In [37]:
```
import pandas as pd
import numpy as np
import tensorflow
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import Pipeline
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from scikeras.wrappers import KerasClassifier, KerasRegressor
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
from sklearn.metrics import classification_report
```

In [31]:
```
# Function to create model
def create_model(neurons=16, optimizer='adam'):
    model = Sequential([
        Dense(neurons, input_dim=X_train.shape[1], activation='relu'),
        Dense(1, activation='sigmoid')
    ])
    model.compile(loss='binary_crossentropy', optimizer=optimizer, metrics=['accura
    return model
```

In [32]:
```
# Define pipeline
pipeline = Pipeline([
    ('scaler', StandardScaler()),
    ('clf', KerasClassifier(build_fn=create_model, epochs=10, batch_size=16, verbos
])
```

In [33]:
```
# Define hyperparameters grid
param_grid = {
    'clf__neurons': [8, 16, 32],
    'clf__optimizer': ['adam', 'rmsprop']
}
```

In [34]:
```
# Perform hyperparameter tuning
grid_search = GridSearchCV(pipeline, param_grid, cv=3, scoring='accuracy', verbose=
grid_search.fit(X_train, y_train)
```

```
Fitting 3 folds for each of 6 candidates, totalling 18 fits
```

```
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```

Out[34]:

```
▸ GridSearchCV
▸ estimator: Pipeline
    ▸ StandardScaler
    ▸ KerasClassifier
```

In [35]:

```python
# Best hyperparameters
print("Best hyperparameters:", grid_search.best_params_)
```

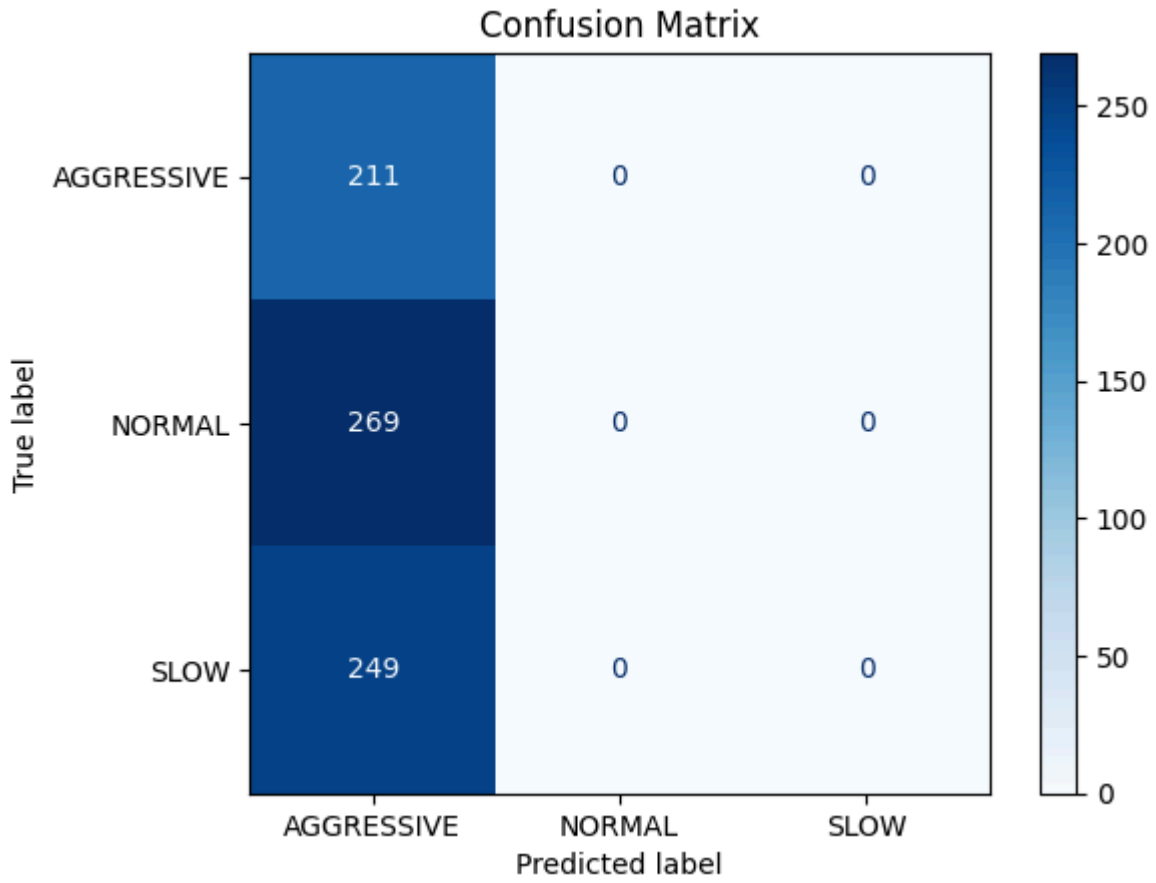
```
Best hyperparameters: {'clf__neurons': 8, 'clf__optimizer': 'adam'}
```

In [36]:

```python
# Evaluate model
best_model = grid_search.best_estimator_
test_accuracy = best_model.score(X_test, y_test)
print("Test Accuracy:", test_accuracy)
```

```
Test Accuracy: 0.289437585733882
```

In [48]:
```
# Plot confusion matrix
y_pred = best_model.predict(X_test)
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=best_model.classe
disp.plot(cmap='Blues', values_format='d')
plt.title('Confusion Matrix')
plt.show()
```



In [49]:
```
# Classification report
print("Classification Report:")
print(classification_report(y_test, y_pred, target_names=best_model.classes_))
```

```
Classification Report:
              precision    recall  f1-score   support

  AGGRESSIVE       0.29      1.00      0.45       211
      NORMAL       0.00      0.00      0.00       269
        SLOW       0.00      0.00      0.00       249

    accuracy                           0.29       729
   macro avg       0.10      0.33      0.15       729
weighted avg       0.08      0.29      0.13       729
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1509: U
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