df['chol'].describe()
```

Out[62]:
```
count    303.000000
mean     246.264026
std       51.830751
min      126.000000
25%      211.000000
50%      240.000000
75%      274.500000
max      564.000000
Name: chol, dtype: float64
```

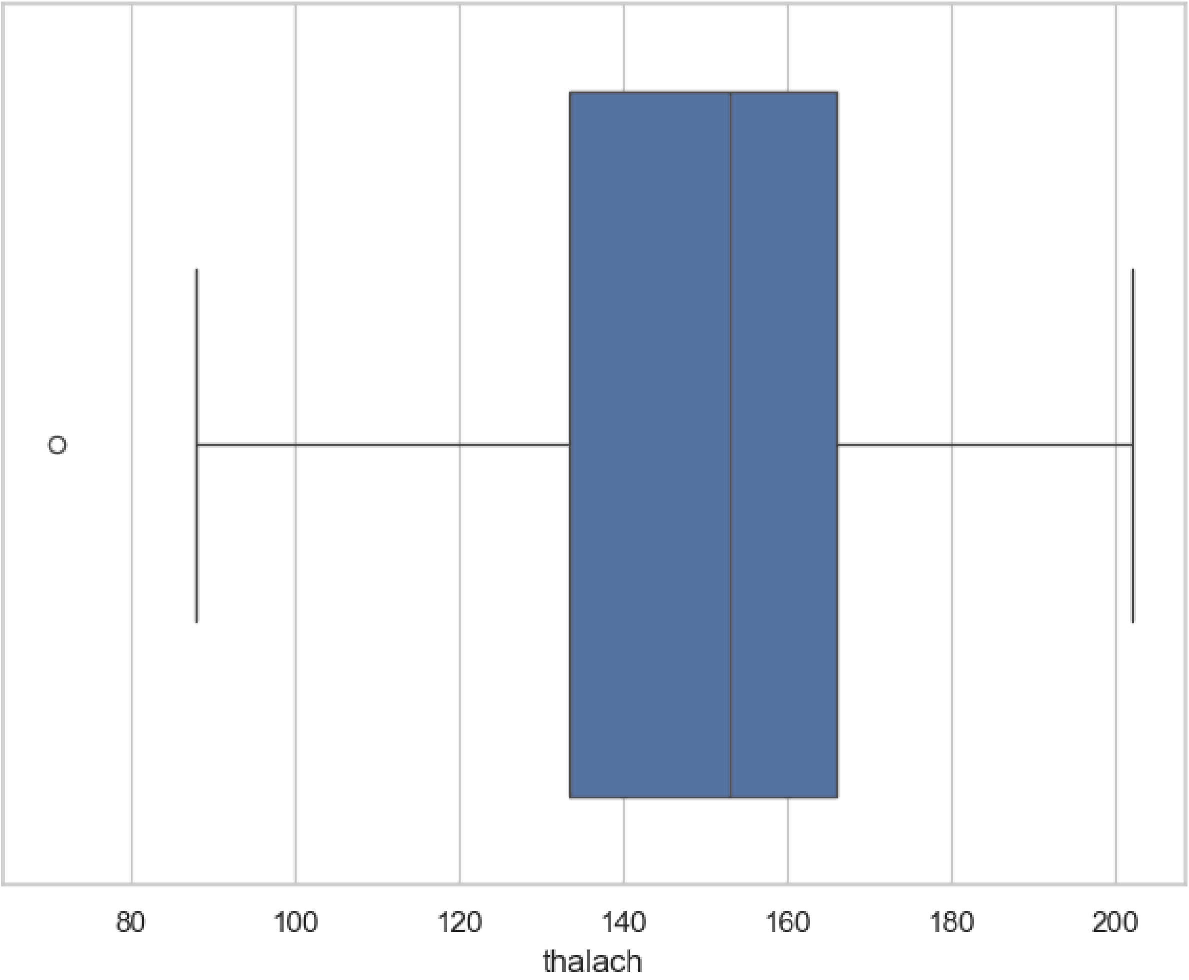
In [63]:
```
f, ax = plt.subplots(figsize=(8, 6))
sns.boxplot(x=df["chol"])
plt.show()
```



In [64]:
```
df['thalach'].describe()
```

Out[64]:
```
count    303.000000
mean     149.646865
std       22.905161
min       71.000000
25%      133.500000
50%      153.000000
75%      166.000000
max      202.000000
Name: thalach, dtype: float64
