```
The source of the data is kaggle on: Worldwide deaths by country/risk factors WHO data - deaths by country and risk factors url
          link: <a href="https://www.kaggle.com/varpit94/worldwide-deaths-by-risk-factors">https://www.kaggle.com/varpit94/worldwide-deaths-by-risk-factors</a> The data was previously downloaded from WHO Website.
 In [2]: #import the necessary libraries
          import pandas as pd
          import numpy as np
          from sklearn.decomposition import FactorAnalysis
          from factor_analyzer import FactorAnalyzer
          import matplotlib.pyplot as plt
 In [3]: #path to the data
          path='D:/coding/deaths2.csv'
          Data=pd.read_csv(path)
          Data.head()
 Out[3]:
                                                                                                                                    High
                                               Household
                                   No access to
                                                                                                        Low birth
                                                                Non-
                                               air pollution
                                                                     Discontinued
                                                                                      Child
                                                                                                Child
                                                                                                                Secondhand
             Unsafe water
                            Unsafe
                                                                                                                                 systolic
                                                                                                       weight for
                                   handwashing
                                                            exclusive
                                                                                    wasting
                          sanitation
                                                from solid
                                                                     breastfeeding
                                                                                              stunting
                                                                                                                                   blood
                  source
                                                                                                                     smoke
                                        facility
                                                         breastfeeding
                                                                                                        gestation
                                                    fuels
                                                                                                                                 pressure
              7554.049543 5887.747628
                                   5412.314513 22388.49723
                                                          3221.138842
                                                                       156.097553 22778.84925 10408.43885 12168.56463
                                                                                                                4234.808095
                                                                                                                              28183.98335 6
          1 7359.676749 5732.770160
                                   5287.891103 22128.75821
                                                          3150.559597
                                                                       151.539851 \quad 22292.69111 \quad 10271.97643 \quad 12360.63537 \quad 4219.597324 \quad \dots \quad 28435.39751 \quad 6
          2 7650.437822 5954.804987
                                   5506.657363 22873.76879
                                                          3331.349048
                                                                       156.609194 23102.19794 10618.87978 13459.59372 4371.907968 ... 29173.61120 6
          3 10270.731380 7986.736613 7104.620351 25599.75628
                                                          4477.006100
                                                                       206.834451 27902.66996 12260.09384 18458.42913 4863.558517 ... 30074.76091 6
          4 11409.177110 8863.010065 8051.515953 28013.16720
                                                          5102.622054
                                                                       233.930571 32929.00593 14197.94796 19958.38854 5292.379854 ... 30809.49117 6
          5 rows × 29 columns
          I then filled any missing values in the data with a zero
 In [4]: Data1= Data.fillna(0)
          Adequacy Test Before I performed factor analysis, I evaluated the "factorability" of the dataset which means can we found the factors in the dataset?". The two
          main methods to check the factorability adequacy are:
          Bartlett's Test Kaiser-Meyer-Olkin Test
 In [5]: #step 2 determining factorability using barlett-sphericity method
          from factor_analyzer.factor_analyzer import calculate_bartlett_sphericity
          chi_square_value,p_value=calculate_bartlett_sphericity(Data1)
          chi_square_value, p_value
 Out[5]: (920298.3045915877, 0.0)
          since we found the data to be statistically significant I went ahead with the analysis
 In [6]: | #KMO test
          from factor_analyzer.factor_analyzer import calculate_kmo
          kmo_all, kmo_model=calculate_kmo(Data1)
          print("n\nKMO Model\n", kmo_model)
          KMO Model
           0.9310832018826186
          The KMO Value is more than 0.5 so we proceed with the analysis.
 In [7]:
         #extract the factors
          factor=FactorAnalysis().fit(Data1)
          Factors=pd.DataFrame(factor.components_)
          print(Factors)
                                         1
              113856.951345 83590.009787 66248.451654 166055.838007
                                                                             21343.658553
                              76062.757177
                                             59021.213812
                                                             79985.233377
               98457.102940
                                                                             18271.207564
               16751.273885
                              11283.947595 10955.094073
                                                             -30508.766773
                                                                               664.988040
                              -3557.161669
                                                                              -526.404285
               -5139.182210
                                             -3583.771424
                                                               5331.532247
                                              1015.469668
                7951.885701
                               8082.366441
                                                              -1056.232175
                                                                              1897.482590
               11227.261200
                               4782.709906
                                                485.141911
                                                               7369.330862
                                                                             -2873.380861
                               -701.369504
                                               368.822831
                                                              -5056.557237
               -2499.291876
                                                                              1708.329892
                                              -195.087848
               -2858.831494
                              -2944.892112
                                                                784.382639
                                                                              1544.538887
                              -7830.717611 -6687.826303
                                                              14163.593559
              -10803.605805
                                                                              1041.370810
                               3854.772361
                                              1241.710425
                                                               -868.542086
          9
                5764.256602
                                                                              -613.350963
          10
                -805.478074
                                -91.435740
                                               111.423630
                                                               1651.070635
                                                                              -320.375709
                3574.918396
                               3418.384330
                                              1171.837517
                                                               1363.521841
                                                                               -42.070005
                 978.626842
                               1790.722780
                                               -114.065300
                                                              -1656.980840
          12
                                                                              -289.349981
                1000.863140
                                -44.478747
                                               1257.242433
                                                               1593.562018
          13
                                                                              -828.616490
                               -311.283698
                                              -711.668401
          14
                -569.306180
                                                              -3127.260613
                                                                              -198.679971
          15
                 514.573806
                                750.630523
                                              -1886.156713
                                                               -350.556888
                                                                               104.498218
          16
                   4.079557
                              -1412.143839
                                              1518.075619
                                                              -1755.278971
                                                                               -51.133674
          17
                 847.961090
                               -540.773861
                                               -557.468145
                                                              -1050.505290
                                                                               820.144475
          18
                 408.289426
                                -53.024600
                                                58.019442
                                                               -346.187205
                                                                               140.761414
                 459.794766
                               -146.168339
                                               -150.651770
                                                                220.542969
                                                                               636.815889
          20
                 663.784725
                              -1274.400594
                                                648.714061
                                                                511.032994
                                                                               423.093359
                 -33.473438
                                 38.760459
                                                518.451283
                                                                  2.708432
                                                                               766.223194
          21
                               -481.070724
          22
                 106.549336
                                                67.676407
                                                                125.443598
                                                                               575.001117
          23
                 171.979218
                               -361.662496
                                                474.442476
                                                               -118.899623
                                                                               629.555508
          24
                               -230.891043
                                             -1028.291017
                                                                 60.819496
                 563.480132
                                                                               252.539386
          25
                 473.684948
                               -589.294272
                                                 47.242213
                                                                 39.735443
                                                                              -895.103820
          26
                                -98.963007
                                               -253.399593
                 216.967610
                                                                -21.649609
                                                                               102.762036
          27
                  -1.754601
                                 -37.077841
                                                 10.462208
                                                                 -0.011809
                                                                               133.160088
                   2.538540
                                  -1.606661
                                                 -1.421763
                                                                 -0.833070
                                                                                15.479783
                        5
              1350.224661 147038.176381 39639.495793 111578.198182 97730.465070
              1181.920884
                            134484.380126 40730.522205
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               119.116204
                              8805.531425
                                             2725.243015
                                                             5633.898015 -19701.332966
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                             -5208.948074
                                           -1562.467565
               -58.440316
                                                             -2388.701719
                                                                             4023.217158
                77.321992
                             11125.831854
                                             6194.221332
                                                              2716.845275
                                                                             -211.953699
              -286.319969
                            -25980.496653
                                            -8414.539445
                                                              2006.901049
                                                                             1418.610043
               171.745875
                             11903.841565
                                             4616.170639
                                                              -501.380626
                                                                             1867.188587
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               154.933033
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                               354.914633 -1569.158749
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                65.646276
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               -57.847243
                             -3260.259373
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          10
               -35.935248
                              2036.790397
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                 5.277151
                              -4120.380861 -1262.363317
                                                              2355.832724
                                                                              161.975389
               -17.946554
                              -396.114956
                                              911.070894
                                                               604.066106
                                                                             -736.856972
                               117.265693
                                              180.425603
                                                             -7462.621466
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              -130.336009
               -13.792483
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                15.498516
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                               840.317949
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                                              263.859025
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               147.801406
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                51.299606
                              -278.877666
                                              325.602409
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               107.911414
                               837.471120
                                             -995.668550
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                                                                              466.738101
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                              -529.181658
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                90.183073
                              -303.522176
                                               81.376041
                                                              -163.172454
                                                                              490.594719
          21
                85.949265
                              -203.891361
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                                                               -19.858689
                                                                             -649.144509
          23
                78.656017
                              -234.027399
                                              -274.692267
                                                                99.551381
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                44.442110
                                98.569796
                                              -320.353664
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                                                                             -448.346894
                                              182.149576
              -122.534416
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                                76.436323
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                42.268452
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                                   -29599.930263
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                    23301.681900
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          3
                     -7809.033386
                                      4078.345425
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                                                                  5458.278538
                      2128.860091
                                     24055.551142
                                                     -69.930532
                     23159.917239
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                                                                   5206.113729
                                    -11224.260913
                     -2307.463473
                                                    -201.902682
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                      1088.395415
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                      6074.266865
                                        99.883432
                                                     243.529552
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              . . .
                     -3566.967168
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                                                                   1420.453994
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                      -806.639603
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                                                     337.448844
                                                                  -2902.597435
          12
                     -3908.370731
                                       366.660449
                                                     286.886655
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          13
                       464.134926
                                      -311.412571
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                      -836.475329
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                      -668.773848
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                                                      43.379106
          15
                                                                   1440.390771
                       -39.030795
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          16
                                                                   -626.176796
                                       -82.159692
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                       380.776391
                                                    -308.754863
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          18
                       425.631589
                                        11.827261
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                      -541.741804
                                       125.618695
                                                    -266.587500
                                                                  -1360.315012
          20
                                                    -318.217277
                       -72.720250
                                       136.691681
                                                                   1074.171252
                      -216.165231
                                      -107.407032
                                                    -215.437256
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              . . .
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                       -40.299374
                                        16.876416
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                                                                    -751.190293
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                      -109.950527
                                                    -169.058132
                                                                     452.674548
                                        -4.985825
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                        58.144528
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                      -106.283242
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                                                                    -153.598823
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                                         5.786960
                                                      27.857827
                                                                     77.317048
                        -0.189508
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                                        -0.416953
                                                                      -0.352824
                        -2.049032
                                                     452.834007
              . . .
          28
                         0.068073
                                         0.234007
                                                     -11.841479
                                                                      0.232593
                         23
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                                                                                          27
              18262.986644
                             380288.804499
                                              227079.562069
                                                              227165.220702
          0
                                                                              208711.838337
                 -2.951322
                                               -4906.008532
                              72481.629868
                                                              -40997.208654
                                                                              -11470.326530
          1
               1479.876232
                              -46331.068649
                                              -21561.232610
                                                              -67950.616385
                                                                                3788.167926
               -386.146071
                               8262.772177
                                                4522.684634
                                                               13801.845035
                                                                                -985.924304
               -395.150265
                               -8255.471163
                                               -6996.033991
                                                              -23712.729288
                                                                                2051.010611
               2215.825525
                              22560.034422
                                               16942.261823
                                                              -10718.141383
                                                                                6295.337661
                                                                               12439.471117
               -3111.746980
                               -9725.239831
                                               -6324.978838
                                                                9021.404716
          7
                566.891004
                                -518.439729
                                               -3565.280780
                                                               17948.543532
                                                                                -5468.450791
              -1758.877268
                               1638.225424
                                              -14654.654560
                                                               -6896.323833
          8
                                                                                1825.832220
                                               -7874.569474
                798.174059
          9
                               -4436.994082
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                                                                                -2302.605957
          10
                204.253017
                                 -72.404369
                                               -2650.844948
                                                                -773.048575
                                                                                -2842.519956
                215.052728
                                               -6099.097164
                                 548.539217
                                                                3036.128018
          11
                                                                                -544.881237
          12
                -136.634879
                               -2196.200202
                                                 223.473337
                                                                1228.835542
                                                                                3397.038277
                 92.367991
                                               -1996.058319
          13
                               2508.927715
                                                               -1054.940363
                                                                                 246.880097
          14
                233.070405
                                3086.793521
                                               -2282.016106
                                                                -283.112772
                                                                                2132.264503
                255.000900
                                   7.255058
                                                 358.545114
                                                                 650.189721
          15
                                                                                 -593.959432
                               1322.938314
                                                -572.685900
                                                                 173.080816
          16
                281.497785
                                                                                -904.618417
                                                 -61.448657
          17
                368.929348
                                181.599533
                                                                -395.103546
                                                                                -232.691541
                                                  20.049287
          18
               -312.230935
                                 -38.233250
                                                                -402.922606
                                                                                -232.790502
                                                                 211.810587
                -92.524658
                                                  47.916600
          19
                                -335.203845
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          20
                373.948840
                                -424.971993
                                                  40.475510
                                                                  67.375358
                                                                                1014.979191
          21
                137.262391
                                                 -24.124348
                                 -35.467360
                                                                 199.874559
                                                                                 523.349522
          22
                 38.184428
                                 111.596094
                                                  -0.093197
                                                                  39.130252
                                                                                -176.288993
          23
               -265.891376
                                 -74.931697
                                                 -11.482193
                                                                 -34.024246
                                                                                 -892.958804
                722.568344
                                  54.723555
                                                 -20.844243
                                                                 -10.575932
                                                                                 -220.597424
          24
          25
                -25.265653
                                -113.246637
                                                   3.101590
                                                                  65.363993
                                                                                 -21.072042
          26
               -762.752826
                                  66.172717
                                                  -2.887726
                                                                  27.557939
                                                                                   35.451192
          27
                 38.548140
                                  3.296447
                                                   0.852598
                                                                  -1.078402
                                                                                  12.175791
                 -3.631259
                                  -0.031548
                                                  -0.014132
                                                                   0.153140
                                                                                   0.942300
              134363.265740
               -6520.103594
          1
          2
               14672.465610
          3
               -3378.415709
                5224.803622
          4
                6435.949885
          5
          6
                6777.702805
                -4698.043481
          8
                1304.926487
                 609.229384
               -2032.517888
          10
          11
                  56.863371
          12
                 -58.266890
          13
                 137.822516
          14
                 516.804519
          15
                2568.069668
          16
                  91.491555
          17
                -187.722255
          18
               -1862.815335
          19
                 685.490920
          20
                  30.352991
          21
                -767.381042
          22
                 217.204512
          23
                 671.109628
          24
                -313.546312
          25
                  58.768215
          26
                 -76.142365
          27
                  12.177696
          28
                  -1.254785
          [29 rows x 29 columns]
          We use the Kaiser criterion and scree plot for Eigen values to determine the number of factors that can be selected. Eigenvalues represent variance explained
          each factor out of the total variance or the number of variables which the factor represents.
 In [8]: #choose factors
          #use the kaiser criterion to get Eigen Values
          fa = FactorAnalyzer()
          fa.analyze(Data1, 5, rotation =None)
          #check eigen values
          ev, v = fa.get_eigenvalues()
          print(ev)
              Original_Eigenvalues
          0
                          23.492734
                           3.598221
          1
          2
                           0.812885
          3
                           0.431647
          4
                           0.266544
          5
                           0.184094
                           0.060976
          6
          7
                           0.048609
          8
                           0.030556
          9
                           0.020190
          10
                           0.013123
                           0.010531
          11
          12
                           0.008364
          13
                           0.005214
          14
                           0.004090
          15
                           0.002823
          16
                           0.002021
          17
                           0.001586
          18
                           0.001276
          19
                           0.000954
          20
                           0.000874
          21
                           0.000689
          22
                           0.000587
          23
                           0.000472
          24
                           0.000391
          25
                           0.000235
          26
                           0.000124
          27
                           0.000105
          28
                           0.000087
 In [9]: #use scree plot
          plt.scatter(range(1, Data1.shape[1]+1), ev)
          plt.plot(range(1, Data1.shape[1]+1), ev)
          plt.title('scree plot')
          plt.xlabel('Factors')
          plt.ylabel('EigenValue')
          plt.grid()
          plt.show()
                                 scree plot
             20
          EigenValue
10
                             10
                                                  25
                                  Factors
          Both show that the factors with a variance more than 1 are only two so they are the number we used. we have two main factors on the causes of death.
In [10]: #Rotate factors
          #generate rotated factor matrix
          fa = FactorAnalyzer()
          fa.analyze(Data1, 2, rotation = "varimax")
          loading_matrix=fa.loadings
          print(loading_matrix)
                                                        Factor1 Factor2
          Unsafe water source
                                                       0.385871 0.906223
          Unsafe sanitation
                                                       0.361155 0.920699
          No access to handwashing facility
                                                       0.369702 0.921487
          Household air pollution from solid fuels 0.619753 0.744131
          Non-exclusive breastfeeding
                                                       0.381585 0.916991
                                                       0.357582 0.901120
          Discontinued breastfeeding
                                                       0.349776 0.932358
          Child wasting
          Child stunting
                                                       0.289539 0.946752
          Low birth weight for gestation
                                                       0.506326 0.855281
          Secondhand smoke
                                                       0.853956 0.468610
          Alcohol use
                                                       0.890533 0.440849
          Drug use
                                                       0.921501 0.337526
          Diet low in fruits
                                                       0.903956 0.408167
          Diet low in vegetables
                                                       0.878158 0.468344
          Unsafe sex
                                                       0.473779 0.650320
          Low physical activity
                                                       0.914967 0.344474
                                                       0.904754 0.388915
          High fasting plasma glucose
          High total cholesterol
                                                       0.361550 0.229210
          High body-mass index
                                                       0.927156 0.292084
          High systolic blood pressure
                                                       0.927156 0.370068
          Smoking
                                                       0.924004 0.359923
          Iron deficiency
                                                       0.379257 0.912440
          Vitamin A deficiency
                                                       0.279312 0.944060
          Low bone mineral density
                                                       0.869799 0.421458
          Air pollution
                                                       0.801756 0.575941
          Outdoor air pollution
                                                       0.905158 0.401295
          Diet high in sodium
                                                       0.912796 0.245394
          Diet low in whole grains
                                                       0.916576 0.392835
          Diet low in nuts and seeds
                                                       0.901765 0.404487
                               factor 1: Lifestyle RISK FACTORS
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Diet low in fruits 0.911009 Secondhand smoke 0.905284 Alcohol use 0.890582 Drug use 0.899371 Diet low in fruits 0.903956 Diet low in vegetables 0.874991 Low physical activity 0.911511 High fasting plasma glucose 0.875397 High body-mass index 0.905352 High systolic blood pressure 0.919181 Smoking 0.943606 Low bone mineral density 0.861579 Air pollution 0.835579 Outdoor air pollution 0.856643 Diet high in sodium 0.930164 Diet low in whole grains

to fill hunger they may lack enough iron or vitamin A.

0.910706 Diet low in nuts and seeds 0.89298

Most of the risk factors in this category are caused by lifestyle choices, for example alcohol, smoking and drug use are caused by people choosing to do drugs and smoke or drink. Drug and substance abuse are on the rise in developing countries. The other risk factors that involve high BMI, High Blood pressure, diets

low in whole grains, nuts, seeds, fruits and vegetables are related to what people eat in their daily life. If they choose fast foods instead of choosing healthy options in their foods. The other factor also related to this can be the low physical activity where people choose not to exercise or keep fit, low mineral bone density when they do not have enough minerals in their food or water. Air pollution is because the developing countries are trying to catch up with the developed world by building more factories for use by the people. Studies show that Developing Countries Are Responsible for 63 Percent of Current Carbon Emissions.

factor 2:3RD WORLD RISK FACTORS.

because water is mostly scarse and the household air pollution results from use of carbon fuels like charcoal in the house. Because mothers can be busy looking for a source of income they do not have time to exclusively breastfeed the children or even stop breastfeeding them because they have to work to make a living. Many factors like these and even diseases or lack of access to vaccines can lead to child wasting, child stunting and low birth weight for

gestation. Some people will turn to prostitution to make a living and end up having unsafe sex. Because the food are not usually balanced and are only eaten

Unsafe water source 0.87029 Unsafe sanitation 0.898389 No access to handwashing facility 0.912765 Household air pollution from solid fuels 0.717296 Non-exclusive breastfeeding 0.918999 Discontinued breastfeeding 0.915102 Child wasting 0.919382 Child stunting 0.933583 Low birth weight for gestation