In [1]:
```
import pandas as pd
health_data = pd.read_csv('healthmonitoring.csv')
print(health_data.head())
```

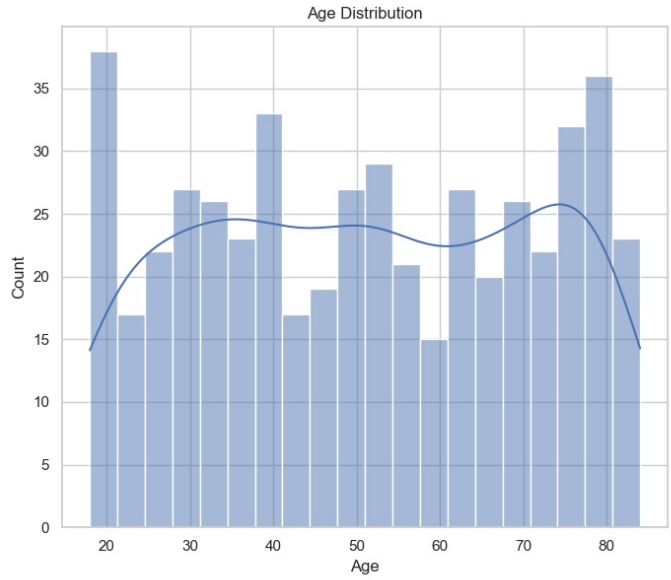
```
   PatientID  Age  Gender  HeartRate BloodPressure  RespiratoryRate  \
0          1   69    Male  60.993428        130/85               15
1          2   32    Male  98.723471        120/80               23
2          3   78  Female  82.295377        130/85               13
3          4   38  Female  80.000000        111/78               19
4          5   41    Male  87.531693        120/80               14

   BodyTemperature ActivityLevel  OxygenSaturation SleepQuality StressLevel  \
0        98.885236       resting              95.0    excellent         low
1        98.281883       walking              97.0         good        high
2        98.820286       resting              98.0         fair        high
3        98.412594       running              98.0         poor    moderate
4        99.369871       resting              98.0         good         low

                  Timestamp
0  2024-04-26 17:28:55.286711
1  2024-04-26 17:23:55.286722
2  2024-04-26 17:18:55.286726
3  2024-04-26 17:13:55.286728
4  2024-04-26 17:08:55.286731
```

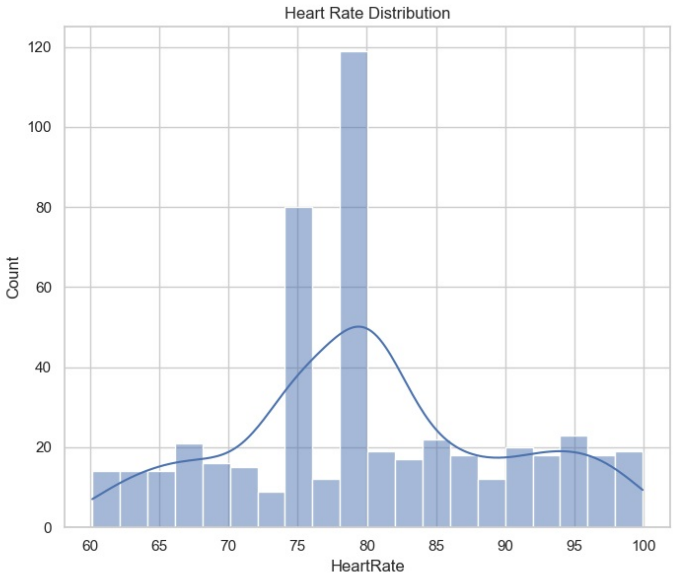
In [2]:
```
health_data.isnull().sum()
```

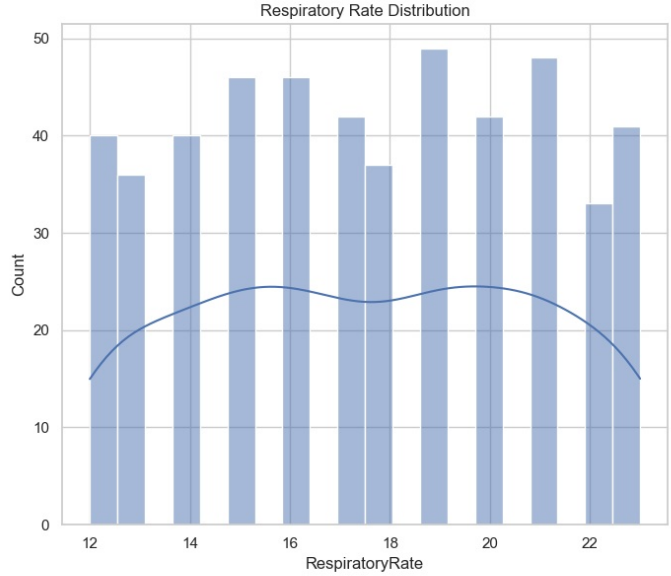
Out[2]:
```
PatientID             0
Age                   0
Gender                0
HeartRate             0
BloodPressure         0
RespiratoryRate       0
BodyTemperature      18
ActivityLevel         0
OxygenSaturation    163
SleepQuality          0
StressLevel           0
Timestamp             0
dtype: int64
```

