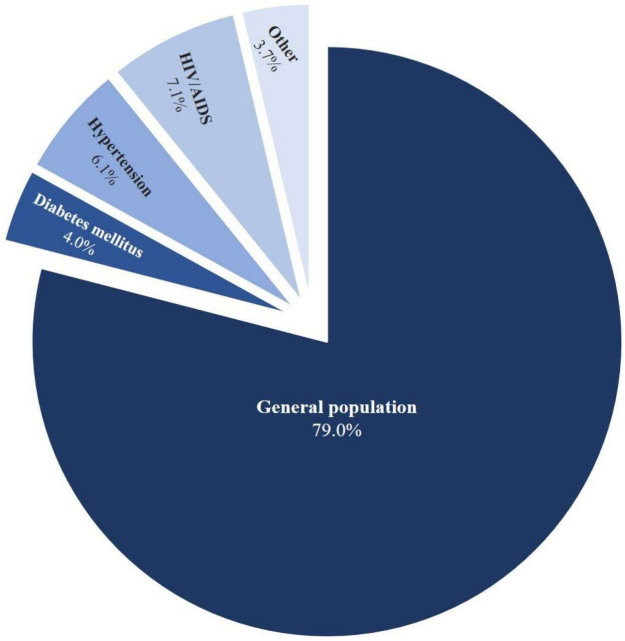
Group 5: Comorbidities

Aim

- To provide an overview of morbidity and comorbidities

- To discuss the role of data science in assessing and managing comorbidities
- To illustrate real-world applications by presenting a case study on common diabetes comorbidities

Morbidity and Comorbidities



1 - Global Prevalence

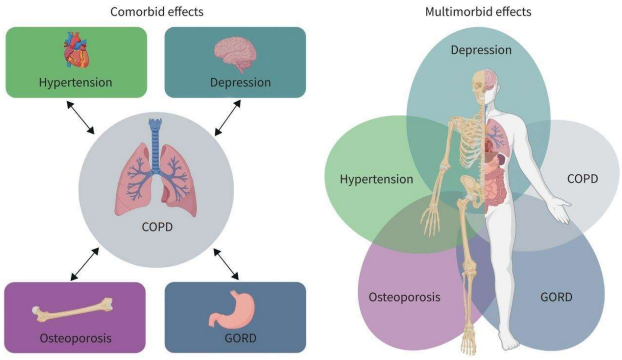
- The presence of diseases in a population [1,2]
- The rate at which diseases occur in a population [1,2]
- The overall global prevalence of comorbidities is 37.2% [2]

Common Comorbidities in the UK

Condition	Prevalence (%)	Frequently associated comorbidities
Hypertension	18.2	Pain, diabetes, hearing loss
Depression/anxiety	10.3	Pain, hypertension, irritable bowel syndrome
Chronic pain	10.1	Hypertension, depression/anxiety, hearing loss
Hearing loss	9.5	Hypertension, pain, depression/anxiety
Irritable bowel syndrome	7.9	Depression/anxiety, hypertension, pain
Diabetes	5.9	Hypertension, pain, depression/anxiety
Prostate disorders	5.7	Hypertension, hearing loss, pain
Thyroid disorders	4.7	Hypertension, pain, depression/anxiety
Coronary heart disease	4.3	Hypertension, pain, diabetes
Asthma	3.7	Hypertension, pain, depression/anxiety

2 - [3]

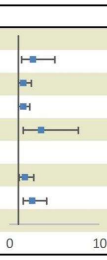
Trends in Comorbidities



- Who comorbidities affect [1]
- Why diseases intersect [1]

Impacts of Comorbidities

Features	Hazard Ratio (95%CI)		P Value
Type of comorbidities			
COPD	2.681	(1.424-5.048)	0.002
Diabetes	1.586	(1.028-2.449)	0.037
Hypertension	1.575	(1.069-2.322)	0.022
Malignant tumor	3.501	(1.604-7.643)	0.002
Number of comorbidities			
1	1.789	(1.155-2.772)	0.009
2 or more	2.592	(1.611-4.171)	<0.001



- Increased healthcare costs [4]
- Poorer patient outcomes [4]
- Longer hospital stays [4]
- Healthcare strains [4]
- Need for specialised tools [4]

Tools for Predicting Patient Survival Rates

- *Charlson Comorbidity Index [5]*
- *Elixhauser Comorbidity Index [5]*
- *Cumulative Illness Rating Scale [6]*
- *Karnofsky Performance Scale [7]*
- *Kaplan-Feinstein Index [8]*
- *Simplified Comorbidity Score [9]*
- *Adult Comorbidity Evaluation-27 [10]*

Table 2

Modified Charlson Index

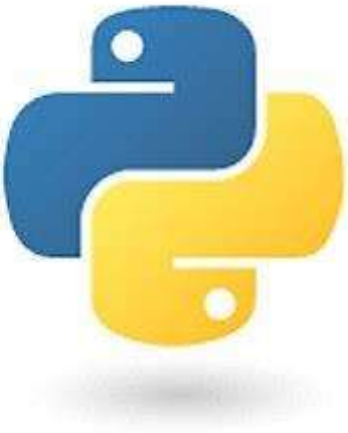
PATHOLOGY	SCORE
Coronary disease	1
Congestive heart failure	1
Peripheral vascular disease	1
Cerebrovascular disease	1
Dementia	1
Chronic pulmonary disease	1
Connective tissue disease	1
Peptic ulcer	1
Mild liver disease	1
Diabetes	1
Hemiplegia	2
Moderate-severe renal disease	2
Diabetes with damage to target organs	2
Any tumor, leukemia, lymphoma	2
Moderate-severe liver disease	3
Solid metastasic tumor	6
AIDS	6

In addition, for each decade > 50 years 1 extra point is added.

