In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from wordcloud import WordCloud
import warnings
from datetime import datetime
from collections import Counter
import re

warnings.filterwarnings('ignore')
plt.style.use('seaborn-v0_8-darkgrid')
sns.set_palette("husl")

%matplotlib inline

print("✅ All libraries imported successfully!")
```

```
✅ All libraries imported successfully!
```

In [3]:
```
data_path = '../data/processed/merged_health_data.csv'

df = pd.read_csv(data_path)

print("="*60)
print("DATA LOADED SUCCESSFULLY")
print("="*60)
print(f"Total Records: {len(df):,}")
print(f"Total Columns: {len(df.columns)}")
print(f"\nColumn Names:")
print(df.columns.tolist())
```

```
============================================================
DATA LOADED SUCCESSFULLY
============================================================
Total Records: 19,080
Total Columns: 10

Column Names:
['id', 'title', 'text', 'created_utc', 'score', 'num_comments', 'subreddit', 'c
ategory', 'health_category', 'source_file']
```

In [4]:
```
print("="*60)
print("DATASET OVERVIEW")
print("="*60)

print("\nFirst 5 Rows:")
print(df.head())

print("\n" + "="*60)
print("Data Types:")
print(df.dtypes)

print("\n" + "="*60)
print("Dataset Shape:", df.shape)
print(f"Rows: {df.shape[0]:,}")
print(f"Columns: {df.shape[1]}")
```

```
============================================================
DATASET OVERVIEW
============================================================

First 5 Rows:
        id                                              title  \
0  1qan9dz                                Diabetes and wounds
1  1qan06o                                      T1D in Movies
2  1qakrrm                                            Patches
3  1qaipk4  Accidental double dose of Jardiance today (10m...
4  1qaggi1                         Silly question, but curious?

                                                text   created_utc  score  \
0  35. M. I've been a bad diabetic for a while, a...  1.768198e+09      1
1  Curious, for the movie buffs on the sub, what ...  1.768197e+09      1
2  Hi, I'm caring for someone who has very fragil...  1.768191e+09      1
3  Hey all. My Mother called me a bit ago pretty ...  1.768185e+09      2
4  So I am on insulin injections, I am wondering ...  1.768179e+09      1

   num_comments subreddit  category health_category   source_file
0             0  diabetes  diabetes        diabetes  diabetes.csv
1             1  diabetes  diabetes        diabetes  diabetes.csv
2             8  diabetes  diabetes        diabetes  diabetes.csv
3             5  diabetes  diabetes        diabetes  diabetes.csv
4             1  diabetes  diabetes        diabetes  diabetes.csv

============================================================
Data Types:
id                  object
title               object
text                object
created_utc        float64
score                int64
num_comments         int64
subreddit           object
category            object
health_category     object
source_file         object
dtype: object

============================================================
Dataset Shape: (19080, 10)
Rows: 19,080
Columns: 10
```

In [5]:
```
print("="*60)
print("MISSING VALUES ANALYSIS")
print("="*60)

missing_values = df.isnull().sum()
```

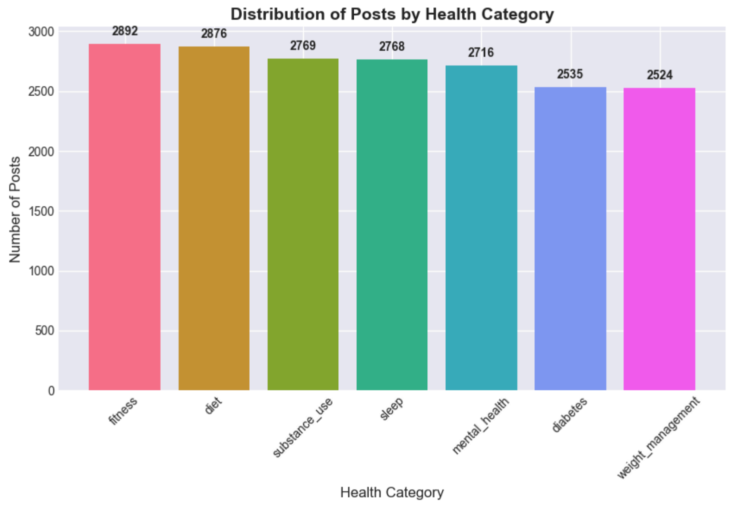
```
missing_percentage = (missing_values / len(df)) * 100

missing_df = pd.DataFrame({
    'Column': missing_values.index,
    'Missing_Count': missing_values.values,
    'Percentage': missing_percentage.values
})

missing_df = missing_df[missing_df['Missing_Count'] > 0].sort_values('Missing_

if len(missing_df) > 0:
    print(missing_df.to_string(index=False))
else:
    print("✅ No missing values found!")

plt.figure(figsize=(10, 6))
if len(missing_df) > 0:
    plt.barh(missing_df['Column'], missing_df['Percentage'])
    plt.xlabel('Missing Percentage (%)')
    plt.title('Missing Values by Column')
    plt.tight_layout()
    plt.savefig('../reports/missing_values.png', dpi=300, bbox_inches='tight')
    plt.show()
else:
    print("\n(No visualization needed - no missing values)")
```

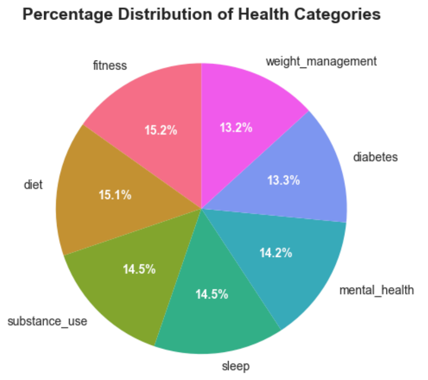
```
============================================================
MISSING VALUES ANALYSIS
============================================================
✅ No missing values found!