```

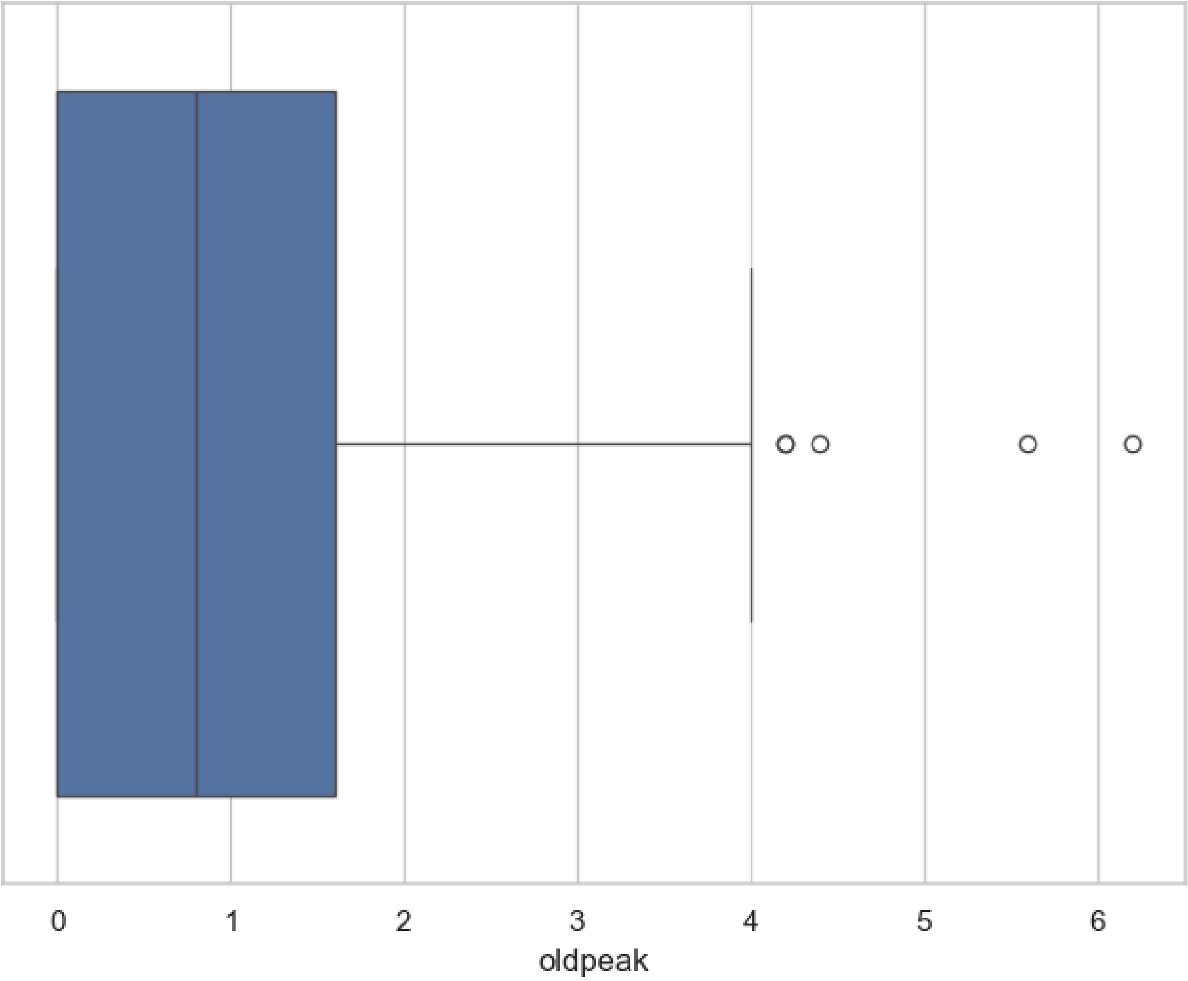
In [65]:
```
f, ax = plt.subplots(figsize=(8, 6))
sns.boxplot(x=df["thalach"])
plt.show()
```



```
In [66]: df['oldpeak'].describe()
```

```
Out[66]: count    303.000000
         mean       1.039604
         std        1.161075
         min        0.000000
         25%        0.000000
         50%        0.800000
         75%        1.600000
         max        6.200000
         Name: oldpeak, dtype: float64
```

```
In [67]: f, ax = plt.subplots(figsize=(8, 6))
         sns.boxplot(x=df["oldpeak"])
         plt.show()
```



```
In [ ]:
```