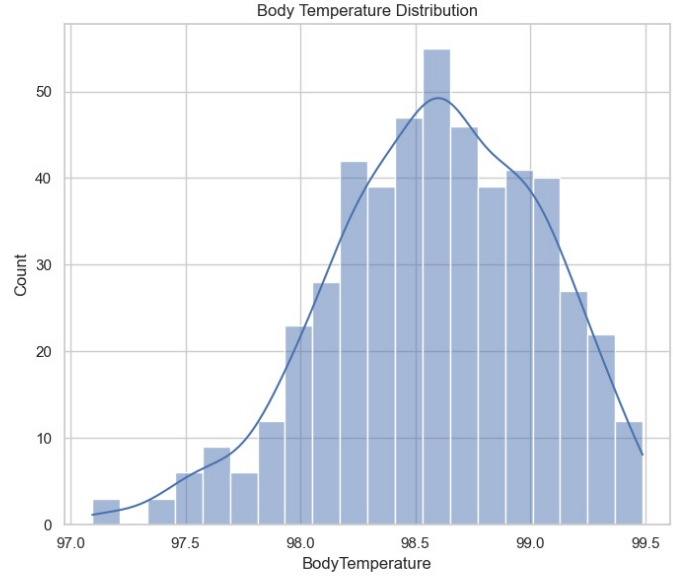
In [3]:
```
# calculate medians
median_body_temp = health_data['BodyTemperature'].median()
median_oxygen_sat = health_data['OxygenSaturation'].median()

# fill missing values
health_data['BodyTemperature'].fillna(median_body_temp, inplace=True)
health_data['OxygenSaturation'].fillna(median_oxygen_sat, inplace=True)
```

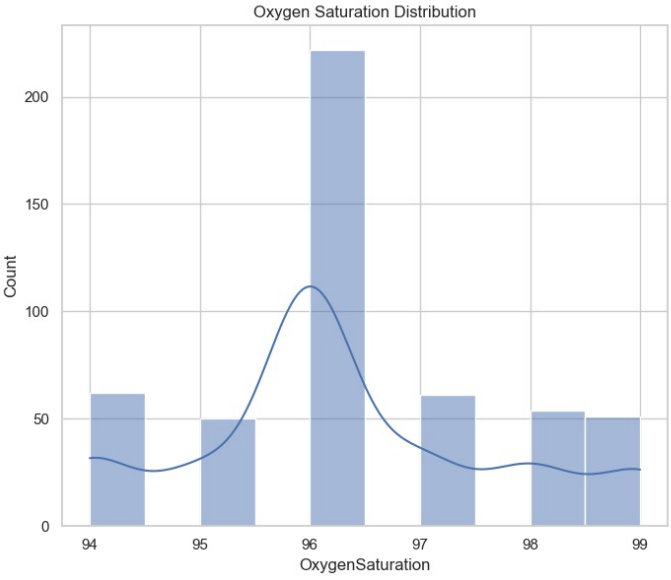
In [4]:
```
import matplotlib.pyplot as plt
import seaborn as sns
sns.set(style="whitegrid")

# summary statistics
summary_stats = health_data.describe()

# plotting distributions of numerical features
fig, axes = plt.subplots(3, 2, figsize=(14, 18))
sns.histplot(health_data['Age'], bins=20, kde=True, ax=axes[0, 0])
axes[0, 0].set_title('Age Distribution')

sns.histplot(health_data['HeartRate'], bins=20, kde=True, ax=axes[0, 1])
axes[0, 1].set_title('Heart Rate Distribution')

sns.histplot(health_data['RespiratoryRate'], bins=20, kde=True, ax=axes[1, 0])
axes[1, 0].set_title('Respiratory Rate Distribution')

sns.histplot(health_data['BodyTemperature'], bins=20, kde=True, ax=axes[1, 1])
axes[1, 1].set_title('Body Temperature Distribution')

sns.histplot(health_data['OxygenSaturation'], bins=10, kde=True, ax=axes[2, 0])
axes[2, 0].set_title('Oxygen Saturation Distribution')

fig.delaxes(axes[2,1])  # remove unused subplot

plt.tight_layout()
plt.show()
```