Source: *Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. J Clin Epidemiol. 1992; 45[6]:613-619.*

5 points	21 %
Charlson Comorbidity Index	Estimated 10-year survival

Case Study: Diabetes Comorbidities [USA]



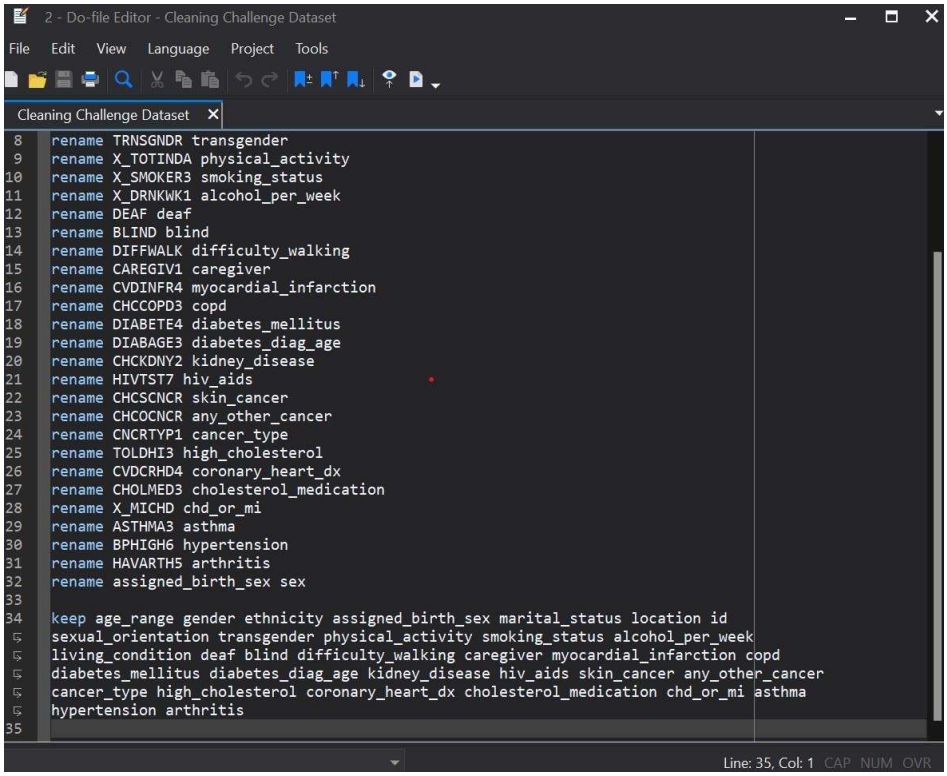
Data Source:

CDC National Health Interview Survey Data

Tools Used:

- STATA
- Excel
- R
- Power BI
- Python

Result - Data Cleaning and Preparation



Result - Exploratory Data Analysis [Excel]

AV	AW	AX
diabetes_mellitus		
1	57616	13.1%
2	3808	0.9%
3	366342	83.5%
4	9942	2.3%
7	613	0.1%
9	369	0.1%
NA	3	0.0%

438693

H	I	J
hypertension		
1	172133	39.2%
2	3474	0.8%
3	256603	58.5%
4	4571	1.0%
7	1191	0.3%
9	719	0.2%
NA	2	0.0%
		0.0%
	438693	

Table Key:

1: Yes

2: Yes, but told only during pregnancy (female)

3: No

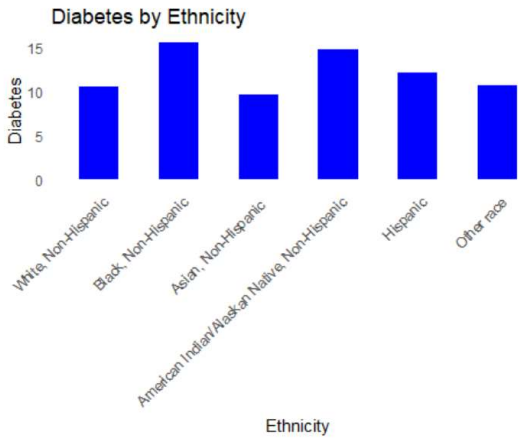
4: Told borderline high or pre-elevated

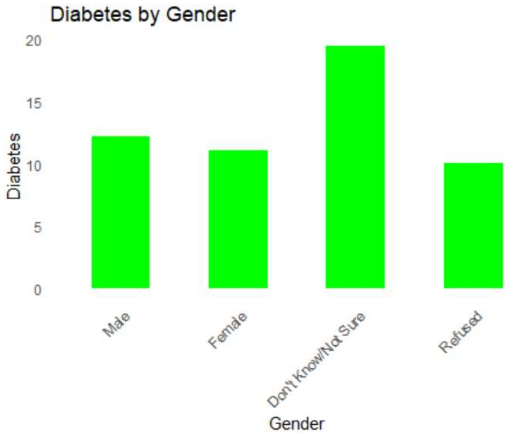
7: Don´t know/Not Sure

9: Refused

BLANK: Not asked or Missing

Result - Data Analysis [R]





Packages Used:

- tidyverse
- survey
- patchwork

Result - Data Analysis [Python]

```
                           Logit Regression Results
==============================================================================
Dep. Variable:      diabetes_mellitus   No. Observations:               438691
Model:                          Logit   Df Residuals:                   438689
Method:                           MLE   Df Model:                            1
Date:                Wed, 21 Aug 2024   Pseudo R-squ.:                0.06112
Time:                        19:22:12   Log-Likelihood:                -13.136
converged:                       True   LL-Null:                       -13.992
Covariance Type:            nonrobust   LLR p-value:                    0.1909
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept      15.1028      1.911      7.901      0.000      11.357      18.849
hypertension   -0.7416      0.407     -1.821      0.069      -1.540       0.057
==============================================================================

Possibly complete quasi-separation: A fraction 1.00 of observations can be
perfectly predicted. This might indicate that there is complete
quasi-separation. In this case some parameters will not be identified.
```

Association between Hypertension and Diabetes:

Hypothesis formulation:

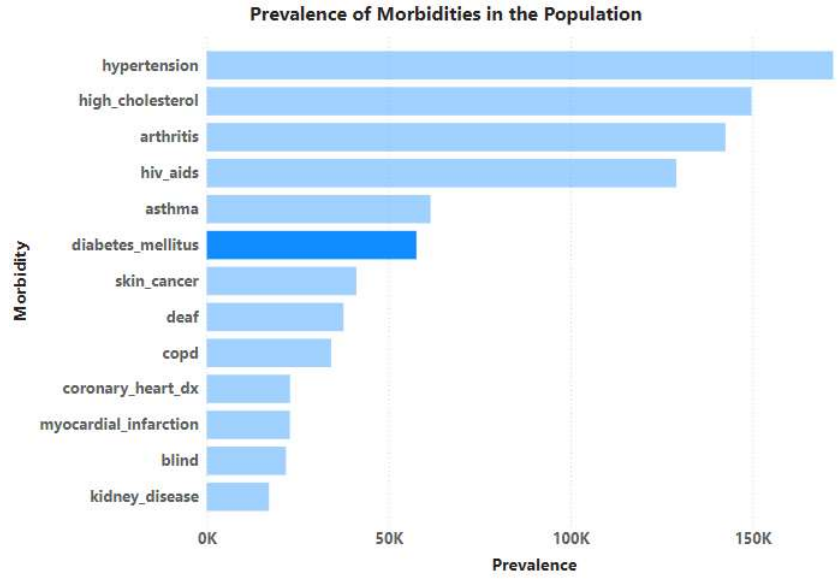
H0: There is no association between hypertension and diabetes in the population

H1: There is an association between hypertension and diabetes in the population

Interpretation:

- *The coefficient for hypertension is negative (-0.7416), suggesting that individuals with hypertension have lower odds of having diabetes.*
- *However, the p-value (0.069) [95% CI: -1.540 – 0.057] is greater than 0.05, indicating this association is not statistically significant.*
- *Based on this model, we cannot confidently reject the null hypothesis that there is no association between hypertension and diabetes.*

Data Visualisation [Power BI]



Key Takeaways and Conclusion

- As the population ages and people live longer, the healthcare system faces growing demands to manage increasingly complex needs
- Tools like the Charlson Comorbidity Index are essential for assessing the complexity of comorbidities
- Effective management of comorbidities will be critical for improving patient outcomes and optimising healthcare resources

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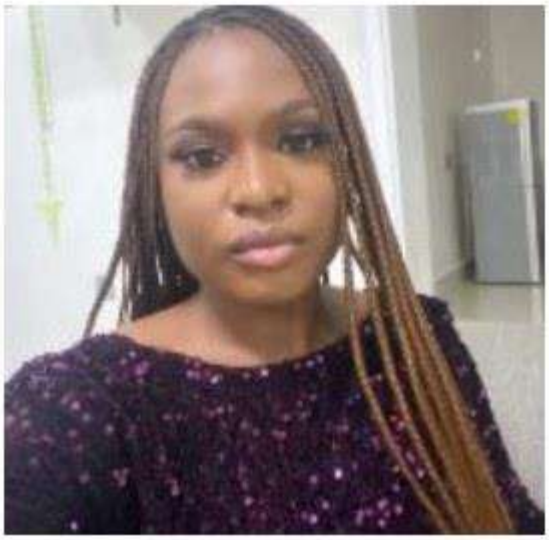

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