Predicting a Child's IQ from Their Mother's Features Using Machine Learning Algorithms

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
import warnings
warnings.filterwarnings('ignore')
```

In [3]:
```
df1 = pd.read_csv('kid_iq.csv')
df2 = pd.read_csv('child_iq.csv')
```

In [4]:
```
df1
```

Out[4]:

	Unnamed: 0	kid_score	mom_hs	mom_iq	mom_work	mom_age
0	1	65	1	121.117529	4	27
1	2	98	1	89.361882	4	25
2	3	85	1	115.443165	4	27
3	4	83	1	99.449639	3	25
4	5	115	1	92.745710	4	27
...	...	...	...	...	...	...
429	430	94	0	84.877412	4	21
430	431	76	1	92.990392	4	23
431	432	50	0	94.859708	2	24
432	433	88	1	96.856624	2	21
433	434	70	1	91.253336	2	25

434 rows × 6 columns

In [5]:
```
df2
```

Out[5]:

	Unnamed: 0	ppvt	educ_cat	momage
0	1	120	2	21
1	2	89	1	17
2	3	78	2	19
3	4	42	1	20
4	5	115	4	26
...	...	...	...	...
395	396	87	3	21
396	397	69	2	20
397	398	80	1	25
398	399	98	1	18
399	400	81	2	22

400 rows × 4 columns

In [6]:
```
df1 = df1.drop('Unnamed: 0', axis = 1)
df2 = df2.drop('Unnamed: 0', axis = 1)
```

In [7]:
```
df1.shape
```

Out[7]:
```
(434, 5)
```

In [8]:
```
df2.shape
```

Out[8]:
```
(400, 3)
```

In [9]:
```
df1.columns
```

Out[9]:
```
Index(['kid_score', 'mom_hs', 'mom_iq', 'mom_work', 'mom_age'], dtype='object')
```

In [10]:
```
df2.columns
```

Out[10]:
```
Index(['ppvt', 'educ_cat', 'momage'], dtype='object')
```

In [11]:
```
df1.duplicated().sum()
```

Out[11]:
```
1
```

In [12]:
```
df1 = df1.drop_duplicates()
```

In [13]:
```
df2.duplicated().sum()
```

Out[13]:
```
50
```

In [14]:
```
df2 = df2.drop_duplicates()
```

In [15]:
```
df1.isnull().sum()
```

Out[15]:
```
kid_score    0
mom_hs       0
mom_iq       0
mom_work     0
mom_age      0
dtype: int64
```

In [16]:
```
df2.isnull().sum()
```

Out[16]:
```
ppvt        0
educ_cat    0
momage      0
dtype: int64
```

In [17]:
```
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 433 entries, 0 to 433
Data columns (total 5 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   kid_score  433 non-null    int64
 1   mom_hs     433 non-null    int64
 2   mom_iq     433 non-null    float64
 3   mom_work   433 non-null    int64
 4   mom_age    433 non-null    int64
dtypes: float64(1), int64(4)
memory usage: 20.3 KB
```

In [18]:
```
df2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 350 entries, 0 to 399
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   ppvt      350 non-null    int64
 1   educ_cat  350 non-null    int64
 2   momage    350 non-null    int64
dtypes: int64(3)
memory usage: 10.9 KB
```

In [19]:
```
df1.describe()
```

Out[19]:

	kid_score	mom_hs	mom_iq	mom_work	mom_age
count	433.000000	433.000000	433.000000	433.000000	433.000000
mean	86.757506	0.785219	99.943384	2.893764	22.785219
std	20.417491	0.411145	14.970855	1.181565	2.704174
min	20.000000	0.000000	71.037405	1.000000	17.000000
25%	74.000000	1.000000	88.660321	2.000000	21.000000
50%	90.000000	1.000000	97.915254	3.000000	23.000000
75%	102.000000	1.000000	110.096806	4.000000	25.000000
max	144.000000	1.000000	138.893106	4.000000	29.000000

In [20]:
```
df2.describe()
```

Out[20]:

	ppvt	educ_cat	momage
count	350.000000	350.000000	350.000000
mean	86.351429	2.128571	22.802857
std	21.127243	0.855145	2.756289
min	20.000000	1.000000	17.000000
25%	73.000000	2.000000	21.000000
50%	89.000000	2.000000	23.000000
75%	102.000000	3.000000	25.000000
max	144.000000	4.000000	29.000000

In [21]:
```
df1.nunique()
```

Out[21]:
```
kid_score     85
mom_hs         2
mom_iq       332
mom_work       4
mom_age       13
dtype: int64
```

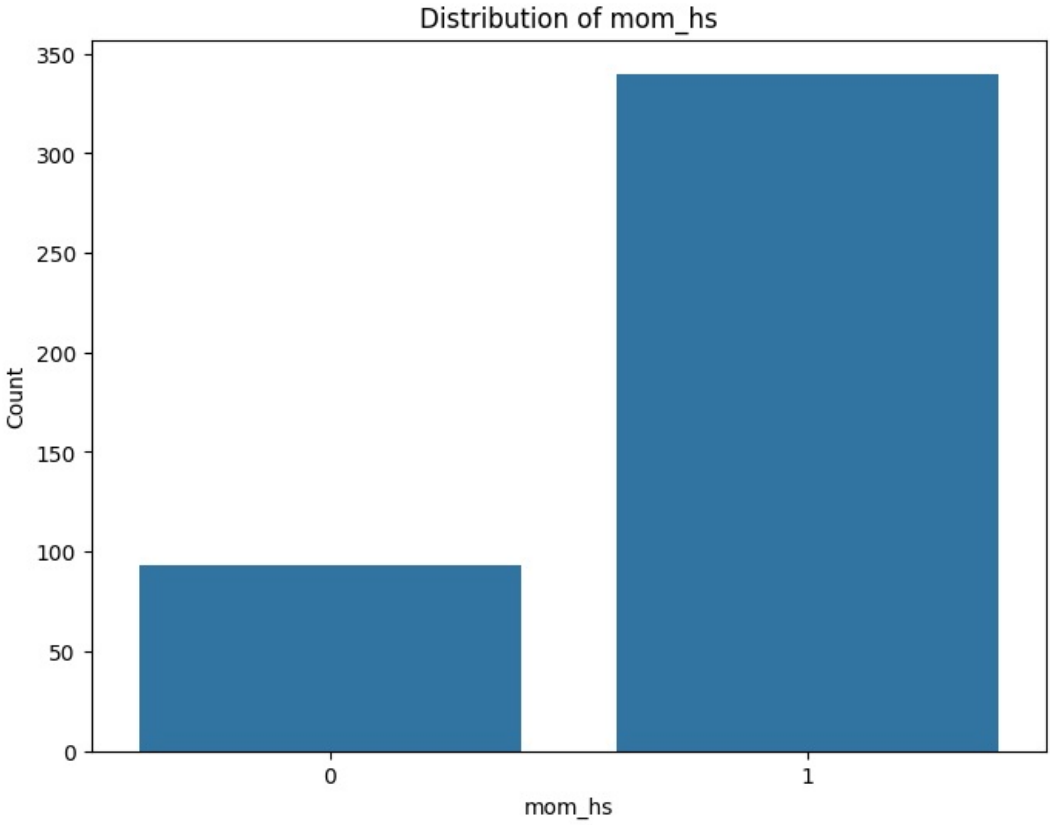
In [22]:
```
df2.nunique()
```

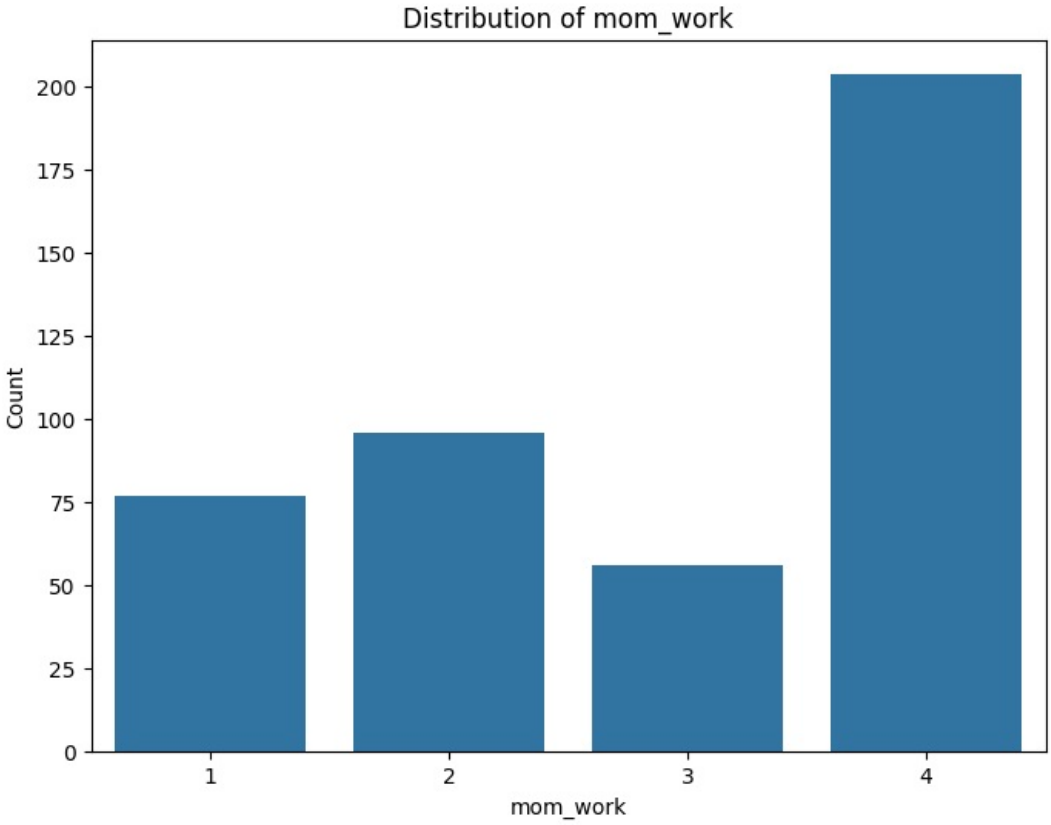
Out[22]:
```
ppvt        84
educ_cat     4
momage      13
dtype: int64
```

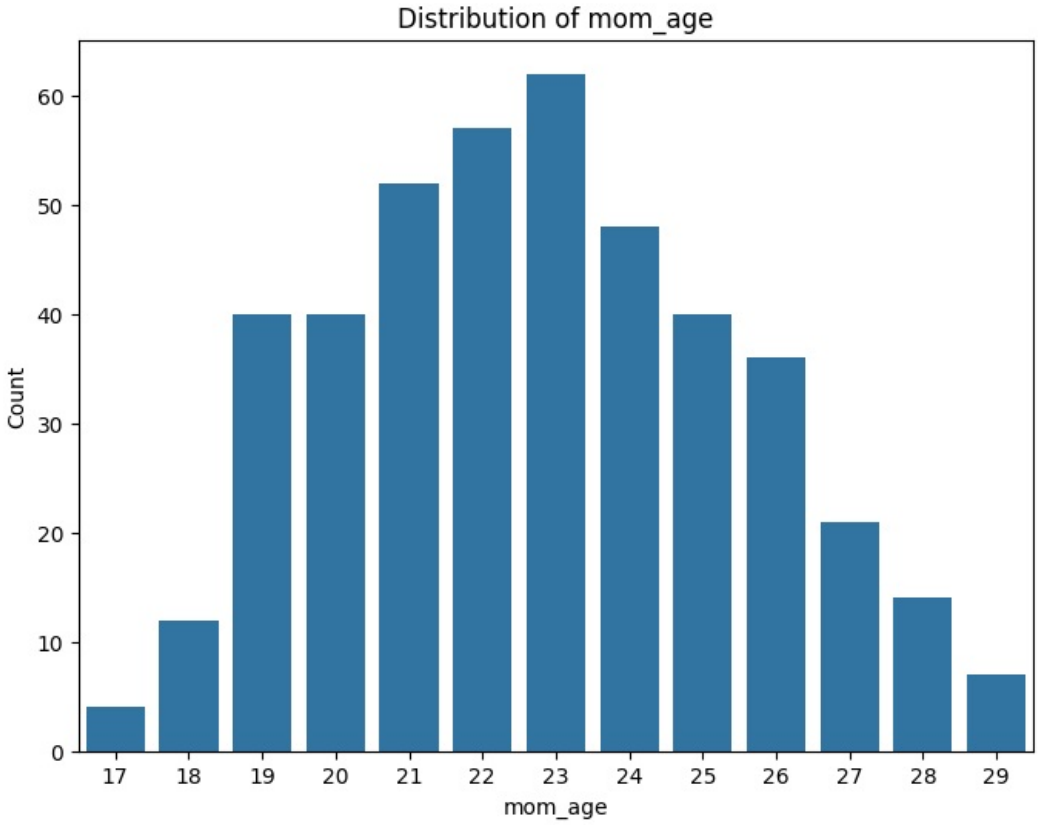
In [23]:
```
discrete_vars = []
continuous_vars = []