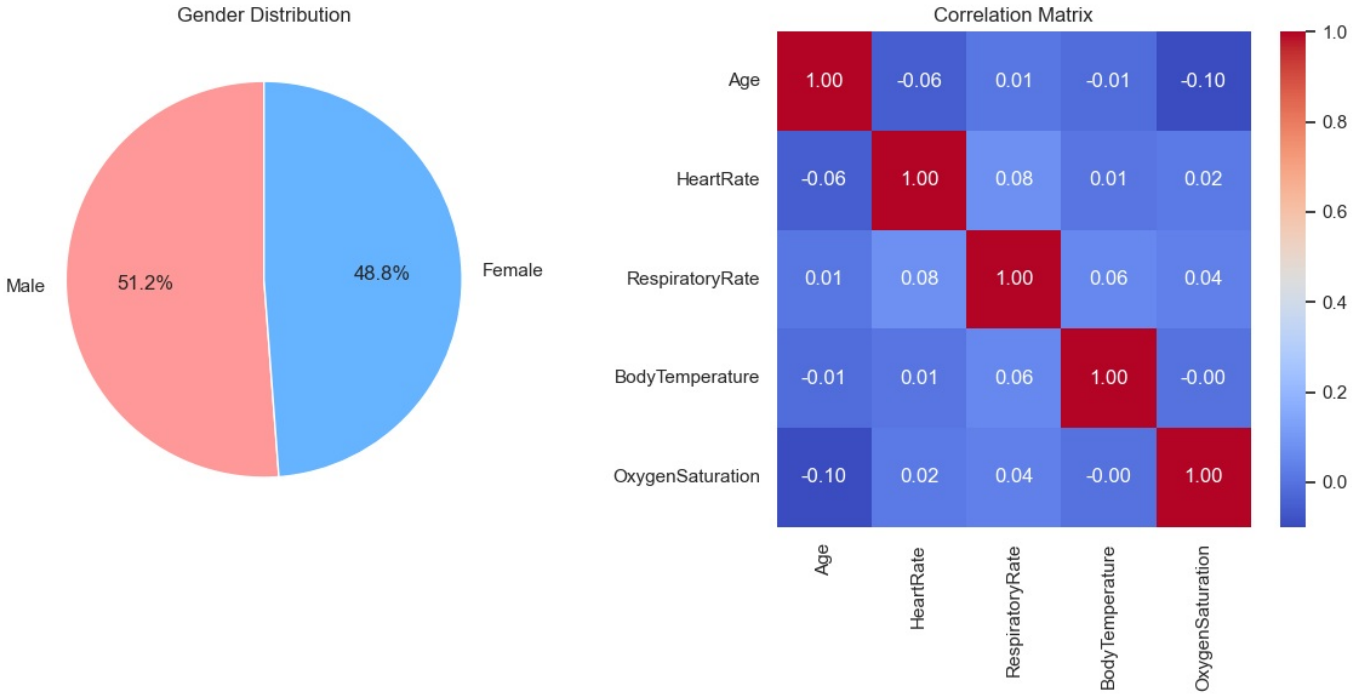




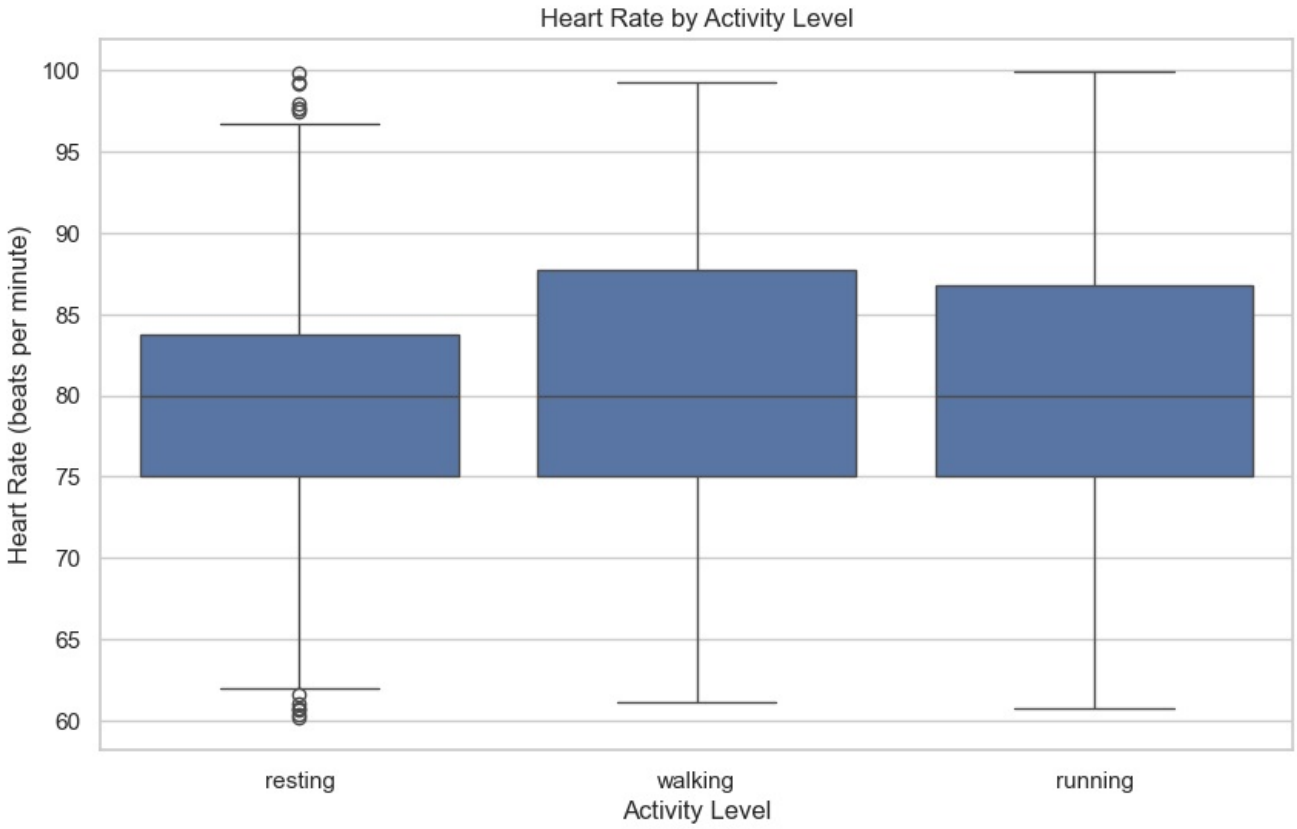
In [5]:
```
print(summary_stats)
```

```
       PatientID         Age   HeartRate  RespiratoryRate  BodyTemperature  \
count  500.000000  500.000000  500.000000       500.000000       500.000000
mean   250.500000   51.146000   80.131613        17.524000        98.584383
std    144.481833   19.821566    9.606273         3.382352         0.461502
min      1.000000   18.000000   60.169259        12.000000        97.094895
25%    125.750000   34.000000   75.000000        15.000000        98.281793
50%    250.500000   51.000000   80.000000        17.500000        98.609167
75%    375.250000   69.000000   86.276413        20.000000        98.930497
max    500.000000   84.000000   99.925508        23.000000        99.489150

       OxygenSaturation
count        500.000000
mean          96.296000
std            1.408671
min           94.000000
25%           96.000000
50%           96.000000
75%           97.000000
max           99.000000
```