(No visualization needed - no missing values)
<Figure size 1000x600 with 0 Axes>
```

In [6]:
```
print("="*60)
print("HEALTH CATEGORY DISTRIBUTION")
print("="*60)

category_counts = df['health_category'].value_counts()
category_percentages = (category_counts / len(df)) * 100

category_df = pd.DataFrame({
    'Category': category_counts.index,
    'Count': category_counts.values,
    'Percentage': category_percentages.values
})

print(category_df.to_string(index=False))

fig, axes = plt.subplots(1, 2, figsize=(16, 6))

axes[0].bar(category_counts.index, category_counts.values, color=sns.color_pal
axes[0].set_xlabel('Health Category', fontsize=12)
axes[0].set_ylabel('Number of Posts', fontsize=12)
```

```
axes[0].set_title('Distribution of Posts by Health Category', fontsize=14, for
axes[0].tick_params(axis='x', rotation=45)
for i, v in enumerate(category_counts.values):
    axes[0].text(i, v + 50, str(v), ha='center', va='bottom', fontweight='bolc

colors = sns.color_palette("husl", len(category_counts))
wedges, texts, autotexts = axes[1].pie(category_counts.values, labels=category
                                        autopct='%1.1f%%', startangle=90, col
axes[1].set_title('Percentage Distribution of Health Categories', fontsize=14,

for autotext in autotexts:
    autotext.set_color('white')
    autotext.set_fontweight('bold')

plt.tight_layout()
plt.savefig('../reports/category_distribution.png', dpi=300, bbox_inches='tigh
plt.show()
```

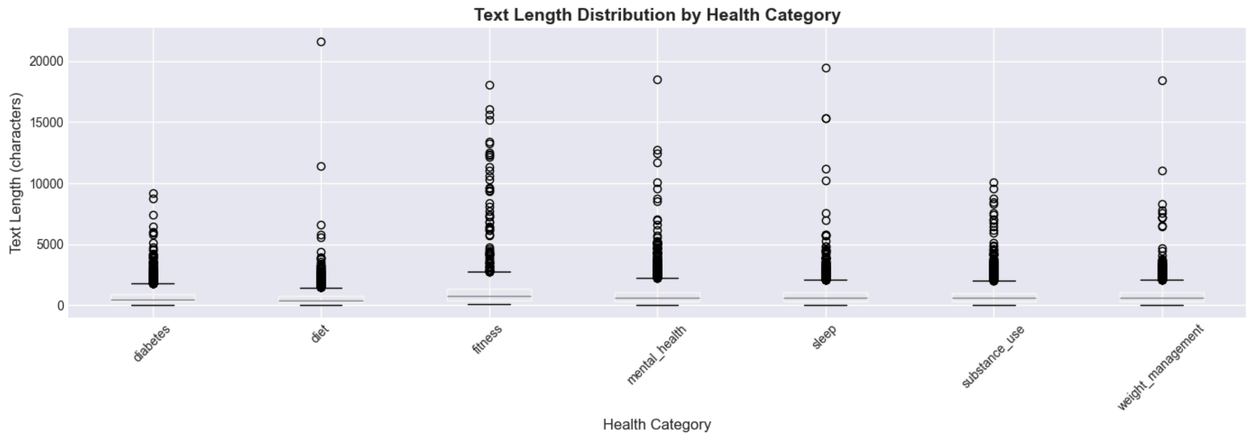
```
============================================================
HEALTH CATEGORY DISTRIBUTION
============================================================
         Category  Count  Percentage
          fitness   2892   15.157233
             diet   2876   15.073375
    substance_use   2769   14.512579
            sleep   2768   14.507338
    mental_health   2716   14.234801
         diabetes   2535   13.286164
weight_management   2524   13.228512
```

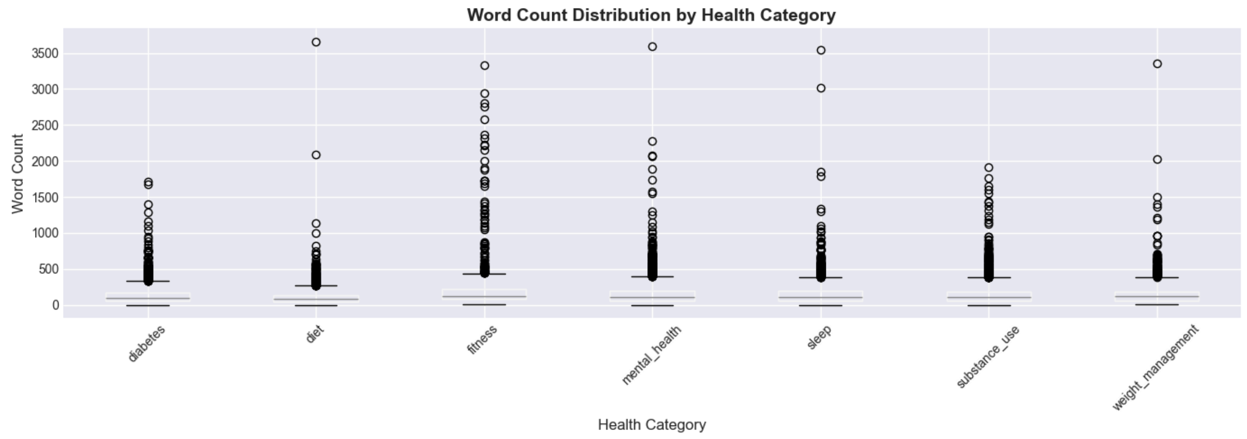




```
In [7]: print("="*60)
        print("TEXT LENGTH ANALYSIS")
        print("="*60)

        df['text_length'] = df['text'].fillna('').astype(str).apply(len)
        df['word_count'] = df['text'].fillna('').astype(str).apply(lambda x: len(x.spl

        print("\nOverall Statistics:")
        print(f"  Mean text length: {df['text_length'].mean():.2f} characters")
        print(f"  Median text length: {df['text_length'].median():.2f} characters")
        print(f"  Max text length: {df['text_length'].max():,} characters")
        print(f"  Min text length: {df['text_length'].min()} characters")

        print(f"\n  Mean word count: {df['word_count'].mean():.2f} words")
        print(f"  Median word count: {df['word_count'].median():.2f} words")

        print("\n" + "="*60)
        print("Text Length by Health Category:")
        print("="*60)

        category_text_stats = df.groupby('health_category').agg({
            'text_length': ['mean', 'median'],
            'word_count': ['mean', 'median']
        }).round(2)

        print(category_text_stats)

        fig, axes = plt.subplots(2, 1, figsize=(14, 10))