for column in df1.columns:
    unique_values = df1[column].nunique()
    total_values = df1.shape[0]
```

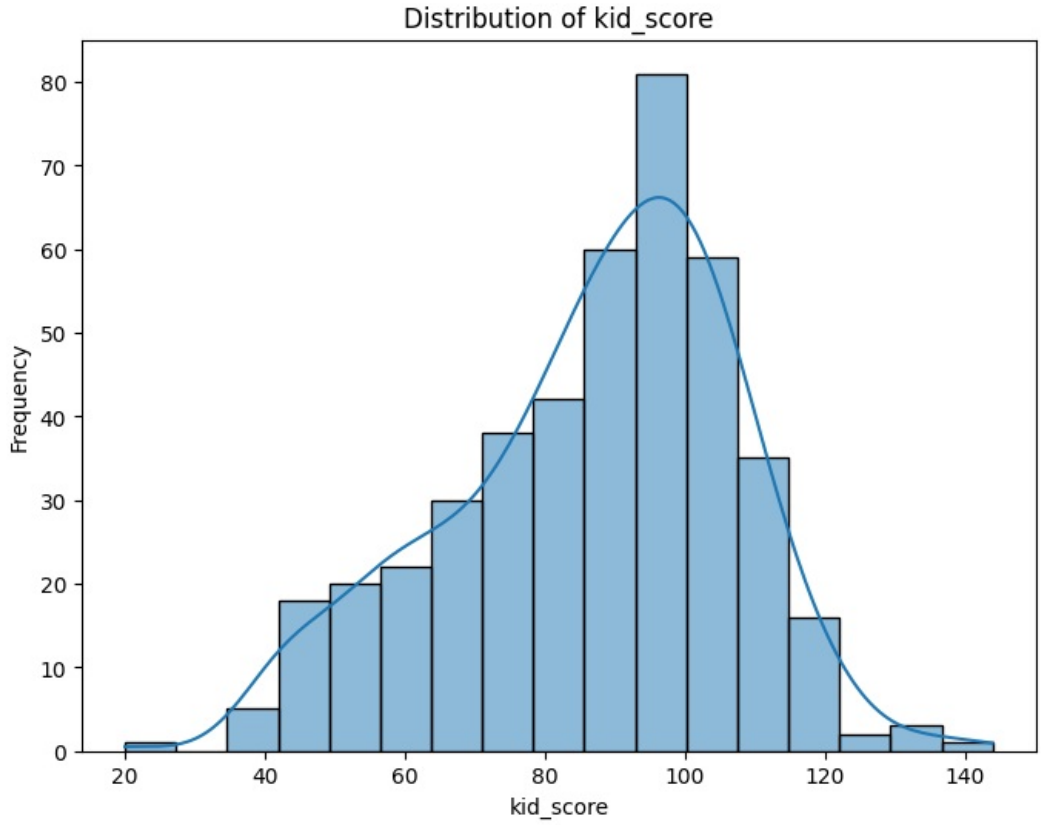
```
    if unique_values / total_values < 0.05 or unique_values < 10:  # You can adjust the threshold for discrete v
        discrete_vars.append(column)
    else:
        continuous_vars.append(column)

print("Discrete Variables:", discrete_vars)
print("Continuous Variables:", continuous_vars)

for var in discrete_vars:
    plt.figure(figsize=(8, 6))
    sns.countplot(x=var, data=df1)
    plt.title(f'Distribution of {var}')
    plt.xlabel(var)
    plt.ylabel('Count')
    plt.show()