In [6]:
```
# gender Distribution
gender_counts = health_data['Gender'].value_counts()

# correlation Matrix for numerical health metrics
correlation_matrix = health_data[['Age', 'HeartRate', 'RespiratoryRate', 'BodyTemperature', 'OxygenSaturation']]

# plotting the findings
fig, axes = plt.subplots(1, 2, figsize=(12, 6))

# gender distribution plot
gender_counts.plot(kind='pie', ax=axes[0], autopct='%1.1f%%', startangle=90, colors=['#ff9999','#66b3ff'])
axes[0].set_ylabel('')
axes[0].set_title('Gender Distribution')

# correlation matrix plot
sns.heatmap(correlation_matrix, annot=True, fmt=".2f", cmap='coolwarm', ax=axes[1])
axes[1].set_title('Correlation Matrix')

plt.tight_layout()
plt.show()
```

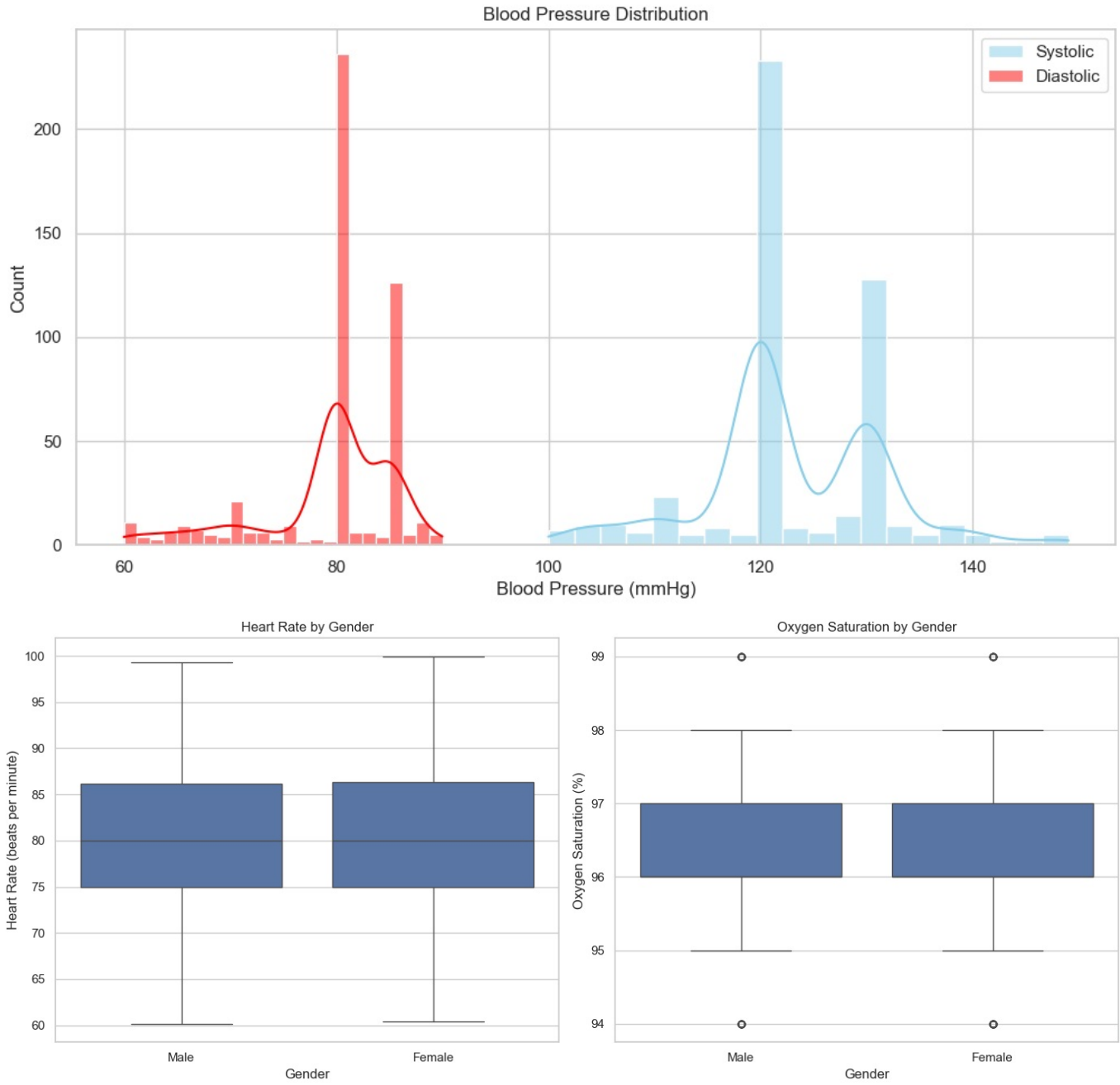


In [7]:
```
# heart Rate by activity level
plt.figure(figsize=(10, 6))
sns.boxplot(x='ActivityLevel', y='HeartRate', data=health_data)
plt.title('Heart Rate by Activity Level')
plt.ylabel('Heart Rate (beats per minute)')
plt.xlabel('Activity Level')
plt.show()
```



In [8]:

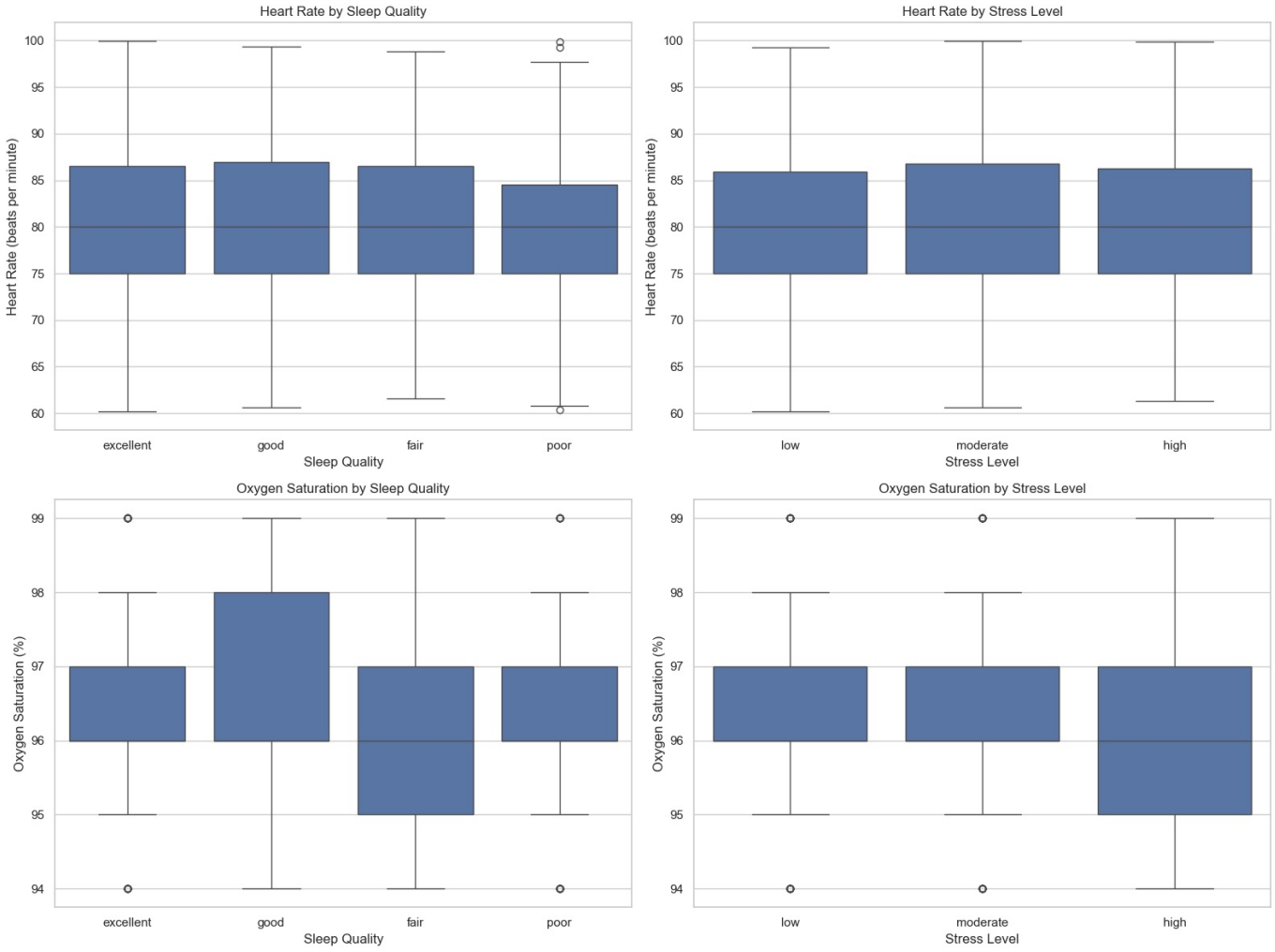
```
# extracting systolic and diastolic blood pressure for analysis
health_data[['SystolicBP', 'DiastolicBP']] = health_data['BloodPressure'].str.split('/', expand=True).astype(in

# blood pressure distribution
plt.figure(figsize=(12, 6))
sns.histplot(health_data['SystolicBP'], color="skyblue", label="Systolic", kde=True)
sns.histplot(health_data['DiastolicBP'], color="red", label="Diastolic", kde=True)
plt.title('Blood Pressure Distribution')
plt.xlabel('Blood Pressure (mmHg)')
plt.legend()
plt.show()

# health metrics by gender
fig, axes = plt.subplots(1, 2, figsize=(14, 6))
sns.boxplot(x='Gender', y='HeartRate', data=health_data, ax=axes[0])
axes[0].set_title('Heart Rate by Gender')
axes[0].set_xlabel('Gender')
axes[0].set_ylabel('Heart Rate (beats per minute)')

sns.boxplot(x='Gender', y='OxygenSaturation', data=health_data, ax=axes[1])
axes[1].set_title('Oxygen Saturation by Gender')
axes[1].set_xlabel('Gender')
axes[1].set_ylabel('Oxygen Saturation (%)')

plt.tight_layout()
plt.show()
```



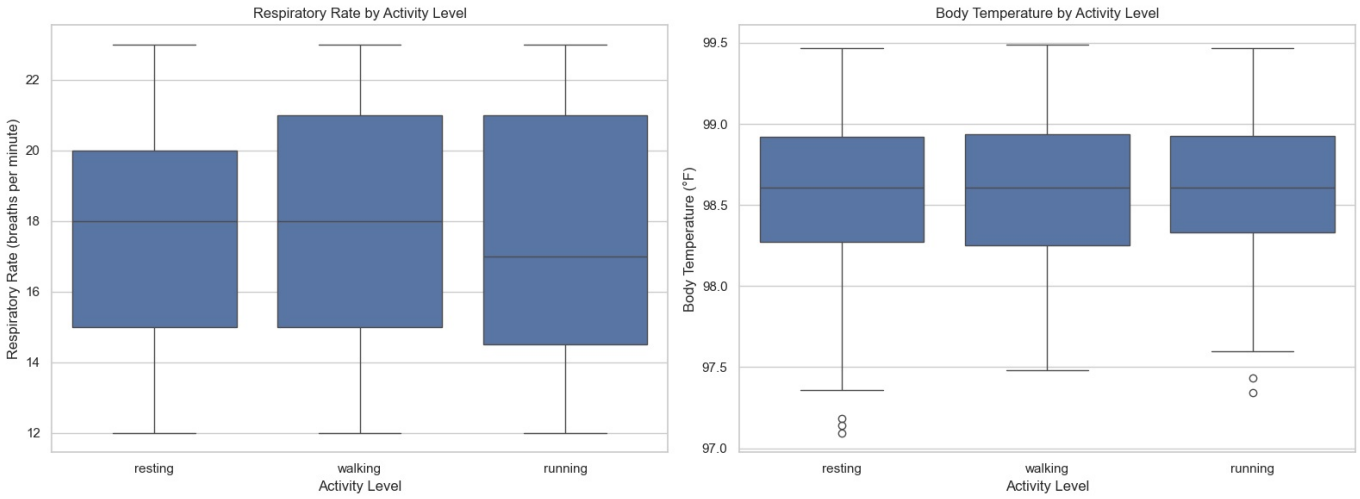
In [9]:

```
# categorizing sleep quality and stress level for better analysis
sleep_quality_order = ['excellent', 'good', 'fair', 'poor']
stress_level_order = ['low', 'moderate', 'high']

# creating plots to examine relationships
fig, axes = plt.subplots(2, 2, figsize=(16, 12))

# heart rate by sleep quality
sns.boxplot(x='SleepQuality', y='HeartRate', data=health_data, order=sleep_quality_order, ax=axes[0, 0])
axes[0, 0].set_title('Heart Rate by Sleep Quality')
axes[0, 0].set_xlabel('Sleep Quality')
axes[0, 0].set_ylabel('Heart Rate (beats per minute)')

# heart rate by stress level
sns.boxplot(x='StressLevel', y='HeartRate', data=health_data, order=stress_level_order, ax=axes[0, 1])
axes[0, 1].set_title('Heart Rate by Stress Level')
axes[0, 1].set_xlabel('Stress Level')
axes[0, 1].set_ylabel('Heart Rate (beats per minute)')

# oxygen saturation by sleep quality
sns.boxplot(x='SleepQuality', y='OxygenSaturation', data=health_data, order=sleep_quality_order, ax=axes[1, 0])
axes[1, 0].set_title('Oxygen Saturation by Sleep Quality')
axes[1, 0].set_xlabel('Sleep Quality')
axes[1, 0].set_ylabel('Oxygen Saturation (%)')

# oxygen saturation by stress level
sns.boxplot(x='StressLevel', y='OxygenSaturation', data=health_data, order=stress_level_order, ax=axes[1, 1])
axes[1, 1].set_title('Oxygen Saturation by Stress Level')
axes[1, 1].set_xlabel('Stress Level')
axes[1, 1].set_ylabel('Oxygen Saturation (%)')

plt.tight_layout()
```

```
plt.show()
```



In [10]:
```
# creating plots to examine relationships between activity level and other health metrics
fig, axes = plt.subplots(1, 2, figsize=(16, 6))

# respiratory rate by activity level
sns.boxplot(x='ActivityLevel', y='RespiratoryRate', data=health_data, ax=axes[0])
axes[0].set_title('Respiratory Rate by Activity Level')
axes[0].set_xlabel('Activity Level')
axes[0].set_ylabel('Respiratory Rate (breaths per minute)')

# body temperature by activity level
sns.boxplot(x='ActivityLevel', y='BodyTemperature', data=health_data, ax=axes[1])
axes[1].set_title('Body Temperature by Activity Level')
axes[1].set_xlabel('Activity Level')
axes[1].set_ylabel('Body Temperature (°F)')

plt.tight_layout()
plt.show()
```



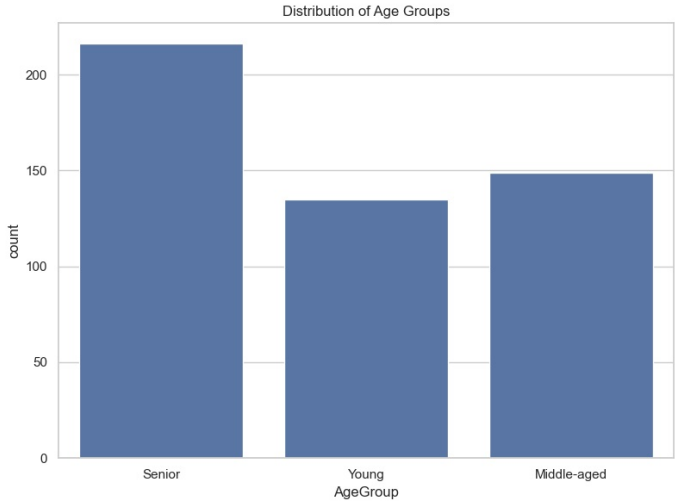
In [11]:
```
# function to categorize Age
def age_group(age):
    if age <= 35:
        return 'Young'
```

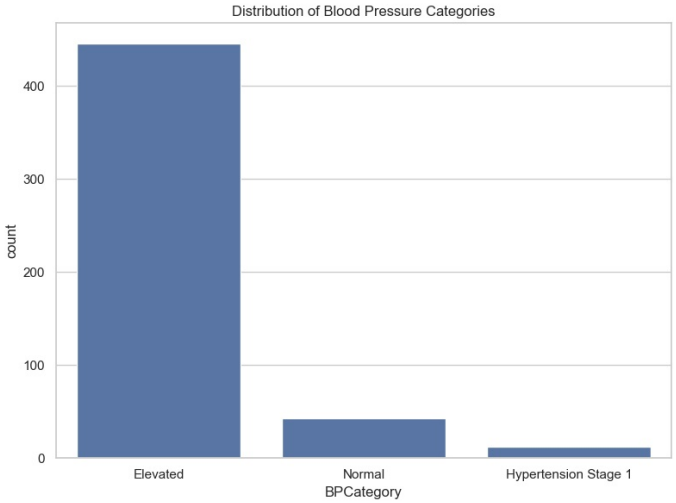
```
    elif age <= 55:
        return 'Middle-aged'
    else:
        return 'Senior'

# function to categorize Blood Pressure
def bp_category(systolic, diastolic):
    if systolic < 120 and diastolic < 80:
        return 'Normal'
    elif 120 <= systolic < 140 or 80 <= diastolic < 90:
        return 'Elevated'
    elif 140 <= systolic < 160 or 90 <= diastolic < 100:
        return 'Hypertension Stage 1'
    else:
        return 'Hypertension Stage 2'

# function to categorize Heart Rate
def hr_category(hr):
    if hr < 60:
        return 'Low'
    elif hr <= 100:
        return 'Normal'
    else:
        return 'High'

# function to categorize Oxygen Saturation
def oxy_category(oxy):
    if oxy < 94:
        return 'Low'
    else:
        return 'Normal'

# applying categorizations
health_data['AgeGroup'] = health_data['Age'].apply(age_group)
health_data['BPCategory'] = health_data.apply(lambda x: bp_category(x['SystolicBP'], x['DiastolicBP']), axis=1)
health_data['HRCategory'] = health_data['HeartRate'].apply(hr_category)
health_data['OxyCategory'] = health_data['OxygenSaturation'].apply(oxy_category)

print(health_data[['Age', 'AgeGroup', 'SystolicBP', 'DiastolicBP', 'BPCategory', 'HeartRate', 'HRCategory', 'Oxy
```

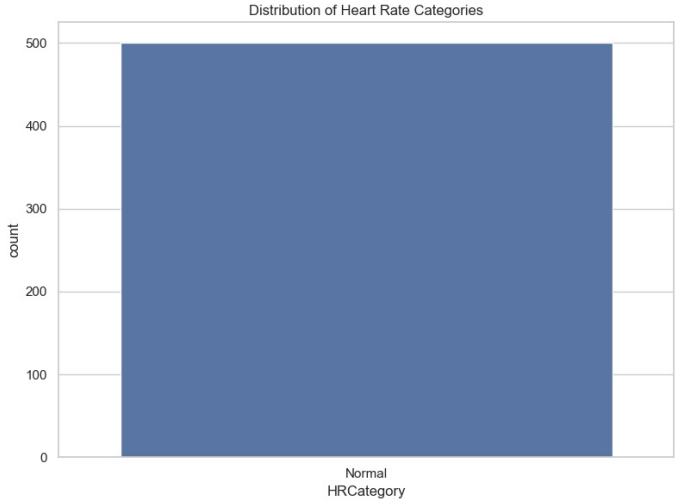
```
   Age     AgeGroup  SystolicBP  DiastolicBP BPCategory  HeartRate HRCategory  \
0   69       Senior         130           85   Elevated  60.993428     Normal
1   32        Young         120           80   Elevated  98.723471     Normal
2   78       Senior         130           85   Elevated  82.295377     Normal
3   38  Middle-aged         111           78     Normal  80.000000     Normal
4   41  Middle-aged         120           80   Elevated  87.531693     Normal

   OxygenSaturation OxyCategory
0              95.0      Normal
1              97.0      Normal
2              98.0      Normal
3              98.0      Normal
4              98.0      Normal
```

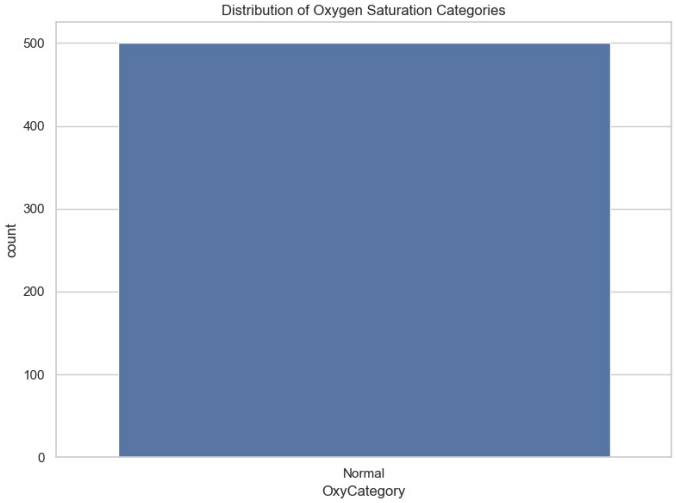
In [12]:

```
fig, axes = plt.subplots(2, 2, figsize=(16, 12))

# Age Group count plot
sns.countplot(x='AgeGroup', data=health_data, ax=axes[0, 0])
axes[0, 0].set_title('Distribution of Age Groups')

# Blood Pressure Category count plot
sns.countplot(x='BPCategory', data=health_data, ax=axes[0, 1])
axes[0, 1].set_title('Distribution of Blood Pressure Categories')

# Heart Rate Category count plot
sns.countplot(x='HRCategory', data=health_data, ax=axes[1, 0])
axes[1, 0].set_title('Distribution of Heart Rate Categories')

# Oxygen Saturation Category count plot
sns.countplot(x='OxyCategory', data=health_data, ax=axes[1, 1])
axes[1, 1].set_title('Distribution of Oxygen Saturation Categories')

# Show the plots
plt.tight_layout()
plt.show()
```









In [ ]: