Health Status Indicators

Project Introduction

1. Goal of The Project

```
1. Analysing health status indicators and understand how behavioural factors such as obesity, tobacco use, diet, physical activity, drugs, alcohol usage
and others contribute and relate to leading causes of death like obesity, heart disease, cancer etc and determine what affects them at the county level.
2.Using Predictive Modeling for predicting and understanding the leading causes of death like Lung Cancer, Breast Cancer, Colon Cancer, Poverty, Heart D
iseases etc using various feature selection techniques.
```

2. Expected Outcome

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    1.After exploratory data analysis, a one-time report to be prepared providing insights and measures to be taken to improve healthcare across the country.
    2.Predictive Analytics to be done using Machine Learning based models to provide and assist with evidence based decisions for better healthcare on Leading Ca
uses of Death like Diabetes, Cancer, Heart Diseases etc.
    3.Spread awareness about the issues affecting public health and a tool to local public health agencies for improving their community's health and provide the
m with insights to assist in the development of public policies, health programs and prioritise funding in the most effective pathway.
```

3. About the Data

```
1.HEALTHY_PEOPLE_2010.csv (Healthy People 2010 Targets and the U.S. Percentages or Rates)
2.DEMOGRAPHICS.csv (Demographics indicator domain)                                         3141 rows, 44 columns
3.LEADING_CAUSES_OF_DEATH.csv (Leading Causes of Death indicator domain)                  3000+ rows, 235 columns
4.SUMMARY_MEASURES_OF_HEALTH.csv (Summary Measures of Health indicator domain)            3141 rows, 141 columns
5.MEASURES_OF_BIRTH_AND_DEATH.csv (Measures of Birth and Death indicator domain)          3000+ rows, 141 columns
6.RELATIVE_HEALTH_IMPORTANCE. (Relative Health Importance indicator domain)               3141 rows, 28 columns
7.VULNERABLE_POPS_AND_ENV_HEALTH.csv (Vulnerable Populations and Environmental Health)    3141 rows, 28 columns
8.PREVENTIVE_SERVICES_USE. (Preventive Services indicator domain)                          3141 rows, 43 columns
9.RISK_FACTORS_AND_ACCESS_TO_CARE.csv (Risk Factors and Access to Care indicator domain)  3141 rows, 31 columns
```

4. Goals Updated

```
   Earlier Goal: Broad goals of predicting heart disease, obesity and cancer.
   Refined Goal: Other leading causes of death like average life expetancy, diabetes, different types of cancers added(Please see dependent variables below)

- We  strive to provide as much useful insights as possible from the dataset to spread awareness about general issues pertaining to health and give correlations
 of each of the above attribute with other attributes in the dataset and find actionable insights.
 - We intend to determine the important factors which are responsible or have correlation for higher values for each of the attributes in leading causes of deat
h.
```

5. About Data Cleaning

```
A data dump was picked up from the link below in a zip file consisting of 10 csvs. The data dump consisted of the data dictionary as well as the description of t
he default values therein.
        1. All missing values and default values were replaced to nan or handled appropriately for plotting purposes.
        Default Values= [-9999,-2222,-2222.2,-2,-1111.1,-1111,-1,-9998.9]
        2.During Modeling Phase missing values in all numerical attributes were replaced by the mean of the column
```

In [4]:

```python
import os
from os import listdir
from os.path import isfile, join
codepath=r'C:\Users\Varun\Desktop\IDS Project\Codes'
datapath=r'C:\Users\Varun\Desktop\IDS Project\Dataset'
os.chdir(datapath)
onlyfiles = [f for f in listdir(datapath) if isfile(join(datapath, f))]
os.chdir(codepath)
%run LibrariesImport.py # loading libraries
%run DD.py# loading datadictionary
```

```
All Libraries loaded
```

6. Data Dictionary (Description About All CSVs and Columns)

In [6]:

```python
DD.head(5) #manually change the integer to display more rows
```

Out[6]:

	PAGE_NAME	COLUMN_NAME	DESCRIPTION	IS_PERCENT_DATA
0	Demographics	State_FIPS_Code	Two-digit state identifier, developed by the N...	N
1	Demographics	County_FIPS_Code	Three-digit county identifier, developed by th...	N
2	Demographics	CHSI_County_Name	Name of county	N
3	Demographics	CHSI_State_Name	Name of State or District of Columbia	N
4	Demographics	CHSI_State_Abbr	Two-character postal abbreviation for state name	N

7. Exploratory Data Analysis

We have studied every attribute in all the files, merged all of them on the basis of the primary keys: 'State_FIPS_Code', 'County_FIPS_Code', 'CHSI_County_Name','CHSI_State_Name', 'CHSI_State_Abbr', 'Strata_ID_Number'.

1.The Data Granularity is of a county level.
2.Each row represents various values in percentages/or numeric of a particular county of a particular state.
3.The scope of the dataset is entire population of United States of America.
4. One Time Survey Data 1993-2003
5.Merged CSV of 9CSVs (Check About the Data Heading)

Independent Attributes: 'No_Exercise', 'Few_Fruit_Veg', 'Obesity', 'High_Blood_Pres', 'Smoker', 'Uninsured', 'Elderly_Medicare', 'Disabled_Medicare', 'Prim_Care_Phys_Rate', 'Dentist_Rate', 'FluB_Rpt', 'HepA_Rpt', 'HepB_Rpt', 'Meas_Rpt', 'Pert_Rpt', 'CRS_Rpt', 'Syphilis_Rpt', 'FluB_Rpt%', 'HepA_Rpt%', 'HepB_Rpt%', 'Meas_Rpt%', 'Pert_Rpt%', 'CRS_Rpt%', 'Syphilis_Rpt%', 'Pap_Smear', 'Mammogram', 'Proctoscopy', 'Pneumo_Vax', 'Flu_Vac', 'Pap_Smear%', 'Mammogram%', 'Proctoscopy%', 'Pneumo_Vax%', 'Flu_Vac%', 'Population_Size', 'Population_Density', 'Poverty', 'Age_19_Under', 'Age_19_64', 'Age_65_84', 'Age_85_and_Over', 'White', 'Black', 'Native_American', 'Asian', 'Hispanic', 'No_HS_Diploma', 'No_HS_Diploma%', 'Unemployed', 'Unemployed%', 'Sev_Work_Disabled', 'Sev_Work_Disabled%', 'Major_Depression', 'Major_Depression%', 'Recent_Drug_Use', 'Recent_Drug_Use%', 'Ecol_Rpt', 'Salm_Rpt', 'Shig_Rpt', 'Toxic_Chem', 'All_Death', 'Health_Status', 'Unhealthy_Days', 'LBW', 'VLBW', 'Premature', 'Under_18', 'Total_Births', 'Total_Deaths', 'Total_Births%', 'Total_Deaths%', 'Over_40', 'Unmarried', 'Late_Care', 'Infant_Mortality', 'IM_Neonatal', 'IM_Postneonatal' 'Homicide', 'Homicide%'

Dependent Attributes(Leading Causes of Death): 'ALE', 'Diabetes', 'Lung_Cancer', 'Brst_Cancer', 'Col_Cancer', 'MVA', 'Stroke', 'Suicide', 'Injury', 'CHD'

After Careful EDA of all attributes we found many Observations, some of the intuitive ones have been listed below:

In [20]:
```
PSU_Demo_VPEH_SMOH_RFAC_df.head()# merged, collated, cleaned ready for analysis dataset
```

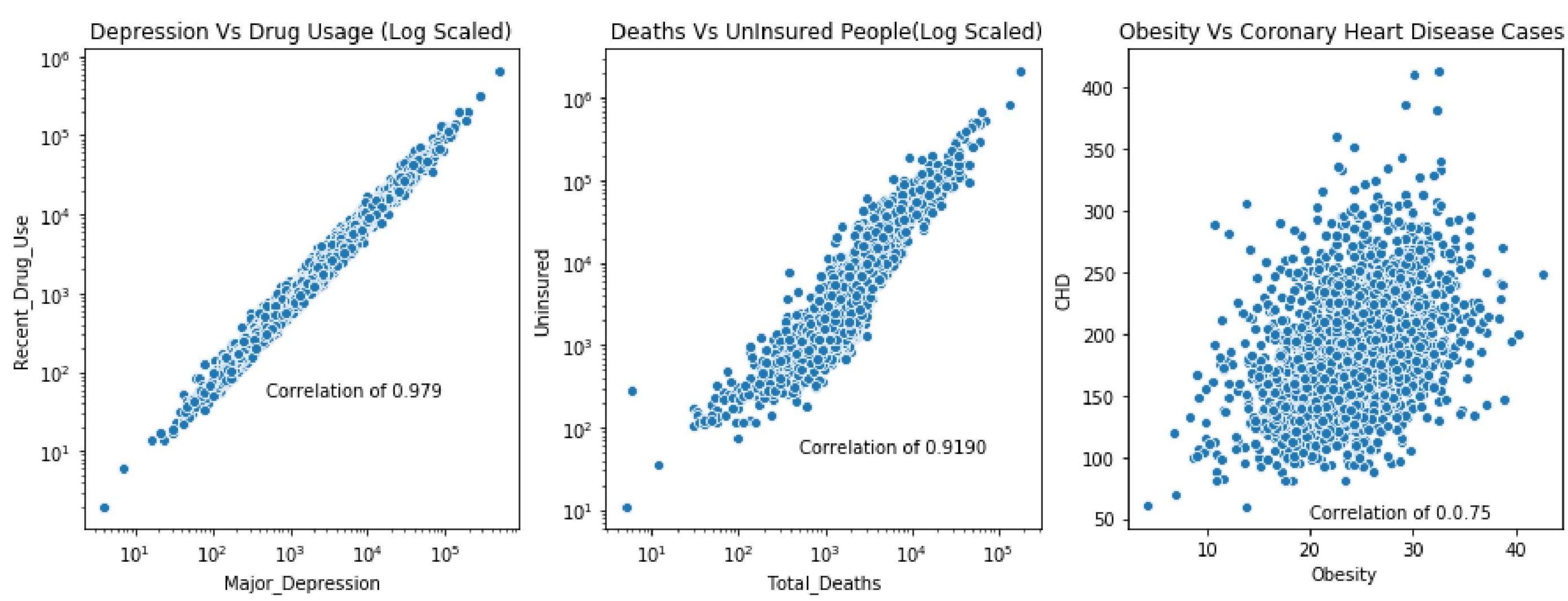
Out[20]:

	State_FIPS_Code	County_FIPS_Code	CHSI_County_Name	CHSI_State_Name	CHSI_State_Abbr	Strata_ID_Number	No_Exercise	Few_Fruit_Veg	Ob
0	1	1	Autauga	Alabama	AL	29	27.8	78.6	
1	1	3	Baldwin	Alabama	AL	16	27.2	76.2	
2	1	5	Barbour	Alabama	AL	51	NaN	NaN	
3	1	7	Bibb	Alabama	AL	42	NaN	86.6	
4	1	9	Blount	Alabama	AL	28	33.5	74.6	

5 rows × 71 columns

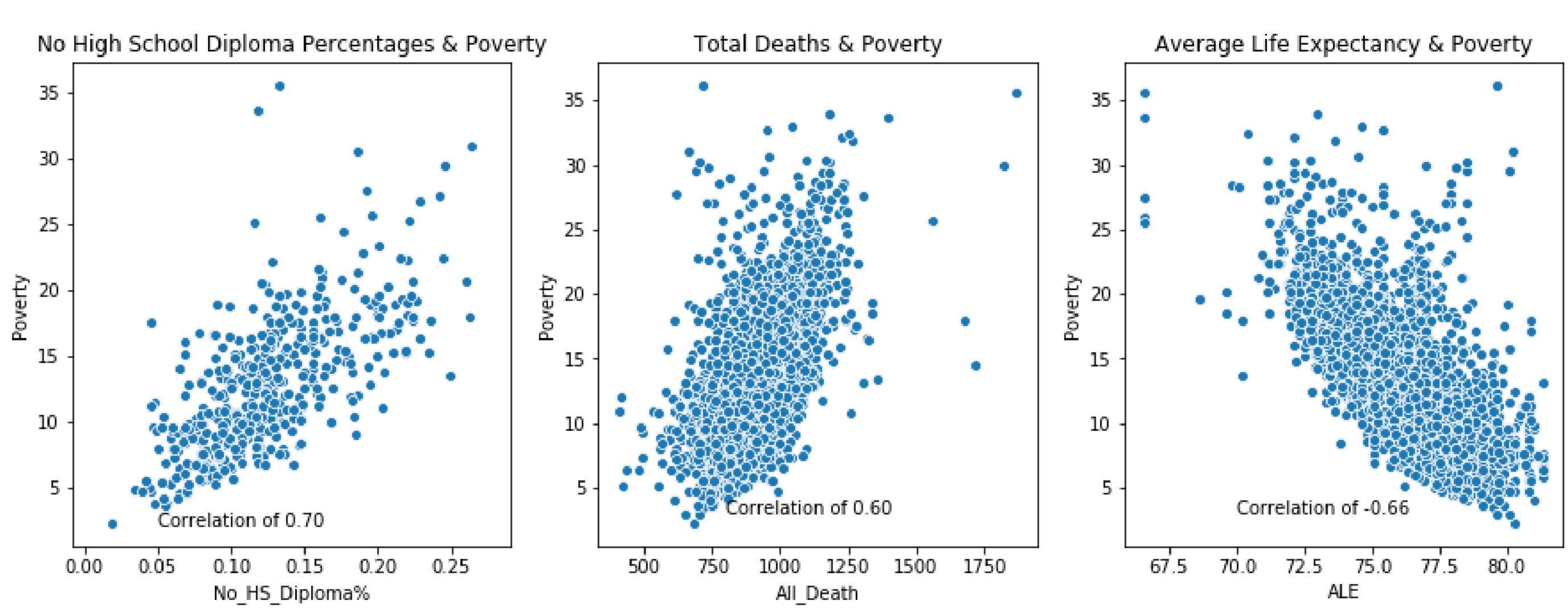
In [8]:
```
os.chdir(codepath)
%run EDA.py
os.chdir(codepath)
%run plotter1.py
```

1.Higher cases of depression in a county are correlated with higher drug usage
2.Counties with more insured people, have higher death rates
3.Higher Coronary Heart Disease Cases in a county seen in counties with more obesity levels



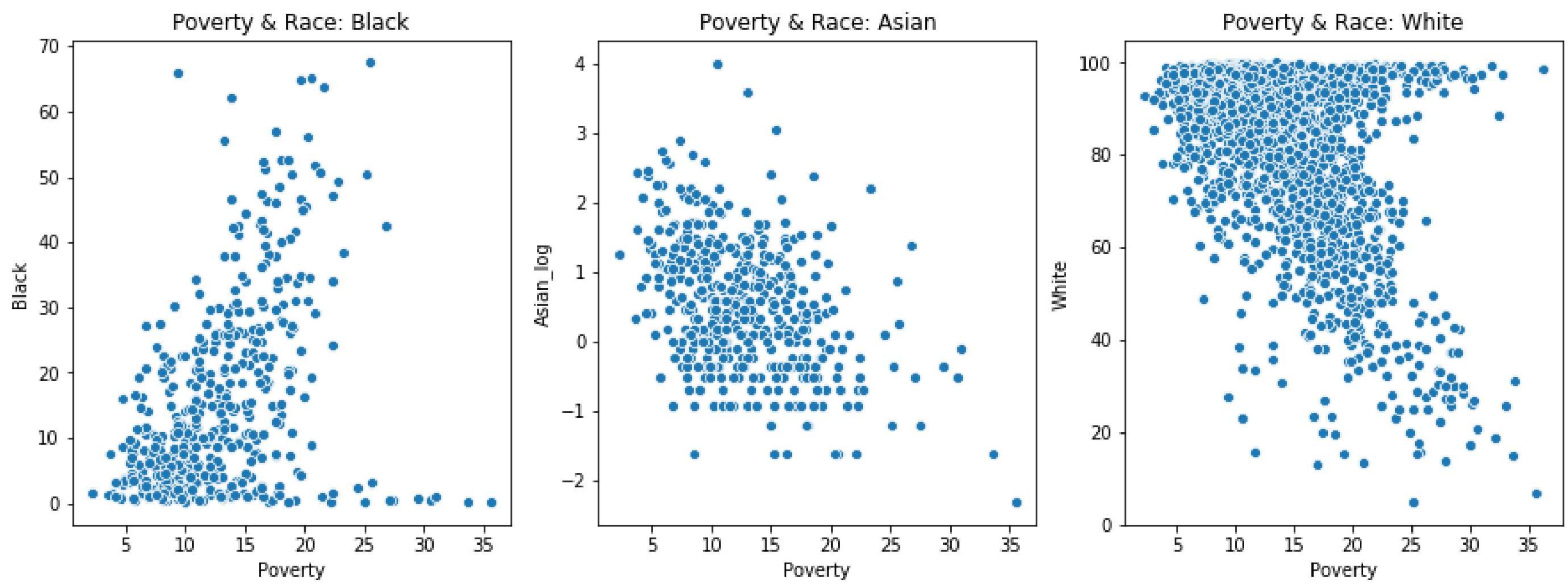
In [9]:
```
os.chdir(codepath)
%run plotter2.py
```

4 . Counties with Higher Povery Level have more people who are less educated
5 . Counties with Higher Povery Level have more death rates
6 . Counties with Higher Povery Level have more lower average life expectancy levels

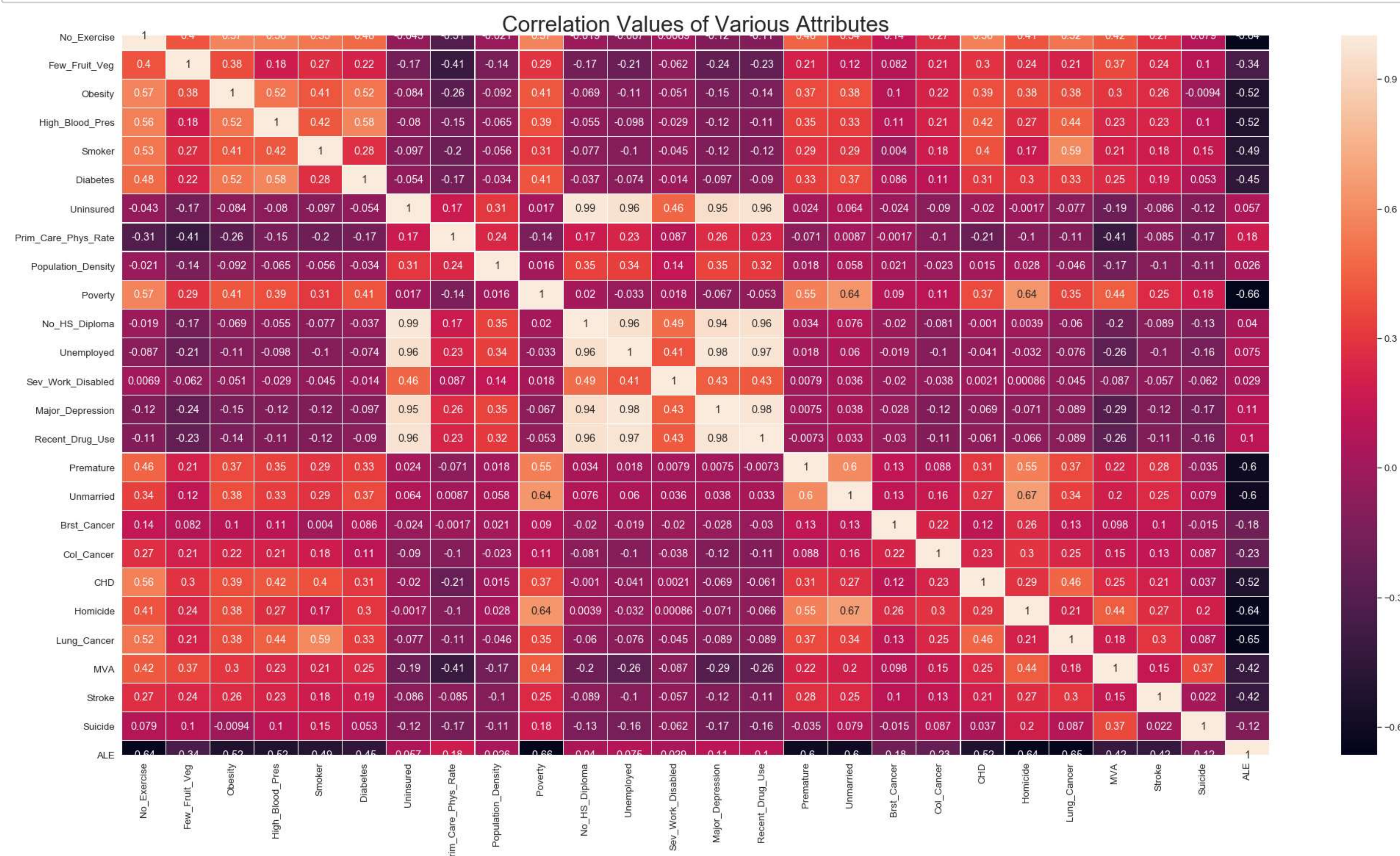


```
In [10]: os.chdir(codepath)
%run plotter3.py
print("Poverty Ridden Counties are the ones which have higher population of Blacks")
```

```
Poverty Ridden Counties are the ones which have higher population of Blacks
```

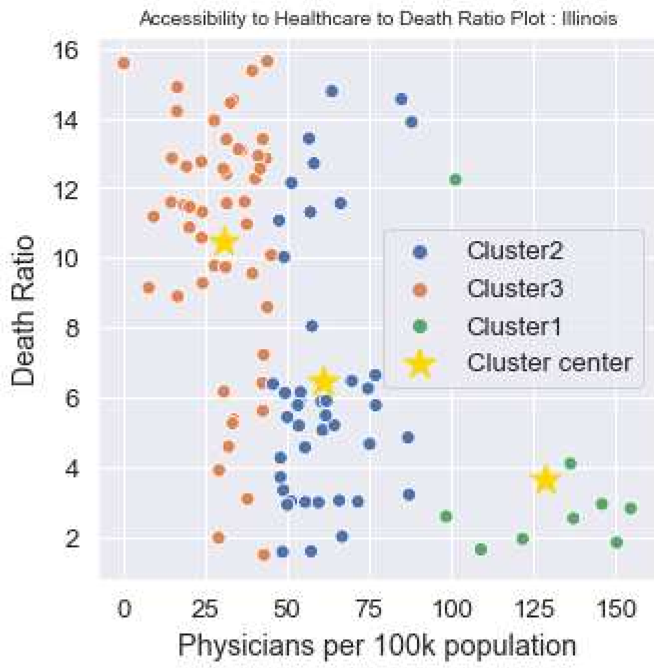



```
In [23]: os.chdir(codepath)
%run plotter4.py
```



Few Observations:
No High School Diploma, Has high correlation with drug use, depression and unemployment.
Average life expectancy is negatively correlated with obesity and high blood pressure.
No Excercise Correlated with Obesity and high Blood Pressure, Heart Disease.
Lung Cancer & Smoker are highly correlated

In [12]:
```
os.chdir(codepath)
%run Kmeans.py
```



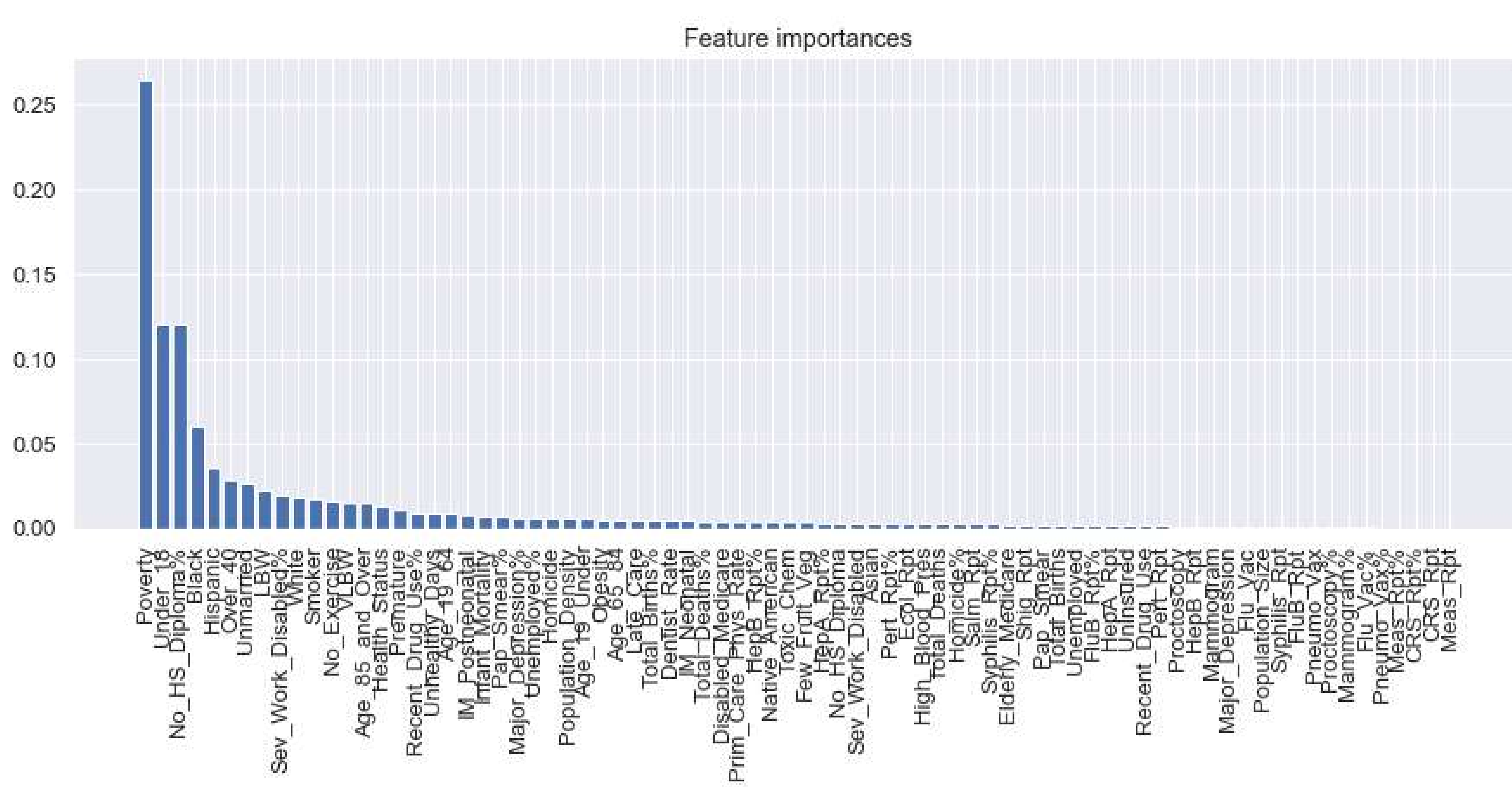
Ratio of Deaths Vs Physician Rate have been clustered by Kmeans, an inversely proportional relationship shows that staffing of medical depts is one of the top concerns.

8. Modelling & Inferencing

```
# choose one of the leading causes from the list above eg. ALE(Average Life Expectancy)
# the baseline model predicts the median always
```

In [14]:
```
os.chdir(codepath)
%run Modeling.py
ToBePredicted=['ALE','Diabetes','Lung_Cancer','Brst_Cancer','Col_Cancer','Brst_Cancer%','Col_Cancer%','Lung_Cancer%','MVA'
strval='ALE' # choose one of the leading causes from the list above eg. ALE(Average Life Expectancy)
colname=ToBePredicted[ToBePredicted.index(strval)]
modelrun(colname,mlmodel,X1)
```

```
['ALE', 'Diabetes', 'Lung_Cancer', 'Brst_Cancer', 'Col_Cancer', 'Brst_Cancer%', 'Col_Cancer%', 'Lung_Cancer%', 'MVA', 'M
VA%', 'Stroke', 'Stroke%', 'Suicide', 'Suicide%', 'Injury', 'Injury%', 'CHD', 'CHD%']
------------------Data Specs------------------------
Amount of Training Data 2197
Amount of Training Labels Data 2197
Amount of Testing Data 942
Amount of Testing Labels Data 942
-------------------------------------------------------
Baseline : Train Root Mean Squared Error: 2.003518752569599
RandomForest: Train Root Mean Squared Error: 0.3702769004339355
Baseline : Test Root Mean Squared Error: 2.0085195401339235
Random Forest: Test Root Mean Squared Error: 0.9241368699409664
Feature ranking:
Attribute Predicted     ALE
Predictor Columns
 36           Poverty
65          Under_18
47     No_HS_Diploma%
42             Black
45          Hispanic
Name: cols, dtype: object
```



9. Reflection, Results & Progress

1.What is hardest part of the project that you've encountered so far?
- Defining a concrete problem definition since the dataset consists of wide variety of health related data.
- Collating all datasets/csvs and merging them into one dataframe.
- Imputing Missing and Default Values
- The incomplete data dictionary and missing reference links.

2. What are your initial insights?
- Understanding and exploration of the data (of all attributes) in all csvs.
- We have shortlisted the attributes (by calculating feature importance using random forest) from the entire dataset which are correlated or are responsible for their 'effects' with the leading causes of death attributes
- Useful Correlations achieved during Exploratory Data Analysis.
- Modelling phase summarises all the model outputs with useful statistical information

Observations : Exploratory Data Analysis: <font size="2>

1. There is a positive correlation of poverty and unemployment.
2. Negative correlation of poverty and population density.
3. No relationship between poverty and depression observed.
4. Strong positive correlation between population density and depression.
5. Positive correlation between poverty and No High School Diploma Percentages.
6. Population size and E.Colli, Salmonella and Shigella Correlated (Hygiene Related Diseases)
7. Depression & Drug Use Positive Correlation
8. Povery & Number of Deaths Positive Correlation
9. Poverty & Average Life Expectancy Negative Correlation
10. UnInsured People Vs Number of Deaths Positive Correlation
11. Depression Vs Suicide Rate Positive Correlation
12. Heart Disease Vs Obesity Positive Correlation

Results: Random Forest Regressor(9 Models) for each leading cause of death & Variable Importance (determining attribute for that cause):

```
1.Average Life Expectancy  Train MSE=0.361304375017007    Test MSE=0.977328605007327
1.Poverty, 2.No_HS_Diploma, 3.Under_18, 4.Black, 5.Over_40

2. Diabetes                Train MSE=0.814102003689945    Test MSE=2.29140400291951
1.Obesity, 2.No_HS_Diploma, 3.Unmarried, 4.Poverty, 5.Recent_Drug_Use%

3. Lung_Cancer:            Train MSE=3.35822064794277    Test MSE=8.40868361996625
1. Smoker,  2. NO_HS_Diploma, 3. Poverty, 4. Major_Depression, 5. Sev_Work_Disabled%

4.Breast_Cancer:           Train MSE=1.96858600852315    Test MSE=5.09185013278892
1.Major_Depression, 2.Recent_Drug_Use%, 3.Black, 4.Unemployed%, 5.Population_Size

5.Colon_Cancer             Train MSE=1.40279823772743    Test MSE=3.99720364350038
1.Unmarried, 2.Hispanic, 3.No_Exercise, 4.Smoker, 5.Major_Depression

6.Motor Vehicle Injuries:  Train MSE=2.2402199328038    Test MSE=5.96104038324399
1.Under_18, 2.Population_Density, 3.Recent_Drug_Use%, 4.Asian, 5.No_HS_Diploma

7.Heart Stroke             Train MSE=4.58634474894955    Test MSE=13.4173059174712
1.Black, 2.High_Blood_Pres, 3.No_HS_Diploma, 4.Premature, 5.Mammogram

8. Suicide:                  Train MSE=1.15818004036267    Test MSE=3.12497294467384
1.Population_Density, 2.Unemployment, 3.Recent_Drug_Use%, 4.Major_Depression, 5.Under_18

9. Coronary Heart Disease:          Train MSE=12.4806249718433    Test MSE=34.9709746818494
1.No_Excercise, 2.No_HS_Diploma, 3.Smoker, 4.Unemployment, 5.Major_Depression
```

3. Are there any concrete results you can show at this point? If not, why not?
- Set of features for every leading cause of death has been listed above. (Goal of the project)
- We intend to increase our accuracy of our models(9) using grid search technique.
- Making a generic framework to understand the models better - which takes custom input of data (work in progress)

4.Going forward, what are the current biggest problems you're facing
- Current problems include the deployment of the models as a web application (work in progress).
- Increasing the accuracy of the models (work in progress)

5.Do you think you are on track with your project? If not, what parts do you need to dedicate more time to?
- Moving forward, We intend to improve all the models using grid search, generalise them and extract more insights.

6. Given your initial exploration of the data, is it worth proceeding with your project, why? If not, how are you going to change your project and why do you think it's better than your current results?
The dataset is quite promising because of so many interesting and useful features.

10. Next Steps

- Project is 90% Complete.
- We still intend to improve the accuracy of all the models using grid search.
- A web-page with django framework to be deployed, with backend in python for the project. (Not yet decided)
- Generalising the code for custom inputs for the model to get better insight into the data.