for var in continuous_vars:
    plt.figure(figsize=(8, 6))
    sns.histplot(df1[var], kde=True)
    plt.title(f'Distribution of {var}')
    plt.xlabel(var)
    plt.ylabel('Frequency')
    plt.show()
```

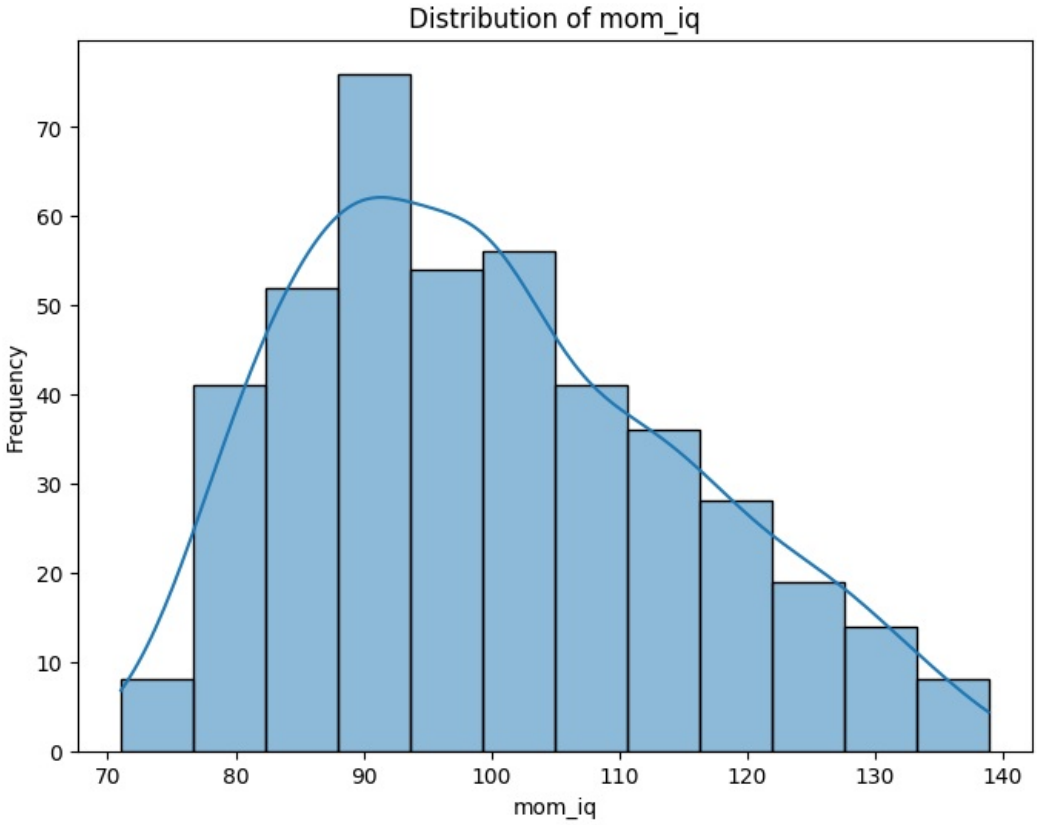
```
Discrete Variables: ['mom_hs', 'mom_work', 'mom_age']
Continuous Variables: ['kid_score', 'mom_iq']
```




Distribution of mom_work
Count
0
25
50
75
100
125
150
175
200
1
2
3
4
mom_work


Distribution of mom_age
Count
mom_age
0
10
20
30
40
50
60
17
18
19
20
21
22
23
24
25
26
27
28
29

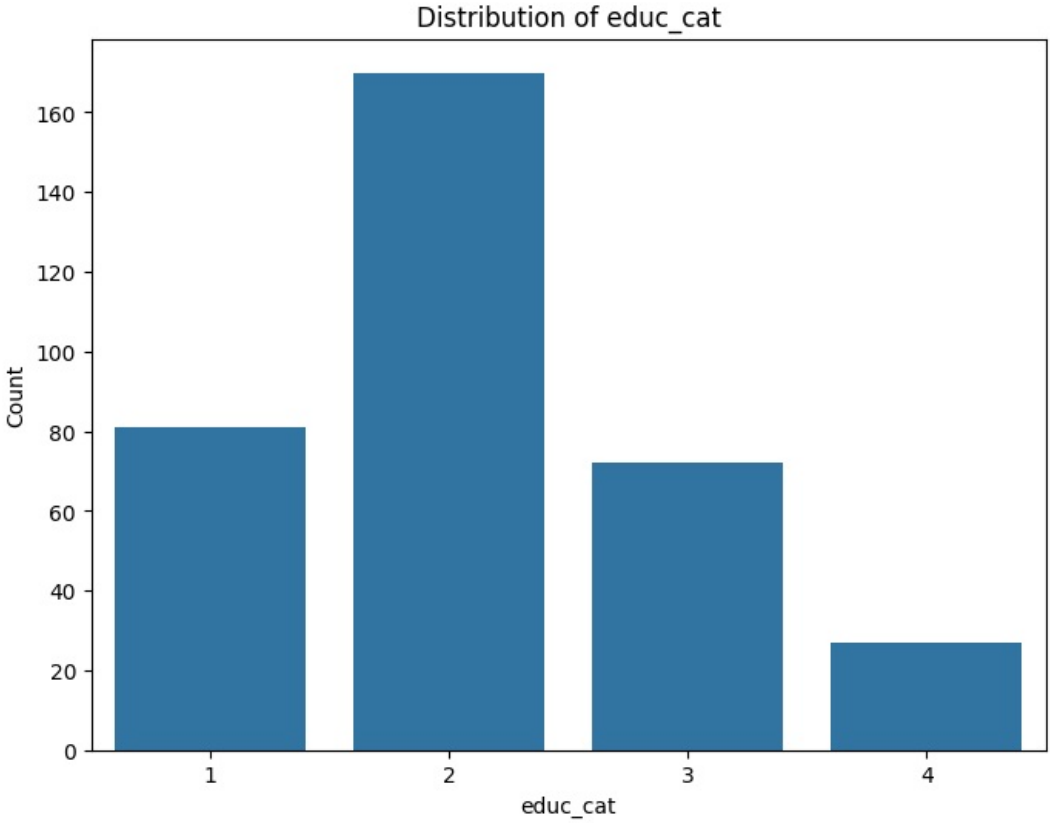

Distribution of kid_score
Frequency
kid_score
0
10
20
30
40
50
60
70
80
20
40
60
80
100
120
140

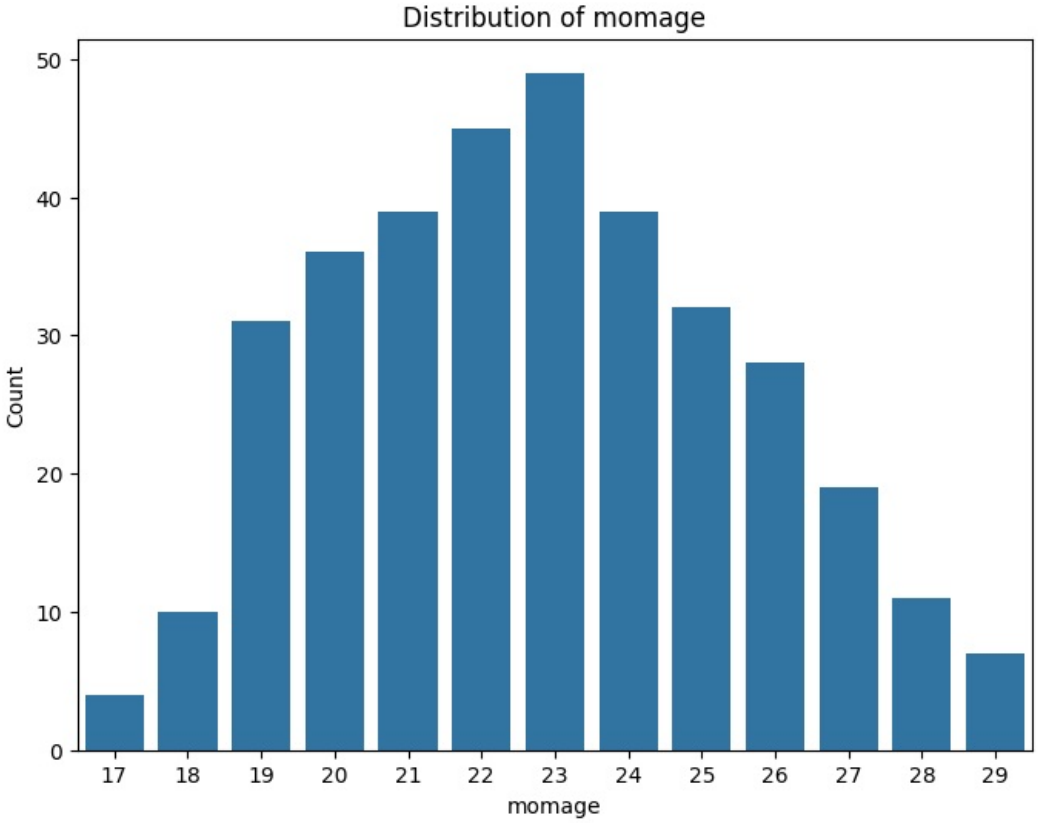


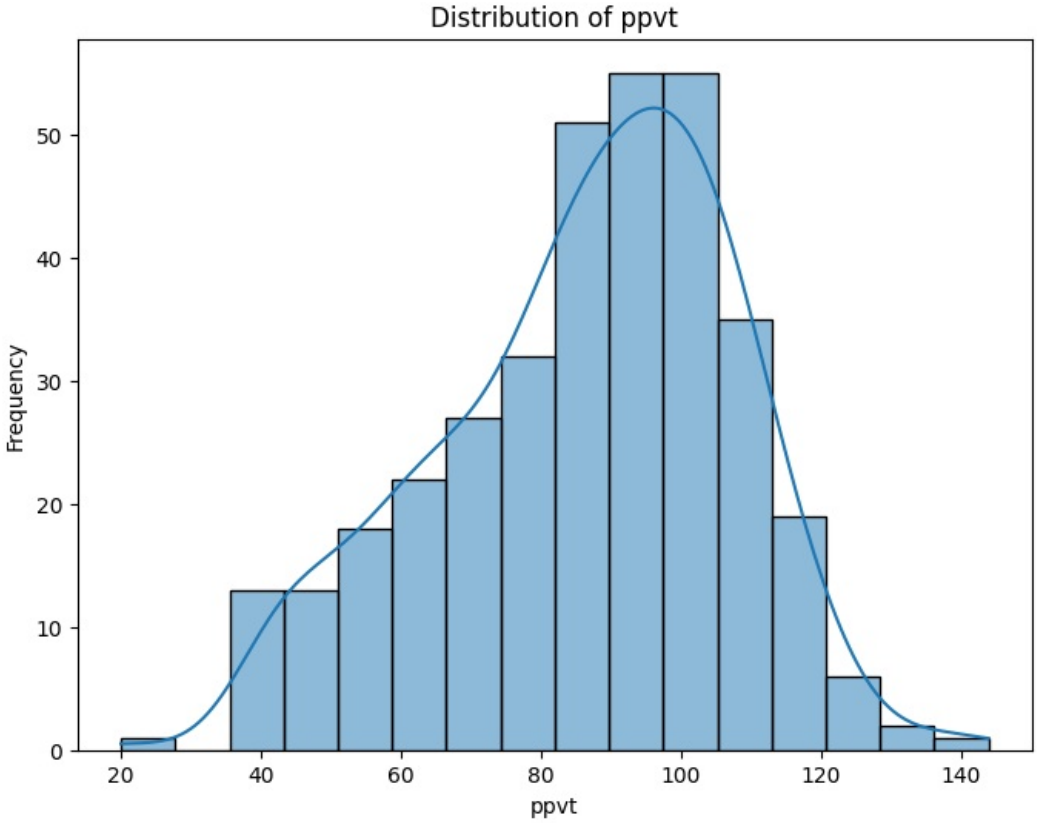
In [24]:
```
discrete_vars = []
continuous_vars = []

for column in df2.columns:
    unique_values = df2[column].nunique()
    total_values = df2.shape[0]
    if unique_values / total_values < 0.05 or unique_values < 10:  # You can adjust the threshold for discrete v
        discrete_vars.append(column)
    else:
        continuous_vars.append(column)

print("Discrete Variables:", discrete_vars)
print("Continuous Variables:", continuous_vars)

for var in discrete_vars:
    plt.figure(figsize=(8, 6))
    sns.countplot(x=var, data=df2)
    plt.title(f'Distribution of {var}')
    plt.xlabel(var)
    plt.ylabel('Count')
    plt.show()

for var in continuous_vars:
    plt.figure(figsize=(8, 6))
```

```
    sns.histplot(df2[var], kde=True)
    plt.title(f'Distribution of {var}')
    plt.xlabel(var)
    plt.ylabel('Frequency')
    plt.show()
```

```
Discrete Variables: ['educ_cat', 'momage']
Continuous Variables: ['ppvt']
```

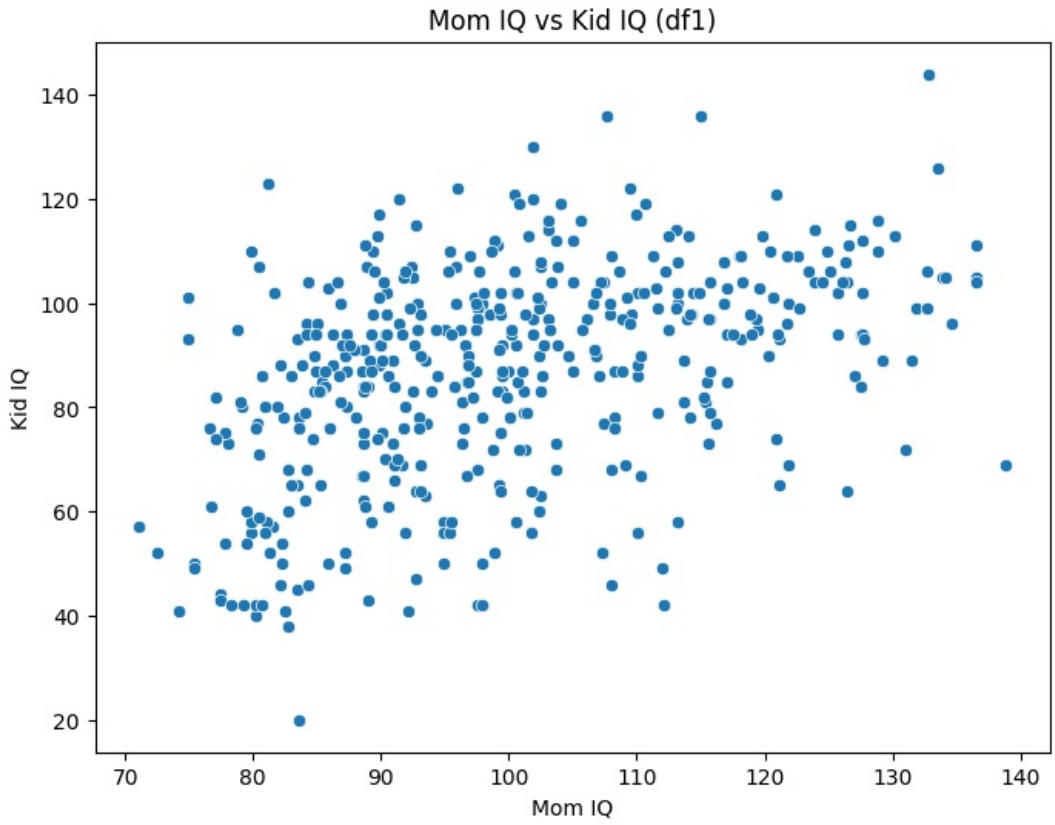


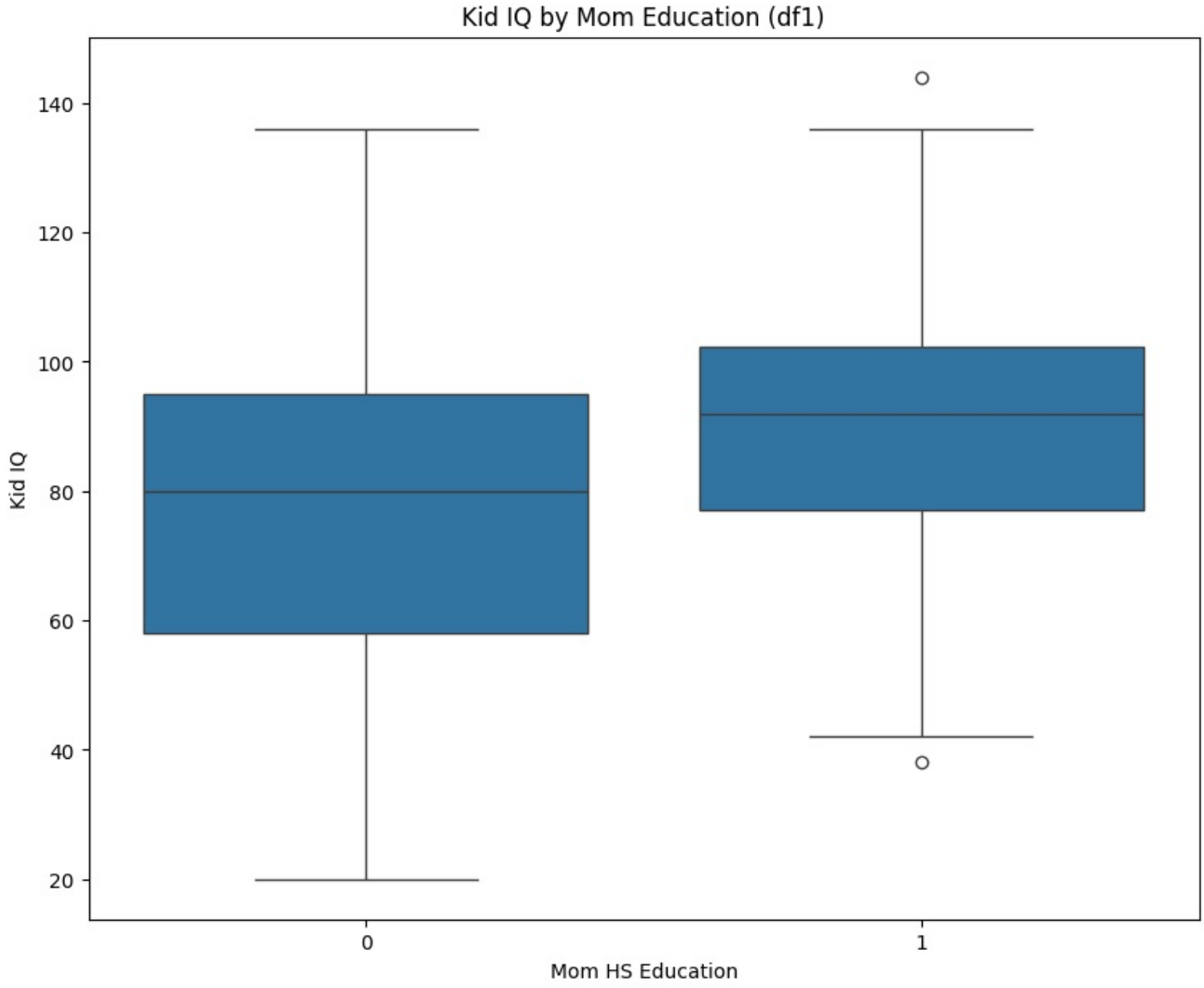


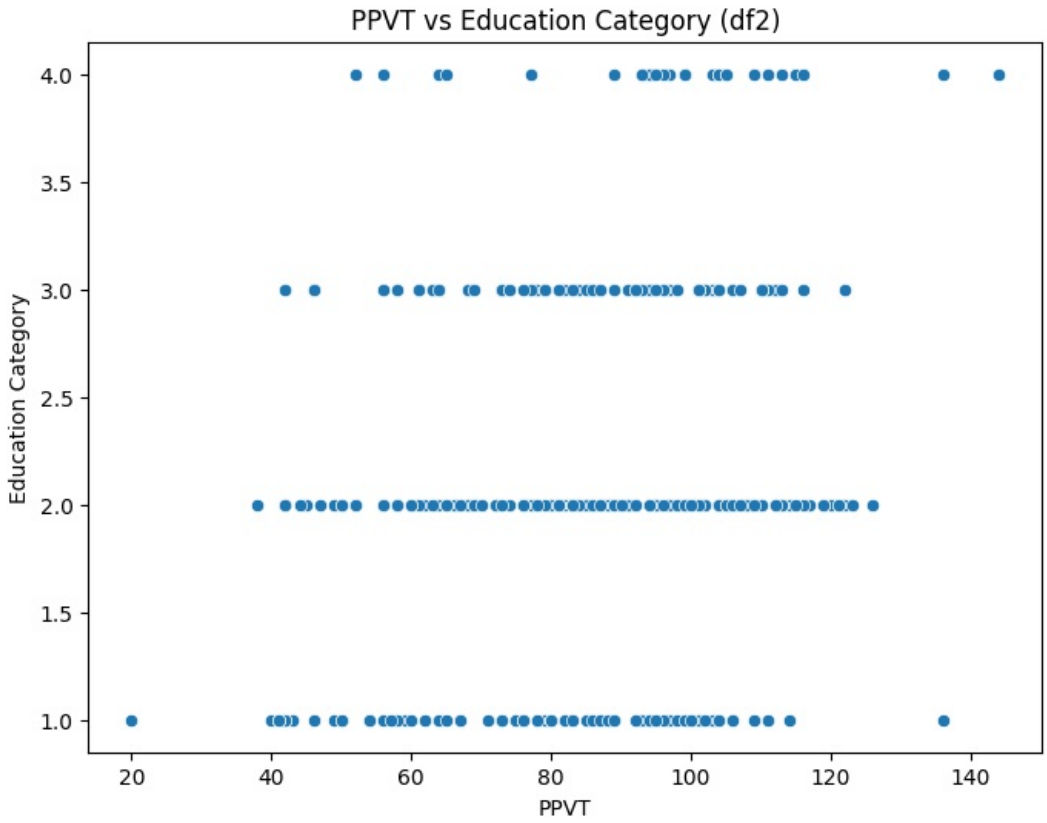


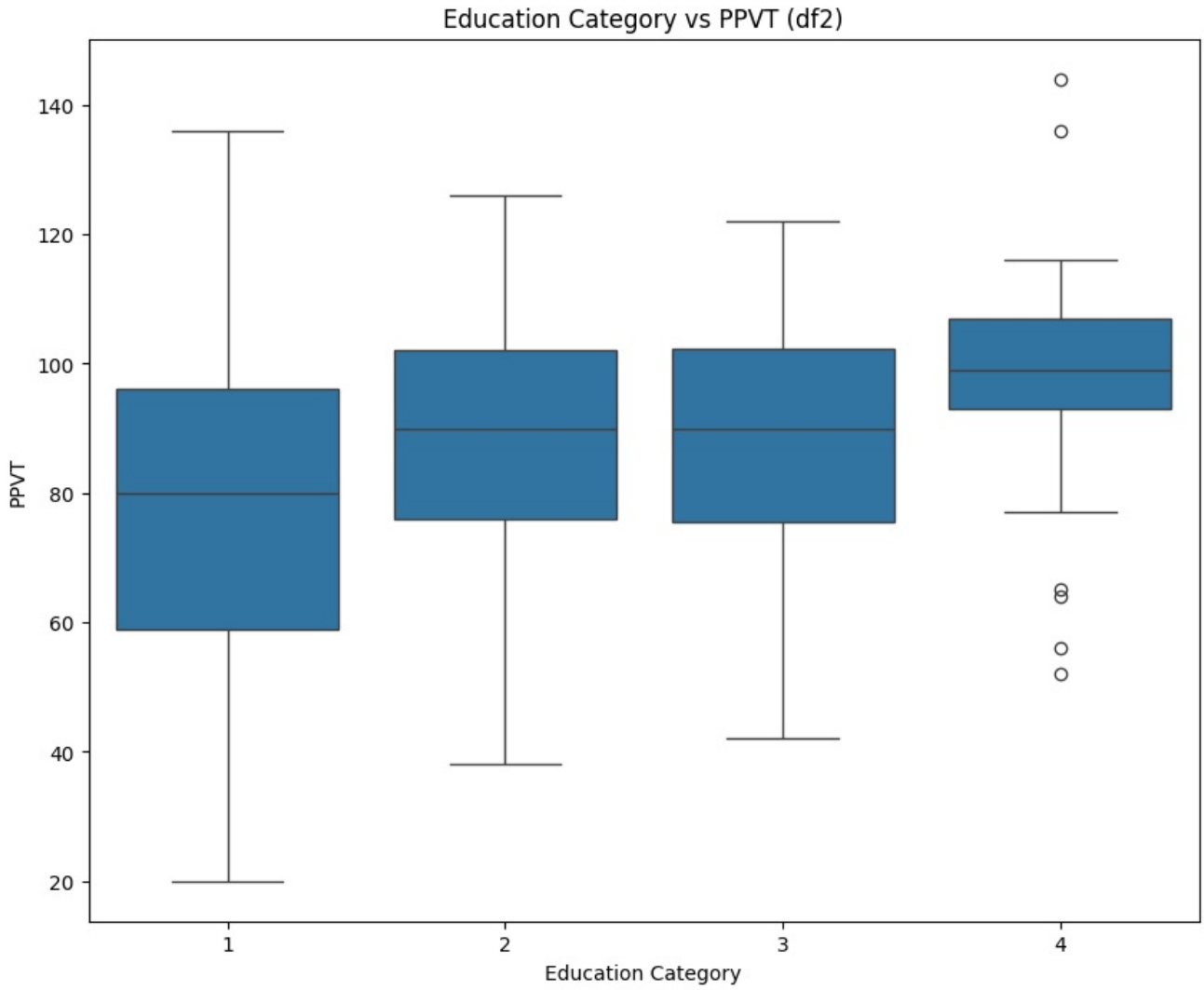
In [25]:

```
plt.figure(figsize=(8, 6))
sns.scatterplot(x='mom_iq', y='kid_score', data=df1)
plt.title('Mom IQ vs Kid IQ (df1)')
plt.xlabel('Mom IQ')
plt.ylabel('Kid IQ')
plt.show()

plt.figure(figsize=(10, 8))
sns.boxplot(x='mom_hs', y='kid_score', data=df1)
plt.title('Kid IQ by Mom Education (df1)')
plt.xlabel('Mom HS Education')
plt.ylabel('Kid IQ')
plt.show()

plt.figure(figsize=(8, 6))
sns.scatterplot(x='ppvt', y='educ_cat', data=df2)
plt.title('PPVT vs Education Category (df2)')
plt.xlabel('PPVT')
plt.ylabel('Education Category')
plt.show()

plt.figure(figsize=(10, 8))
sns.boxplot(x='educ_cat', y='ppvt', data=df2)
plt.title('Education Category vs PPVT (df2)')
plt.xlabel('Education Category')
plt.ylabel('PPVT')
plt.show()
```


Mom IQ vs Kid IQ (df1)
Kid IQ
Mom IQ
20
40
60
80
100
120
140
70
80
90
100
110
120
130
140


Kid IQ by Mom Education (df1)
Kid IQ
Mom HS Education
20
40
60
80
100
120
140
0
1





In [26]:
```
pivot_table_df1 = pd.pivot_table(df1, index='mom_hs', values='kid_score', aggfunc='mean')
print("Pivot Table for df1:")
pivot_table_df1
```

```
Pivot Table for df1:
```

Out[26]:

mom_hs	kid_score
0	77.548387
1	89.276471

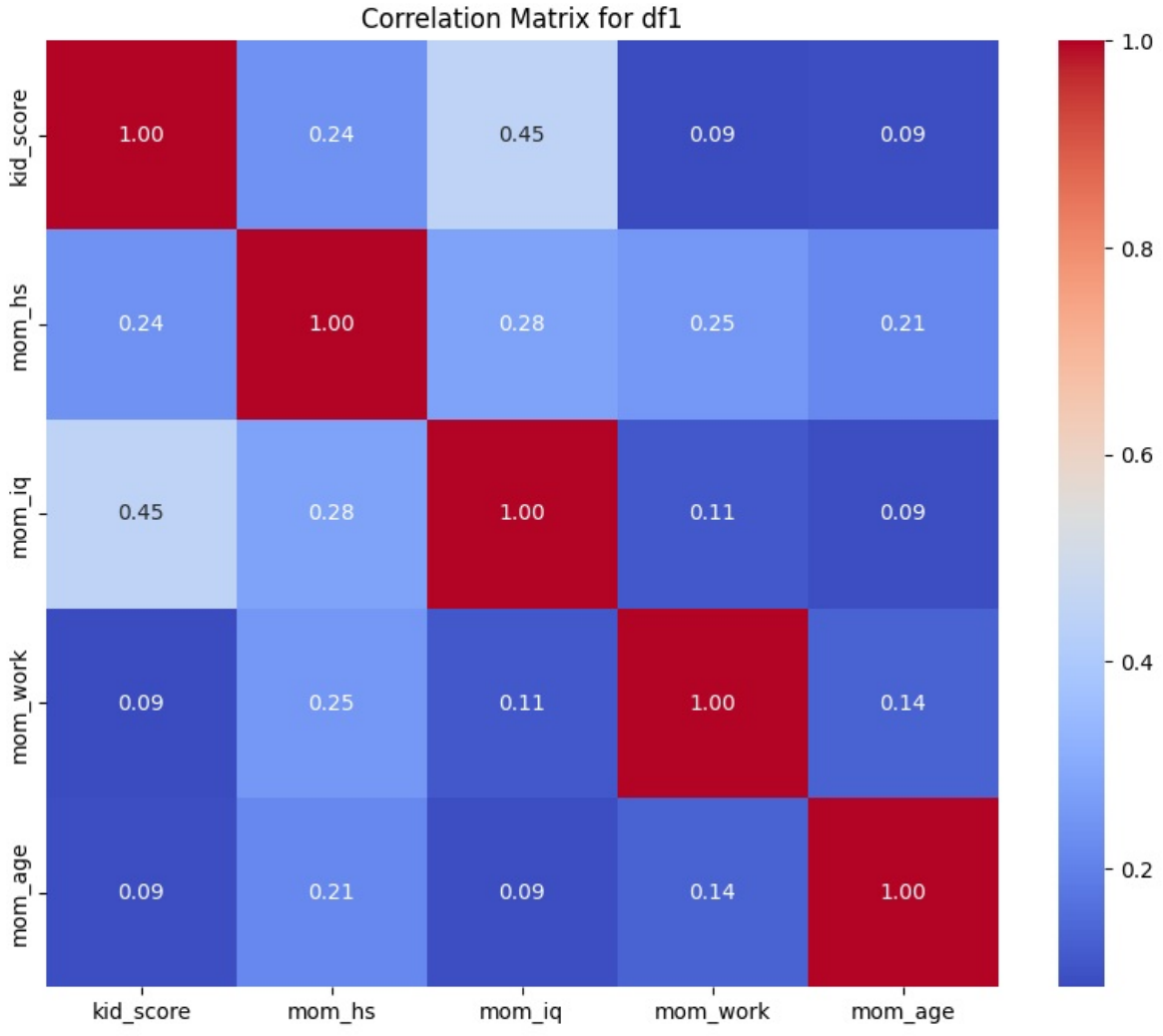
In [27]:
```
pivot_table_df2 = pd.pivot_table(df2, index='educ_cat', values='ppvt', aggfunc='mean')
print("\nPivot Table for df2:")
pivot_table_df2
```

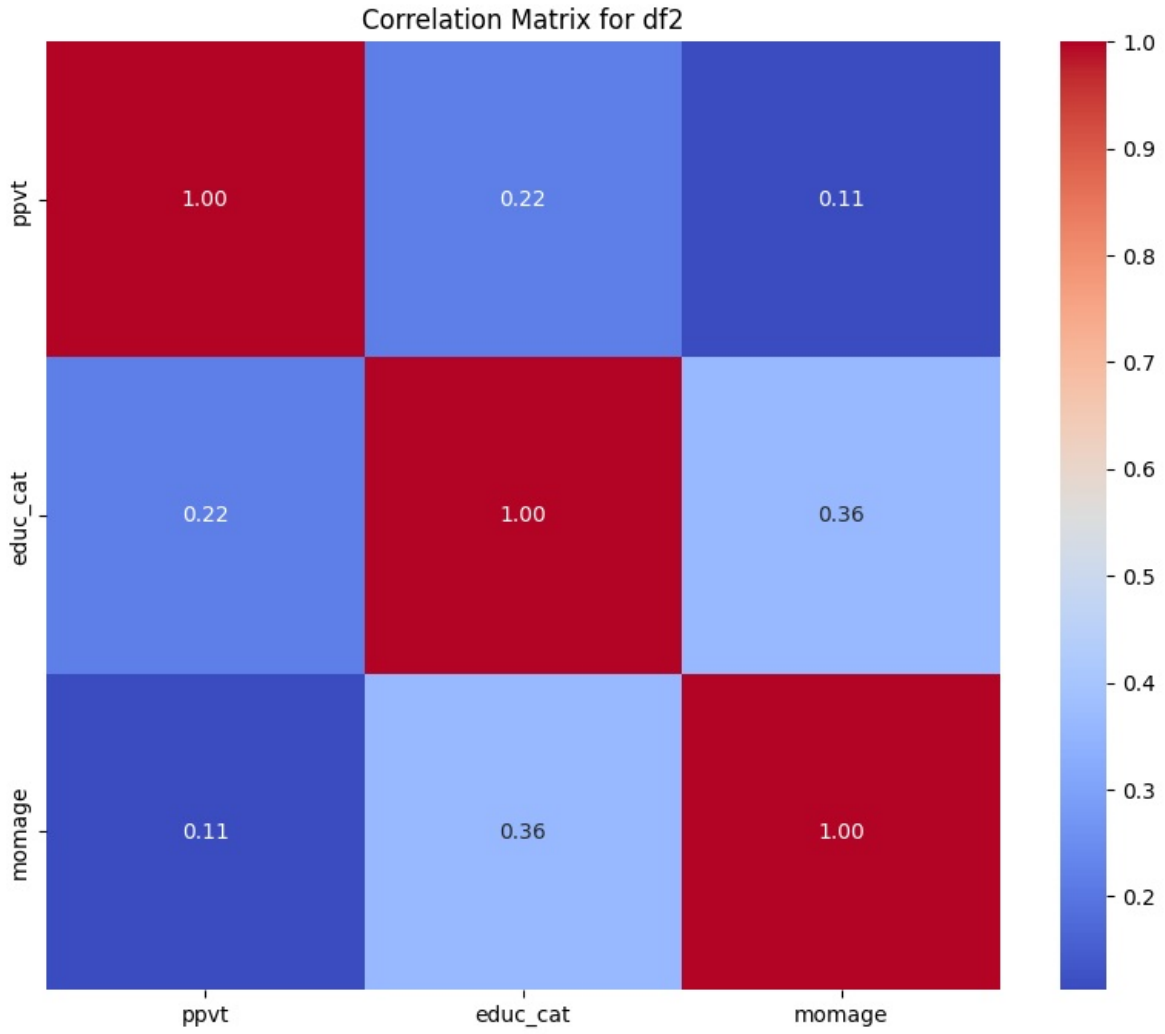
```
Pivot Table for df2:
```

Out[27]:

educ_cat	ppvt
1	77.913580
2	88.058824
3	87.694444
4	97.333333

In [28]:
```
correlation_matrix_df1 = df1.corr()

plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix_df1, annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Matrix for df1')
plt.show()

correlation_matrix_df2 = df2.corr()

plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix_df2, annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Matrix for df2')
plt.show()
```





In [29]:
```
df2.rename(columns={'momage': 'mom_age'}, inplace=True)
```

In [30]:
```
merged_df = pd.merge(df1, df2, on='mom_age', how='inner')
```

In [31]:
```
merged_df
```

Out[31]:

	kid_score	mom_hs	mom_iq	mom_work	mom_age	ppvt	educ_cat
0	65	1	121.117529	4	27	84	2
1	65	1	121.117529	4	27	101	3
2	65	1	121.117529	4	27	109	4
3	65	1	121.117529	4	27	82	3
4	65	1	121.117529	4	27	113	4
...	...	...	...	...	...	...	...
15204	102	1	127.675717	4	29	107	2
15205	102	1	127.675717	4	29	104	4
15206	102	1	127.675717	4	29	107	3
15207	102	1	127.675717	4	29	108	2
15208	102	1	127.675717	4	29	104	3

15209 rows × 7 columns

In [32]:
```
merged_df.duplicated().sum()
```

Out[32]:
```
0
```

In [33]:
```
merged_df.isnull().sum()
```

Out[33]:
```
kid_score    0
mom_hs       0
mom_iq       0
mom_work     0
mom_age      0
ppvt         0
educ_cat     0
dtype: int64
```

In [34]:
```
merged_df.shape
```

Out[34]:
```
(15209, 7)
```

In [35]:
```
merged_df.columns
```

Out[35]:
```
Index(['kid_score', 'mom_hs', 'mom_iq', 'mom_work', 'mom_age', 'ppvt',
       'educ_cat'],
      dtype='object')
```

In [36]:
```
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
```

In [37]:
```
X = merged_df.drop('kid_score', axis=1)
y = merged_df['kid_score']
```

In [38]:
```
from sklearn.model_selection import train_test_split
```

In [39]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

In [40]:
```
model = LinearRegression()
model.fit(X_train, y_train)
```

Out[40]:
▾ LinearRegression

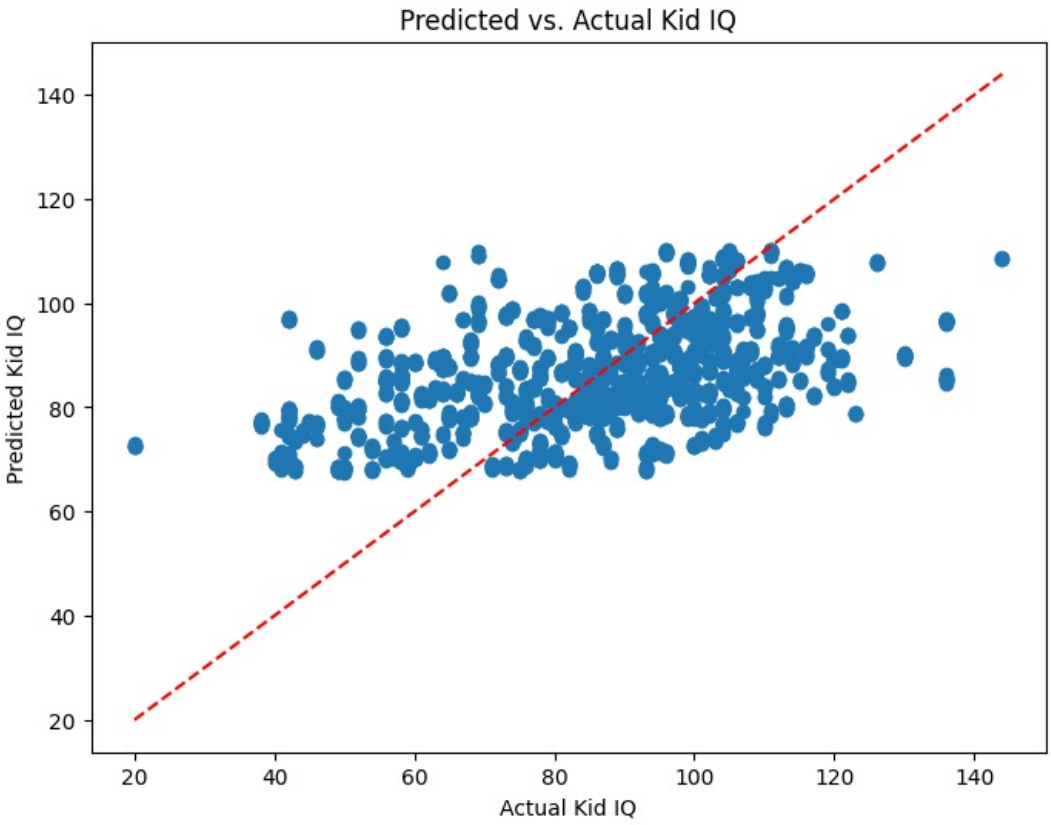
LinearRegression()

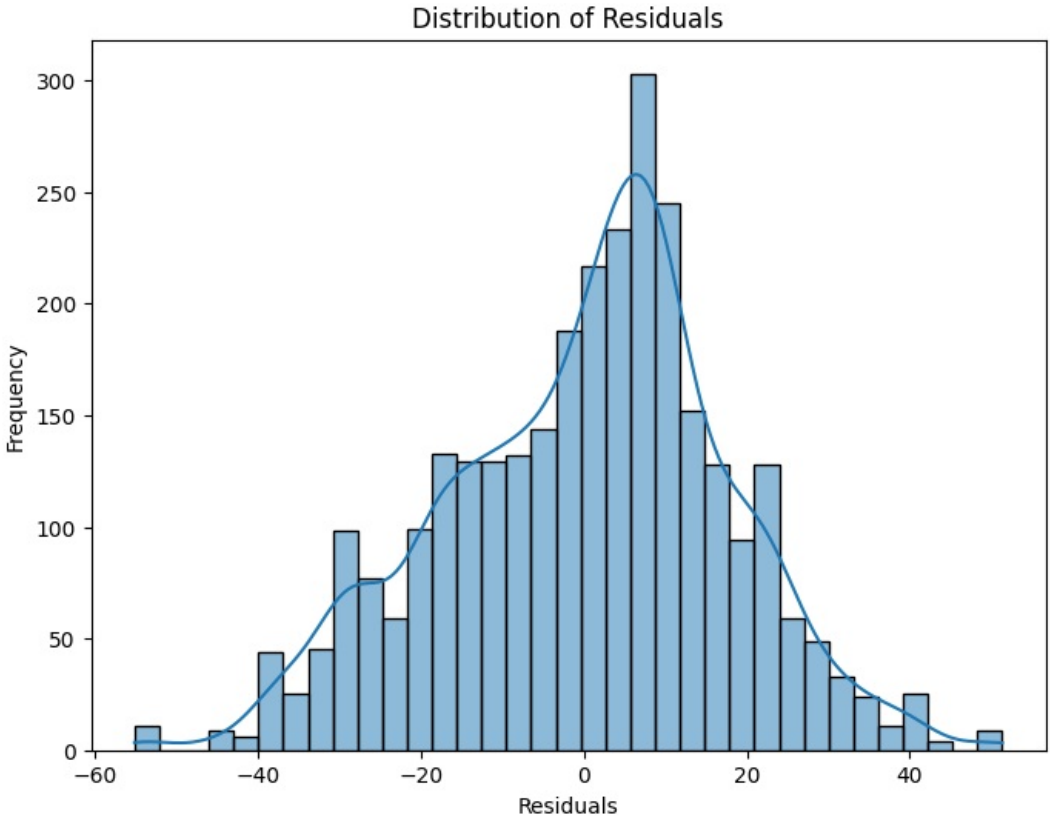
In [41]:
```
y_pred = model.predict(X_test)
```

In [42]:
```
print("Mean Squared Error:", mean_squared_error(y_test, y_pred))
print("R-squared:", r2_score(y_test, y_pred))
```

```
Mean Squared Error: 307.2657563269772
R-squared: 0.20925015748013875
```

In [43]:
```
plt.figure(figsize=(8, 6))
plt.scatter(y_test, y_pred)
plt.plot([min(y_test), max(y_test)], [min(y_test), max(y_test)], linestyle='--', color='red')  # Plotting the d
plt.title('Predicted vs. Actual Kid IQ')
plt.xlabel('Actual Kid IQ')
plt.ylabel('Predicted Kid IQ')
plt.show()

residuals = y_test - y_pred
plt.figure(figsize=(8, 6))
sns.histplot(residuals, kde=True)
plt.title('Distribution of Residuals')
plt.xlabel('Residuals')
plt.ylabel('Frequency')
plt.show()
```





In [44]:
```
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
```

In [45]:
```
dt_regressor = DecisionTreeRegressor(random_state=42)
dt_regressor.fit(X_train, y_train)
```

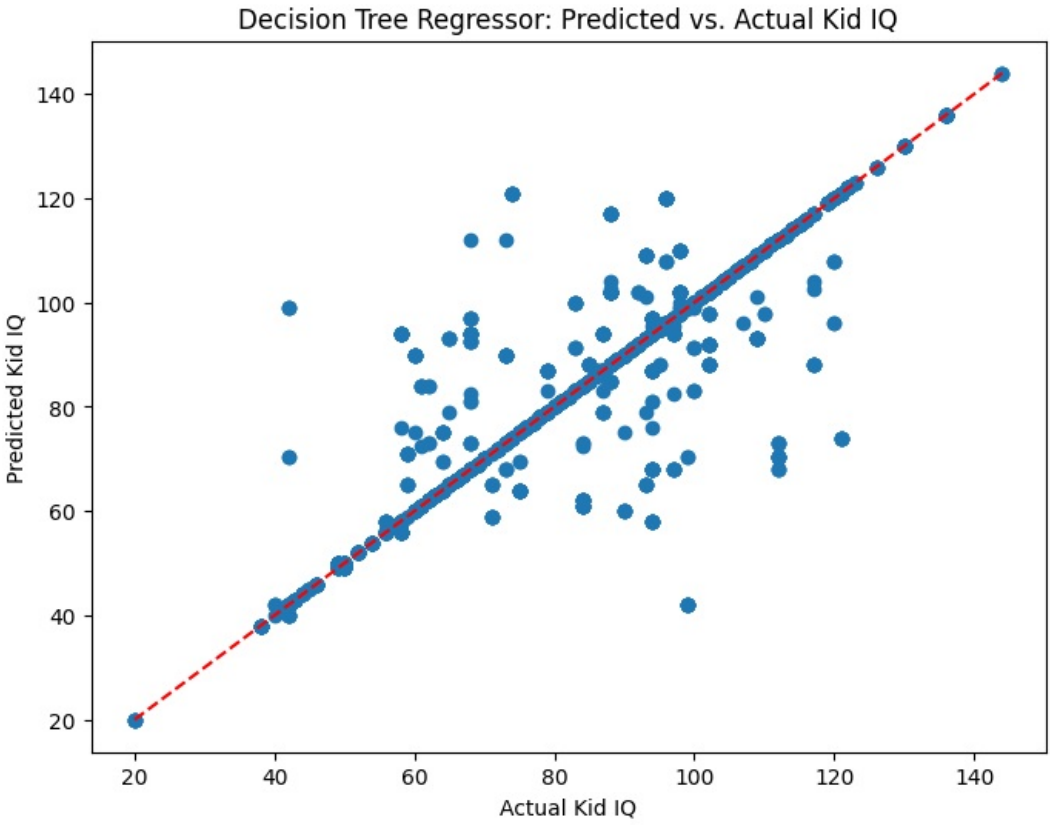
Out[45]:
```
DecisionTreeRegressor
DecisionTreeRegressor(random_state=42)
```

In [46]:
```
y_pred_dt = dt_regressor.predict(X_test)
```

In [47]:
```
print("Decision Tree Regressor:")
print("Mean Squared Error:", mean_squared_error(y_test, y_pred_dt))
print("R-squared:", r2_score(y_test, y_pred_dt))
```

```
Decision Tree Regressor:
Mean Squared Error: 64.92135108481263
R-squared: 0.8329246032484585
```

In [48]:
```
plt.figure(figsize=(8, 6))
plt.scatter(y_test, y_pred_dt)
plt.plot([min(y_test), max(y_test)], [min(y_test), max(y_test)], linestyle='--', color='red')  # Plotting the d
plt.title('Decision Tree Regressor: Predicted vs. Actual Kid IQ')
plt.xlabel('Actual Kid IQ')
plt.ylabel('Predicted Kid IQ')
plt.show()
```



In [49]:
```
rf_regressor = RandomForestRegressor(random_state=42)
rf_regressor.fit(X_train, y_train)
```

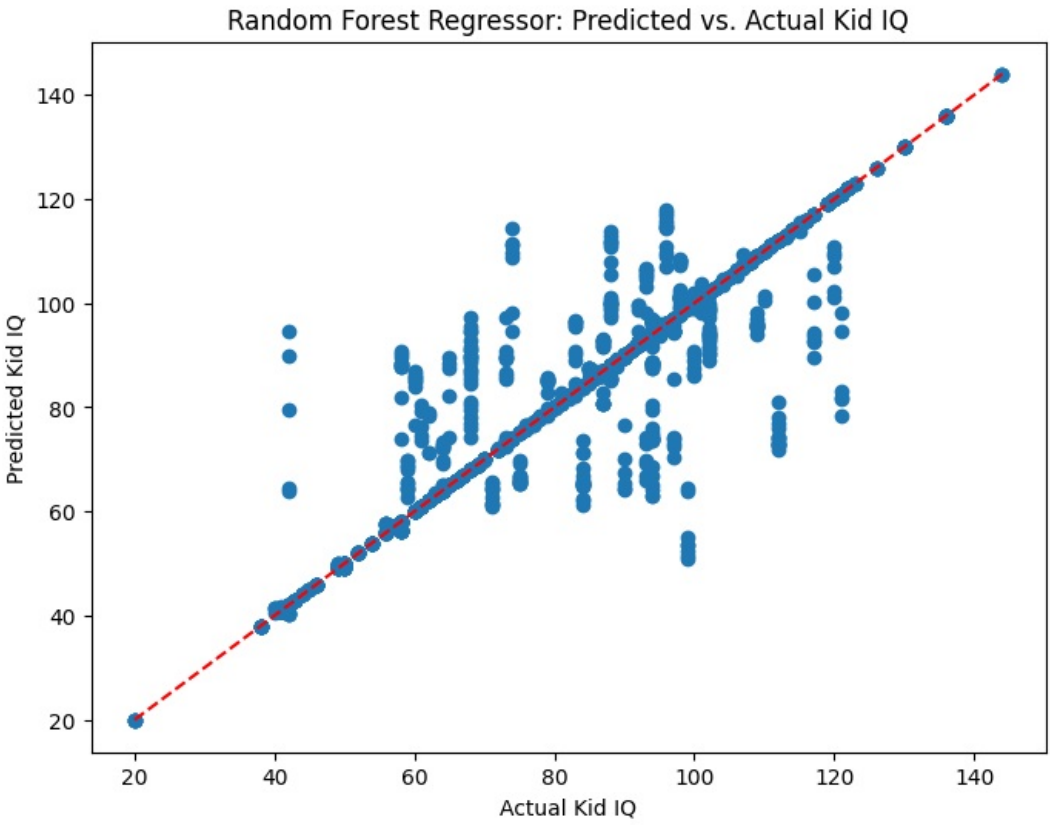
Out[49]:
```
RandomForestRegressor
RandomForestRegressor(random_state=42)
```

In [50]:
```
y_pred_rf = rf_regressor.predict(X_test)
```

In [51]:
```
print("\nRandom Forest Regressor:")
print("Mean Squared Error:", mean_squared_error(y_test, y_pred_rf))
print("R-squared:", r2_score(y_test, y_pred_rf))
```

```
Random Forest Regressor:
Mean Squared Error: 45.4579823959602
R-squared: 0.8830136724294644
```

In [52]:
```
plt.figure(figsize=(8, 6))
plt.scatter(y_test, y_pred_rf)
plt.plot([min(y_test), max(y_test)], [min(y_test), max(y_test)], linestyle='--', color='red')  # Plotting the d
plt.title('Random Forest Regressor: Predicted vs. Actual Kid IQ')
plt.xlabel('Actual Kid IQ')
plt.ylabel('Predicted Kid IQ')
plt.show()
```



In [53]:
```
from sklearn.preprocessing import StandardScaler
```

In [54]:
```
scaler = StandardScaler()

X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)
```

In [55]:
```
model = LinearRegression()
model.fit(X_train_scaled, y_train)
```

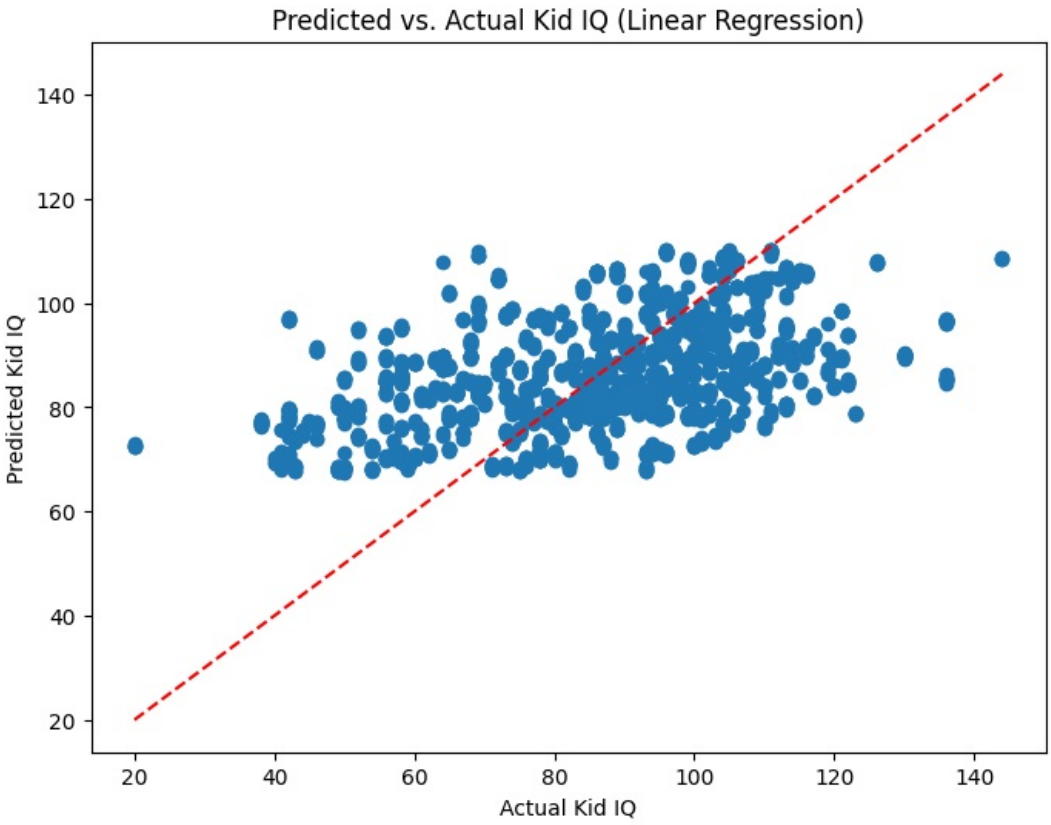
Out[55]:
```
▾ LinearRegression
LinearRegression()
```

In [56]:
```
y_pred = model.predict(X_test_scaled)
```

In [57]:
```
print("Mean Squared Error:", mean_squared_error(y_test, y_pred))
print("R-squared:", r2_score(y_test, y_pred))
```

```
Mean Squared Error: 307.2657563269768
R-squared: 0.20925015748013986
```

In [58]:
```
plt.figure(figsize=(8, 6))
plt.scatter(y_test, y_pred)
plt.plot([min(y_test), max(y_test)], [min(y_test), max(y_test)], linestyle='--', color='red')  # Plotting the d
plt.title('Predicted vs. Actual Kid IQ (Linear Regression)')
plt.xlabel('Actual Kid IQ')
plt.ylabel('Predicted Kid IQ')
plt.show()
```



Thanks !!!