        df.boxplot(column='text_length', by='health_category', ax=axes[0])
        axes[0].set_xlabel('Health Category', fontsize=12)
        axes[0].set_ylabel('Text Length (characters)', fontsize=12)
        axes[0].set_title('Text Length Distribution by Health Category', fontsize=14,
        axes[0].get_figure().suptitle('')
        plt.setp(axes[0].xaxis.get_majorticklabels(), rotation=45)

        df.boxplot(column='word_count', by='health_category', ax=axes[1])
        axes[1].set_xlabel('Health Category', fontsize=12)
        axes[1].set_ylabel('Word Count', fontsize=12)
        axes[1].set_title('Word Count Distribution by Health Category', fontsize=14, f
        axes[1].get_figure().suptitle('')
        plt.setp(axes[1].xaxis.get_majorticklabels(), rotation=45)

        plt.tight_layout()
        plt.savefig('../reports/text_length_analysis.png', dpi=300, bbox_inches='tight
        plt.show()
```

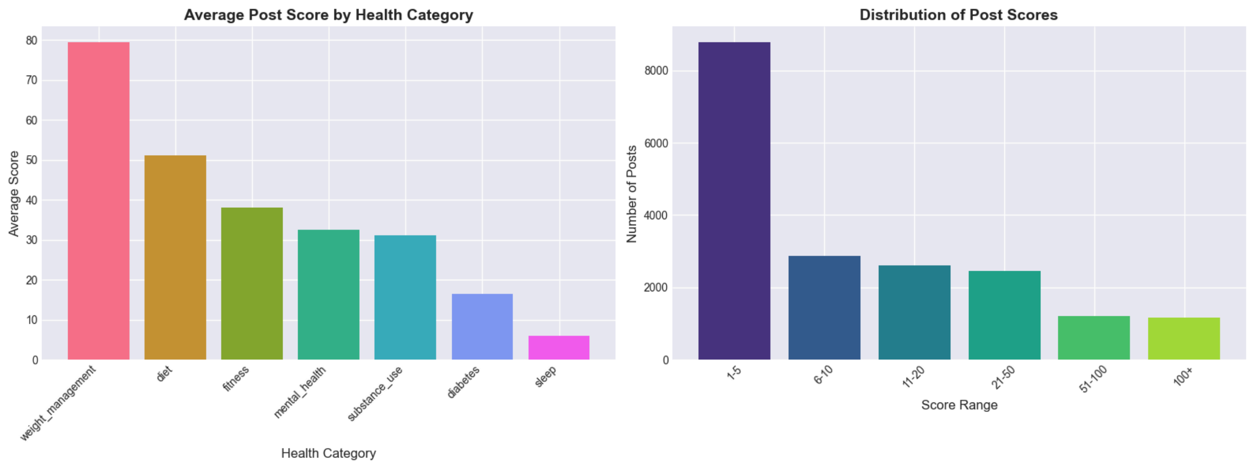
```
============================================================
TEXT LENGTH ANALYSIS
============================================================

Overall Statistics:
  Mean text length: 811.97 characters
  Median text length: 576.00 characters
  Max text length: 21,613 characters
  Min text length: 51 characters

  Mean word count: 145.43 words
  Median word count: 105.00 words

============================================================
Text Length by Health Category:
============================================================
                  text_length        word_count
                         mean median       mean median
health_category
diabetes               705.75  496.0     131.82   93.0
diet                   593.80  428.5     107.32   78.0
fitness                996.99  769.0     160.07  118.0
mental_health          928.77  594.5     166.67  110.0
sleep                  826.98  598.0     152.85  111.0
substance_use          816.49  599.0     154.49  113.0
weight_management      808.15  624.0     144.76  118.0
```





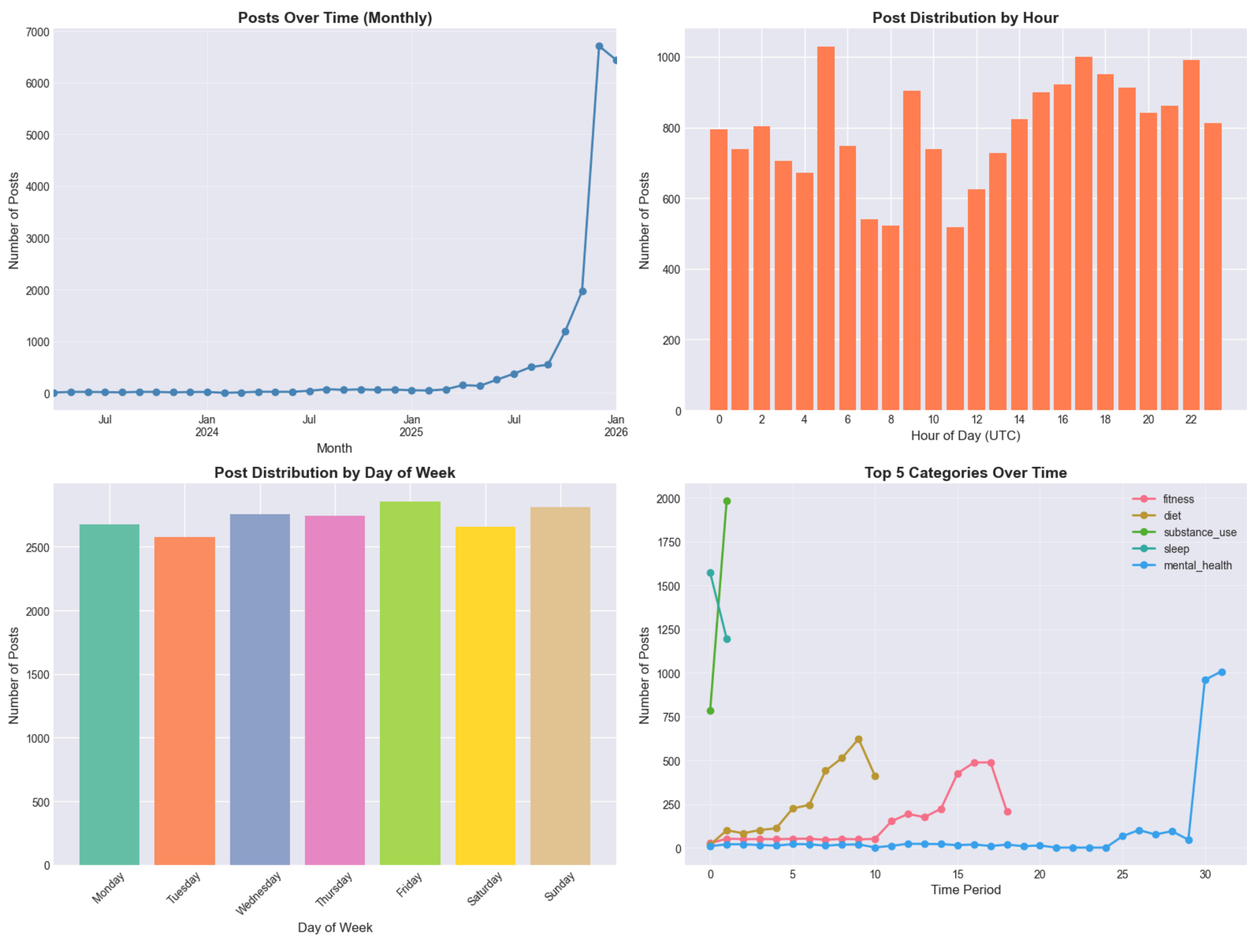
In [8]:
```python
print("="*60)
print("ENGAGEMENT METRICS ANALYSIS")
print("="*60)

print("\nOverall Score Statistics:")
print(f"  Mean score: {df['score'].mean():.2f}")
print(f"  Median score: {df['score'].median():.2f}")
print(f"  Max score: {df['score'].max()}")
print(f"  Min score: {df['score'].min()}")

print("\nScore Distribution:")
print(f"  Low engagement (score 1-5): {len(df[df['score'] <= 5]):,} posts ({le
print(f"  Medium engagement (score 6-50): {len(df[(df['score'] > 5) & (df['sco
print(f"  High engagement (score > 50): {len(df[df['score'] > 50]):,} posts ({

print("\n" + "="*60)
print("Average Score by Health Category:")
print("="*60)

category_scores = df.groupby('health_category')['score'].agg(['mean', 'median'
print(category_scores)

fig, axes = plt.subplots(1, 2, figsize=(16, 6))

avg_scores = df.groupby('health_category')['score'].mean().sort_values(ascendi
axes[0].bar(range(len(avg_scores)), avg_scores.values, color=sns.color_palette
axes[0].set_xticks(range(len(avg_scores)))
axes[0].set_xticklabels(avg_scores.index, rotation=45, ha='right')
axes[0].set_xlabel('Health Category', fontsize=12)
axes[0].set_ylabel('Average Score', fontsize=12)
axes[0].set_title('Average Post Score by Health Category', fontsize=14, fontwe

score_bins = [0, 5, 10, 20, 50, 100, df['score'].max()]
score_labels = ['1-5', '6-10', '11-20', '21-50', '51-100', '100+']
df['score_range'] = pd.cut(df['score'], bins=score_bins, labels=score_labels,
score_dist = df['score_range'].value_counts().sort_index()

axes[1].bar(range(len(score_dist)), score_dist.values, color=sns.color_palette
axes[1].set_xticks(range(len(score_dist)))
axes[1].set_xticklabels(score_dist.index, rotation=45)
axes[1].set_xlabel('Score Range', fontsize=12)
axes[1].set_ylabel('Number of Posts', fontsize=12)
axes[1].set_title('Distribution of Post Scores', fontsize=14, fontweight='bolc

plt.tight_layout()
plt.savefig('../reports/engagement_analysis.png', dpi=300, bbox_inches='tight'
plt.show()
```

```
============================================================
ENGAGEMENT METRICS ANALYSIS
============================================================

Overall Score Statistics:
  Mean score: 36.15
  Median score: 7.00
  Max score: 10866
  Min score: 0

Score Distribution:
  Low engagement (score 1-5): 8,773 posts (46.0%)
  Medium engagement (score 6-50): 7,936 posts (41.6%)
  High engagement (score > 50): 2,371 posts (12.4%)

============================================================
Average Score by Health Category:
============================================================
                    mean  median    max
health_category
diabetes           16.43     5.0    719
diet               51.05    12.0  10866
fitness            38.12    13.0   8243
mental_health      32.52     7.0   2058
sleep               5.91     2.0    469
substance_use      31.04     7.0   3955
weight_management  79.35     7.0   4490
```



In [9]:
```python
print("="*60)
print("TEMPORAL ANALYSIS")
print("="*60)

df['created_datetime'] = pd.to_datetime(df['created_utc'], unit='s')
df['date'] = df['created_datetime'].dt.date
df['year_month'] = df['created_datetime'].dt.to_period('M')
df['hour'] = df['created_datetime'].dt.hour
df['day_of_week'] = df['created_datetime'].dt.day_name()

print(f"\nDate Range:")
print(f"  Earliest post: {df['created_datetime'].min()}")
print(f"  Latest post: {df['created_datetime'].max()}")
print(f"  Time span: {(df['created_datetime'].max() - df['created_datetime'].m

posts_per_month = df['year_month'].value_counts().sort_index()

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

posts_per_month.plot(kind='line', marker='o', ax=axes[0, 0], color='steelblue'
axes[0, 0].set_xlabel('Month', fontsize=12)
axes[0, 0].set_ylabel('Number of Posts', fontsize=12)
axes[0, 0].set_title('Posts Over Time (Monthly)', fontsize=14, fontweight='bol
axes[0, 0].grid(True, alpha=0.3)

hour_dist = df['hour'].value_counts().sort_index()
axes[0, 1].bar(hour_dist.index, hour_dist.values, color='coral')
axes[0, 1].set_xlabel('Hour of Day (UTC)', fontsize=12)
axes[0, 1].set_ylabel('Number of Posts', fontsize=12)
axes[0, 1].set_title('Post Distribution by Hour', fontsize=14, fontweight='bol
axes[0, 1].set_xticks(range(0, 24, 2))

day_order = ['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday
day_dist = df['day_of_week'].value_counts().reindex(day_order)
axes[1, 0].bar(range(len(day_dist)), day_dist.values, color=sns.color_palette(
axes[1, 0].set_xticks(range(len(day_dist)))
axes[1, 0].set_xticklabels(day_dist.index, rotation=45)
axes[1, 0].set_xlabel('Day of Week', fontsize=12)
axes[1, 0].set_ylabel('Number of Posts', fontsize=12)
axes[1, 0].set_title('Post Distribution by Day of Week', fontsize=14, fontweig

top_5_categories = df['health_category'].value_counts().head(5).index
filtered_df = df[df['health_category'].isin(top_5_categories)]
for category in top_5_categories:
    category_data = filtered_df[filtered_df['health_category'] == category]
    monthly_counts = category_data['year_month'].value_counts().sort_index()
    axes[1, 1].plot(range(len(monthly_counts)), monthly_counts.values, marker=

axes[1, 1].set_xlabel('Time Period', fontsize=12)
axes[1, 1].set_ylabel('Number of Posts', fontsize=12)
axes[1, 1].set_title('Top 5 Categories Over Time', fontsize=14, fontweight='bo
axes[1, 1].legend()
axes[1, 1].grid(True, alpha=0.3)

plt.tight_layout()
plt.savefig('../reports/temporal_analysis.png', dpi=300, bbox_inches='tight')
plt.show()
```

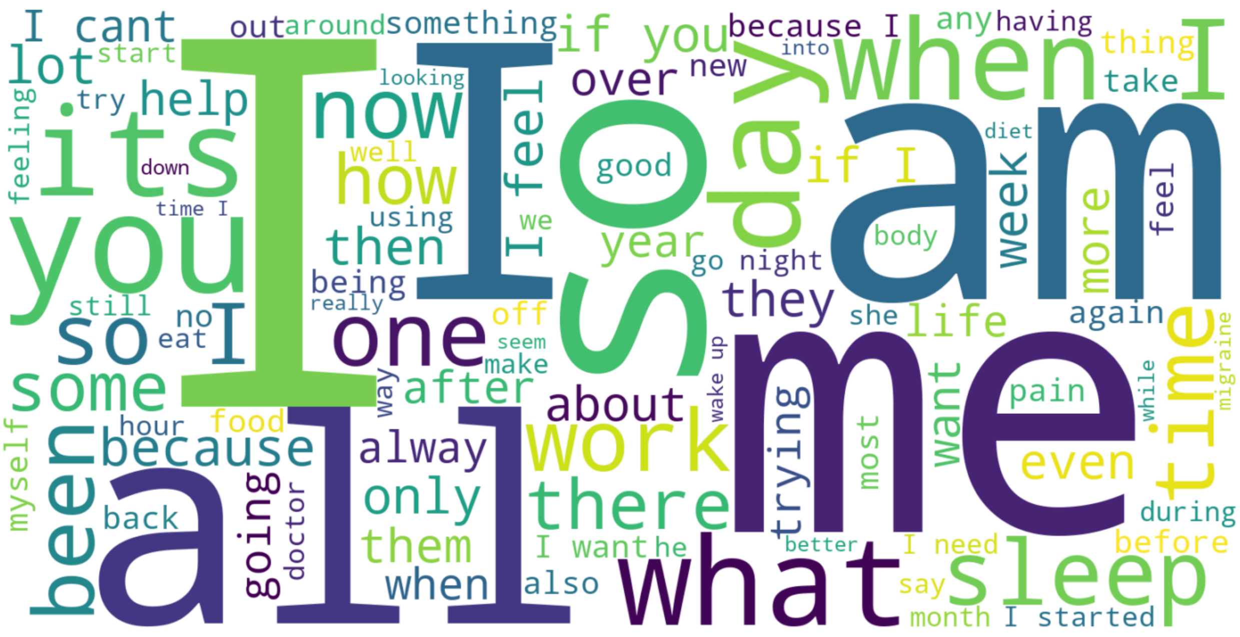
```
============================================================
TEMPORAL ANALYSIS
============================================================

Date Range:
  Earliest post: 2023-04-07 18:44:44
  Latest post: 2026-01-12 06:15:02
  Time span: 1010 days
```



In [10]:
```
print("="*60)
print("GENERATING OVERALL WORD CLOUD")
print("="*60)

all_text = ' '.join(df['text'].fillna('').astype(str))

all_text = re.sub(r'http\S+|www\S+|https\S+', '', all_text, flags=re.MULTILINE
all_text = re.sub(r'\[deleted\]|\[removed\]', '', all_text)
all_text = re.sub(r'[^a-zA-Z\s]', '', all_text)

stopwords_custom = set(['the', 'and', 'to', 'of', 'a', 'in', 'is', 'it', 'that
                        'was', 'at', 'by', 'an', 'be', 'this', 'which', 'or',
                        'my', 'have', 'has', 'had', 'do', 'does', 'did', 'will
                        'can', 'just', 'like', 'get', 'got', 'im', 'ive', 'dor

wordcloud = WordCloud(width=1600, height=800, background_color='white',
                      stopwords=stopwords_custom, max_words=100,
                      colormap='viridis', relative_scaling=0.5).generate(all_te

plt.figure(figsize=(16, 8))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.title('Most Common Words in All Health Discussions', fontsize=18, fontweig
plt.tight_layout()
plt.savefig('../reports/wordcloud_overall.png', dpi=300, bbox_inches='tight')
plt.show()

print("✅ Overall word cloud generated!")
```

```
============================================================
GENERATING OVERALL WORD CLOUD
============================================================
```

Most Common Words in All Health Discussions

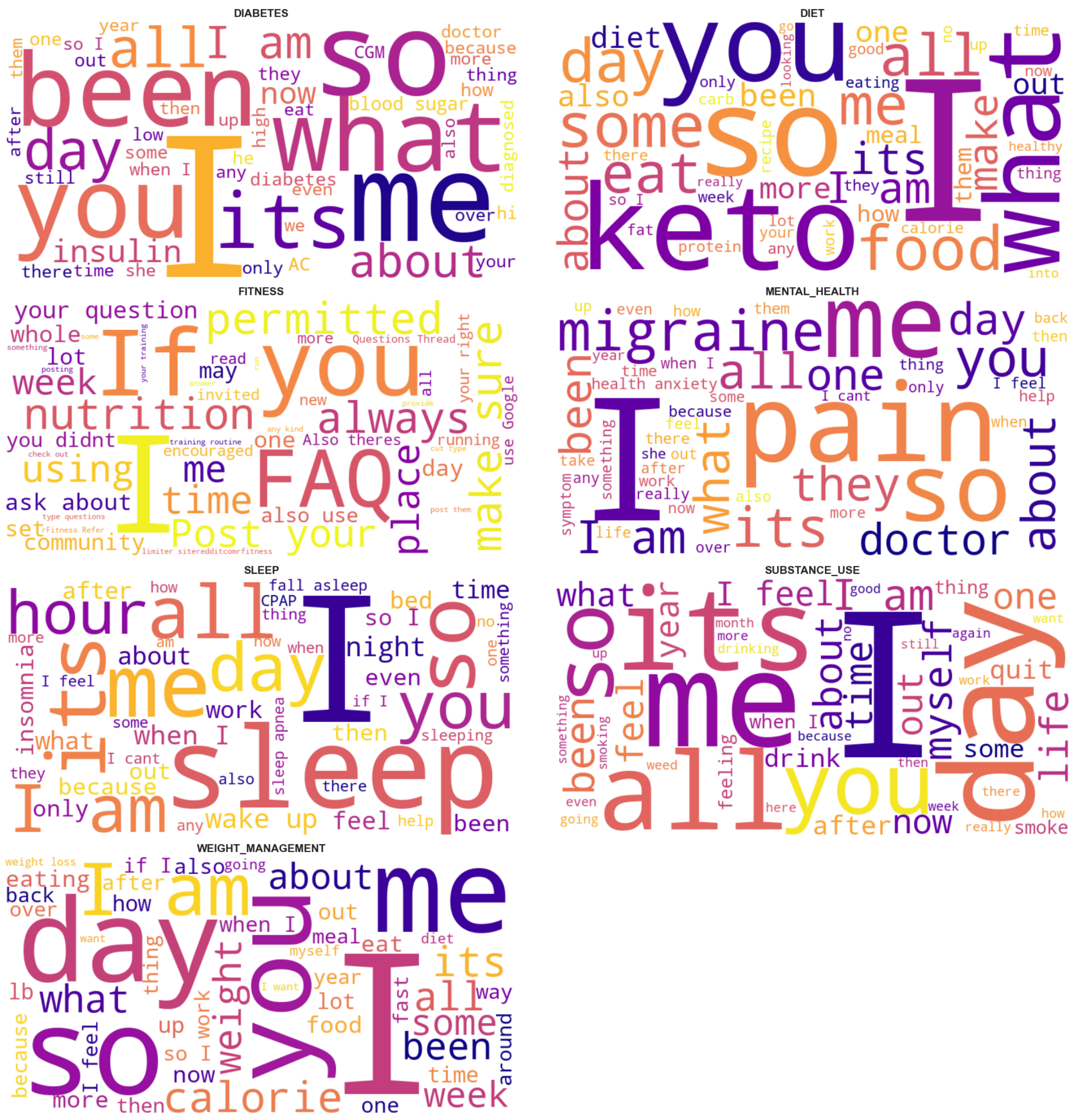


```
✅ Overall word cloud generated!
```

```
In [11]: print("="*60)
         print("GENERATING WORD CLOUDS BY CATEGORY")
         print("="*60)

         categories = df['health_category'].unique()
         n_categories = len(categories)

         rows = (n_categories + 1) // 2
         fig, axes = plt.subplots(rows, 2, figsize=(20, 5 * rows))
         axes = axes.flatten()

         for idx, category in enumerate(categories):
             category_text = ' '.join(df[df['health_category'] == category]['text'].fil

             category_text = re.sub(r'http\S+|www\S+|https\S+', '', category_text, flag
             category_text = re.sub(r'\[deleted\]|\[removed\]', '', category_text)
             category_text = re.sub(r'[^a-zA-Z\s]', '', category_text)

             wordcloud = WordCloud(width=800, height=400, background_color='white',
                                   stopwords=stopwords_custom, max_words=50,
                                   colormap='plasma').generate(category_text)

             axes[idx].imshow(wordcloud, interpolation='bilinear')
             axes[idx].axis('off')
             axes[idx].set_title(f'{category.upper()}', fontsize=14, fontweight='bold')
```

```
    print(f"✅ Generated word cloud for: {category}")

for idx in range(n_categories, len(axes)):
    axes[idx].axis('off')

plt.tight_layout()
plt.savefig('../reports/wordcloud_by_category.png', dpi=300, bbox_inches='tigh
plt.show()

print("\n✅ All category word clouds generated!")
```

```
============================================================
GENERATING WORD CLOUDS BY CATEGORY
============================================================
✅ Generated word cloud for: diabetes
✅ Generated word cloud for: diet
✅ Generated word cloud for: fitness
✅ Generated word cloud for: mental_health
✅ Generated word cloud for: sleep
✅ Generated word cloud for: substance_use
✅ Generated word cloud for: weight_management
```



```
✅ All category word clouds generated!
```

In [12]:
```python
print("="*60)
print("TOP WORDS ANALYSIS BY CATEGORY")
print("="*60)

def get_top_words(text, n=20):
    text = re.sub(r'http\S+|www\S+|https\S+', '', text, flags=re.MULTILINE)
    text = re.sub(r'\[deleted\]|\[removed\]', '', text)
    text = re.sub(r'[^a-zA-Z\s]', '', text.lower())

    words = text.split()
    words = [w for w in words if w not in stopwords_custom and len(w) > 3]

    word_counts = Counter(words)
    return word_counts.most_common(n)
```

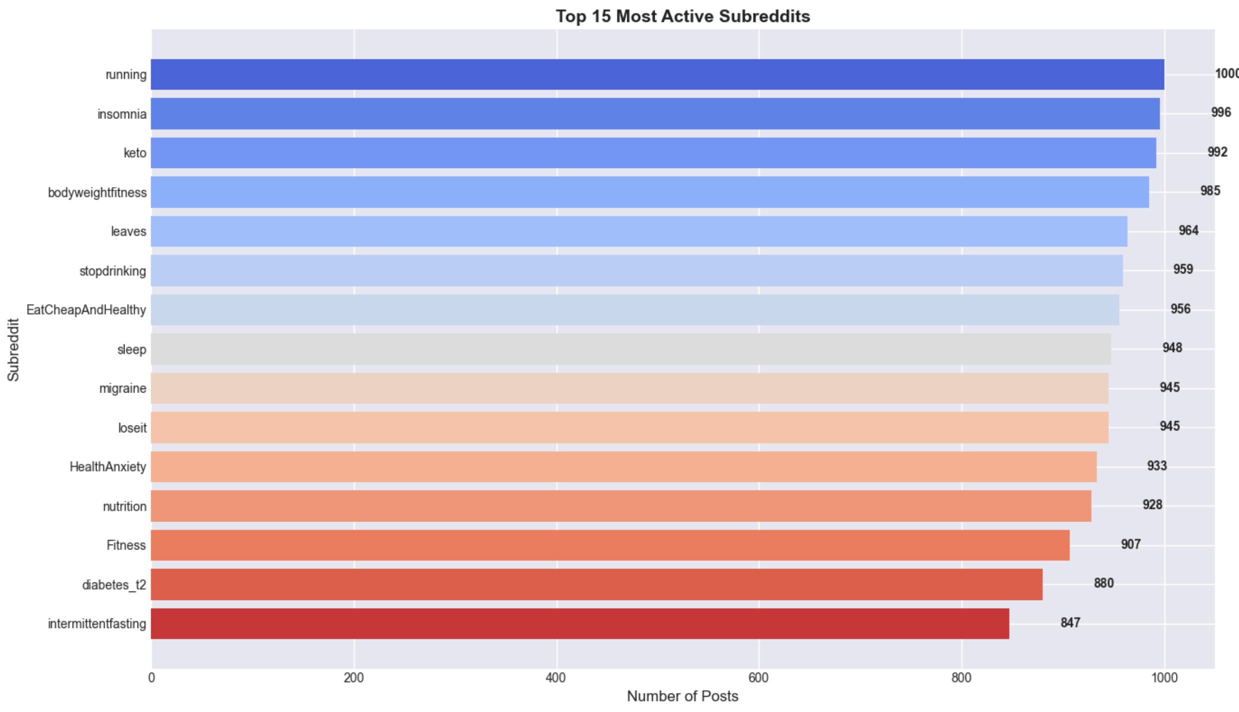
```python

for category in df['health_category'].unique():
    category_text = ' '.join(df[df['health_category'] == category]['text'].fil
    top_words = get_top_words(category_text, 15)

    print(f"\n{category.upper()}:")
    print("-" * 60)
    for word, count in top_words:
        print(f"  {word:20s}: {count:5,}")
```

```
============================================================
TOP WORDS ANALYSIS BY CATEGORY
============================================================

DIABETES:
------------------------------------------------------------
  been                : 1,605
  what                : 1,238
  about               : 1,227
  sugar               : 1,085
  blood               : 1,061
  insulin             : 1,058
  when                : 1,033
  diabetes            :   928
  after               :   882
  because             :   858
  time                :   795
  they                :   790
  some                :   750
  more                :   743
  also                :   718

DIET:
------------------------------------------------------------
  keto                : 1,613
  some                : 1,338
  what                : 1,245
  about               : 1,059
  been                : 1,049
  more                :   937
  protein             :   929
  food                :   792
  diet                :   761
  also                :   741
  eating              :   738
  weight              :   708
  when                :   699
  your                :   699
  time                :   692

FITNESS:
------------------------------------------------------------
  your                : 5,257
  questions           : 4,398
  post                : 2,766
  thread              : 2,610
  also                : 2,244
  search              : 2,072
  rfitness            : 2,000
  sure                : 1,927
  about               : 1,881
  here                : 1,510
  training            : 1,483
  only                : 1,417
  fitness             : 1,408
  what                : 1,350
  some                : 1,314

MENTAL_HEALTH:
------------------------------------------------------------
  pain                : 2,908
  been                : 1,643
  about               : 1,616
  what                : 1,608
  they                : 1,545
  anxiety             : 1,530
  your                : 1,449
  when                : 1,382
  feel                : 1,327
  health              : 1,248
  because             : 1,176
  some                : 1,134
  time                : 1,131
  more                : 1,023
  migraine            : 1,014

SLEEP:
------------------------------------------------------------
  sleep               : 6,915
  night               : 1,974
  when                : 1,681
  been                : 1,663
  about               : 1,430
  feel                : 1,351
  what                : 1,349
  time                : 1,346
  asleep              : 1,337
  hours               : 1,324
  even                : 1,165
  wake                : 1,122
  because             : 1,121
  then                : 1,000
  back                :   966

SUBSTANCE_USE:
------------------------------------------------------------
  been                : 2,103
  feel                : 1,867
  time                : 1,854
  about               : 1,499
  years               : 1,464
  myself              : 1,448
  when                : 1,444
  smoking             : 1,420
  quit                : 1,380
  days                : 1,322
  more                : 1,224
  what                : 1,174
  want                 : 1,138
  really               : 1,111
  life                 : 1,100

WEIGHT_MANAGEMENT:
------------------------------------------------------------
  weight               : 2,350
  been                 : 1,482
  about                : 1,395
  more                 : 1,163
  calories             : 1,150
  your                 : 1,148
  eating               : 1,145
  what                 : 1,128
  some                 : 1,038
  time                 : 1,025
  when                 :   984
  feel                 :   915
  want                 :   888
  really               :   876
  week                 :   824
```

In [13]:

```python
print("="*60)
print("SUBREDDIT ANALYSIS")
print("="*60)

if 'subreddit' in df.columns:
    subreddit_counts = df['subreddit'].value_counts().head(15)

    print("\nTop 15 Subreddits:")
    print(subreddit_counts)

    plt.figure(figsize=(14, 8))
    plt.barh(range(len(subreddit_counts)), subreddit_counts.values, color=sns.
    plt.yticks(range(len(subreddit_counts)), subreddit_counts.index)
    plt.xlabel('Number of Posts', fontsize=12)
    plt.ylabel('Subreddit', fontsize=12)
    plt.title('Top 15 Most Active Subreddits', fontsize=14, fontweight='bold')
    plt.gca().invert_yaxis()

    for i, v in enumerate(subreddit_counts.values):
        plt.text(v + 50, i, str(v), va='center', fontweight='bold')

    plt.tight_layout()
    plt.savefig('../reports/subreddit_distribution.png', dpi=300, bbox_inches=
    plt.show()
else:
    print("⚠ 'subreddit' column not found in dataset")
```

```
============================================================
SUBREDDIT ANALYSIS
============================================================

Top 15 Subreddits:
subreddit
running                1000
insomnia                996
keto                    992
bodyweightfitness       985
leaves                  964
stopdrinking            959
EatCheapAndHealthy      956
sleep                   948
migraine                945
loseit                  945
HealthAnxiety           933
nutrition               928
Fitness                 907
diabetes_t2             880
intermittentfasting     847
Name: count, dtype: int64
```



In [14]:
```python
print("="*80)
print(" " * 25 + "EXPLORATORY DATA ANALYSIS SUMMARY")
print("="*80)

print("\n📊 DATASET OVERVIEW:")
print("-" * 80)
print(f"  Total Posts: {len(df):,}")
print(f"  Total Categories: {df['health_category'].nunique()}")
print(f"  Date Range: {df['created_datetime'].min().date()} to {df['created_da
print(f"  Time Span: {(df['created_datetime'].max() - df['created_datetime'].m

print("\n📈 CATEGORY DISTRIBUTION:")
print("-" * 80)
for category, count in df['health_category'].value_counts().items():
    percentage = (count / len(df)) * 100
    print(f"  {category:25s}: {count:6,} posts ({percentage:5.2f}%)")

print("\n📝 TEXT STATISTICS:")
print("-" * 80)
print(f"  Average text length: {df['text_length'].mean():.0f} characters")
print(f"  Average word count: {df['word_count'].mean():.0f} words")
print(f"  Median text length: {df['text_length'].median():.0f} characters")
print(f"  Median word count: {df['word_count'].median():.0f} words")

print("\n💬 ENGAGEMENT METRICS:")
print("-" * 80)
print(f"  Average score: {df['score'].mean():.2f}")
print(f"  Median score: {df['score'].median():.2f}")
print(f"  Highest score: {df['score'].max()}")
print(f"  Low engagement posts (score ≤ 5): {len(df[df['score'] <= 5]):,} ({le
print(f"  High engagement posts (score > 50): {len(df[df['score'] > 50]):,} ({

if 'subreddit' in df.columns:
    print("\n🌐 SUBREDDIT STATISTICS:")
    print("-" * 80)
    print(f"  Total unique subreddits: {df['subreddit'].nunique()}")
    print(f"  Most active subreddit: {df['subreddit'].value_counts().index[0]}

print("\n📁 OUTPUT FILES GENERATED:")
print("-" * 80)
print("  ✅ missing_values.png")
print("  ✅ category_distribution.png")
print("  ✅ text_length_analysis.png")
print("  ✅ engagement_analysis.png")
print("  ✅ temporal_analysis.png")
print("  ✅ wordcloud_overall.png")
print("  ✅ wordcloud_by_category.png")
print("  ✅ subreddit_distribution.png")

print("\n" + "="*80)
print(" " * 30 + "EDA COMPLETED SUCCESSFULLY! ✅")
print("="*80)
```

```
================================================================================
=
                         EXPLORATORY DATA ANALYSIS SUMMARY
================================================================================
=

📊 DATASET OVERVIEW:
--------------------------------------------------------------------------------
-
  Total Posts: 19,080
  Total Categories: 7
  Date Range: 2023-04-07 to 2026-01-12
  Time Span: 1010 days

📈 CATEGORY DISTRIBUTION:
--------------------------------------------------------------------------------
-
  fitness                    :  2,892 posts (15.16%)
  diet                       :  2,876 posts (15.07%)
  substance_use              :  2,769 posts (14.51%)
  sleep                      :  2,768 posts (14.51%)
  mental_health              :  2,716 posts (14.23%)
  diabetes                   :  2,535 posts (13.29%)
  weight_management          :  2,524 posts (13.23%)

📝 TEXT STATISTICS:
--------------------------------------------------------------------------------
-
  Average text length: 812 characters
  Average word count: 145 words
  Median text length: 576 characters
  Median word count: 105 words

💬 ENGAGEMENT METRICS:
--------------------------------------------------------------------------------
-
  Average score: 36.15
  Median score: 7.00
  Highest score: 10866
  Low engagement posts (score ≤ 5): 8,773 (46.0%)
  High engagement posts (score > 50): 2,371 (12.4%)

🌐 SUBREDDIT STATISTICS:
--------------------------------------------------------------------------------
-
  Total unique subreddits: 21
  Most active subreddit: running (1,000 posts)

📁 OUTPUT FILES GENERATED:
--------------------------------------------------------------------------------
-
  ✅ missing_values.png
  ✅ category_distribution.png
  ✅ text_length_analysis.png
  ✅ engagement_analysis.png
  ✅ temporal_analysis.png
  ✅ wordcloud_overall.png
  ✅ wordcloud_by_category.png
  ✅ subreddit_distribution.png

================================================================================
=
                              EDA COMPLETED SUCCESSFULLY! ✅
================================================================================
=
```

In [15]:

```
print("="*60)
print("SAVING PROCESSED DATA WITH NEW FEATURES")
print("="*60)

output_columns = ['id', 'title', 'text', 'created_utc', 'score', 'num_comments
                  'subreddit', 'health_category', 'text_length', 'word_count',
                  'created_datetime', 'date', 'hour', 'day_of_week']

available_columns = [col for col in output_columns if col in df.columns]

df_output = df[available_columns]

output_path = '../data/processed/eda_processed_data.csv'
df_output.to_csv(output_path, index=False)

print(f"✅ Processed data saved to: {output_path}")
print(f"   Shape: {df_output.shape}")
print(f"   Columns: {list(df_output.columns)}")
```

```
============================================================
SAVING PROCESSED DATA WITH NEW FEATURES
============================================================
✅ Processed data saved to: ../data/processed/eda_processed_data.csv
   Shape: (19080, 14)
   Columns: ['id', 'title', 'text', 'created_utc', 'score', 'num_comments', 'su
breddit', 'health_category', 'text_length', 'word_count', 'created_datetime',
'date', 'hour', 'day_of_week']
```

In [ ]: