Stratified Analysis

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Contents

```
library(here)
```

```
## Warning in readLines(f, n): line 1 appears to contain an embedded nul
```

```
## Warning in readLines(f, n): incomplete final line found on '/Volumes/
## ALVINDRIVE2/flood-risk-health-effects/._flood-risk-health-effects.Rproj'
```

```
## here() starts at /Volumes/ALVINDRIVE2/flood-risk-health-effects
```

```
library(coda)
library(CARBayes)
```

```
## Loading required package: MASS
```

```
## Loading required package: Rcpp
```

```
## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2
```

```
library(ggplot2)
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v tibble  3.1.6     v dplyr   1.0.7
## v tidyr   1.1.4     v stringr 1.4.0
## v readr   2.1.1     v forcats 0.5.1
## v purrr   0.3.4
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## x dplyr::select() masks MASS::select()
```

```
fhs_model_df <- readRDS(here("intermediary_data/fhs_model_df_all_census_tract_pc.rds"))
```

CHD Stratified Analysis

CAR model results, Coronary Heart Disease Stratified on Poverty

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_poverty.RData"))
```

Beta samples

```
beta_samples <- mcmc.list(chain1$samples$beta, chain2$samples$beta,
                          chain3$samples$beta)
```

```
effectiveSize(beta_samples)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 68447.2046 36382.4841 37761.1319 53281.5366 68914.2531 78405.5864 87890.6361
```

```
##       var8       var9      var10      var11      var12      var13      var14
## 41973.9980 61353.3136 50147.4980 60253.3373 74957.3127 89787.3447 35155.2520
##      var15      var16      var17      var18      var19      var20      var21
## 63037.1789 62136.1468 70022.6252 73724.5058 32342.7837 88478.5492 57534.7711
##      var22      var23      var24      var25      var26      var27      var28
## 10909.7609  6229.8757   323.8625  4500.4463  2003.7053  2883.0879   996.6574
##      var29      var30      var31      var32      var33      var34      var35
##   161.4431   672.4907  1167.2441 28855.9245 78428.6550 39030.9892 34364.0083
##      var36      var37      var38      var39      var40      var41      var42
## 52293.7785 66509.7765 69269.6952 76671.2019 56050.2334 50185.4620 50495.6724
##      var43      var44      var45      var46      var47      var48      var49
## 60423.8387 60221.4781 80050.1425 28753.4787 41256.5990 55529.6434 37611.9176
##      var50      var51      var52      var53      var54      var55      var56
## 63008.8724 35946.8002 79938.2627 47002.3867  8686.7542  6769.6085   325.5017
##      var57      var58      var59      var60      var61      var62      var63
##  3937.8319  2135.7717  2707.4575  1039.3790   163.8511   680.0737  1232.0642
##      var64
## 28006.0742
```

Examining sigma2, nu2, rho

```
sigma2_samples <- mcmc.list(chain1$samples$sigma2, chain2$samples$sigma2,
                            chain3$samples$sigma2)

nu2_samples <- mcmc.list(chain1$samples$nu2, chain2$samples$nu2,
                         chain3$samples$nu2)
```

```
effectiveSize(sigma2_samples)
```

```
##     var1
## 6808.768
```

```
effectiveSize(nu2_samples)
```

```
##     var1
## 9364.658
```

Examining a sample of the 3108 phi parameters

```
phi_samples <- mcmc.list(chain1$samples$phi, chain2$samples$phi, chain3$samples$phi)
```

```
set.seed(1157, kind = "Mersenne-Twister", normal.kind = "Inversion", sample.kind = "Rejection")

phi_subset_idx <- sample(1:ncol(phi_samples[[1]]), size = 10)

phi_samples_subset <- phi_samples[, phi_subset_idx]
```

```
effectiveSize(phi_samples_subset)
```

```
##      var1      var2      var3      var4      var5      var6      var7      var8
## 37202.660  4572.161  6806.516 20135.793 93307.470 39089.413 33554.743 40535.330
##      var9     var10
## 70212.189  4821.368
```

Inference

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     6.43057  6.41684  6.44428
## strat0:flood_risk_pc1     -0.01479 -0.02603 -0.00362
## strat0:flood_risk_pc2      0.00961 -0.00341  0.02245
## strat0:flood_risk_pc3     -0.00201 -0.01169  0.00766
## strat0:flood_risk_pc4      0.00792 -0.00135  0.01719
## strat0:flood_risk_pc5      0.00190 -0.00692  0.01075
## strat0:EP_UNEMP            0.05020  0.03500  0.06527
## strat0:EP_PCI             -0.04941 -0.06333 -0.03545
## strat0:EP_NOHSDP           0.23345  0.20579  0.26097
## strat0:EP_AGE65            1.23105  1.21750  1.24458
## strat0:EP_AGE17            0.15970  0.14417  0.17523
## strat0:EP_DISABL           0.22445  0.20776  0.24128
## strat0:EP_SNGPNT           0.01504 -0.00063  0.03067
## strat0:EP_MINRTY          -0.17432 -0.19679 -0.15201
## strat0:EP_LIMENG          -0.02997 -0.05533 -0.00480
## strat0:EP_MUNIT           -0.05975 -0.07265 -0.04682
## strat0:EP_MOBILE           0.07762  0.06456  0.09065
## strat0:EP_CROWD            0.01336 -0.00717  0.03394
## strat0:EP_NOVEH            0.08992  0.06770  0.11209
## strat0:EP_GROUPQ          -0.09386 -0.10680 -0.08081
## strat0:EP_UNINSUR          0.13585  0.11884  0.15277
## strat0:co                 -0.11942 -0.15848 -0.07998
## strat0:no2                 0.01534 -0.03633  0.06636
## strat0:o3                 -0.14595 -0.21856 -0.07619
## strat0:pm10               -0.19961 -0.23314 -0.16712
## strat0:pm25                0.43798  0.39060  0.48763
## strat0:so2                 0.05621  0.02290  0.09022
## strat0:summer_tmmx         0.13280  0.08339  0.18615
## strat0:winter_tmmx        -0.31593 -0.47846 -0.18847
## strat0:summer_rmax         0.00254 -0.06569  0.07049
## strat0:winter_rmax         0.05320  0.00389  0.10322
## strat0:Data_Value_CSMOKING 0.70817  0.67899  0.73708
## strat1                     6.74754  6.73568  6.75929
## strat1:flood_risk_pc1     -0.01268 -0.02315 -0.00227
## strat1:flood_risk_pc2      0.00658 -0.00523  0.01846
## strat1:flood_risk_pc3      0.00569 -0.00365  0.01504
## strat1:flood_risk_pc4     -0.00259 -0.01103  0.00583
## strat1:flood_risk_pc5      0.00154 -0.00691  0.00993
## strat1:EP_UNEMP            0.05283  0.04390  0.06177
## strat1:EP_PCI             -0.08201 -0.10645 -0.05750
## strat1:EP_NOHSDP           0.14347  0.12630  0.16066
## strat1:EP_AGE65            1.63400  1.61986  1.64827
## strat1:EP_AGE17            0.30099  0.28704  0.31510
## strat1:EP_DISABL           0.22420  0.21232  0.23611
## strat1:EP_SNGPNT          -0.05794 -0.06914 -0.04666
```

```
## strat1:EP_MINRTY            0.01348 -0.00424  0.03122
## strat1:EP_LIMENG           -0.04214 -0.05721 -0.02698
## strat1:EP_MUNIT            -0.00647 -0.01763  0.00469
## strat1:EP_MOBILE            0.05158  0.04197  0.06119
## strat1:EP_CROWD            -0.02294 -0.03467 -0.01119
## strat1:EP_NOVEH             0.19940  0.18479  0.21408
## strat1:EP_GROUPQ           -0.05314 -0.06171 -0.04457
## strat1:EP_UNINSUR           0.08819  0.07621  0.10005
## strat1:co                  -0.14840 -0.19083 -0.10638
## strat1:no2                 -0.02954 -0.08115  0.02160
## strat1:o3                  -0.15649 -0.22953 -0.08649
## strat1:pm10                -0.14592 -0.18058 -0.11255
## strat1:pm25                 0.45173  0.40449  0.50151
## strat1:so2                  0.01675 -0.01555  0.04973
## strat1:summer_tmmx          0.04595 -0.00426  0.09936
## strat1:winter_tmmx         -0.16618 -0.32870 -0.03905
## strat1:summer_rmax         -0.07471 -0.14382 -0.00705
## strat1:winter_rmax          0.04073 -0.00820  0.09070
## strat1:Data_Value_CSMOKING  1.03745  1.01707  1.05807
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CHD_poverty
```

List of significant beta coefficients:

```
colnames(beta_samples_matrix)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
##  [3] "strat0:EP_UNEMP"           "strat0:EP_PCI"
##  [5] "strat0:EP_NOHSDP"          "strat0:EP_AGE65"
##  [7] "strat0:EP_AGE17"           "strat0:EP_DISABL"
##  [9] "strat0:EP_MINRTY"          "strat0:EP_LIMENG"
## [11] "strat0:EP_MUNIT"           "strat0:EP_MOBILE"
## [13] "strat0:EP_NOVEH"           "strat0:EP_GROUPQ"
## [15] "strat0:EP_UNINSUR"         "strat0:co"
## [17] "strat0:o3"                 "strat0:pm10"
## [19] "strat0:pm25"               "strat0:so2"
## [21] "strat0:summer_tmmx"        "strat0:winter_tmmx"
## [23] "strat0:winter_rmax"        "strat0:Data_Value_CSMOKING"
## [25] "strat1"                    "strat1:flood_risk_pc1"
## [27] "strat1:EP_UNEMP"           "strat1:EP_PCI"
## [29] "strat1:EP_NOHSDP"          "strat1:EP_AGE65"
## [31] "strat1:EP_AGE17"           "strat1:EP_DISABL"
## [33] "strat1:EP_SNGPNT"          "strat1:EP_LIMENG"
## [35] "strat1:EP_MOBILE"          "strat1:EP_CROWD"
## [37] "strat1:EP_NOVEH"           "strat1:EP_GROUPQ"
## [39] "strat1:EP_UNINSUR"         "strat1:co"
## [41] "strat1:o3"                 "strat1:pm10"
## [43] "strat1:pm25"               "strat1:winter_tmmx"
## [45] "strat1:summer_rmax"        "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
```

```
beta_inference_df <- as.data.frame(beta_inference)

beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))

beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)

beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))

beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

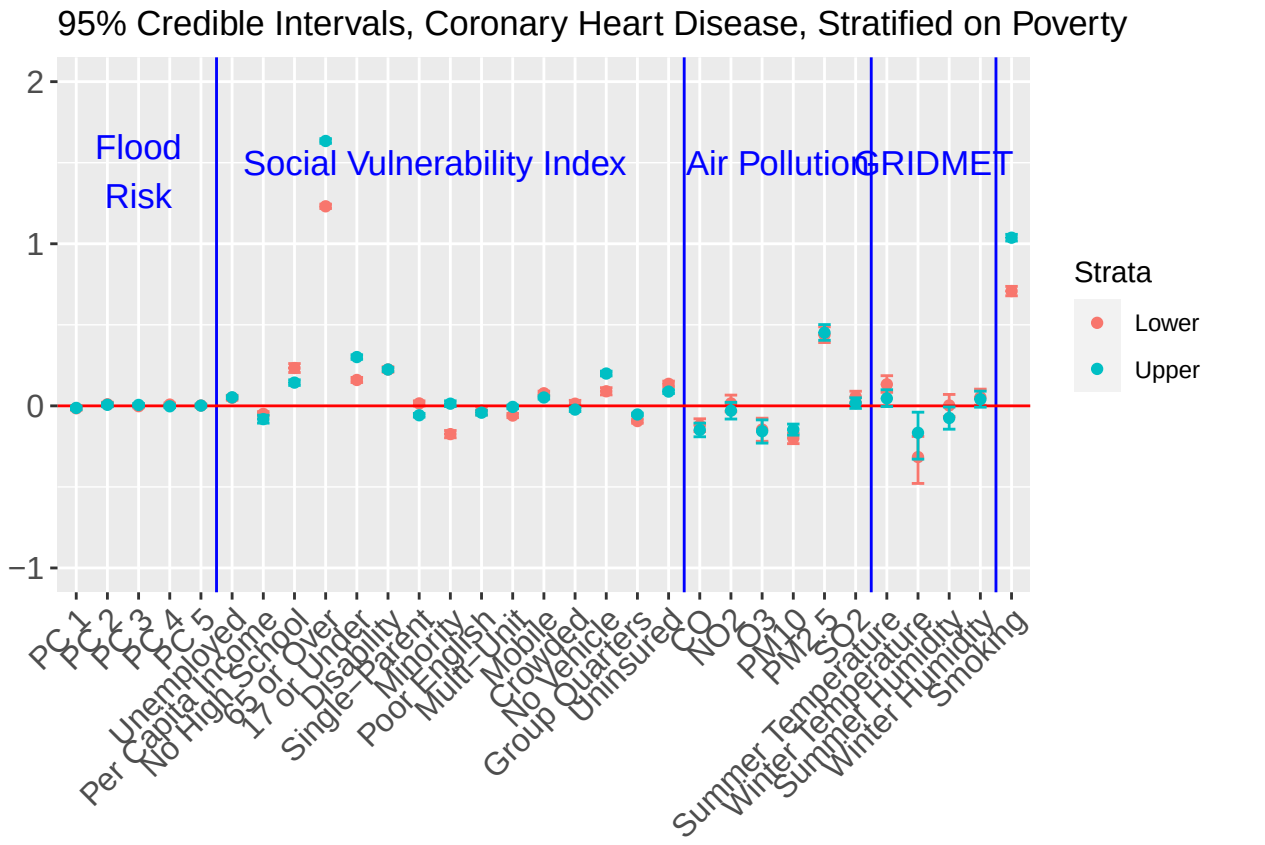
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 20.5, 26.5, 30.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 23.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 28.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)
```

```
p
```

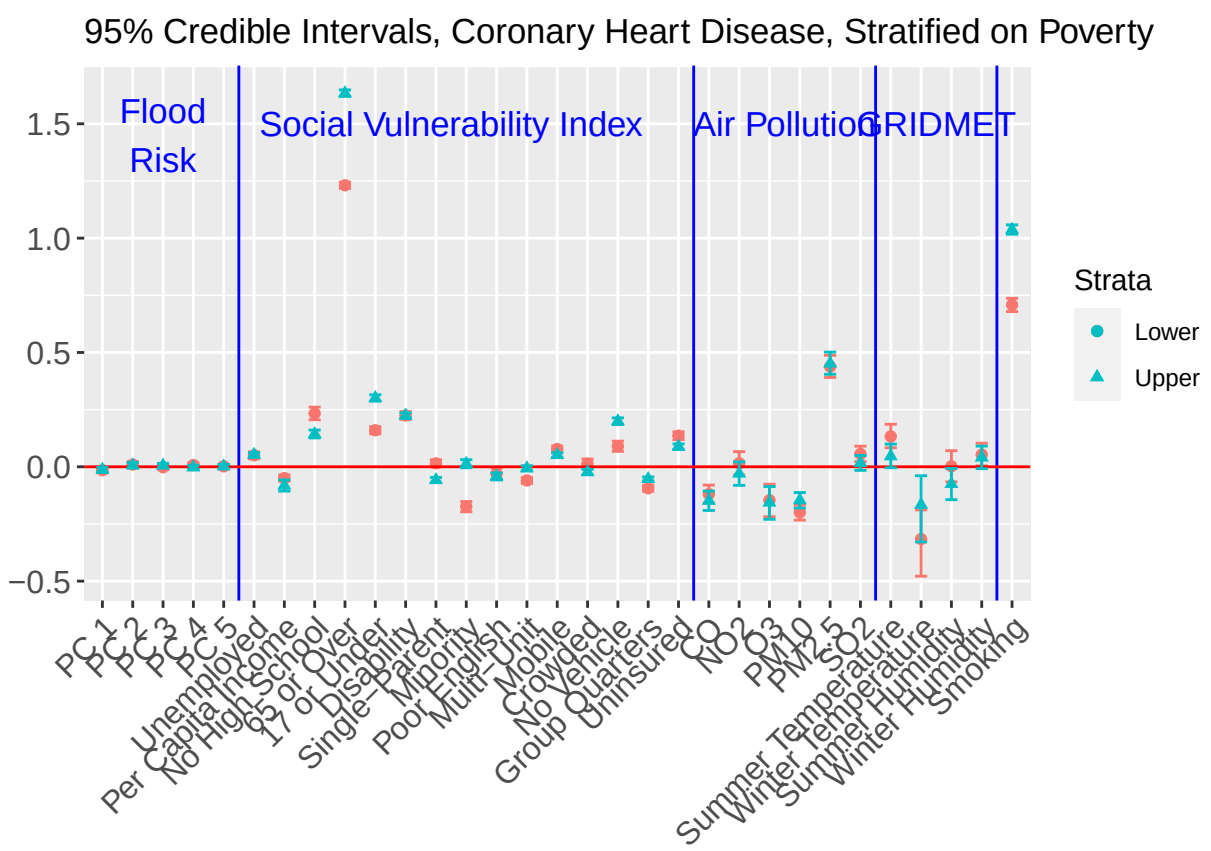



```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_poverty.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Below is my best attempt to use both color and shape to indicate the strata. The only problem is the legend.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat, shape = s
  geom_point() +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 20.5, 26.5, 30.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 23.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 28.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
```

```
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_shape_manual(name = "Strata",
                     values = c(19, 17),
                     drop = FALSE) +
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```



CAR model results, Coronary Heart Disease Stratified on RPL_THEME1

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl1.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     6.45402  6.43867  6.46944
## strat0:flood_risk_pc1     -0.01373 -0.02504 -0.00250
## strat0:flood_risk_pc2      0.01940  0.00628  0.03251
## strat0:flood_risk_pc3     -0.00281 -0.01244  0.00678
## strat0:flood_risk_pc4      0.01097  0.00171  0.02027
## strat0:flood_risk_pc5     -0.00040 -0.00931  0.00847
## strat0:EP_AGE65            1.25700  1.24396  1.27002
## strat0:EP_AGE17            0.19428  0.17933  0.20931
## strat0:EP_DISABL           0.23010  0.21400  0.24622
## strat0:EP_SNGPNT           0.00391 -0.01205  0.01993
## strat0:EP_MINRTY          -0.13127 -0.15406 -0.10848
## strat0:EP_LIMENG           0.05495  0.02828  0.08153
## strat0:EP_MUNIT           -0.05162 -0.06380 -0.03945
## strat0:EP_MOBILE           0.08315  0.06849  0.09783
## strat0:EP_CROWD            0.03774  0.01391  0.06135
## strat0:EP_NOVEH            0.11075  0.08929  0.13216
## strat0:EP_GROUPQ          -0.05570 -0.06636 -0.04511
## strat0:EP_UNINSUR          0.15819  0.14010  0.17630
## strat0:co                 -0.10803 -0.14862 -0.06744
## strat0:no2                 0.01240 -0.04062  0.06543
## strat0:o3                 -0.18017 -0.25288 -0.10678
## strat0:pm10               -0.22289 -0.25677 -0.18884
## strat0:pm25                0.49051  0.44084  0.53994
## strat0:so2                 0.05745  0.02305  0.09116
## strat0:summer_tmmx         0.12253  0.07118  0.17360
## strat0:winter_tmmx        -0.31262 -0.43899 -0.17723
## strat0:summer_rmax        -0.00054 -0.06838  0.06803
## strat0:winter_rmax         0.05775  0.00683  0.10815
## strat0:Data_Value_CSMOKING 0.89818  0.87352  0.92311
## strat1                     6.68605  6.67465  6.69750
## strat1:flood_risk_pc1     -0.01704 -0.02776 -0.00619
## strat1:flood_risk_pc2      0.00178 -0.01015  0.01371
## strat1:flood_risk_pc3      0.00354 -0.00636  0.01337
## strat1:flood_risk_pc4     -0.00033 -0.00887  0.00824
## strat1:flood_risk_pc5      0.00002 -0.00852  0.00859
## strat1:EP_AGE65            1.70414  1.68925  1.71910
## strat1:EP_AGE17            0.28821  0.27392  0.30257
## strat1:EP_DISABL           0.24440  0.23236  0.25646
## strat1:EP_SNGPNT          -0.02580 -0.03688 -0.01474
## strat1:EP_MINRTY           0.06665  0.04966  0.08361
## strat1:EP_LIMENG           0.02108  0.00815  0.03399
## strat1:EP_MUNIT           -0.01386 -0.02566 -0.00205
## strat1:EP_MOBILE           0.05589  0.04646  0.06526
## strat1:EP_CROWD            0.00304 -0.00842  0.01452
## strat1:EP_NOVEH            0.21061  0.19575  0.22548
## strat1:EP_GROUPQ          -0.02986 -0.03868 -0.02099
## strat1:EP_UNINSUR          0.11241  0.10070  0.12410
## strat1:co                 -0.15616 -0.19852 -0.11415
## strat1:no2                -0.02130 -0.07389  0.03080
## strat1:o3                 -0.17981 -0.25226 -0.10658
## strat1:pm10               -0.13845 -0.17356 -0.10333
```

```
## strat1:pm25                 0.49868  0.44917  0.54790
## strat1:so2                  0.02675 -0.00619  0.05901
## strat1:summer_tmmx          0.02545 -0.02723  0.07781
## strat1:winter_tmmx         -0.15659 -0.28254 -0.02076
## strat1:summer_rmax         -0.08239 -0.15016 -0.01307
## strat1:winter_rmax          0.06055  0.00976  0.11082
## strat1:Data_Value_CSMOKING  1.19512  1.17709  1.21304
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CHD_rpl1.R
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"     "strat0:flood_risk_pc4"
##  [5] "strat0:EP_AGE65"           "strat0:EP_AGE17"
##  [7] "strat0:EP_DISABL"          "strat0:EP_MINRTY"
##  [9] "strat0:EP_LIMENG"          "strat0:EP_MUNIT"
## [11] "strat0:EP_MOBILE"          "strat0:EP_CROWD"
## [13] "strat0:EP_NOVEH"           "strat0:EP_GROUPQ"
## [15] "strat0:EP_UNINSUR"         "strat0:co"
## [17] "strat0:o3"                 "strat0:pm10"
## [19] "strat0:pm25"               "strat0:so2"
## [21] "strat0:summer_tmmx"        "strat0:winter_tmmx"
## [23] "strat0:winter_rmax"        "strat0:Data_Value_CSMOKING"
## [25] "strat1"                    "strat1:flood_risk_pc1"
## [27] "strat1:EP_AGE65"           "strat1:EP_AGE17"
## [29] "strat1:EP_DISABL"          "strat1:EP_SNGPNT"
## [31] "strat1:EP_MINRTY"          "strat1:EP_LIMENG"
## [33] "strat1:EP_MUNIT"           "strat1:EP_MOBILE"
## [35] "strat1:EP_NOVEH"           "strat1:EP_GROUPQ"
## [37] "strat1:EP_UNINSUR"         "strat1:co"
## [39] "strat1:o3"                 "strat1:pm10"
## [41] "strat1:pm25"               "strat1:winter_tmmx"
## [43] "strat1:summer_rmax"        "strat1:winter_rmax"
## [45] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

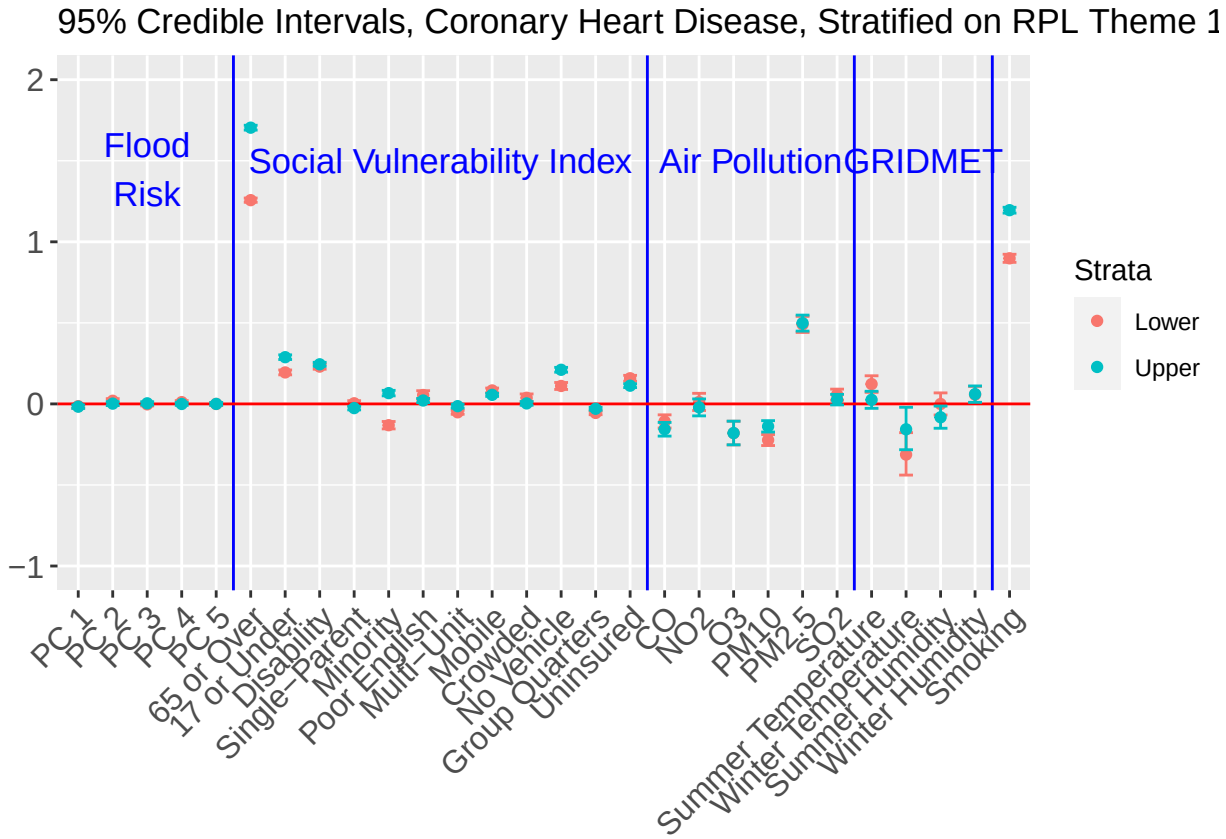
```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 17.5, 23.5, 27.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11.5, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 20.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 25.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)
p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_rpl1.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

CAR model results, Coronary Heart Disease Stratified on RPL_THEME2

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl2.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     6.30423  6.28996  6.31858
## strat0:flood_risk_pc1     -0.06673 -0.08370 -0.04983
## strat0:flood_risk_pc2      0.03380  0.01456  0.05310
## strat0:flood_risk_pc3     -0.02927 -0.04362 -0.01490
## strat0:flood_risk_pc4      0.01555  0.00232  0.02886
## strat0:flood_risk_pc5     -0.01854 -0.03140 -0.00567
## strat0:EP_POV              0.17521  0.15077  0.19948
## strat0:EP_UNEMP            0.14020  0.12108  0.15921
## strat0:EP_PCI              0.05835  0.03835  0.07856
## strat0:EP_NOHSDP           0.84768  0.81526  0.88063
## strat0:EP_MINRTY          -0.69547 -0.72610 -0.66503
```

```
## strat0:EP_LIMENG           -0.02521 -0.05299  0.00254
## strat0:EP_MUNIT            -0.07892 -0.09462 -0.06322
## strat0:EP_MOBILE            0.26763  0.24778  0.28737
## strat0:EP_CROWD            -0.25308 -0.27413 -0.23196
## strat0:EP_NOVEH             0.50768  0.48130  0.53391
## strat0:EP_GROUPQ           -0.29208 -0.30253 -0.28167
## strat0:EP_UNINSUR          -0.06808 -0.08957 -0.04657
## strat0:co                  -0.26079 -0.32410 -0.19767
## strat0:no2                  0.00479 -0.08237  0.09049
## strat0:o3                   0.03266 -0.10392  0.16851
## strat0:pm10                -0.52101 -0.57945 -0.46236
## strat0:pm25                 0.53864  0.45407  0.62318
## strat0:so2                 -0.06112 -0.11984 -0.00350
## strat0:summer_tmmx         -0.00153 -0.09792  0.09139
## strat0:winter_tmmx         -0.25447 -0.48549  0.01561
## strat0:summer_rmax          0.00042 -0.12539  0.12497
## strat0:winter_rmax          0.01963 -0.07374  0.11369
## strat0:Data_Value_CSMOKING -0.04856 -0.08570 -0.01111
## strat1                      7.02421  7.00937  7.03925
## strat1:flood_risk_pc1      -0.05120 -0.06865 -0.03360
## strat1:flood_risk_pc2      -0.00071 -0.01997  0.01843
## strat1:flood_risk_pc3      -0.00739 -0.02342  0.00851
## strat1:flood_risk_pc4       0.01246 -0.00160  0.02677
## strat1:flood_risk_pc5      -0.01306 -0.02721  0.00109
## strat1:EP_POV               0.65182  0.62551  0.67798
## strat1:EP_UNEMP             0.07042  0.05548  0.08540
## strat1:EP_PCI              -0.03986 -0.07767 -0.00180
## strat1:EP_NOHSDP            0.60882  0.57970  0.63782
## strat1:EP_MINRTY           -0.54699 -0.57551 -0.51871
## strat1:EP_LIMENG           -0.17493 -0.20235 -0.14773
## strat1:EP_MUNIT             0.07210  0.04990  0.09420
## strat1:EP_MOBILE            0.20244  0.18781  0.21696
## strat1:EP_CROWD            -0.23715 -0.25767 -0.21643
## strat1:EP_NOVEH             0.54499  0.51862  0.57143
## strat1:EP_GROUPQ            0.12809  0.09979  0.15653
## strat1:EP_UNINSUR          -0.04980 -0.06976 -0.02978
## strat1:co                  -0.30915 -0.38079 -0.23805
## strat1:no2                 -0.19977 -0.29126 -0.10965
## strat1:o3                   0.06285 -0.07316  0.19868
## strat1:pm10                -0.45389 -0.51216 -0.39624
## strat1:pm25                 0.61054  0.52651  0.69397
## strat1:so2                 -0.03964 -0.09686  0.01733
## strat1:summer_tmmx          0.01070 -0.08642  0.10425
## strat1:winter_tmmx         -0.28525 -0.51747 -0.01566
## strat1:summer_rmax          0.02450 -0.10133  0.14917
## strat1:winter_rmax          0.03539 -0.05743  0.12851
## strat1:Data_Value_CSMOKING -0.21323 -0.24947 -0.17705
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CHD_rpl2.RD
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
```

```
##  [3] "strat0:flood_risk_pc2"      "strat0:flood_risk_pc3"
##  [5] "strat0:flood_risk_pc4"      "strat0:flood_risk_pc5"
##  [7] "strat0:EP_POV"              "strat0:EP_UNEMP"
##  [9] "strat0:EP_PCI"              "strat0:EP_NOHSDP"
## [11] "strat0:EP_MINRTY"           "strat0:EP_MUNIT"
## [13] "strat0:EP_MOBILE"           "strat0:EP_CROWD"
## [15] "strat0:EP_NOVEH"            "strat0:EP_GROUPQ"
## [17] "strat0:EP_UNINSUR"          "strat0:co"
## [19] "strat0:pm10"                "strat0:pm25"
## [21] "strat0:so2"                 "strat0:Data_Value_CSMOKING"
## [23] "strat1"                     "strat1:flood_risk_pc1"
## [25] "strat1:EP_POV"              "strat1:EP_UNEMP"
## [27] "strat1:EP_PCI"              "strat1:EP_NOHSDP"
## [29] "strat1:EP_MINRTY"           "strat1:EP_LIMENG"
## [31] "strat1:EP_MUNIT"            "strat1:EP_MOBILE"
## [33] "strat1:EP_CROWD"            "strat1:EP_NOVEH"
## [35] "strat1:EP_GROUPQ"           "strat1:EP_UNINSUR"
## [37] "strat1:co"                  "strat1:no2"
## [39] "strat1:pm10"                "strat1:pm25"
## [41] "strat1:winter_tmmx"         "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

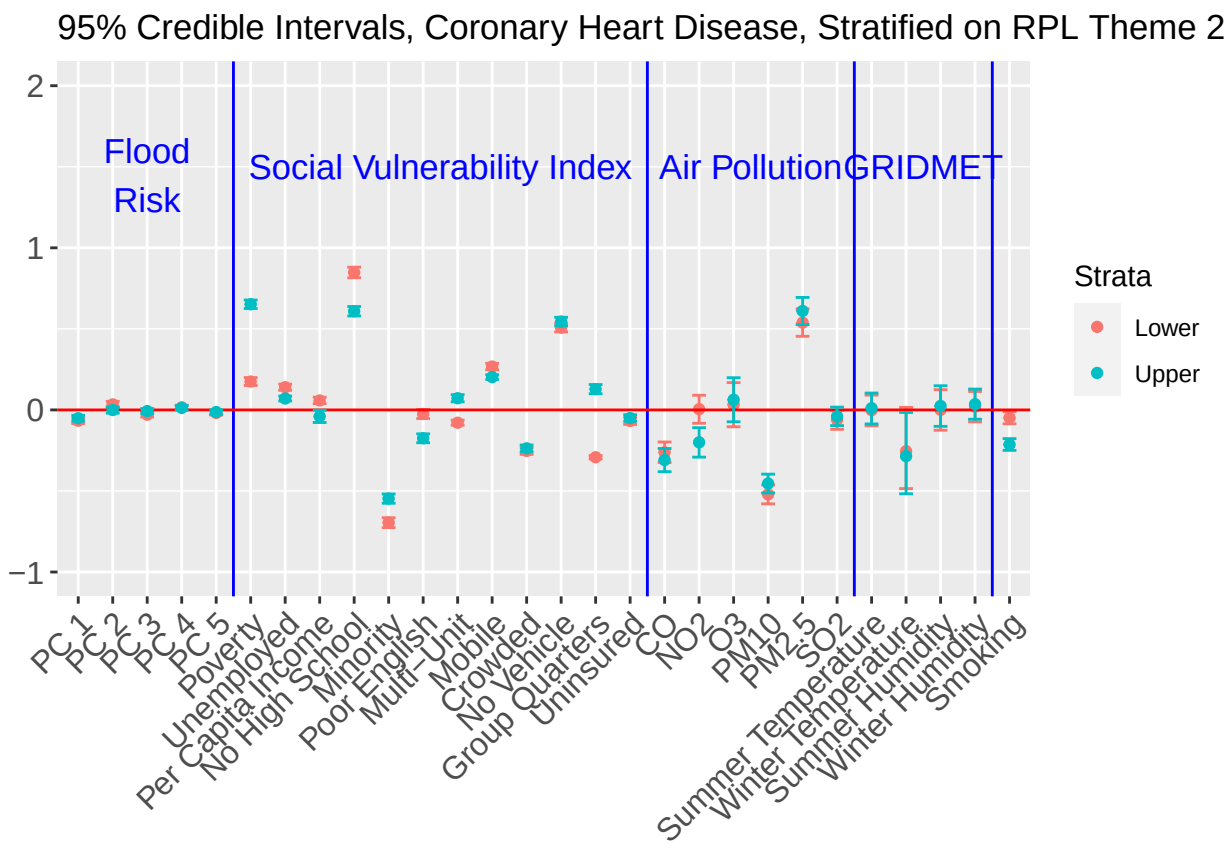
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 17.5, 23.5, 27.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
```

```
          col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11.5, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 20.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 25.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_rpl2.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

CAR model results, Coronary Heart Disease Stratified on RPL_THEME3

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl3.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     6.76501  6.74767  6.78232
## strat0:flood_risk_pc1     -0.01483 -0.02636 -0.00329
## strat0:flood_risk_pc2      0.01941  0.00585  0.03304
## strat0:flood_risk_pc3      0.01204  0.00166  0.02237
## strat0:flood_risk_pc4      0.01696  0.00631  0.02751
## strat0:flood_risk_pc5      0.00355 -0.00677  0.01390
## strat0:EP_POV              0.31113  0.29337  0.32879
## strat0:EP_UNEMP            0.03773  0.02563  0.04977
## strat0:EP_PCI             -0.02874 -0.04289 -0.01464
## strat0:EP_NOHSDP           0.27300  0.24645  0.29950
## strat0:EP_AGE65            1.30345  1.29075  1.31612
## strat0:EP_AGE17            0.29597  0.28110  0.31068
## strat0:EP_DISABL           0.26693  0.25282  0.28102
## strat0:EP_SNGPNT          -0.01633 -0.03074 -0.00193
## strat0:EP_MUNIT           -0.05652 -0.07218 -0.04082
## strat0:EP_MOBILE           0.06397  0.05291  0.07506
## strat0:EP_CROWD           -0.00750 -0.03182  0.01660
## strat0:EP_NOVEH            0.13557  0.11469  0.15648
## strat0:EP_GROUPQ          -0.12827 -0.13845 -0.11820
## strat0:EP_UNINSUR          0.10768  0.09121  0.12411
## strat0:co                 -0.12087 -0.16222 -0.07935
## strat0:no2                -0.04947 -0.10435  0.00505
## strat0:o3                 -0.15967 -0.23060 -0.07892
## strat0:pm10               -0.14755 -0.18179 -0.11344
## strat0:pm25                0.39031  0.33941  0.44041
## strat0:so2                 0.04042  0.00561  0.07503
## strat0:summer_tmmx         0.07608  0.02380  0.12765
## strat0:winter_tmmx        -0.27667 -0.40808 -0.15117
## strat0:summer_rmax        -0.01973 -0.08950  0.04666
## strat0:winter_rmax         0.07179  0.01947  0.12320
## strat0:Data_Value_CSMOKING 0.69089  0.66326  0.71846
## strat1                     6.70294  6.69188  6.71406
## strat1:flood_risk_pc1     -0.02118 -0.03244 -0.00987
## strat1:flood_risk_pc2      0.00852 -0.00349  0.02045
## strat1:flood_risk_pc3     -0.00779 -0.01750  0.00194
## strat1:flood_risk_pc4     -0.00117 -0.00917  0.00686
## strat1:flood_risk_pc5      0.00156 -0.00624  0.00930
## strat1:EP_POV              0.32643  0.31130  0.34164
## strat1:EP_UNEMP            0.02950  0.01973  0.03931
## strat1:EP_PCI             -0.03701 -0.05396 -0.02003
```

```
## strat1:EP_NOHSDP            0.13020  0.11521  0.14521
## strat1:EP_AGE65             1.55164  1.53707  1.56633
## strat1:EP_AGE17             0.24312  0.22915  0.25720
## strat1:EP_DISABL            0.24637  0.23310  0.25961
## strat1:EP_SNGPNT           -0.06454 -0.07580 -0.05327
## strat1:EP_MUNIT            -0.06197 -0.07234 -0.05155
## strat1:EP_MOBILE            0.09291  0.08235  0.10348
## strat1:EP_CROWD            -0.02666 -0.03815 -0.01518
## strat1:EP_NOVEH             0.09375  0.07817  0.10935
## strat1:EP_GROUPQ           -0.06692 -0.07650 -0.05736
## strat1:EP_UNINSUR           0.08772  0.07555  0.09989
## strat1:co                  -0.12116 -0.16478 -0.07813
## strat1:no2                 -0.05278 -0.10570  0.00006
## strat1:o3                  -0.15822 -0.22952 -0.07679
## strat1:pm10                -0.16850 -0.20472 -0.13198
## strat1:pm25                 0.44519  0.39367  0.49574
## strat1:so2                  0.02409 -0.01298  0.06035
## strat1:summer_tmmx          0.04815 -0.00518  0.10083
## strat1:winter_tmmx         -0.21012 -0.34171 -0.08545
## strat1:summer_rmax         -0.07801 -0.14827 -0.01132
## strat1:winter_rmax          0.04087 -0.01191  0.09299
## strat1:Data_Value_CSMOKING  0.84659  0.82323  0.86998
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CHD_rpl3.R
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                     "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"      "strat0:flood_risk_pc3"
##  [5] "strat0:flood_risk_pc4"      "strat0:EP_POV"
##  [7] "strat0:EP_UNEMP"            "strat0:EP_PCI"
##  [9] "strat0:EP_NOHSDP"           "strat0:EP_AGE65"
## [11] "strat0:EP_AGE17"            "strat0:EP_DISABL"
## [13] "strat0:EP_SNGPNT"           "strat0:EP_MUNIT"
## [15] "strat0:EP_MOBILE"           "strat0:EP_NOVEH"
## [17] "strat0:EP_GROUPQ"           "strat0:EP_UNINSUR"
## [19] "strat0:co"                  "strat0:o3"
## [21] "strat0:pm10"                "strat0:pm25"
## [23] "strat0:so2"                 "strat0:summer_tmmx"
## [25] "strat0:winter_tmmx"         "strat0:winter_rmax"
## [27] "strat0:Data_Value_CSMOKING" "strat1"
## [29] "strat1:flood_risk_pc1"      "strat1:EP_POV"
## [31] "strat1:EP_UNEMP"            "strat1:EP_PCI"
## [33] "strat1:EP_NOHSDP"           "strat1:EP_AGE65"
## [35] "strat1:EP_AGE17"            "strat1:EP_DISABL"
## [37] "strat1:EP_SNGPNT"           "strat1:EP_MUNIT"
## [39] "strat1:EP_MOBILE"           "strat1:EP_CROWD"
## [41] "strat1:EP_NOVEH"            "strat1:EP_GROUPQ"
## [43] "strat1:EP_UNINSUR"          "strat1:co"
## [45] "strat1:o3"                  "strat1:pm10"
## [47] "strat1:pm25"                "strat1:winter_tmmx"
## [49] "strat1:summer_rmax"         "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

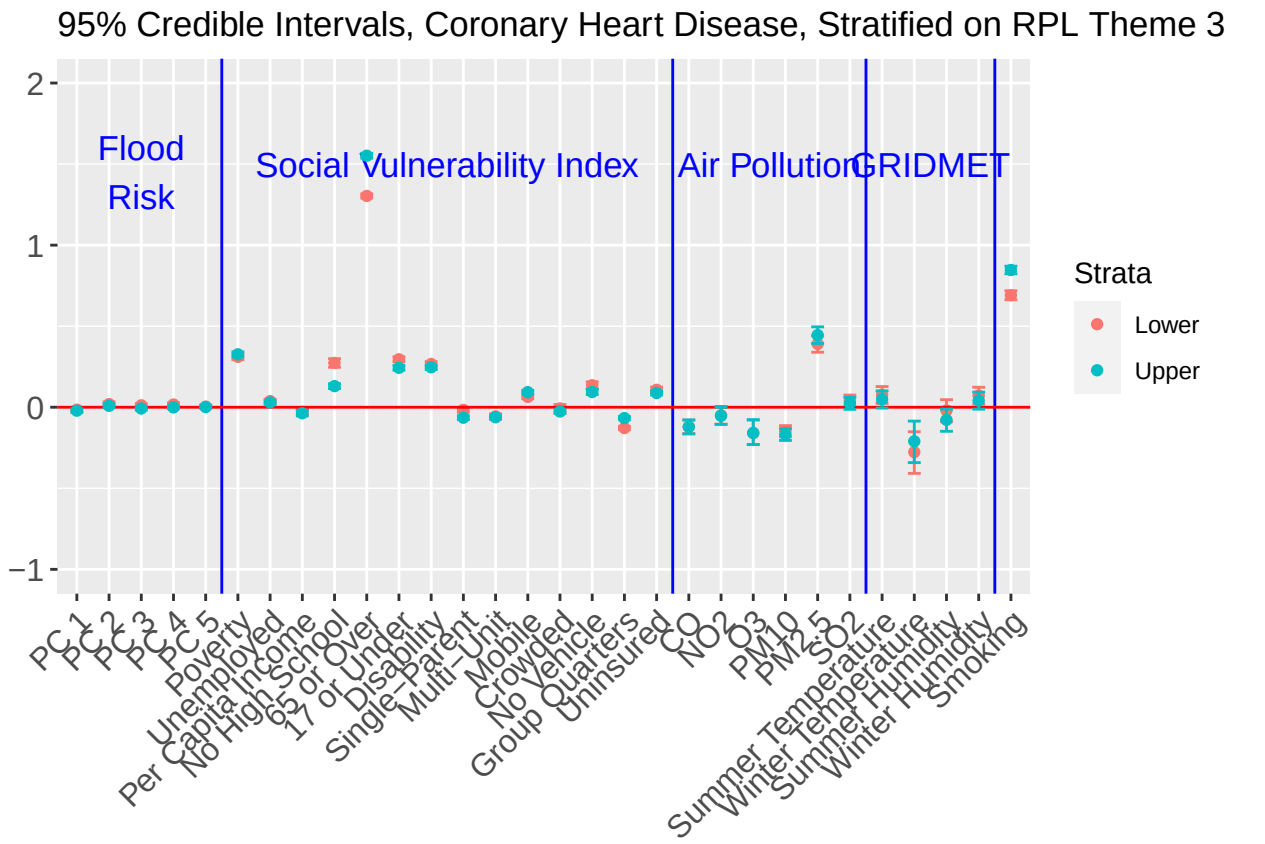
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 19.5, 25.5, 29.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 22.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 27.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)
```

```
p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_rpl3.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

CAR model results, Coronary Heart Disease Stratified on RPL_THEME4

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl4.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                              50%     2.5%    97.5%
## strat0                   6.63735  6.62864  6.64598
## strat0:flood_risk_pc1   -0.00364 -0.01457  0.00737
## strat0:flood_risk_pc2    0.02375  0.01129  0.03624
## strat0:flood_risk_pc3    0.00200 -0.00753  0.01157
## strat0:flood_risk_pc4    0.00945  0.00023  0.01875
## strat0:flood_risk_pc5    0.00102 -0.00800  0.01002
```

```
## strat0:EP_POV               0.35369  0.33530  0.37222
## strat0:EP_UNEMP             0.02864  0.01693  0.04041
## strat0:EP_PCI               0.00055 -0.01324  0.01443
## strat0:EP_NOHSDP            0.25463  0.23257  0.27695
## strat0:EP_AGE65             1.31732  1.30509  1.32956
## strat0:EP_AGE17             0.28532  0.27281  0.29780
## strat0:EP_DISABL            0.24523  0.23103  0.25938
## strat0:EP_SNGPNT           -0.05462 -0.06811 -0.04103
## strat0:EP_MINRTY           -0.11497 -0.13396 -0.09593
## strat0:EP_LIMENG           -0.10944 -0.13225 -0.08678
## strat0:EP_UNINSUR           0.15000  0.13483  0.16519
## strat0:co                  -0.14266 -0.18588 -0.09948
## strat0:no2                 -0.01346 -0.06727  0.04026
## strat0:o3                  -0.18840 -0.25888 -0.11536
## strat0:pm10                -0.18489 -0.21851 -0.15140
## strat0:pm25                 0.39730  0.34927  0.44605
## strat0:so2                  0.04539  0.01126  0.07893
## strat0:summer_tmmx          0.11469  0.06126  0.16597
## strat0:winter_tmmx         -0.27003 -0.39622 -0.11920
## strat0:summer_rmax         -0.03065 -0.09464  0.03626
## strat0:winter_rmax          0.06184  0.01007  0.11092
## strat0:Data_Value_CSMOKING  0.76785  0.74208  0.79377
## strat1                      6.69248  6.68424  6.70077
## strat1:flood_risk_pc1      -0.01305 -0.02363 -0.00250
## strat1:flood_risk_pc2      -0.00001 -0.01185  0.01190
## strat1:flood_risk_pc3       0.00253 -0.00697  0.01204
## strat1:flood_risk_pc4       0.00372 -0.00465  0.01210
## strat1:flood_risk_pc5       0.00187 -0.00655  0.01020
## strat1:EP_POV               0.27532  0.26177  0.28878
## strat1:EP_UNEMP             0.02950  0.01933  0.03962
## strat1:EP_PCI              -0.02088 -0.03821 -0.00346
## strat1:EP_NOHSDP            0.12811  0.11050  0.14567
## strat1:EP_AGE65             1.58104  1.56781  1.59430
## strat1:EP_AGE17             0.36873  0.35667  0.38077
## strat1:EP_DISABL            0.29361  0.28102  0.30624
## strat1:EP_SNGPNT           -0.08524 -0.09724 -0.07322
## strat1:EP_MINRTY           -0.00064 -0.01896  0.01768
## strat1:EP_LIMENG           -0.03896 -0.05410 -0.02382
## strat1:EP_UNINSUR           0.10881  0.09672  0.12092
## strat1:co                  -0.13901 -0.17730 -0.10084
## strat1:no2                 -0.06750 -0.11743 -0.01767
## strat1:o3                  -0.20967 -0.28003 -0.13643
## strat1:pm10                -0.13527 -0.16996 -0.10129
## strat1:pm25                 0.40482  0.35736  0.45303
## strat1:so2                  0.04802  0.01488  0.08091
## strat1:summer_tmmx          0.08015  0.02752  0.13014
## strat1:winter_tmmx         -0.20823 -0.33365 -0.05768
## strat1:summer_rmax         -0.06400 -0.12763  0.00301
## strat1:winter_rmax          0.05103 -0.00009  0.09987
## strat1:Data_Value_CSMOKING  0.92192  0.89936  0.94454
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CHD_rpl4.RD
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc2"
##  [3] "strat0:flood_risk_pc4"     "strat0:EP_POV"
##  [5] "strat0:EP_UNEMP"           "strat0:EP_NOHSDP"
##  [7] "strat0:EP_AGE65"           "strat0:EP_AGE17"
##  [9] "strat0:EP_DISABL"          "strat0:EP_SNGPNT"
## [11] "strat0:EP_MINRTY"          "strat0:EP_LIMENG"
## [13] "strat0:EP_UNINSUR"         "strat0:co"
## [15] "strat0:o3"                 "strat0:pm10"
## [17] "strat0:pm25"               "strat0:so2"
## [19] "strat0:summer_tmmx"        "strat0:winter_tmmx"
## [21] "strat0:winter_rmax"        "strat0:Data_Value_CSMOKING"
## [23] "strat1"                    "strat1:flood_risk_pc1"
## [25] "strat1:EP_POV"             "strat1:EP_UNEMP"
## [27] "strat1:EP_PCI"             "strat1:EP_NOHSDP"
## [29] "strat1:EP_AGE65"           "strat1:EP_AGE17"
## [31] "strat1:EP_DISABL"          "strat1:EP_SNGPNT"
## [33] "strat1:EP_LIMENG"          "strat1:EP_UNINSUR"
## [35] "strat1:co"                 "strat1:no2"
## [37] "strat1:o3"                 "strat1:pm10"
## [39] "strat1:pm25"               "strat1:so2"
## [41] "strat1:summer_tmmx"        "strat1:winter_tmmx"
## [43] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

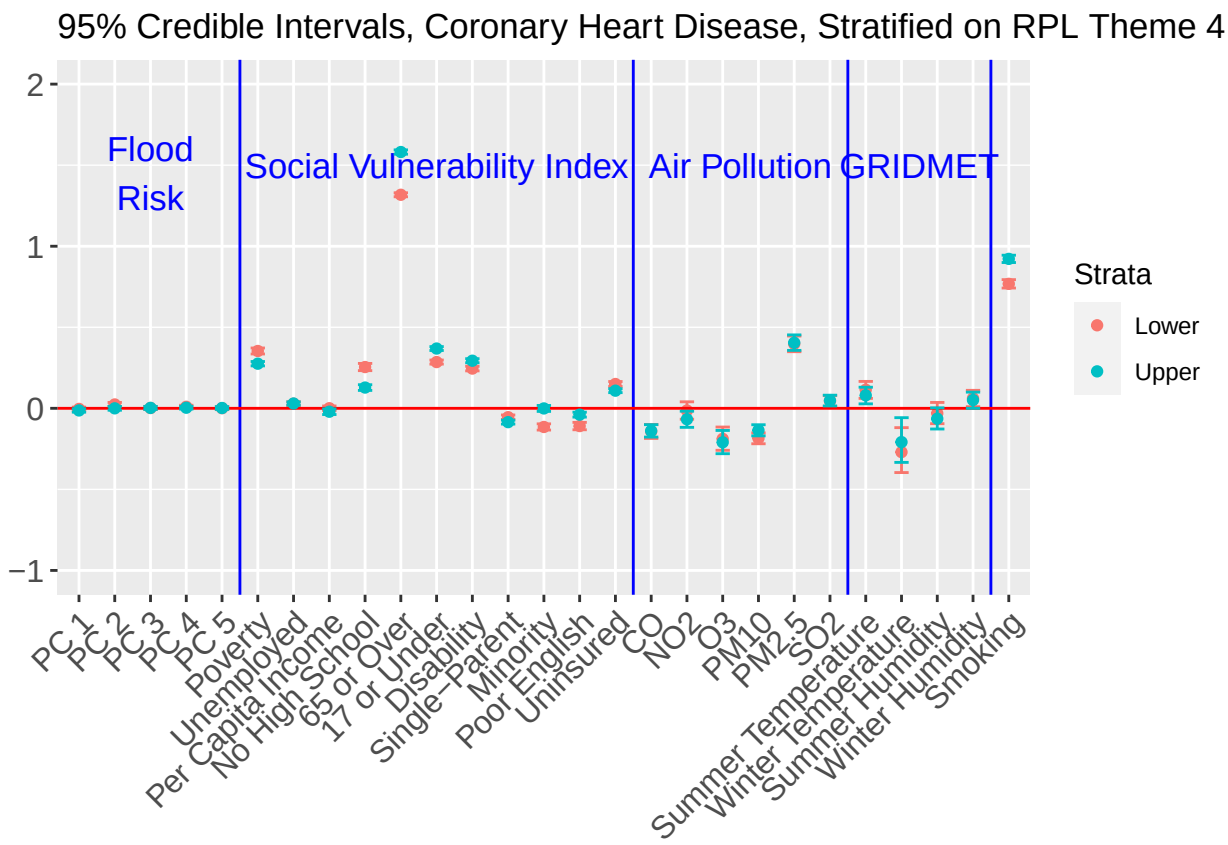
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
```

```
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 16.5, 22.5, 26.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 19.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 24.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent",
                              "Minority", "Poor English",
                              "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```



```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_rpl4.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

CAR model results, Coronary Heart Disease Stratified on RPL_THEMES

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpls.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                               50%     2.5%    97.5%
## strat0                    6.22923  6.20960  6.24873
## strat0:flood_risk_pc1    -0.09529 -0.11554 -0.07482
## strat0:flood_risk_pc2     0.02648  0.00304  0.04975
## strat0:flood_risk_pc3    -0.03070 -0.04791 -0.01340
## strat0:flood_risk_pc4     0.01623 -0.00086  0.03324
## strat0:flood_risk_pc5    -0.03153 -0.04782 -0.01522
## strat0:EP_UNINSUR        -0.00946 -0.03789  0.01914
## strat0:co                -0.31590 -0.39066 -0.24136
## strat0:no2               -0.34359 -0.44004 -0.24469
## strat0:o3                -0.41323 -0.57595 -0.26473
## strat0:pm10              -0.69297 -0.76084 -0.62591
## strat0:pm25               0.81704  0.72026  0.91460
## strat0:so2                0.02995 -0.03554  0.09841
## strat0:summer_tmmx        0.08278 -0.03023  0.20197
## strat0:winter_tmmx       -0.46540 -0.80970 -0.12863
## strat0:summer_rmax       -0.02028 -0.15795  0.12244
## strat0:winter_rmax        0.12838  0.02425  0.23107
## strat0:Data_Value_CSMOKING  0.36589  0.33407  0.39785
## strat1                    6.86194  6.84507  6.87874
## strat1:flood_risk_pc1    -0.06508 -0.08469 -0.04536
## strat1:flood_risk_pc2     0.03272  0.01137  0.05412
## strat1:flood_risk_pc3    -0.02048 -0.03820 -0.00300
## strat1:flood_risk_pc4     0.01250 -0.00257  0.02757
## strat1:flood_risk_pc5    -0.00153 -0.01654  0.01355
## strat1:EP_UNINSUR        -0.13812 -0.15672 -0.11934
## strat1:co                -0.49377 -0.57383 -0.41376
## strat1:no2               -0.04214 -0.14042  0.05686
## strat1:o3                -0.52150 -0.68436 -0.37188
## strat1:pm10              -0.62719 -0.69743 -0.55768
## strat1:pm25               0.82231  0.72475  0.91947
## strat1:so2                0.03199 -0.03275  0.09900
## strat1:summer_tmmx        0.00419 -0.10952  0.12432
## strat1:winter_tmmx       -0.25761 -0.59916  0.07707
## strat1:summer_rmax       -0.07899 -0.21757  0.06513
## strat1:winter_rmax        0.10485  0.00059  0.20788
```

```
## strat1:Data_Value_CSMOKING  0.86591  0.84219  0.88957
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CHD_rpls.R
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"     "strat0:flood_risk_pc3"
##  [5] "strat0:flood_risk_pc5"     "strat0:co"
##  [7] "strat0:no2"                "strat0:o3"
##  [9] "strat0:pm10"               "strat0:pm25"
## [11] "strat0:winter_tmmx"        "strat0:winter_rmax"
## [13] "strat0:Data_Value_CSMOKING" "strat1"
## [15] "strat1:flood_risk_pc1"     "strat1:flood_risk_pc2"
## [17] "strat1:flood_risk_pc3"     "strat1:EP_UNINSUR"
## [19] "strat1:co"                 "strat1:o3"
## [21] "strat1:pm10"               "strat1:pm25"
## [23] "strat1:winter_rmax"        "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

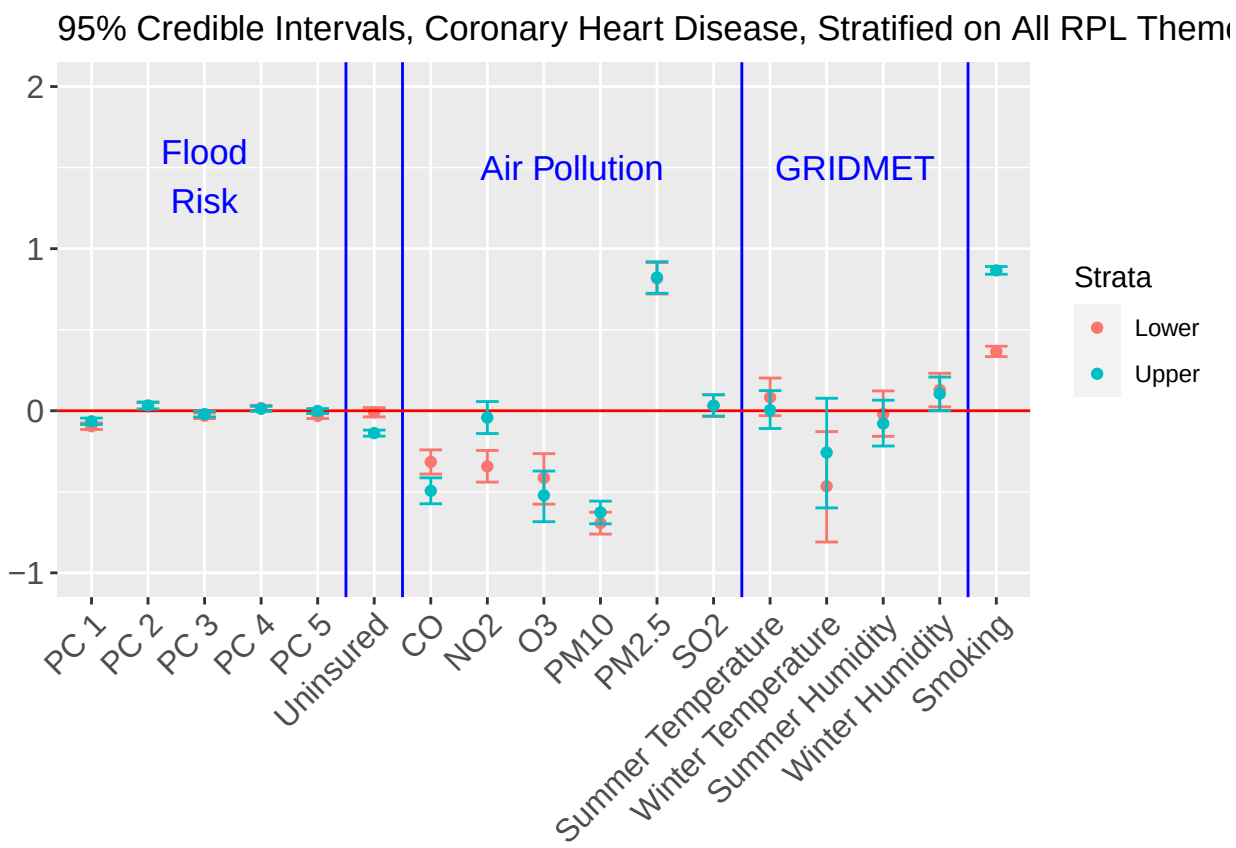
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 6.5, 12.5, 16.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 9.5, y = 1.5, label = "Air Pollution",
```

```
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 14.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_rpls.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

BPHIGH Stratified Analysis

Repeating the stratified analysis in the last section, this time just doing the plots

Stratified on Poverty

```
load(here("modeling_files/stratified_analysis/model_stratif_poverty_BPHIGH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     31.81072 31.76808 31.85316
## strat0:flood_risk_pc1       0.00942 -0.02697  0.04548
## strat0:flood_risk_pc2       0.05889  0.01730  0.10010
## strat0:flood_risk_pc3       0.01296 -0.01790  0.04395
## strat0:flood_risk_pc4       0.04486  0.01528  0.07444
## strat0:flood_risk_pc5       0.01254 -0.01536  0.04061
## strat0:EP_UNEMP             0.10481  0.05762  0.15164
## strat0:EP_PCI               0.10979  0.06522  0.15466
## strat0:EP_NOHSDP            0.26285  0.17595  0.34920
## strat0:EP_AGE65             3.69131  3.64823  3.73430
## strat0:EP_AGE17             0.26898  0.21980  0.31812
## strat0:EP_DISABL            0.64584  0.59379  0.69845
## strat0:EP_SNGPNT            0.05582  0.00695  0.10473
## strat0:EP_MINRTY            1.78954  1.71692  1.86169
## strat0:EP_LIMENG           -0.84896 -0.92822 -0.77018
## strat0:EP_MUNIT            -0.70297 -0.74363 -0.66217
## strat0:EP_MOBILE            0.18471  0.14378  0.22560
## strat0:EP_CROWD            -0.01549 -0.07955  0.04878
## strat0:EP_NOVEH             0.25038  0.17968  0.32075
## strat0:EP_GROUPQ           -0.71909 -0.75996 -0.67807
## strat0:EP_UNINSUR           0.38212  0.32853  0.43530
## strat0:co                  -0.52543 -0.65490 -0.39521
## strat0:no2                 -0.59173 -0.76546 -0.41967
## strat0:o3                  -0.48358 -0.74541 -0.22200
## strat0:pm10                -0.51405 -0.62941 -0.40235
## strat0:pm25                 1.07335  0.91211  1.24476
## strat0:so2                  0.15815  0.04247  0.27580
## strat0:summer_tmmx          0.28587  0.10736  0.47950
## strat0:winter_tmmx         -0.89791 -1.49153 -0.43034
## strat0:summer_rmax         -0.15934 -0.40798  0.09149
## strat0:winter_rmax          0.24545  0.06530  0.42711
## strat0:Data_Value_CSMOKING  1.83412  1.74082  1.92630
## strat1                     32.31804 32.28175 32.35408
## strat1:flood_risk_pc1      -0.02892 -0.06274  0.00486
## strat1:flood_risk_pc2       0.08176  0.04389  0.11985
## strat1:flood_risk_pc3       0.06746  0.03762  0.09730
## strat1:flood_risk_pc4       0.02925  0.00222  0.05602
## strat1:flood_risk_pc5       0.00818 -0.01859  0.03488
## strat1:EP_UNEMP             0.09299  0.06486  0.12128
## strat1:EP_PCI               0.43201  0.35438  0.50905
## strat1:EP_NOHSDP           -0.14034 -0.19509 -0.08587
## strat1:EP_AGE65             4.42987  4.38491  4.47519
## strat1:EP_AGE17             0.72096  0.67688  0.76560
```

```
## strat1:EP_DISABL            0.75897  0.72140  0.79667
## strat1:EP_SNGPNT           -0.10875 -0.14398 -0.07336
## strat1:EP_MINRTY            3.08881  3.03057  3.14727
## strat1:EP_LIMENG           -0.88186 -0.93034 -0.83323
## strat1:EP_MUNIT            -0.50383 -0.53926 -0.46831
## strat1:EP_MOBILE            0.11469  0.08422  0.14508
## strat1:EP_CROWD            -0.14332 -0.18035 -0.10618
## strat1:EP_NOVEH             0.57222  0.52562  0.61891
## strat1:EP_GROUPQ           -0.49463 -0.52152 -0.46768
## strat1:EP_UNINSUR           0.19596  0.15789  0.23357
## strat1:co                  -0.80327 -0.94502 -0.66230
## strat1:no2                 -0.55613 -0.73215 -0.38318
## strat1:o3                  -0.55544 -0.81800 -0.29313
## strat1:pm10                -0.46440 -0.58334 -0.34982
## strat1:pm25                 1.31189  1.15016  1.48344
## strat1:so2                 -0.02503 -0.13820  0.09058
## strat1:summer_tmmx          0.01667 -0.16454  0.21049
## strat1:winter_tmmx         -0.47474 -1.06863 -0.00922
## strat1:summer_rmax         -0.29181 -0.54163 -0.04171
## strat1:winter_rmax          0.13001 -0.04799  0.31213
## strat1:Data_Value_CSMOKING  2.74937  2.68355  2.81552
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/BPHIGH_pov
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc2"
##  [3] "strat0:flood_risk_pc4"     "strat0:EP_UNEMP"
##  [5] "strat0:EP_PCI"             "strat0:EP_NOHSDP"
##  [7] "strat0:EP_AGE65"           "strat0:EP_AGE17"
##  [9] "strat0:EP_DISABL"          "strat0:EP_SNGPNT"
## [11] "strat0:EP_MINRTY"          "strat0:EP_LIMENG"
## [13] "strat0:EP_MUNIT"           "strat0:EP_MOBILE"
## [15] "strat0:EP_NOVEH"           "strat0:EP_GROUPQ"
## [17] "strat0:EP_UNINSUR"         "strat0:co"
## [19] "strat0:no2"                "strat0:o3"
## [21] "strat0:pm10"               "strat0:pm25"
## [23] "strat0:so2"                "strat0:summer_tmmx"
## [25] "strat0:winter_tmmx"        "strat0:winter_rmax"
## [27] "strat0:Data_Value_CSMOKING" "strat1"
## [29] "strat1:flood_risk_pc2"     "strat1:flood_risk_pc3"
## [31] "strat1:flood_risk_pc4"     "strat1:EP_UNEMP"
## [33] "strat1:EP_PCI"             "strat1:EP_NOHSDP"
## [35] "strat1:EP_AGE65"           "strat1:EP_AGE17"
## [37] "strat1:EP_DISABL"          "strat1:EP_SNGPNT"
## [39] "strat1:EP_MINRTY"          "strat1:EP_LIMENG"
## [41] "strat1:EP_MUNIT"           "strat1:EP_MOBILE"
## [43] "strat1:EP_CROWD"           "strat1:EP_NOVEH"
## [45] "strat1:EP_GROUPQ"          "strat1:EP_UNINSUR"
## [47] "strat1:co"                 "strat1:no2"
## [49] "strat1:o3"                 "strat1:pm10"
## [51] "strat1:pm25"               "strat1:winter_tmmx"
## [53] "strat1:summer_rmax"        "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

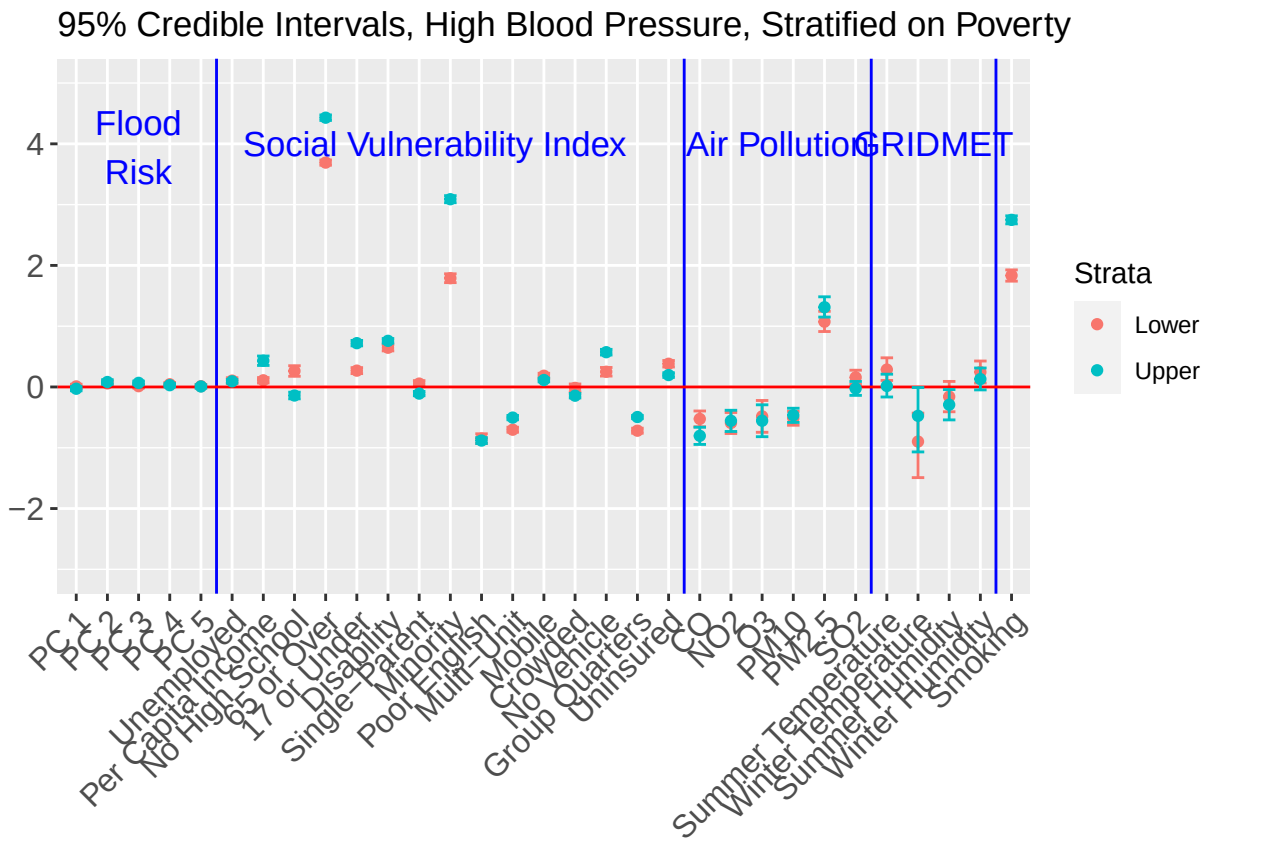
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-3, 5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 20.5, 26.5, 30.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 4, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 23.5, y = 4, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 28.5, y = 4, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, High Blood Pressure, Strati
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)
```

```
p
```




```
ggsave(here("figures/final_figures/stratified_analysis/BPHIGH_CI_poverty.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME1

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl1_BPHIGH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                    31.75099 31.70342 31.79852
## strat0:flood_risk_pc1      0.00235 -0.03414  0.03842
## strat0:flood_risk_pc2      0.10135  0.05966  0.14310
## strat0:flood_risk_pc3      0.01665 -0.01398  0.04732
## strat0:flood_risk_pc4      0.04505  0.01570  0.07450
## strat0:flood_risk_pc5      0.01600 -0.01201  0.04409
## strat0:EP_AGE65            3.78311  3.74198  3.82395
## strat0:EP_AGE17            0.47906  0.43214  0.52616
## strat0:EP_DISABL           0.63102  0.58084  0.68107
```

```
## strat0:EP_SNGPNT           -0.07256 -0.12214 -0.02288
## strat0:EP_MINRTY            1.67401  1.60131  1.74694
## strat0:EP_LIMENG           -0.67208 -0.75482 -0.58976
## strat0:EP_MUNIT            -0.65183 -0.69018 -0.61333
## strat0:EP_MOBILE            0.19232  0.14667  0.23816
## strat0:EP_CROWD            -0.07846 -0.15196 -0.00524
## strat0:EP_NOVEH             0.22505  0.15718  0.29284
## strat0:EP_GROUPQ           -0.59108 -0.62483 -0.55739
## strat0:EP_UNINSUR           0.41334  0.35717  0.46994
## strat0:co                  -0.49746 -0.63013 -0.36529
## strat0:no2                 -0.55779 -0.73639 -0.37994
## strat0:o3                  -0.53962 -0.80646 -0.27464
## strat0:pm10                -0.52247 -0.63757 -0.40611
## strat0:pm25                 1.04560  0.87661  1.21440
## strat0:so2                  0.13944  0.02163  0.25470
## strat0:summer_tmmx          0.26548  0.07906  0.44780
## strat0:winter_tmmx         -0.85863 -1.31658 -0.34198
## strat0:summer_rmax         -0.20968 -0.45496  0.03449
## strat0:winter_rmax          0.21920  0.03709  0.40092
## strat0:Data_Value_CSMOKING  2.05272  1.97409  2.13205
## strat1                     32.04895 32.01390 32.08427
## strat1:flood_risk_pc1      -0.04157 -0.07595 -0.00676
## strat1:flood_risk_pc2       0.05277  0.01470  0.09086
## strat1:flood_risk_pc3       0.06164  0.03023  0.09268
## strat1:flood_risk_pc4       0.03777  0.01066  0.06494
## strat1:flood_risk_pc5      -0.00299 -0.03005  0.02420
## strat1:EP_AGE65             4.49072  4.44376  4.53788
## strat1:EP_AGE17             0.55995  0.51526  0.60498
## strat1:EP_DISABL            0.77355  0.73582  0.81155
## strat1:EP_SNGPNT           -0.01326 -0.04790  0.02131
## strat1:EP_MINRTY            3.06203  3.00626  3.11747
## strat1:EP_LIMENG           -1.01014 -1.05192 -0.96862
## strat1:EP_MUNIT            -0.42028 -0.45755 -0.38309
## strat1:EP_MOBILE            0.12143  0.09177  0.15094
## strat1:EP_CROWD            -0.11758 -0.15370 -0.08131
## strat1:EP_NOVEH             0.53785  0.49070  0.58485
## strat1:EP_GROUPQ           -0.57288 -0.60034 -0.54534
## strat1:EP_UNINSUR           0.21087  0.17394  0.24765
## strat1:co                  -0.80996 -0.95135 -0.66940
## strat1:no2                 -0.58030 -0.75933 -0.40401
## strat1:o3                  -0.58185 -0.84861 -0.31803
## strat1:pm10                -0.49926 -0.61924 -0.37969
## strat1:pm25                 1.32042  1.15090  1.48843
## strat1:so2                  0.04465 -0.06941  0.15670
## strat1:summer_tmmx          0.05546 -0.13527  0.24183
## strat1:winter_tmmx         -0.49115 -0.95010  0.02275
## strat1:summer_rmax         -0.30221 -0.54817 -0.05525
## strat1:winter_rmax          0.15729 -0.02456  0.33965
## strat1:Data_Value_CSMOKING  2.68359  2.62601  2.74077
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/BPHIGH_rpl
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                     "strat0:flood_risk_pc2"
##  [3] "strat0:flood_risk_pc4"      "strat0:EP_AGE65"
##  [5] "strat0:EP_AGE17"            "strat0:EP_DISABL"
##  [7] "strat0:EP_SNGPNT"           "strat0:EP_MINRTY"
##  [9] "strat0:EP_LIMENG"           "strat0:EP_MUNIT"
## [11] "strat0:EP_MOBILE"           "strat0:EP_CROWD"
## [13] "strat0:EP_NOVEH"            "strat0:EP_GROUPQ"
## [15] "strat0:EP_UNINSUR"          "strat0:co"
## [17] "strat0:no2"                 "strat0:o3"
## [19] "strat0:pm10"                "strat0:pm25"
## [21] "strat0:so2"                 "strat0:summer_tmmx"
## [23] "strat0:winter_tmmx"         "strat0:winter_rmax"
## [25] "strat0:Data_Value_CSMOKING" "strat1"
## [27] "strat1:flood_risk_pc1"      "strat1:flood_risk_pc2"
## [29] "strat1:flood_risk_pc3"      "strat1:flood_risk_pc4"
## [31] "strat1:EP_AGE65"            "strat1:EP_AGE17"
## [33] "strat1:EP_DISABL"           "strat1:EP_MINRTY"
## [35] "strat1:EP_LIMENG"           "strat1:EP_MUNIT"
## [37] "strat1:EP_MOBILE"           "strat1:EP_CROWD"
## [39] "strat1:EP_NOVEH"            "strat1:EP_GROUPQ"
## [41] "strat1:EP_UNINSUR"          "strat1:co"
## [43] "strat1:no2"                 "strat1:o3"
## [45] "strat1:pm10"                "strat1:pm25"
## [47] "strat1:summer_rmax"         "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

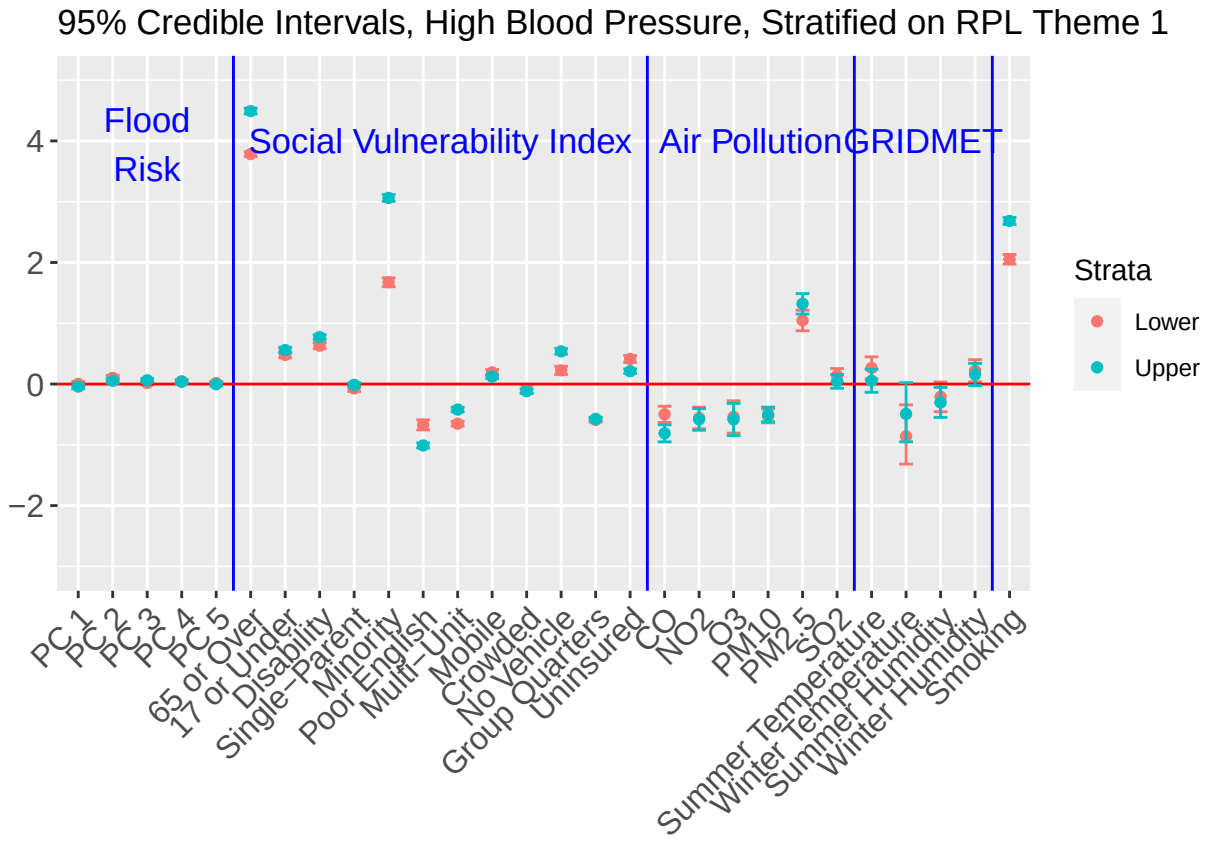
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-3, 5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
```

```
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 17.5, 23.5, 27.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11.5, y = 4, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 20.5, y = 4, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 25.5, y = 4, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, High Blood Pressure, Strat
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)
p
```



```
ggsave(here("figures/final_figures/stratified_analysis/BPHIGH_CI_rpl1.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME2

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl2_BPHIGH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     31.45644 31.41414 31.49878
## strat0:flood_risk_pc1      -0.15907 -0.21088 -0.10769
## strat0:flood_risk_pc2       0.10597  0.04751  0.16427
## strat0:flood_risk_pc3      -0.05471 -0.09848 -0.01104
## strat0:flood_risk_pc4       0.06027  0.02014  0.10069
## strat0:flood_risk_pc5      -0.05735 -0.09625 -0.01839
## strat0:EP_POV              -0.31666 -0.39095 -0.24294
## strat0:EP_UNEMP             0.47713  0.41939  0.53423
## strat0:EP_PCI               0.60769  0.54669  0.66893
## strat0:EP_NOHSDP            2.15542  2.05747  2.25526
## strat0:EP_MINRTY            0.17523  0.08203  0.26778
## strat0:EP_LIMENG           -0.74571 -0.82980 -0.66178
## strat0:EP_MUNIT            -0.58412 -0.63164 -0.53651
## strat0:EP_MOBILE            0.68516  0.62533  0.74468
## strat0:EP_CROWD            -0.75870 -0.82214 -0.69460
## strat0:EP_NOVEH             1.68505  1.60514  1.76453
## strat0:EP_GROUPQ           -1.13523 -1.16670 -1.10382
## strat0:EP_UNINSUR          -0.20329 -0.26804 -0.13817
## strat0:co                  -1.01654 -1.21089 -0.82295
## strat0:no2                 -0.34208 -0.61510 -0.07642
## strat0:o3                   0.01710 -0.41361  0.44528
## strat0:pm10                -1.53872 -1.72068 -1.35653
## strat0:pm25                 1.29982  1.03644  1.56257
## strat0:so2                 -0.18497 -0.36830 -0.00551
## strat0:summer_tmmx         -0.16230 -0.47360  0.13139
## strat0:winter_tmmx         -0.66324 -1.38476  0.22514
## strat0:summer_rmax         -0.13863 -0.54006  0.25056
## strat0:winter_rmax          0.09776 -0.19686  0.39737
## strat0:Data_Value_CSMOKING  0.33173  0.21910  0.44520
## strat1                     33.45418 33.41013 33.49867
## strat1:flood_risk_pc1      -0.16718 -0.22021 -0.11349
## strat1:flood_risk_pc2       0.05373 -0.00505  0.11220
## strat1:flood_risk_pc3       0.02929 -0.01953  0.07754
## strat1:flood_risk_pc4       0.07414  0.03138  0.11758
## strat1:flood_risk_pc5      -0.02092 -0.06375  0.02206
## strat1:EP_POV               1.09702  1.01749  1.17566
## strat1:EP_UNEMP             0.23621  0.19112  0.28118
## strat1:EP_PCI               0.18125  0.06716  0.29630
```

```
## strat1:EP_NOHSDP            1.08862  1.00082  1.17642
## strat1:EP_MINRTY            1.42124  1.33371  1.50796
## strat1:EP_LIMENG           -1.25858 -1.34144 -1.17614
## strat1:EP_MUNIT            -0.22499 -0.29241 -0.15840
## strat1:EP_MOBILE            0.51224  0.46785  0.55613
## strat1:EP_CROWD            -0.75327 -0.81570 -0.69085
## strat1:EP_NOVEH             1.77914  1.69929  1.85939
## strat1:EP_GROUPQ            0.05134 -0.03340  0.13678
## strat1:EP_UNINSUR          -0.24698 -0.30716 -0.18627
## strat1:co                  -1.17901 -1.39911 -0.96066
## strat1:no2                 -0.99470 -1.27990 -0.71519
## strat1:o3                   0.09953 -0.33101  0.52902
## strat1:pm10                -1.43858 -1.62036 -1.25976
## strat1:pm25                 1.76715  1.50517  2.02726
## strat1:so2                 -0.10709 -0.28578  0.07125
## strat1:summer_tmmx         -0.07195 -0.38376  0.22479
## strat1:winter_tmmx         -0.88206 -1.61019  0.00593
## strat1:summer_rmax         -0.00825 -0.40890  0.38234
## strat1:winter_rmax          0.14057 -0.15296  0.43661
## strat1:Data_Value_CSMOKING -0.70961 -0.81996 -0.59947
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/BPHIGH_rpl
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"     "strat0:flood_risk_pc3"
##  [5] "strat0:flood_risk_pc4"     "strat0:flood_risk_pc5"
##  [7] "strat0:EP_POV"             "strat0:EP_UNEMP"
##  [9] "strat0:EP_PCI"             "strat0:EP_NOHSDP"
## [11] "strat0:EP_MINRTY"          "strat0:EP_LIMENG"
## [13] "strat0:EP_MUNIT"           "strat0:EP_MOBILE"
## [15] "strat0:EP_CROWD"           "strat0:EP_NOVEH"
## [17] "strat0:EP_GROUPQ"          "strat0:EP_UNINSUR"
## [19] "strat0:co"                 "strat0:no2"
## [21] "strat0:pm10"               "strat0:pm25"
## [23] "strat0:so2"                "strat0:Data_Value_CSMOKING"
## [25] "strat1"                    "strat1:flood_risk_pc1"
## [27] "strat1:flood_risk_pc4"     "strat1:EP_POV"
## [29] "strat1:EP_UNEMP"           "strat1:EP_PCI"
## [31] "strat1:EP_NOHSDP"          "strat1:EP_MINRTY"
## [33] "strat1:EP_LIMENG"          "strat1:EP_MUNIT"
## [35] "strat1:EP_MOBILE"          "strat1:EP_CROWD"
## [37] "strat1:EP_NOVEH"           "strat1:EP_UNINSUR"
## [39] "strat1:co"                 "strat1:no2"
## [41] "strat1:pm10"               "strat1:pm25"
## [43] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
```

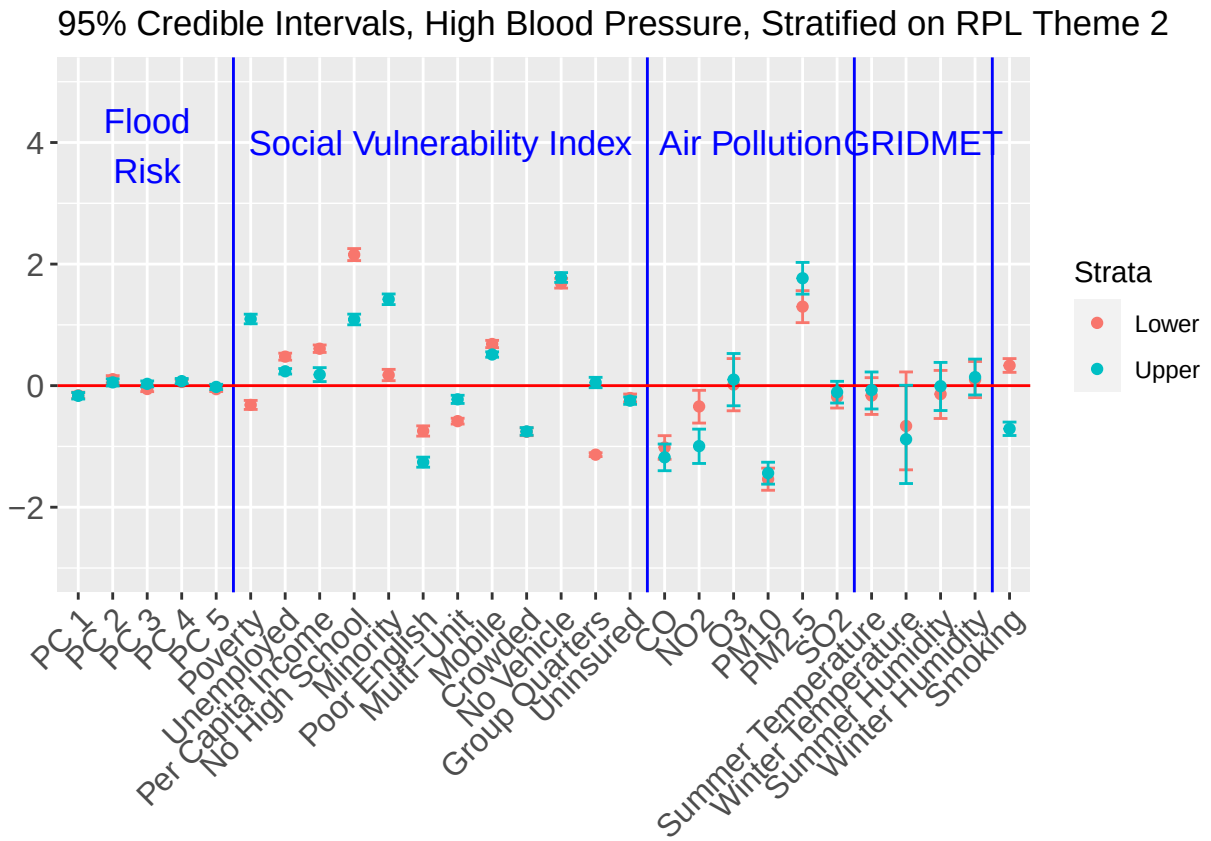
```
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-3, 5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 17.5, 23.5, 27.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11.5, y = 4, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 20.5, y = 4, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 25.5, y = 4, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, High Blood Pressure, Strati
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/BPHIGH_CI_rpl2.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME3

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl3_BPHIGH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                    32.28737 32.22942 32.34502
## strat0:flood_risk_pc1      0.02503 -0.01548  0.06552
## strat0:flood_risk_pc2      0.08669  0.03980  0.13364
## strat0:flood_risk_pc3      0.05534  0.01958  0.09100
## strat0:flood_risk_pc4      0.08586  0.04940  0.12195
## strat0:flood_risk_pc5      0.00407 -0.03118  0.03913
## strat0:EP_POV              0.18981  0.12915  0.25028
## strat0:EP_UNEMP            0.28633  0.24586  0.32663
```

```
## strat0:EP_PCI               0.02792 -0.02063  0.07603
## strat0:EP_NOHSDP            0.39995  0.31001  0.48925
## strat0:EP_AGE65             3.74150  3.69827  3.78479
## strat0:EP_AGE17             0.72611  0.67620  0.77587
## strat0:EP_DISABL            0.61926  0.57176  0.66656
## strat0:EP_SNGPNT            0.23762  0.18914  0.28607
## strat0:EP_MUNIT            -0.61392 -0.66696 -0.56087
## strat0:EP_MOBILE           -0.04925 -0.08687 -0.01190
## strat0:EP_CROWD            -0.09792 -0.17969 -0.01703
## strat0:EP_NOVEH             0.87654  0.80603  0.94746
## strat0:EP_GROUPQ           -0.75868 -0.79292 -0.72484
## strat0:EP_UNINSUR           0.22181  0.16669  0.27722
## strat0:co                  -0.67584 -0.82265 -0.52933
## strat0:no2                 -0.35850 -0.55997 -0.15878
## strat0:o3                  -0.12599 -0.42188  0.21995
## strat0:pm10                -0.46740 -0.59682 -0.33828
## strat0:pm25                 1.00437  0.81358  1.19087
## strat0:so2                  0.00872 -0.12507  0.14204
## strat0:summer_tmmx          0.14279 -0.06532  0.34788
## strat0:winter_tmmx         -0.36038 -0.91051  0.14173
## strat0:summer_rmax         -0.21700 -0.49917  0.04503
## strat0:winter_rmax          0.16550 -0.04391  0.37366
## strat0:Data_Value_CSMOKING  2.22017  2.12460  2.31535
## strat1                     32.50600 32.46942 32.54260
## strat1:flood_risk_pc1       0.00260 -0.03650  0.04199
## strat1:flood_risk_pc2      -0.00353 -0.04469  0.03764
## strat1:flood_risk_pc3       0.00012 -0.03324  0.03351
## strat1:flood_risk_pc4      -0.01653 -0.04394  0.01103
## strat1:flood_risk_pc5      -0.01238 -0.03899  0.01412
## strat1:EP_POV               0.06810  0.01683  0.11948
## strat1:EP_UNEMP             0.32142  0.28864  0.35412
## strat1:EP_PCI              -0.19614 -0.25398 -0.13820
## strat1:EP_NOHSDP           -0.14544 -0.19695 -0.09375
## strat1:EP_AGE65             4.03199  3.98265  4.08162
## strat1:EP_AGE17             0.54709  0.50015  0.59433
## strat1:EP_DISABL            0.87819  0.83365  0.92249
## strat1:EP_SNGPNT            0.24037  0.20280  0.27796
## strat1:EP_MUNIT            -0.55411 -0.58944 -0.51865
## strat1:EP_MOBILE            0.06642  0.03083  0.10188
## strat1:EP_CROWD            -0.12233 -0.16130 -0.08354
## strat1:EP_NOVEH             0.65654  0.60312  0.70976
## strat1:EP_GROUPQ           -0.42558 -0.45805 -0.39346
## strat1:EP_UNINSUR           0.24401  0.20280  0.28507
## strat1:co                  -0.94943 -1.10967 -0.79146
## strat1:no2                  0.07153 -0.12768  0.26723
## strat1:o3                  -0.21019 -0.51031  0.13707
## strat1:pm10                -0.64967 -0.78516 -0.51307
## strat1:pm25                 1.32532  1.13300  1.51525
## strat1:so2                  0.10701 -0.03450  0.24633
## strat1:summer_tmmx          0.04272 -0.16969  0.25301
## strat1:winter_tmmx          0.08564 -0.46721  0.58400
## strat1:summer_rmax         -0.18357 -0.46706  0.07935
## strat1:winter_rmax         -0.13457 -0.34600  0.07657
## strat1:Data_Value_CSMOKING  2.67161  2.59059  2.75253
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/BPHIGH_rpl3
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc2"
##  [3] "strat0:flood_risk_pc3"     "strat0:flood_risk_pc4"
##  [5] "strat0:EP_POV"             "strat0:EP_UNEMP"
##  [7] "strat0:EP_NOHSDP"          "strat0:EP_AGE65"
##  [9] "strat0:EP_AGE17"           "strat0:EP_DISABL"
## [11] "strat0:EP_SNGPNT"          "strat0:EP_MUNIT"
## [13] "strat0:EP_MOBILE"          "strat0:EP_CROWD"
## [15] "strat0:EP_NOVEH"           "strat0:EP_GROUPQ"
## [17] "strat0:EP_UNINSUR"         "strat0:co"
## [19] "strat0:no2"                "strat0:pm10"
## [21] "strat0:pm25"               "strat0:Data_Value_CSMOKING"
## [23] "strat1"                    "strat1:EP_POV"
## [25] "strat1:EP_UNEMP"           "strat1:EP_PCI"
## [27] "strat1:EP_NOHSDP"          "strat1:EP_AGE65"
## [29] "strat1:EP_AGE17"           "strat1:EP_DISABL"
## [31] "strat1:EP_SNGPNT"          "strat1:EP_MUNIT"
## [33] "strat1:EP_MOBILE"          "strat1:EP_CROWD"
## [35] "strat1:EP_NOVEH"           "strat1:EP_GROUPQ"
## [37] "strat1:EP_UNINSUR"         "strat1:co"
## [39] "strat1:pm10"               "strat1:pm25"
## [41] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

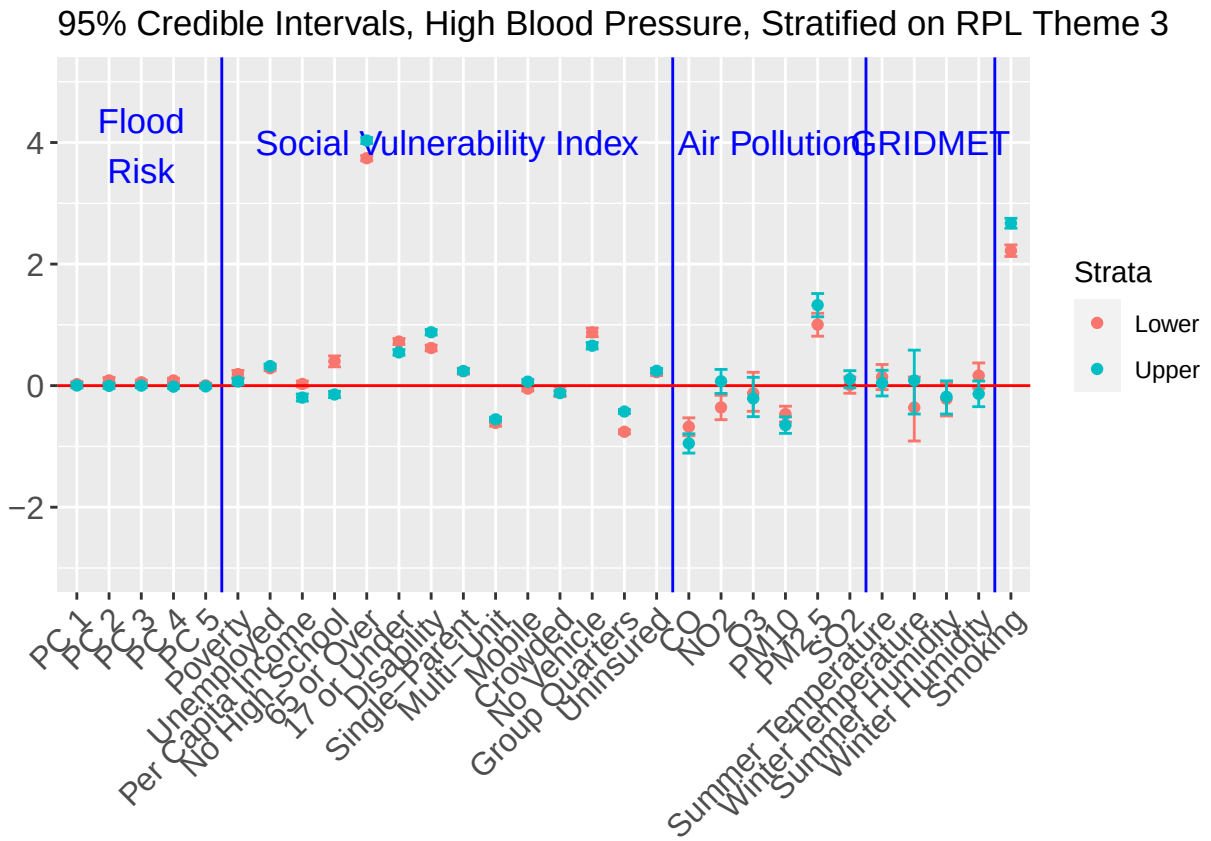
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-3, 5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
```

```
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 19.5, 25.5, 29.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 4, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 22.5, y = 4, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 27.5, y = 4, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, High Blood Pressure, Strat
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/BPHIGH_CI_rpl3.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME4

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl4_BPHIGH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                              50%     2.5%    97.5%
## strat0                   32.34453 32.31740 32.37151
## strat0:flood_risk_pc1     0.06184  0.02539  0.09855
## strat0:flood_risk_pc2     0.06510  0.02411  0.10639
## strat0:flood_risk_pc3     0.03537  0.00397  0.06677
## strat0:flood_risk_pc4     0.04385  0.01349  0.07438
## strat0:flood_risk_pc5     0.01329 -0.01614  0.04266
## strat0:EP_POV             0.02618 -0.03366  0.08657
## strat0:EP_UNEMP           0.13564  0.09771  0.17357
```

```
## strat0:EP_PCI               0.42478  0.37912  0.47031
## strat0:EP_NOHSDP            0.20797  0.13574  0.28030
## strat0:EP_AGE65             4.17003  4.13004  4.21045
## strat0:EP_AGE17             0.94565  0.90493  0.98638
## strat0:EP_DISABL            0.70167  0.65582  0.74749
## strat0:EP_SNGPNT           -0.08897 -0.13249 -0.04518
## strat0:EP_MINRTY            2.42272  2.35904  2.48662
## strat0:EP_LIMENG           -1.23105 -1.30488 -1.15722
## strat0:EP_UNINSUR           0.45511  0.40619  0.50423
## strat0:co                  -0.69204 -0.84010 -0.54424
## strat0:no2                 -0.82668 -1.01427 -0.63891
## strat0:o3                  -0.74798 -1.01166 -0.47192
## strat0:pm10                -0.66789 -0.78680 -0.55013
## strat0:pm25                 1.53866  1.36935  1.71008
## strat0:so2                  0.17573  0.05340  0.29551
## strat0:summer_tmmx          0.22435  0.02714  0.41565
## strat0:winter_tmmx         -1.09844 -1.58431 -0.53500
## strat0:summer_rmax         -0.30462 -0.54211 -0.05615
## strat0:winter_rmax          0.27902  0.08614  0.46189
## strat0:Data_Value_CSMOKING  2.55474  2.46990  2.64055
## strat1                     32.20324 32.17764 32.22885
## strat1:flood_risk_pc1      -0.01286 -0.04786  0.02226
## strat1:flood_risk_pc2       0.04268  0.00352  0.08184
## strat1:flood_risk_pc3       0.03559  0.00439  0.06688
## strat1:flood_risk_pc4       0.02087 -0.00657  0.04835
## strat1:flood_risk_pc5       0.01193 -0.01578  0.03917
## strat1:EP_POV              -0.20455 -0.24903 -0.16026
## strat1:EP_UNEMP             0.10909  0.07622  0.14173
## strat1:EP_PCI               0.35805  0.30077  0.41545
## strat1:EP_NOHSDP           -0.23818 -0.29585 -0.18043
## strat1:EP_AGE65             4.57784  4.53462  4.62100
## strat1:EP_AGE17             1.17516  1.13594  1.21434
## strat1:EP_DISABL            0.92201  0.88107  0.96312
## strat1:EP_SNGPNT           -0.12497 -0.16399 -0.08614
## strat1:EP_MINRTY            2.80770  2.74604  2.86928
## strat1:EP_LIMENG           -0.77106 -0.82119 -0.72107
## strat1:EP_UNINSUR           0.28775  0.24814  0.32724
## strat1:co                  -0.78142 -0.91253 -0.65074
## strat1:no2                 -0.80869 -0.98417 -0.63432
## strat1:o3                  -0.86265 -1.12641 -0.58625
## strat1:pm10                -0.62093 -0.74304 -0.50113
## strat1:pm25                 1.67358  1.50604  1.84456
## strat1:so2                  0.11688 -0.00223  0.23414
## strat1:summer_tmmx          0.07222 -0.12310  0.25914
## strat1:winter_tmmx         -0.79578 -1.27834 -0.23410
## strat1:summer_rmax         -0.35252 -0.58756 -0.10294
## strat1:winter_rmax          0.16089 -0.02971  0.34240
## strat1:Data_Value_CSMOKING  3.01174  2.93672  3.08660
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/BPHIGH_rpl
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"     "strat0:flood_risk_pc3"
##  [5] "strat0:flood_risk_pc4"     "strat0:EP_UNEMP"
##  [7] "strat0:EP_PCI"             "strat0:EP_NOHSDP"
##  [9] "strat0:EP_AGE65"           "strat0:EP_AGE17"
## [11] "strat0:EP_DISABL"          "strat0:EP_SNGPNT"
## [13] "strat0:EP_MINRTY"          "strat0:EP_LIMENG"
## [15] "strat0:EP_UNINSUR"         "strat0:co"
## [17] "strat0:no2"                "strat0:o3"
## [19] "strat0:pm10"               "strat0:pm25"
## [21] "strat0:so2"                "strat0:summer_tmmx"
## [23] "strat0:winter_tmmx"        "strat0:summer_rmax"
## [25] "strat0:winter_rmax"        "strat0:Data_Value_CSMOKING"
## [27] "strat1"                    "strat1:flood_risk_pc2"
## [29] "strat1:flood_risk_pc3"     "strat1:EP_POV"
## [31] "strat1:EP_UNEMP"           "strat1:EP_PCI"
## [33] "strat1:EP_NOHSDP"          "strat1:EP_AGE65"
## [35] "strat1:EP_AGE17"           "strat1:EP_DISABL"
## [37] "strat1:EP_SNGPNT"          "strat1:EP_MINRTY"
## [39] "strat1:EP_LIMENG"          "strat1:EP_UNINSUR"
## [41] "strat1:co"                 "strat1:no2"
## [43] "strat1:o3"                 "strat1:pm10"
## [45] "strat1:pm25"               "strat1:winter_tmmx"
## [47] "strat1:summer_rmax"        "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

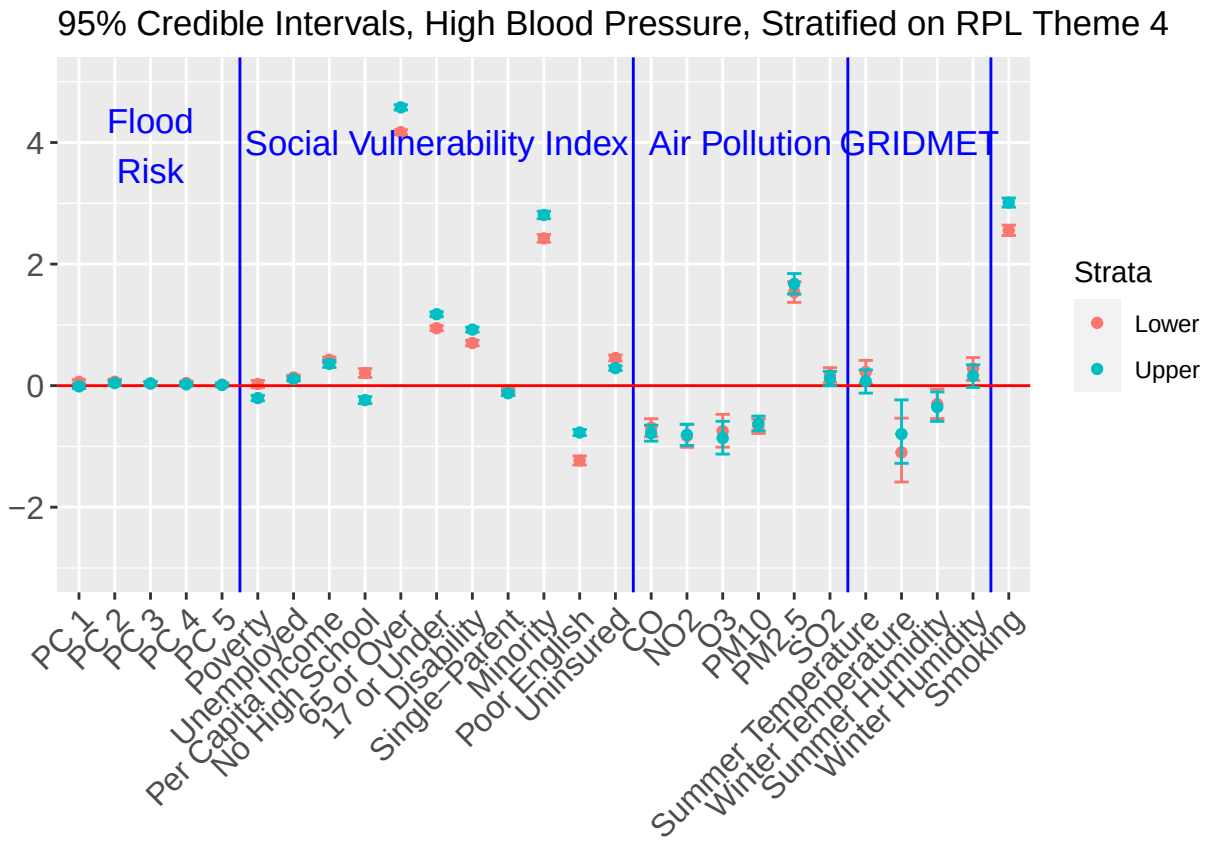
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-3, 5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
```

```
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 16.5, 22.5, 26.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11, y = 4, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 19.5, y = 4, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 24.5, y = 4, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent",
                              "Minority", "Poor English",
                              "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, High Blood Pressure, Strat
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/BPHIGH_CI_rpl4.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEMES

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpls_BPHIGH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                    31.01173 30.95395 31.06938
## strat0:flood_risk_pc1     -0.16883 -0.23044 -0.10707
## strat0:flood_risk_pc2      0.10764  0.03683  0.17758
## strat0:flood_risk_pc3     -0.09087 -0.14283 -0.03877
## strat0:flood_risk_pc4      0.05322  0.00163  0.10460
## strat0:flood_risk_pc5     -0.08951 -0.13859 -0.04066
## strat0:EP_UNINSUR         -0.06353 -0.14842  0.02206
## strat0:co                 -1.41847 -1.64434 -1.19246
```

```
## strat0:no2                -1.88210 -2.17835 -1.57562
## strat0:o3                 -0.62222 -1.13803 -0.16637
## strat0:pm10               -1.91627 -2.13090 -1.70644
## strat0:pm25                2.89261  2.58794  3.19647
## strat0:so2                 0.04869 -0.15835  0.26276
## strat0:summer_tmmx         0.02843 -0.32887  0.42379
## strat0:winter_tmmx        -1.07293 -2.23056 -0.03311
## strat0:summer_rmax        -0.15642 -0.58956  0.29840
## strat0:winter_rmax         0.28693 -0.03901  0.61072
## strat0:Data_Value_CSMOKING  0.58762  0.49157  0.68427
## strat1                    32.81156 32.76215 32.86090
## strat1:flood_risk_pc1     -0.04144 -0.10090  0.01810
## strat1:flood_risk_pc2     -0.04653 -0.11129  0.01813
## strat1:flood_risk_pc3     -0.05677 -0.11025 -0.00410
## strat1:flood_risk_pc4     -0.02001 -0.06536  0.02520
## strat1:flood_risk_pc5     -0.03834 -0.08342  0.00687
## strat1:EP_UNINSUR         -0.48710 -0.54328 -0.43035
## strat1:co                 -2.52394 -2.77092 -2.27706
## strat1:no2                 0.15416 -0.15131  0.46105
## strat1:o3                 -1.09753 -1.61501 -0.64022
## strat1:pm10               -2.24855 -2.47093 -2.03065
## strat1:pm25                3.26321  2.95451  3.56351
## strat1:so2                -0.03677 -0.24123  0.17541
## strat1:summer_tmmx        -0.00683 -0.36702  0.38898
## strat1:winter_tmmx        -0.26963 -1.42854  0.77722
## strat1:summer_rmax        -0.17439 -0.61053  0.28022
## strat1:winter_rmax         0.00397 -0.32229  0.32984
## strat1:Data_Value_CSMOKING  2.18717  2.11541  2.25882
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/BPHIGH_rpls
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"     "strat0:flood_risk_pc3"
##  [5] "strat0:flood_risk_pc4"     "strat0:flood_risk_pc5"
##  [7] "strat0:co"                 "strat0:no2"
##  [9] "strat0:o3"                 "strat0:pm10"
## [11] "strat0:pm25"               "strat0:winter_tmmx"
## [13] "strat0:Data_Value_CSMOKING" "strat1"
## [15] "strat1:flood_risk_pc3"     "strat1:EP_UNINSUR"
## [17] "strat1:co"                 "strat1:o3"
## [19] "strat1:pm10"               "strat1:pm25"
## [21] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
```

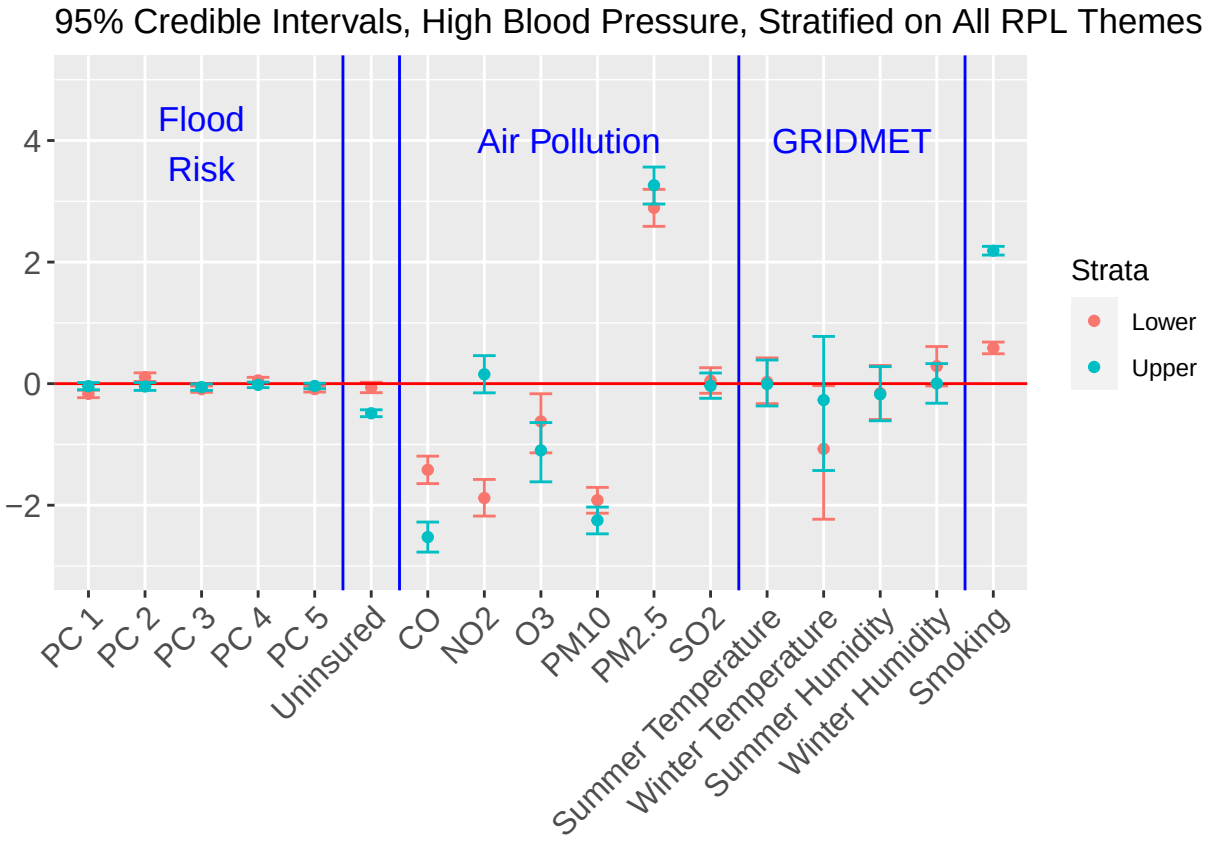
```
                              post_2.5 = `2.5%`,
                              post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-3, 5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 6.5, 12.5, 16.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 9.5, y = 4, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 14.5, y = 4, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, High Blood Pressure, Strat
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/BPHIGH_CI_rpls.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

CASTHMA Stratified Analysis

Repeating the stratified analysis in the last section, this time just doing the plots

Stratified on Poverty

```
load(here("modeling_files/stratified_analysis/model_stratif_poverty_CASTHMA.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                               50%     2.5%    97.5%
## strat0                    9.77557  9.76827  9.78288
## strat0:flood_risk_pc1     0.00844  0.00200  0.01480
## strat0:flood_risk_pc2     0.00038 -0.00698  0.00766
## strat0:flood_risk_pc3    -0.00381 -0.00924  0.00170
## strat0:flood_risk_pc4    -0.00803 -0.01321 -0.00280
## strat0:flood_risk_pc5     0.00290 -0.00200  0.00780
```

```
## strat0:EP_UNEMP             0.06204  0.05388  0.07013
## strat0:EP_PCI              -0.02706 -0.03489 -0.01912
## strat0:EP_NOHSDP            0.07645  0.06143  0.09155
## strat0:EP_AGE65             0.07227  0.06479  0.07974
## strat0:EP_AGE17            -0.00758 -0.01616  0.00094
## strat0:EP_DISABL           -0.00651 -0.01553  0.00258
## strat0:EP_SNGPNT            0.04500  0.03656  0.05349
## strat0:EP_MINRTY            0.18608  0.17325  0.19873
## strat0:EP_LIMENG           -0.15503 -0.16877 -0.14140
## strat0:EP_MUNIT            -0.02435 -0.03147 -0.01724
## strat0:EP_MOBILE           -0.01357 -0.02066 -0.00648
## strat0:EP_CROWD            -0.02428 -0.03536 -0.01318
## strat0:EP_NOVEH             0.11665  0.10430  0.12895
## strat0:EP_GROUPQ           -0.05015 -0.05729 -0.04303
## strat0:EP_UNINSUR           0.01566  0.00637  0.02493
## strat0:co                  -0.05401 -0.07727 -0.03083
## strat0:no2                 -0.06262 -0.09461 -0.03110
## strat0:o3                  -0.00880 -0.05780  0.04370
## strat0:pm10                -0.16041 -0.18167 -0.13977
## strat0:pm25                 0.27139  0.24209  0.30285
## strat0:so2                  0.00999 -0.01163  0.03165
## strat0:summer_tmmx          0.03949  0.00605  0.07677
## strat0:winter_tmmx         -0.07082 -0.18680  0.01287
## strat0:summer_rmax          0.01395 -0.03393  0.06356
## strat0:winter_rmax         -0.05153 -0.08644 -0.01636
## strat0:Data_Value_CSMOKING  0.97555  0.95927  0.99179
## strat1                      9.87323  9.86703  9.87937
## strat1:flood_risk_pc1      -0.00742 -0.01341 -0.00145
## strat1:flood_risk_pc2       0.00525 -0.00141  0.01196
## strat1:flood_risk_pc3      -0.00189 -0.00713  0.00336
## strat1:flood_risk_pc4      -0.00502 -0.00977 -0.00032
## strat1:flood_risk_pc5      -0.00176 -0.00644  0.00293
## strat1:EP_UNEMP             0.09316  0.08825  0.09810
## strat1:EP_PCI              -0.27264 -0.28620 -0.25915
## strat1:EP_NOHSDP            0.03389  0.02427  0.04345
## strat1:EP_AGE65             0.12021  0.11244  0.12806
## strat1:EP_AGE17            -0.00404 -0.01175  0.00378
## strat1:EP_DISABL           -0.09023 -0.09678 -0.08365
## strat1:EP_SNGPNT            0.05595  0.04983  0.06211
## strat1:EP_MINRTY            0.39284  0.38251  0.40324
## strat1:EP_LIMENG           -0.26986 -0.27841 -0.26128
## strat1:EP_MUNIT             0.03982  0.03361  0.04604
## strat1:EP_MOBILE           -0.02345 -0.02880 -0.01814
## strat1:EP_CROWD            -0.00649 -0.01297 -0.00001
## strat1:EP_NOVEH             0.19988  0.19172  0.20804
## strat1:EP_GROUPQ           -0.04258 -0.04725 -0.03789
## strat1:EP_UNINSUR          -0.05330 -0.05996 -0.04674
## strat1:co                  -0.03664 -0.06229 -0.01107
## strat1:no2                 -0.18228 -0.21498 -0.15070
## strat1:o3                   0.00757 -0.04140  0.06026
## strat1:pm10                -0.18556 -0.20756 -0.16444
## strat1:pm25                 0.31354  0.28392  0.34536
## strat1:so2                 -0.01830 -0.03962  0.00311
## strat1:summer_tmmx          0.00971 -0.02420  0.04718
```

```
## strat1:winter_tmmx         -0.07186 -0.18785  0.01162
## strat1:summer_rmax         -0.01595 -0.06402  0.03377
## strat1:winter_rmax         -0.06097 -0.09571 -0.02587
## strat1:Data_Value_CSMOKING  0.99978  0.98824  1.01141
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CASTHMA_po
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                     "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc4"      "strat0:EP_UNEMP"
##  [5] "strat0:EP_PCI"              "strat0:EP_NOHSDP"
##  [7] "strat0:EP_AGE65"            "strat0:EP_SNGPNT"
##  [9] "strat0:EP_MINRTY"           "strat0:EP_LIMENG"
## [11] "strat0:EP_MUNIT"            "strat0:EP_MOBILE"
## [13] "strat0:EP_CROWD"            "strat0:EP_NOVEH"
## [15] "strat0:EP_GROUPQ"           "strat0:EP_UNINSUR"
## [17] "strat0:co"                  "strat0:no2"
## [19] "strat0:pm10"                "strat0:pm25"
## [21] "strat0:summer_tmmx"         "strat0:winter_rmax"
## [23] "strat0:Data_Value_CSMOKING" "strat1"
## [25] "strat1:flood_risk_pc1"      "strat1:flood_risk_pc4"
## [27] "strat1:EP_UNEMP"            "strat1:EP_PCI"
## [29] "strat1:EP_NOHSDP"           "strat1:EP_AGE65"
## [31] "strat1:EP_DISABL"           "strat1:EP_SNGPNT"
## [33] "strat1:EP_MINRTY"           "strat1:EP_LIMENG"
## [35] "strat1:EP_MUNIT"            "strat1:EP_MOBILE"
## [37] "strat1:EP_CROWD"            "strat1:EP_NOVEH"
## [39] "strat1:EP_GROUPQ"           "strat1:EP_UNINSUR"
## [41] "strat1:co"                  "strat1:no2"
## [43] "strat1:pm10"                "strat1:pm25"
## [45] "strat1:winter_rmax"         "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

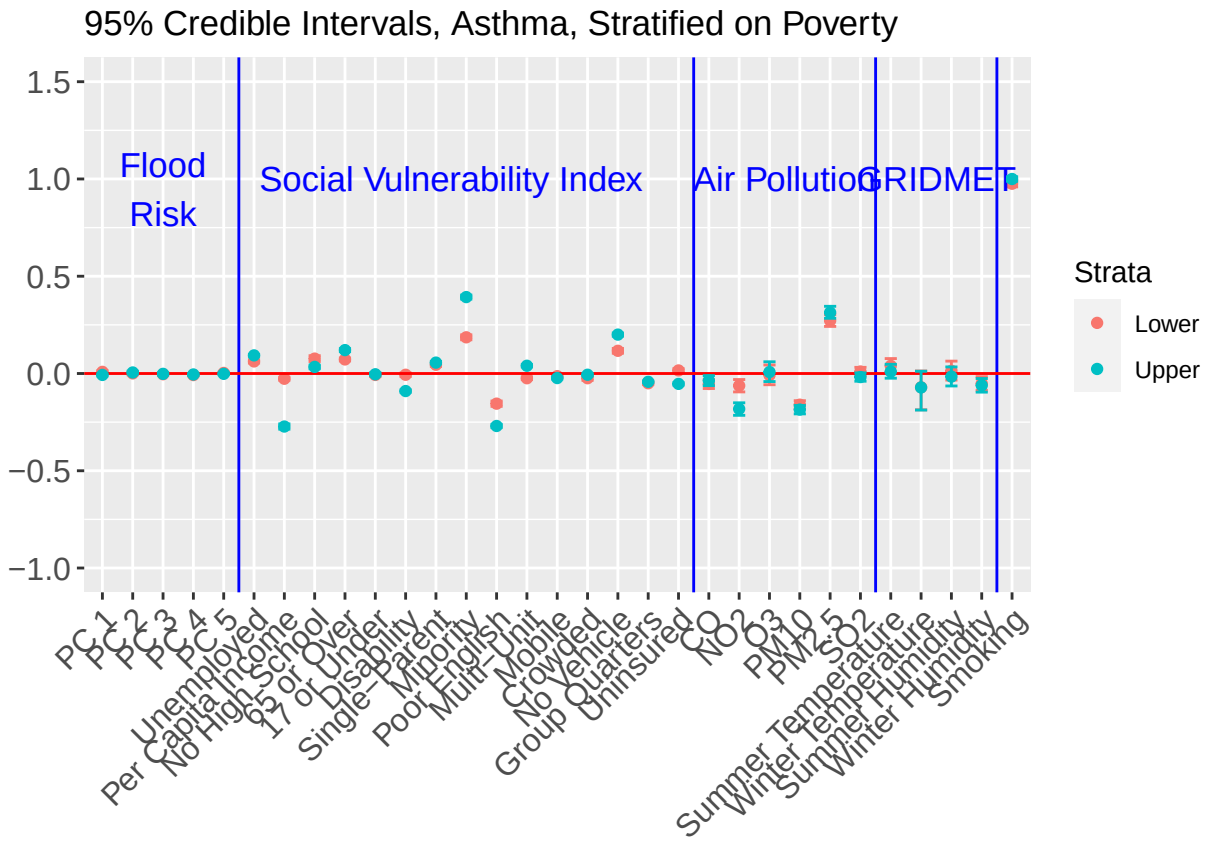
```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 1.5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 20.5, 26.5, 30.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 0.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 1, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 23.5, y = 1, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 28.5, y = 1, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hum
                              "Smoking")) + ggtitle("95% Credible Intervals, Asthma, Stratified on Pover
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CASTHMA_CI_poverty.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME1

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl1_CASTHMA.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     9.75162  9.74319  9.75995
## strat0:flood_risk_pc1      0.00702  0.00041  0.01357
## strat0:flood_risk_pc2      0.00410 -0.00342  0.01162
## strat0:flood_risk_pc3     -0.00465 -0.01020  0.00089
## strat0:flood_risk_pc4     -0.01385 -0.01910 -0.00856
## strat0:flood_risk_pc5      0.00161 -0.00339  0.00665
## strat0:EP_AGE65            0.06838  0.06110  0.07563
## strat0:EP_AGE17           -0.01247 -0.02079 -0.00410
## strat0:EP_DISABL          -0.00960 -0.01850 -0.00074
## strat0:EP_SNGPNT           0.05261  0.04386  0.06138
## strat0:EP_MINRTY           0.17280  0.15973  0.18591
```

```
## strat0:EP_LIMENG           -0.12341 -0.13804 -0.10888
## strat0:EP_MUNIT            -0.02418 -0.03103 -0.01731
## strat0:EP_MOBILE           -0.00477 -0.01286  0.00333
## strat0:EP_CROWD            -0.01419 -0.02710 -0.00128
## strat0:EP_NOVEH             0.13213  0.12003  0.14426
## strat0:EP_GROUPQ           -0.03445 -0.04047 -0.02844
## strat0:EP_UNINSUR           0.02141  0.01145  0.03139
## strat0:co                  -0.05450 -0.07879 -0.03040
## strat0:no2                 -0.04416 -0.07800 -0.01093
## strat0:o3                  -0.01479 -0.06728  0.03669
## strat0:pm10                -0.17061 -0.19253 -0.14864
## strat0:pm25                 0.30260  0.27050  0.33465
## strat0:so2                  0.00884 -0.01345  0.03061
## strat0:summer_tmmx          0.04398  0.00682  0.07933
## strat0:winter_tmmx         -0.10333 -0.19112  0.00406
## strat0:summer_rmax          0.02081 -0.02779  0.06757
## strat0:winter_rmax         -0.04613 -0.08151 -0.01013
## strat0:Data_Value_CSMOKING  1.02432  1.01025  1.03861
## strat1                      9.92445  9.91829  9.93065
## strat1:flood_risk_pc1      -0.00606 -0.01228  0.00022
## strat1:flood_risk_pc2      -0.00026 -0.00713  0.00662
## strat1:flood_risk_pc3      -0.00075 -0.00639  0.00478
## strat1:flood_risk_pc4      -0.00243 -0.00728  0.00244
## strat1:flood_risk_pc5       0.00177 -0.00309  0.00664
## strat1:EP_AGE65             0.13098  0.12266  0.13933
## strat1:EP_AGE17             0.00261 -0.00536  0.01061
## strat1:EP_DISABL           -0.07702 -0.08376 -0.07023
## strat1:EP_SNGPNT            0.06650  0.06035  0.07262
## strat1:EP_MINRTY            0.46604  0.45585  0.47618
## strat1:EP_LIMENG           -0.26184 -0.26943 -0.25433
## strat1:EP_MUNIT             0.04181  0.03513  0.04848
## strat1:EP_MOBILE           -0.01521 -0.02054 -0.00993
## strat1:EP_CROWD             0.00404 -0.00244  0.01051
## strat1:EP_NOVEH             0.22375  0.21528  0.23218
## strat1:EP_GROUPQ           -0.00290 -0.00779  0.00197
## strat1:EP_UNINSUR          -0.04246 -0.04906 -0.03588
## strat1:co                  -0.04215 -0.06856 -0.01610
## strat1:no2                 -0.17775 -0.21185 -0.14456
## strat1:o3                  -0.00921 -0.06167  0.04217
## strat1:pm10                -0.20222 -0.22501 -0.17975
## strat1:pm25                 0.37575  0.34335  0.40738
## strat1:so2                 -0.02989 -0.05164 -0.00857
## strat1:summer_tmmx          0.00915 -0.02873  0.04537
## strat1:winter_tmmx         -0.10258 -0.19064  0.00418
## strat1:summer_rmax         -0.04082 -0.08962  0.00625
## strat1:winter_rmax         -0.04745 -0.08294 -0.01142
## strat1:Data_Value_CSMOKING  1.13814  1.12783  1.14839
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CASTHMA_rp
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
```

```
##  [3] "strat0:flood_risk_pc4"      "strat0:EP_AGE65"
##  [5] "strat0:EP_AGE17"            "strat0:EP_DISABL"
##  [7] "strat0:EP_SNGPNT"           "strat0:EP_MINRTY"
##  [9] "strat0:EP_LIMENG"           "strat0:EP_MUNIT"
## [11] "strat0:EP_CROWD"            "strat0:EP_NOVEH"
## [13] "strat0:EP_GROUPQ"           "strat0:EP_UNINSUR"
## [15] "strat0:co"                  "strat0:no2"
## [17] "strat0:pm10"                "strat0:pm25"
## [19] "strat0:summer_tmmx"         "strat0:winter_rmax"
## [21] "strat0:Data_Value_CSMOKING" "strat1"
## [23] "strat1:EP_AGE65"            "strat1:EP_DISABL"
## [25] "strat1:EP_SNGPNT"           "strat1:EP_MINRTY"
## [27] "strat1:EP_LIMENG"           "strat1:EP_MUNIT"
## [29] "strat1:EP_MOBILE"           "strat1:EP_NOVEH"
## [31] "strat1:EP_UNINSUR"          "strat1:co"
## [33] "strat1:no2"                 "strat1:pm10"
## [35] "strat1:pm25"                "strat1:so2"
## [37] "strat1:winter_rmax"         "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

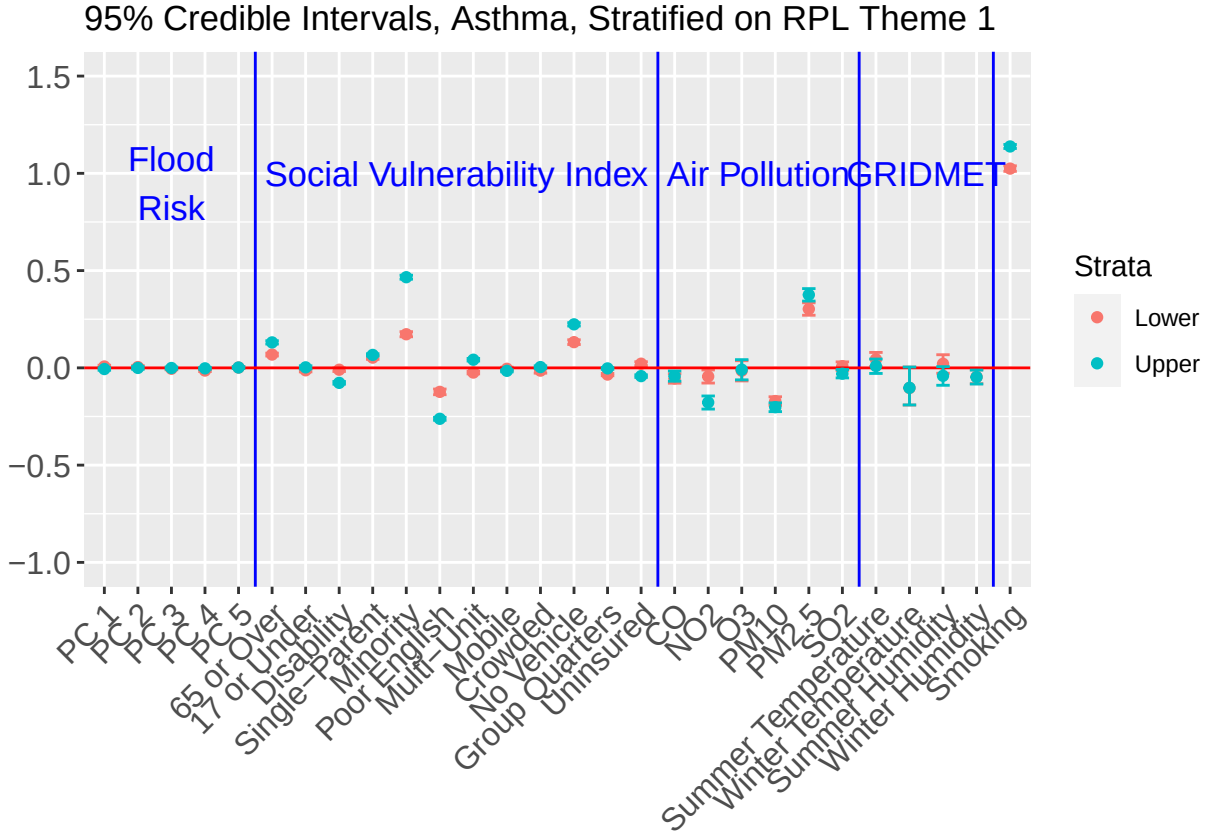
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 1.5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 17.5, 23.5, 27.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 0.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11.5, y = 1, label = "Social Vulnerability Index",
```

```
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 20.5, y = 1, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 25.5, y = 1, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Asthma, Stratified on RPL
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)
p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CASTHMA_CI_rpl1.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME2

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl2_CASTHMA.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     9.83264  9.82786  9.83743
## strat0:flood_risk_pc1      0.00998  0.00412  0.01579
## strat0:flood_risk_pc2     -0.00674 -0.01336 -0.00015
## strat0:flood_risk_pc3     -0.00867 -0.01362 -0.00372
## strat0:flood_risk_pc4     -0.01375 -0.01829 -0.00918
## strat0:flood_risk_pc5     -0.00092 -0.00533  0.00349
## strat0:EP_POV              0.35202  0.34362  0.36034
## strat0:EP_UNEMP            0.09381  0.08729  0.10029
## strat0:EP_PCI             -0.08317 -0.09008 -0.07625
## strat0:EP_NOHSDP           0.10002  0.08895  0.11130
## strat0:EP_MINRTY           0.13569  0.12516  0.14616
## strat0:EP_LIMENG          -0.18991 -0.19947 -0.18036
## strat0:EP_MUNIT           -0.02827 -0.03366 -0.02288
## strat0:EP_MOBILE          -0.02250 -0.02927 -0.01575
## strat0:EP_CROWD           -0.02105 -0.02823 -0.01380
## strat0:EP_NOVEH            0.10760  0.09856  0.11659
## strat0:EP_GROUPQ          -0.03283 -0.03639 -0.02927
## strat0:EP_UNINSUR         -0.00297 -0.01030  0.00439
## strat0:co                 -0.05955 -0.08152 -0.03766
## strat0:no2                -0.14367 -0.17448 -0.11366
## strat0:o3                  0.03335 -0.01517  0.08162
## strat0:pm10               -0.17287 -0.19342 -0.15227
## strat0:pm25                0.29212  0.26239  0.32183
## strat0:so2                -0.00810 -0.02881  0.01215
## strat0:summer_tmmx         0.05552  0.02104  0.08849
## strat0:winter_tmmx        -0.11357 -0.19440 -0.01503
## strat0:summer_rmax         0.03850 -0.00660  0.08232
## strat0:winter_rmax        -0.06366 -0.09684 -0.02998
## strat0:Data_Value_CSMOKING 0.66702  0.65428  0.67988
## strat1                     9.89579  9.89080  9.90083
## strat1:flood_risk_pc1     -0.00536 -0.01136  0.00070
## strat1:flood_risk_pc2      0.01585  0.00919  0.02245
## strat1:flood_risk_pc3      0.00596  0.00044  0.01142
## strat1:flood_risk_pc4      0.00229 -0.00256  0.00721
## strat1:flood_risk_pc5      0.00106 -0.00380  0.00592
## strat1:EP_POV              0.19801  0.18901  0.20691
## strat1:EP_UNEMP            0.04952  0.04441  0.05462
## strat1:EP_PCI              0.00884 -0.00410  0.02188
## strat1:EP_NOHSDP           0.08805  0.07814  0.09799
## strat1:EP_MINRTY           0.46170  0.45180  0.47150
## strat1:EP_LIMENG          -0.27954 -0.28895 -0.27018
## strat1:EP_MUNIT            0.01349  0.00586  0.02104
## strat1:EP_MOBILE          -0.01182 -0.01684 -0.00685
```

```
## strat1:EP_CROWD            -0.02393 -0.03098 -0.01686
## strat1:EP_NOVEH             0.17206  0.16301  0.18114
## strat1:EP_GROUPQ           -0.18147 -0.19107 -0.17179
## strat1:EP_UNINSUR          -0.04491 -0.05172 -0.03803
## strat1:co                  -0.09295 -0.11785 -0.06823
## strat1:no2                 -0.16797 -0.20015 -0.13644
## strat1:o3                   0.03346 -0.01507  0.08188
## strat1:pm10                -0.14327 -0.16377 -0.12308
## strat1:pm25                 0.28095  0.25138  0.31033
## strat1:so2                 -0.03189 -0.05207 -0.01178
## strat1:summer_tmmx          0.00121 -0.03336  0.03451
## strat1:winter_tmmx         -0.08841 -0.17009  0.00969
## strat1:summer_rmax         -0.02166 -0.06670  0.02236
## strat1:winter_rmax         -0.03993 -0.07298 -0.00662
## strat1:Data_Value_CSMOKING  0.92356  0.91109  0.93602
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CASTHMA_rp
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"     "strat0:flood_risk_pc3"
##  [5] "strat0:flood_risk_pc4"     "strat0:EP_POV"
##  [7] "strat0:EP_UNEMP"           "strat0:EP_PCI"
##  [9] "strat0:EP_NOHSDP"          "strat0:EP_MINRTY"
## [11] "strat0:EP_LIMENG"          "strat0:EP_MUNIT"
## [13] "strat0:EP_MOBILE"          "strat0:EP_CROWD"
## [15] "strat0:EP_NOVEH"           "strat0:EP_GROUPQ"
## [17] "strat0:co"                 "strat0:no2"
## [19] "strat0:pm10"               "strat0:pm25"
## [21] "strat0:summer_tmmx"        "strat0:winter_tmmx"
## [23] "strat0:winter_rmax"        "strat0:Data_Value_CSMOKING"
## [25] "strat1"                    "strat1:flood_risk_pc2"
## [27] "strat1:flood_risk_pc3"     "strat1:EP_POV"
## [29] "strat1:EP_UNEMP"           "strat1:EP_NOHSDP"
## [31] "strat1:EP_MINRTY"          "strat1:EP_LIMENG"
## [33] "strat1:EP_MUNIT"           "strat1:EP_MOBILE"
## [35] "strat1:EP_CROWD"           "strat1:EP_NOVEH"
## [37] "strat1:EP_GROUPQ"          "strat1:EP_UNINSUR"
## [39] "strat1:co"                 "strat1:no2"
## [41] "strat1:pm10"               "strat1:pm25"
## [43] "strat1:so2"                "strat1:winter_rmax"
## [45] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
```

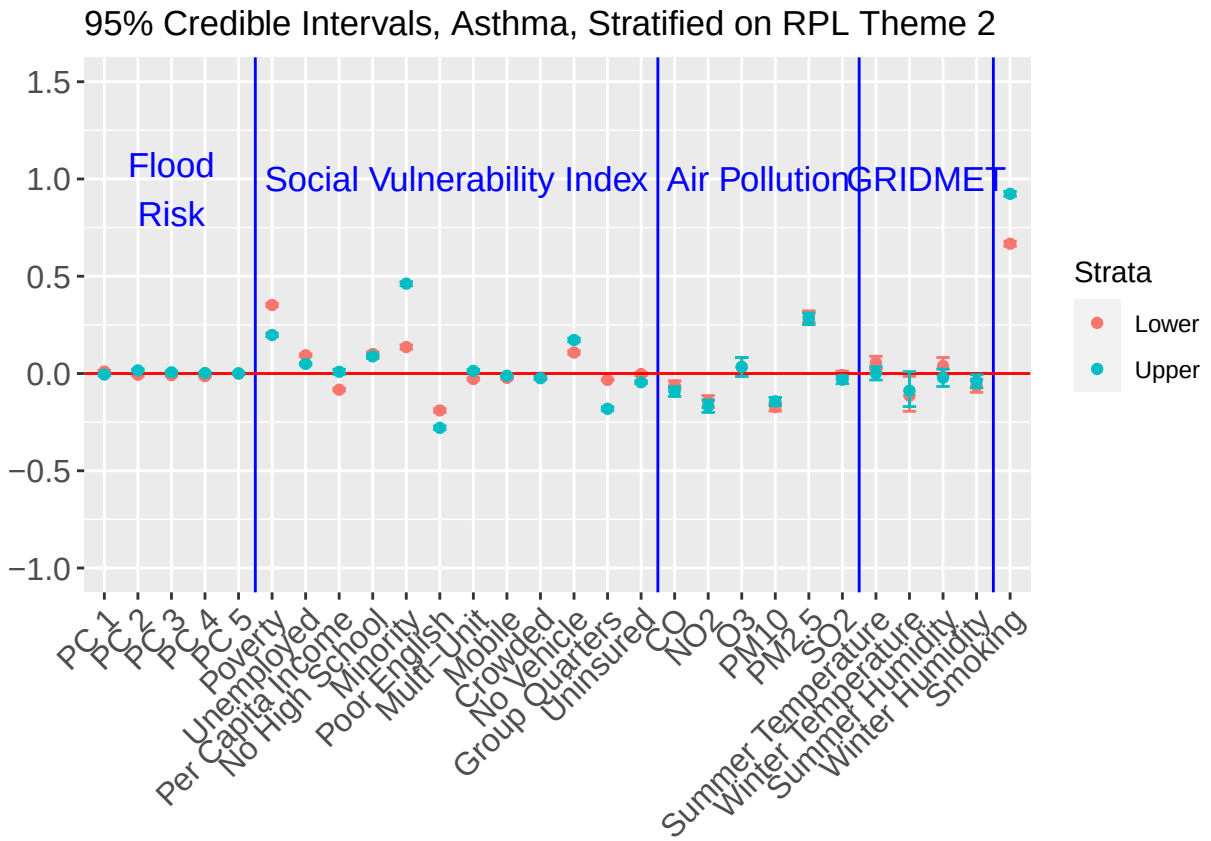
```
                              post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 1.5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 17.5, 23.5, 27.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 0.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11.5, y = 1, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 20.5, y = 1, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 25.5, y = 1, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Asthma, Stratified on RPL
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CASTHMA_CI_rpl2.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME3

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl3_CASTHMA.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     9.99906  9.98953 10.00855
## strat0:flood_risk_pc1      0.00941  0.00266  0.01615
## strat0:flood_risk_pc2     -0.00489 -0.01270  0.00290
## strat0:flood_risk_pc3     -0.01113 -0.01705 -0.00520
## strat0:flood_risk_pc4     -0.00466 -0.01072  0.00134
## strat0:flood_risk_pc5     -0.00309 -0.00889  0.00271
## strat0:EP_POV              0.34665  0.33659  0.35663
## strat0:EP_UNEMP            0.08162  0.07493  0.08824
```

```
## strat0:EP_PCI              -0.08781 -0.09588 -0.07985
## strat0:EP_NOHSDP            0.15158  0.13674  0.16629
## strat0:EP_AGE65             0.04287  0.03577  0.05004
## strat0:EP_AGE17             0.00612 -0.00212  0.01434
## strat0:EP_DISABL           -0.04526 -0.05312 -0.03745
## strat0:EP_SNGPNT            0.06454  0.05654  0.07252
## strat0:EP_MUNIT            -0.03139 -0.04014 -0.02263
## strat0:EP_MOBILE           -0.02874 -0.03496 -0.02257
## strat0:EP_CROWD             0.01581  0.00233  0.02914
## strat0:EP_NOVEH             0.13571  0.12406  0.14738
## strat0:EP_GROUPQ            0.00889  0.00324  0.01451
## strat0:EP_UNINSUR          -0.01708 -0.02614 -0.00797
## strat0:co                  -0.10393 -0.12848 -0.07957
## strat0:no2                 -0.13115 -0.16510 -0.09752
## strat0:o3                   0.05404  0.00160  0.11625
## strat0:pm10                -0.12198 -0.14399 -0.09986
## strat0:pm25                 0.26487  0.23267  0.29648
## strat0:so2                 -0.01024 -0.03321  0.01256
## strat0:summer_tmmx          0.02651 -0.00948  0.06118
## strat0:winter_tmmx         -0.01612 -0.10780  0.07143
## strat0:summer_rmax          0.02342 -0.02535  0.06800
## strat0:winter_rmax         -0.06347 -0.09936 -0.02752
## strat0:Data_Value_CSMOKING  0.73770  0.72186  0.75349
## strat1                      9.91846  9.91248  9.92446
## strat1:flood_risk_pc1       0.00368 -0.00283  0.01024
## strat1:flood_risk_pc2       0.00737  0.00056  0.01419
## strat1:flood_risk_pc3       0.00148 -0.00404  0.00702
## strat1:flood_risk_pc4      -0.00809 -0.01262 -0.00352
## strat1:flood_risk_pc5      -0.00001 -0.00441  0.00439
## strat1:EP_POV               0.21822  0.20970  0.22672
## strat1:EP_UNEMP             0.10426  0.09884  0.10965
## strat1:EP_PCI              -0.11826 -0.12783 -0.10868
## strat1:EP_NOHSDP           -0.03546 -0.04405 -0.02685
## strat1:EP_AGE65             0.09362  0.08550  0.10178
## strat1:EP_AGE17             0.00749 -0.00025  0.01531
## strat1:EP_DISABL           -0.04196 -0.04931 -0.03464
## strat1:EP_SNGPNT            0.08019  0.07401  0.08638
## strat1:EP_MUNIT            -0.01101 -0.01689 -0.00514
## strat1:EP_MOBILE           -0.02878 -0.03466 -0.02296
## strat1:EP_CROWD            -0.05000 -0.05643 -0.04358
## strat1:EP_NOVEH             0.16640  0.15757  0.17518
## strat1:EP_GROUPQ           -0.09129 -0.09665 -0.08602
## strat1:EP_UNINSUR          -0.06280 -0.06960 -0.05603
## strat1:co                  -0.11777 -0.14481 -0.09107
## strat1:no2                 -0.06414 -0.09797 -0.03128
## strat1:o3                   0.07824  0.02542  0.14097
## strat1:pm10                -0.19517 -0.21811 -0.17203
## strat1:pm25                 0.30593  0.27340  0.33815
## strat1:so2                 -0.05205 -0.07625 -0.02818
## strat1:summer_tmmx          0.01795 -0.01894  0.05365
## strat1:winter_tmmx          0.04904 -0.04320  0.13588
## strat1:summer_rmax         -0.00576 -0.05503  0.03902
## strat1:winter_rmax         -0.06682 -0.10313 -0.03037
## strat1:Data_Value_CSMOKING  1.01413  1.00076  1.02756
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CASTHMA_rp
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                     "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc3"      "strat0:EP_POV"
##  [5] "strat0:EP_UNEMP"            "strat0:EP_PCI"
##  [7] "strat0:EP_NOHSDP"           "strat0:EP_AGE65"
##  [9] "strat0:EP_DISABL"           "strat0:EP_SNGPNT"
## [11] "strat0:EP_MUNIT"            "strat0:EP_MOBILE"
## [13] "strat0:EP_CROWD"            "strat0:EP_NOVEH"
## [15] "strat0:EP_GROUPQ"           "strat0:EP_UNINSUR"
## [17] "strat0:co"                  "strat0:no2"
## [19] "strat0:o3"                  "strat0:pm10"
## [21] "strat0:pm25"                "strat0:winter_rmax"
## [23] "strat0:Data_Value_CSMOKING" "strat1"
## [25] "strat1:flood_risk_pc2"      "strat1:flood_risk_pc4"
## [27] "strat1:EP_POV"              "strat1:EP_UNEMP"
## [29] "strat1:EP_PCI"              "strat1:EP_NOHSDP"
## [31] "strat1:EP_AGE65"            "strat1:EP_DISABL"
## [33] "strat1:EP_SNGPNT"           "strat1:EP_MUNIT"
## [35] "strat1:EP_MOBILE"           "strat1:EP_CROWD"
## [37] "strat1:EP_NOVEH"            "strat1:EP_GROUPQ"
## [39] "strat1:EP_UNINSUR"          "strat1:co"
## [41] "strat1:no2"                 "strat1:o3"
## [43] "strat1:pm10"                "strat1:pm25"
## [45] "strat1:so2"                 "strat1:winter_rmax"
## [47] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

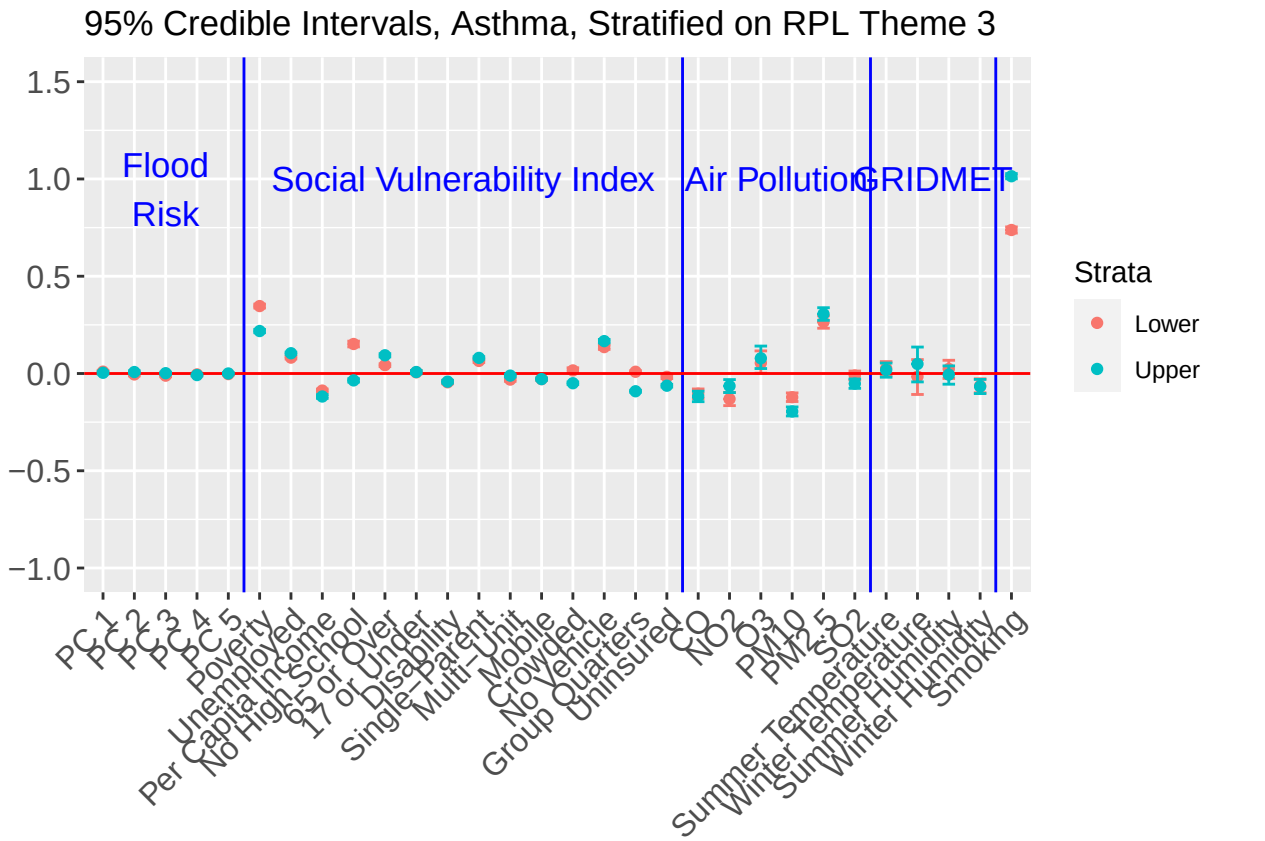
```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```r
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 1.5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 19.5, 25.5, 29.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 0.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 1, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 22.5, y = 1, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 27.5, y = 1, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Asthma, Stratified on RPL
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CASTHMA_CI_rpl3.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME4

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl4_CASTHMA.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     9.88563  9.88127  9.88996
## strat0:flood_risk_pc1      0.00909  0.00296  0.01530
## strat0:flood_risk_pc2     -0.00165 -0.00851  0.00527
## strat0:flood_risk_pc3     -0.00395 -0.00922  0.00128
## strat0:flood_risk_pc4     -0.01283 -0.01792 -0.00770
## strat0:flood_risk_pc5      0.00444 -0.00047  0.00936
## strat0:EP_POV              0.25566  0.24570  0.26572
## strat0:EP_UNEMP            0.06538  0.05905  0.07168
```

```
## strat0:EP_PCI              -0.02582 -0.03350 -0.01817
## strat0:EP_NOHSDP            0.07125  0.05919  0.08336
## strat0:EP_AGE65             0.11614  0.10952  0.12286
## strat0:EP_AGE17             0.03901  0.03223  0.04581
## strat0:EP_DISABL           -0.01989 -0.02749 -0.01227
## strat0:EP_SNGPNT            0.02869  0.02149  0.03595
## strat0:EP_MINRTY            0.33452  0.32379  0.34521
## strat0:EP_LIMENG           -0.24641 -0.25876 -0.23410
## strat0:EP_UNINSUR          -0.01275 -0.02088 -0.00454
## strat0:co                  -0.06220 -0.08760 -0.03704
## strat0:no2                 -0.11861 -0.15119 -0.08586
## strat0:o3                  -0.06525 -0.11252 -0.01469
## strat0:pm10                -0.16075 -0.18154 -0.14025
## strat0:pm25                 0.30707  0.27750  0.33693
## strat0:so2                  0.00511 -0.01644  0.02616
## strat0:summer_tmmx          0.03706  0.00232  0.07170
## strat0:winter_tmmx         -0.13059 -0.21914 -0.03182
## strat0:summer_rmax          0.00201 -0.04007  0.04600
## strat0:winter_rmax         -0.05652 -0.09120 -0.02399
## strat0:Data_Value_CSMOKING  0.89234  0.87810  0.90672
## strat1                      9.88356  9.87949  9.88765
## strat1:flood_risk_pc1       0.00071 -0.00522  0.00664
## strat1:flood_risk_pc2       0.00633 -0.00024  0.01293
## strat1:flood_risk_pc3      -0.00196 -0.00716  0.00328
## strat1:flood_risk_pc4      -0.00484 -0.00946 -0.00024
## strat1:flood_risk_pc5       0.00088 -0.00375  0.00546
## strat1:EP_POV               0.31772  0.31025  0.32516
## strat1:EP_UNEMP             0.07534  0.06984  0.08075
## strat1:EP_PCI              -0.08702 -0.09658 -0.07737
## strat1:EP_NOHSDP            0.05042  0.04074  0.06008
## strat1:EP_AGE65             0.13794  0.13078  0.14509
## strat1:EP_AGE17             0.03907  0.03254  0.04561
## strat1:EP_DISABL           -0.04471 -0.05154 -0.03788
## strat1:EP_SNGPNT            0.04370  0.03722  0.05015
## strat1:EP_MINRTY            0.35996  0.34956  0.37032
## strat1:EP_LIMENG           -0.25852 -0.26697 -0.25011
## strat1:EP_UNINSUR          -0.02638 -0.03300 -0.01979
## strat1:co                  -0.02935 -0.05176 -0.00703
## strat1:no2                 -0.16136 -0.19199 -0.13091
## strat1:o3                  -0.06381 -0.11090 -0.01333
## strat1:pm10                -0.16431 -0.18560 -0.14347
## strat1:pm25                 0.32205  0.29281  0.35179
## strat1:so2                  0.00225 -0.01872  0.02298
## strat1:summer_tmmx          0.02393 -0.01072  0.05793
## strat1:winter_tmmx         -0.13158 -0.21986 -0.03289
## strat1:summer_rmax         -0.00652 -0.04827  0.03752
## strat1:winter_rmax         -0.06836 -0.10291 -0.03595
## strat1:Data_Value_CSMOKING  0.85738  0.84477  0.86999
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CASTHMA_rp
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                     "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc4"      "strat0:EP_POV"
##  [5] "strat0:EP_UNEMP"            "strat0:EP_PCI"
##  [7] "strat0:EP_NOHSDP"           "strat0:EP_AGE65"
##  [9] "strat0:EP_AGE17"            "strat0:EP_DISABL"
## [11] "strat0:EP_SNGPNT"           "strat0:EP_MINRTY"
## [13] "strat0:EP_LIMENG"           "strat0:EP_UNINSUR"
## [15] "strat0:co"                  "strat0:no2"
## [17] "strat0:o3"                  "strat0:pm10"
## [19] "strat0:pm25"                "strat0:summer_tmmx"
## [21] "strat0:winter_tmmx"         "strat0:winter_rmax"
## [23] "strat0:Data_Value_CSMOKING" "strat1"
## [25] "strat1:flood_risk_pc4"      "strat1:EP_POV"
## [27] "strat1:EP_UNEMP"            "strat1:EP_PCI"
## [29] "strat1:EP_NOHSDP"           "strat1:EP_AGE65"
## [31] "strat1:EP_AGE17"            "strat1:EP_DISABL"
## [33] "strat1:EP_SNGPNT"           "strat1:EP_MINRTY"
## [35] "strat1:EP_LIMENG"           "strat1:EP_UNINSUR"
## [37] "strat1:co"                  "strat1:no2"
## [39] "strat1:o3"                  "strat1:pm10"
## [41] "strat1:pm25"                "strat1:winter_tmmx"
## [43] "strat1:winter_rmax"         "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

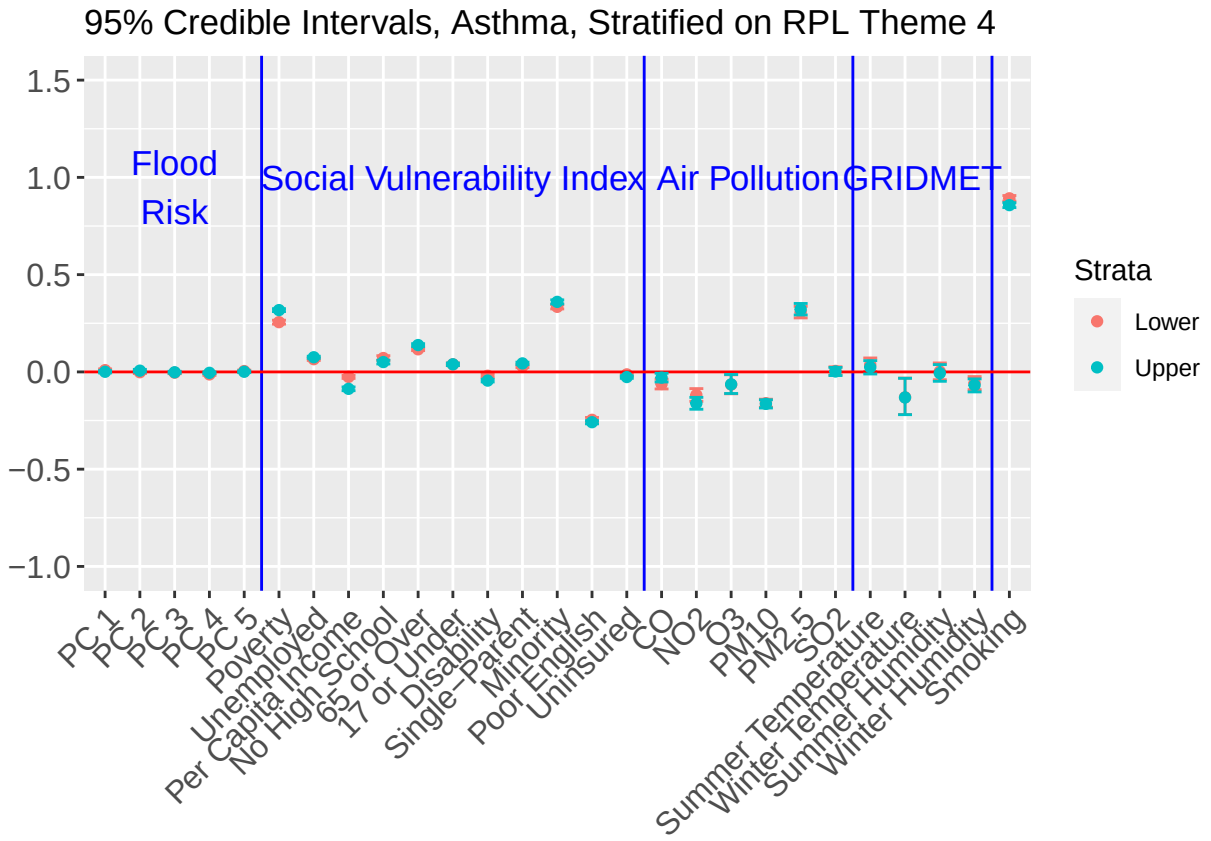
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 1.5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
```

```
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 16.5, 22.5, 26.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 0.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11, y = 1, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 19.5, y = 1, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 24.5, y = 1, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent",
                              "Minority", "Poor English",
                              "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Asthma, Stratified on RPL
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```



```
ggsave(here("figures/final_figures/stratified_analysis/CASTHMA_CI_rpl4.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEMES

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpls_CASTHMA.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                               50%     2.5%    97.5%
## strat0                    9.75622  9.74944  9.76299
## strat0:flood_risk_pc1     0.00327 -0.00404  0.01060
## strat0:flood_risk_pc2     0.01177  0.00340  0.02006
## strat0:flood_risk_pc3    -0.00240 -0.00856  0.00377
## strat0:flood_risk_pc4    -0.01433 -0.02045 -0.00825
## strat0:flood_risk_pc5     0.00004 -0.00577  0.00582
## strat0:EP_UNINSUR        -0.02325 -0.03329 -0.01313
## strat0:co                -0.02119 -0.04792  0.00560
## strat0:no2               -0.05715 -0.09241 -0.02048
## strat0:o3                -0.02102 -0.08280  0.03279
## strat0:pm10              -0.19038 -0.21629 -0.16516
## strat0:pm25               0.40374  0.36681  0.43983
## strat0:so2                0.02362 -0.00121  0.04928
## strat0:summer_tmmx        0.02812 -0.01473  0.07639
## strat0:winter_tmmx       -0.14511 -0.28701 -0.01899
## strat0:summer_rmax        0.00074 -0.05115  0.05542
## strat0:winter_rmax       -0.06271 -0.10157 -0.02412
## strat0:Data_Value_CSMOKING  1.10676  1.09537  1.11818
## strat1                    9.93931  9.93349  9.94509
## strat1:flood_risk_pc1     0.00817  0.00113  0.01523
## strat1:flood_risk_pc2    -0.02120 -0.02891 -0.01355
## strat1:flood_risk_pc3    -0.01027 -0.01660 -0.00402
## strat1:flood_risk_pc4    -0.01417 -0.01955 -0.00882
## strat1:flood_risk_pc5    -0.00308 -0.00841  0.00230
## strat1:EP_UNINSUR        -0.08751 -0.09417 -0.08079
## strat1:co                -0.11410 -0.14362 -0.08465
## strat1:no2                0.12848  0.09206  0.16534
## strat1:o3                -0.06187 -0.12384 -0.00737
## strat1:pm10              -0.27097 -0.29773 -0.24468
## strat1:pm25               0.46442  0.42713  0.50001
## strat1:so2                0.00146 -0.02313  0.02704
## strat1:summer_tmmx        0.01963 -0.02352  0.06782
## strat1:winter_tmmx       -0.06299 -0.20464  0.06378
## strat1:summer_rmax       -0.04780 -0.10020  0.00667
## strat1:winter_rmax       -0.10682 -0.14588 -0.06773
```

```
## strat1:Data_Value_CSMOKING  1.31950  1.31100  1.32798
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/CASTHMA_rp
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc2"
##  [3] "strat0:flood_risk_pc4"     "strat0:EP_UNINSUR"
##  [5] "strat0:no2"                "strat0:pm10"
##  [7] "strat0:pm25"               "strat0:winter_tmmx"
##  [9] "strat0:winter_rmax"        "strat0:Data_Value_CSMOKING"
## [11] "strat1"                    "strat1:flood_risk_pc1"
## [13] "strat1:flood_risk_pc2"     "strat1:flood_risk_pc3"
## [15] "strat1:flood_risk_pc4"     "strat1:EP_UNINSUR"
## [17] "strat1:co"                 "strat1:no2"
## [19] "strat1:o3"                 "strat1:pm10"
## [21] "strat1:pm25"               "strat1:winter_rmax"
## [23] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

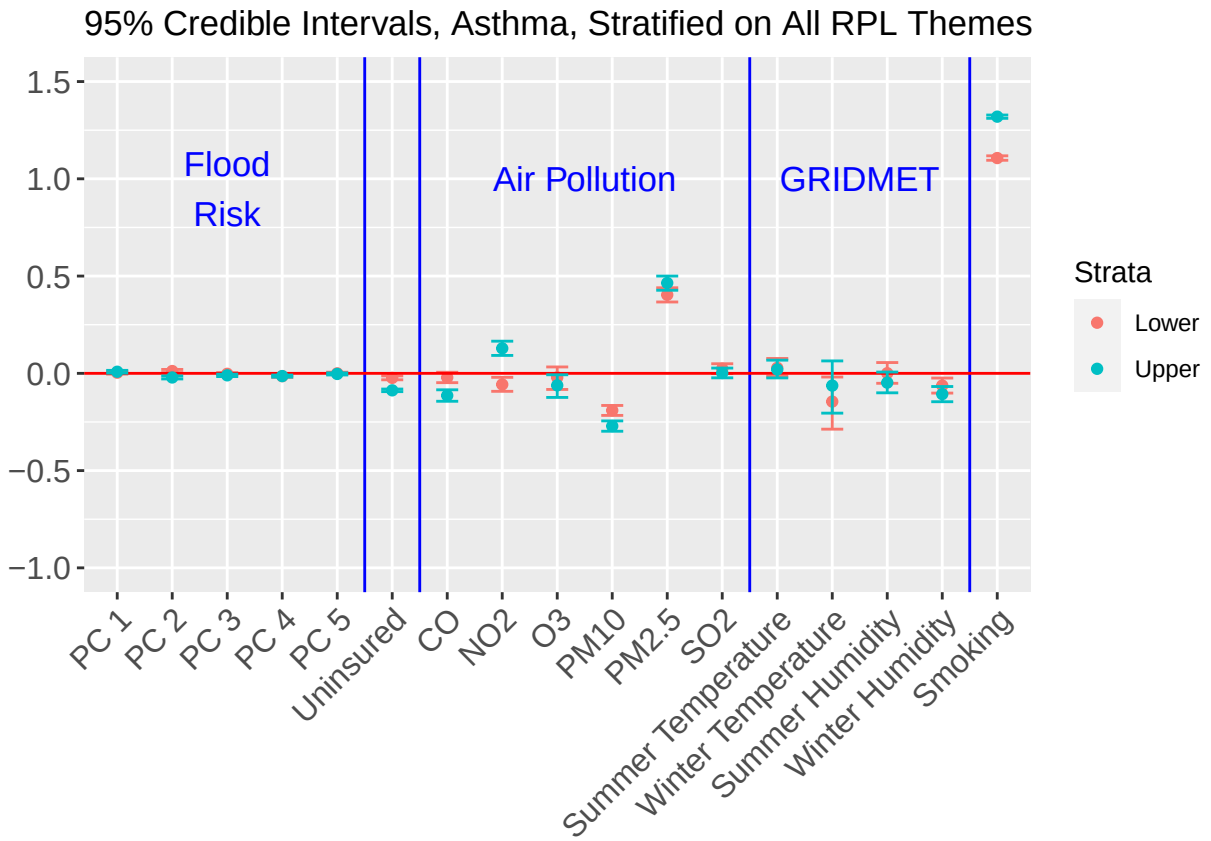
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 1.5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 6.5, 12.5, 16.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 0.95, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 9.5, y = 1, label = "Air Pollution",
```

```
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 14.5, y = 1, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Asthma, Stratified on All
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CASTHMA_CI_rpls.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

MHLTH Stratified Analysis

Repeating the stratified analysis in the last section, this time just doing the plots

Stratified on Poverty

```
load(here("modeling_files/stratified_analysis/model_stratif_poverty_MHLTH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     14.05947 14.04671 14.07223
## strat0:flood_risk_pc1      -0.00184 -0.01307  0.00924
## strat0:flood_risk_pc2       0.01708  0.00431  0.02976
## strat0:flood_risk_pc3       0.00648 -0.00296  0.01608
## strat0:flood_risk_pc4      -0.00581 -0.01485  0.00326
## strat0:flood_risk_pc5       0.00517 -0.00336  0.01371
## strat0:EP_UNEMP             0.08925  0.07501  0.10341
## strat0:EP_PCI              -0.17038 -0.18402 -0.15655
## strat0:EP_NOHSDP            0.11597  0.08972  0.14229
## strat0:EP_AGE65            -0.22733 -0.24039 -0.21431
## strat0:EP_AGE17            -0.03245 -0.04743 -0.01759
## strat0:EP_DISABL           -0.03668 -0.05240 -0.02079
## strat0:EP_SNGPNT            0.07427  0.05954  0.08905
## strat0:EP_MINRTY           -0.07790 -0.10024 -0.05588
## strat0:EP_LIMENG            0.05954  0.03559  0.08327
## strat0:EP_MUNIT             0.08564  0.07322  0.09804
## strat0:EP_MOBILE           -0.02338 -0.03577 -0.01101
## strat0:EP_CROWD             0.07613  0.05683  0.09549
## strat0:EP_NOVEH             0.11751  0.09594  0.13894
## strat0:EP_GROUPQ            0.17599  0.16353  0.18839
## strat0:EP_UNINSUR           0.03959  0.02338  0.05574
## strat0:co                   0.10258  0.06221  0.14291
## strat0:no2                  0.14149  0.08615  0.19601
## strat0:o3                  -0.01658 -0.10130  0.07347
## strat0:pm10                -0.15972 -0.19648 -0.12402
## strat0:pm25                 0.30003  0.24911  0.35454
## strat0:so2                  0.04434  0.00702  0.08183
## strat0:summer_tmmx          0.05300 -0.00508  0.11704
## strat0:winter_tmmx         -0.00398 -0.20391  0.14552
## strat0:summer_rmax          0.03978 -0.04264  0.12482
## strat0:winter_rmax         -0.05081 -0.11053  0.00965
## strat0:Data_Value_CSMOKING  2.74502  2.71650  2.77333
## strat1                     14.21971 14.20887 14.23045
## strat1:flood_risk_pc1      -0.01064 -0.02106 -0.00026
## strat1:flood_risk_pc2      -0.01192 -0.02354 -0.00024
## strat1:flood_risk_pc3      -0.01572 -0.02487 -0.00658
## strat1:flood_risk_pc4      -0.00932 -0.01760 -0.00115
## strat1:flood_risk_pc5      -0.00682 -0.01498  0.00133
## strat1:EP_UNEMP             0.13909  0.13053  0.14771
## strat1:EP_PCI              -0.97670 -1.00046 -0.95314
## strat1:EP_NOHSDP            0.18956  0.17280  0.20620
## strat1:EP_AGE65            -0.40953 -0.42321 -0.39583
## strat1:EP_AGE17            -0.17848 -0.19195 -0.16481
```

```
## strat1:EP_DISABL           -0.24717 -0.25857 -0.23570
## strat1:EP_SNGPNT            0.14464  0.13396  0.15535
## strat1:EP_MINRTY           -0.22903 -0.24695 -0.21095
## strat1:EP_LIMENG           -0.03292 -0.04778 -0.01799
## strat1:EP_MUNIT             0.22072  0.20991  0.23156
## strat1:EP_MOBILE           -0.04202 -0.05136 -0.03277
## strat1:EP_CROWD             0.07309  0.06181  0.08439
## strat1:EP_NOVEH             0.25182  0.23762  0.26604
## strat1:EP_GROUPQ            0.15220  0.14404  0.16040
## strat1:EP_UNINSUR          -0.09023 -0.10184 -0.07879
## strat1:co                   0.10435  0.05997  0.14870
## strat1:no2                 -0.03093 -0.08740  0.02378
## strat1:o3                   0.03027 -0.05432  0.12085
## strat1:pm10                -0.22038 -0.25841 -0.18383
## strat1:pm25                 0.36805  0.31676  0.42310
## strat1:so2                  0.04734  0.01052  0.08444
## strat1:summer_tmmx          0.03700 -0.02192  0.10119
## strat1:winter_tmmx          0.12018 -0.07962  0.26905
## strat1:summer_rmax         -0.00967 -0.09248  0.07530
## strat1:winter_rmax         -0.02356 -0.08296  0.03696
## strat1:Data_Value_CSMOKING  2.51264  2.49246  2.53298
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/MHLTH_pove
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                     "strat0:flood_risk_pc2"
##  [3] "strat0:EP_UNEMP"            "strat0:EP_PCI"
##  [5] "strat0:EP_NOHSDP"           "strat0:EP_AGE65"
##  [7] "strat0:EP_AGE17"            "strat0:EP_DISABL"
##  [9] "strat0:EP_SNGPNT"           "strat0:EP_MINRTY"
## [11] "strat0:EP_LIMENG"           "strat0:EP_MUNIT"
## [13] "strat0:EP_MOBILE"           "strat0:EP_CROWD"
## [15] "strat0:EP_NOVEH"            "strat0:EP_GROUPQ"
## [17] "strat0:EP_UNINSUR"          "strat0:co"
## [19] "strat0:no2"                 "strat0:pm10"
## [21] "strat0:pm25"                "strat0:so2"
## [23] "strat0:Data_Value_CSMOKING" "strat1"
## [25] "strat1:flood_risk_pc1"      "strat1:flood_risk_pc2"
## [27] "strat1:flood_risk_pc3"      "strat1:flood_risk_pc4"
## [29] "strat1:EP_UNEMP"            "strat1:EP_PCI"
## [31] "strat1:EP_NOHSDP"           "strat1:EP_AGE65"
## [33] "strat1:EP_AGE17"            "strat1:EP_DISABL"
## [35] "strat1:EP_SNGPNT"           "strat1:EP_MINRTY"
## [37] "strat1:EP_LIMENG"           "strat1:EP_MUNIT"
## [39] "strat1:EP_MOBILE"           "strat1:EP_CROWD"
## [41] "strat1:EP_NOVEH"            "strat1:EP_GROUPQ"
## [43] "strat1:EP_UNINSUR"          "strat1:co"
## [45] "strat1:pm10"                "strat1:pm25"
## [47] "strat1:so2"                 "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

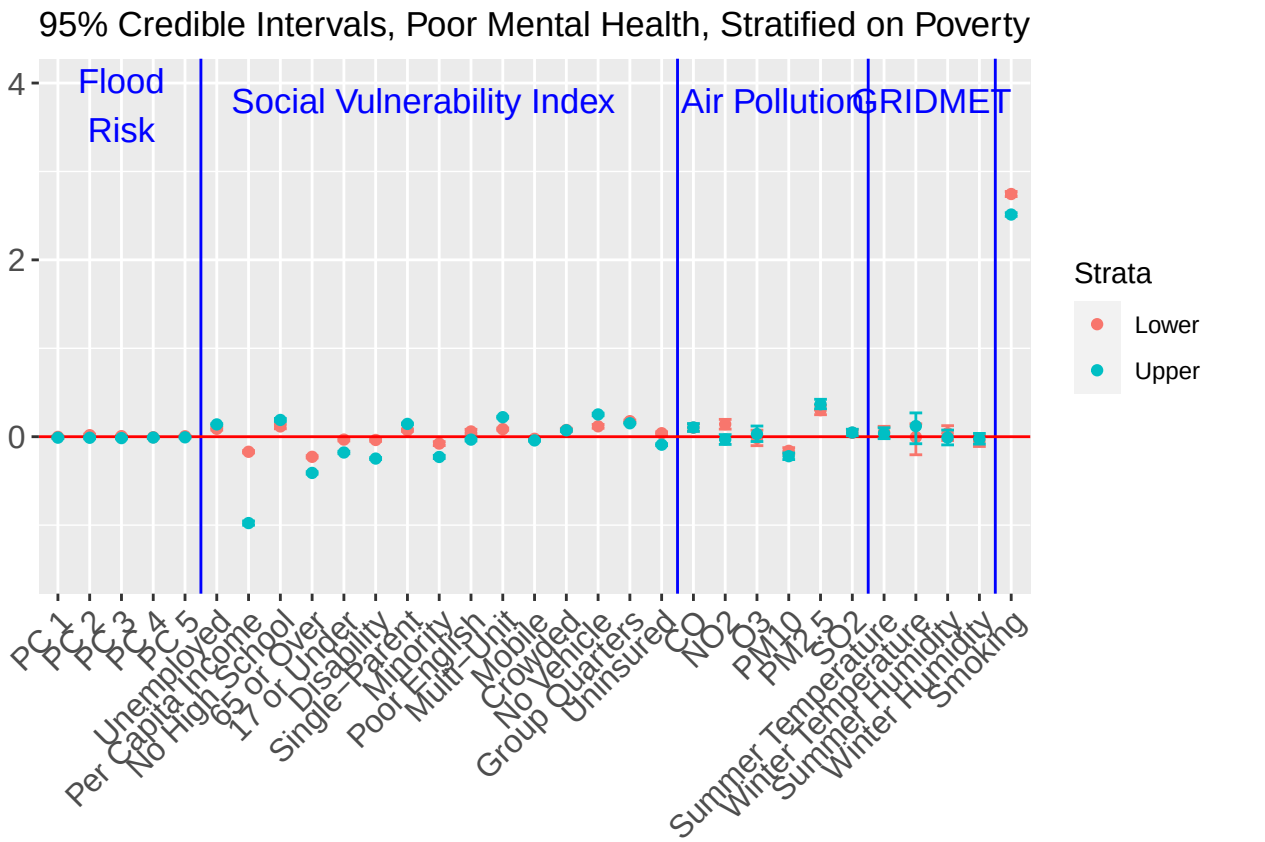
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1.5, 4)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 20.5, 26.5, 30.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.75, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 3.8, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 23.5, y = 3.8, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 28.5, y = 3.8, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Poor Mental Health, Strati
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)
```

```
p
```




```
ggsave(here("figures/final_figures/stratified_analysis/MHLTH_CI_poverty.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME1

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl1_MHLTH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                              50%     2.5%    97.5%
## strat0                   14.07636 14.06121 14.09134
## strat0:flood_risk_pc1      0.00041 -0.01150  0.01220
## strat0:flood_risk_pc2      0.01121 -0.00234  0.02474
## strat0:flood_risk_pc3      0.00295 -0.00704  0.01291
## strat0:flood_risk_pc4     -0.01337 -0.02282 -0.00385
## strat0:flood_risk_pc5      0.00193 -0.00707  0.01100
## strat0:EP_AGE65           -0.25804 -0.27113 -0.24497
## strat0:EP_AGE17           -0.09463 -0.10960 -0.07954
## strat0:EP_DISABL          -0.03532 -0.05129 -0.01939
```

```
## strat0:EP_SNGPNT            0.10692  0.09116  0.12267
## strat0:EP_MINRTY           -0.03117 -0.05468 -0.00757
## strat0:EP_LIMENG            0.05570  0.02948  0.08173
## strat0:EP_MUNIT             0.08816  0.07583  0.10051
## strat0:EP_MOBILE           -0.00470 -0.01925  0.00986
## strat0:EP_CROWD             0.09523  0.07203  0.11844
## strat0:EP_NOVEH             0.18957  0.16786  0.21139
## strat0:EP_GROUPQ            0.21271  0.20189  0.22351
## strat0:EP_UNINSUR           0.05379  0.03591  0.07170
## strat0:co                   0.10014  0.05641  0.14350
## strat0:no2                  0.18211  0.12105  0.24200
## strat0:o3                  -0.04821 -0.14324  0.04472
## strat0:pm10                -0.18750 -0.22709 -0.14783
## strat0:pm25                 0.41384  0.35602  0.47171
## strat0:so2                  0.03062 -0.00961  0.06993
## strat0:summer_tmmx          0.06567 -0.00351  0.13001
## strat0:winter_tmmx         -0.10078 -0.26152  0.10112
## strat0:summer_rmax          0.05608 -0.03233  0.14088
## strat0:winter_rmax         -0.02006 -0.08400  0.04510
## strat0:Data_Value_CSMOKING  2.90290  2.87752  2.92862
## strat1                     14.45215 14.44110 14.46329
## strat1:flood_risk_pc1      -0.00245 -0.01365  0.00884
## strat1:flood_risk_pc2      -0.01903 -0.03142 -0.00665
## strat1:flood_risk_pc3      -0.01167 -0.02182 -0.00172
## strat1:flood_risk_pc4      -0.01038 -0.01910 -0.00163
## strat1:flood_risk_pc5       0.00507 -0.00365  0.01383
## strat1:EP_AGE65            -0.41428 -0.42926 -0.39918
## strat1:EP_AGE17            -0.11709 -0.13144 -0.10269
## strat1:EP_DISABL           -0.21070 -0.22282 -0.19848
## strat1:EP_SNGPNT            0.15432  0.14326  0.16533
## strat1:EP_MINRTY           -0.04108 -0.05933 -0.02283
## strat1:EP_LIMENG            0.06949  0.05589  0.08292
## strat1:EP_MUNIT             0.19108  0.17907  0.20305
## strat1:EP_MOBILE           -0.01789 -0.02745 -0.00839
## strat1:EP_CROWD             0.11279  0.10113  0.12444
## strat1:EP_NOVEH             0.31876  0.30356  0.33394
## strat1:EP_GROUPQ            0.27661  0.26783  0.28538
## strat1:EP_UNINSUR          -0.06466 -0.07656 -0.05285
## strat1:co                   0.10647  0.05888  0.15342
## strat1:no2                 -0.00704 -0.06869  0.05287
## strat1:o3                  -0.02023 -0.11548  0.07256
## strat1:pm10                -0.24547 -0.28660 -0.20493
## strat1:pm25                 0.53593  0.47743  0.59305
## strat1:so2                  0.00160 -0.03766  0.04014
## strat1:summer_tmmx          0.04451 -0.02560  0.11045
## strat1:winter_tmmx          0.05280 -0.10826  0.25412
## strat1:summer_rmax         -0.06693 -0.15553  0.01845
## strat1:winter_rmax          0.02940 -0.03489  0.09462
## strat1:Data_Value_CSMOKING  2.92075  2.90223  2.93919
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/MHLTH_rpl1
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc4"
##  [3] "strat0:EP_AGE65"           "strat0:EP_AGE17"
##  [5] "strat0:EP_DISABL"          "strat0:EP_SNGPNT"
##  [7] "strat0:EP_MINRTY"          "strat0:EP_LIMENG"
##  [9] "strat0:EP_MUNIT"           "strat0:EP_CROWD"
## [11] "strat0:EP_NOVEH"           "strat0:EP_GROUPQ"
## [13] "strat0:EP_UNINSUR"         "strat0:co"
## [15] "strat0:no2"                "strat0:pm10"
## [17] "strat0:pm25"               "strat0:Data_Value_CSMOKING"
## [19] "strat1"                    "strat1:flood_risk_pc2"
## [21] "strat1:flood_risk_pc3"     "strat1:flood_risk_pc4"
## [23] "strat1:EP_AGE65"           "strat1:EP_AGE17"
## [25] "strat1:EP_DISABL"          "strat1:EP_SNGPNT"
## [27] "strat1:EP_MINRTY"          "strat1:EP_LIMENG"
## [29] "strat1:EP_MUNIT"           "strat1:EP_MOBILE"
## [31] "strat1:EP_CROWD"           "strat1:EP_NOVEH"
## [33] "strat1:EP_GROUPQ"          "strat1:EP_UNINSUR"
## [35] "strat1:co"                 "strat1:pm10"
## [37] "strat1:pm25"               "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

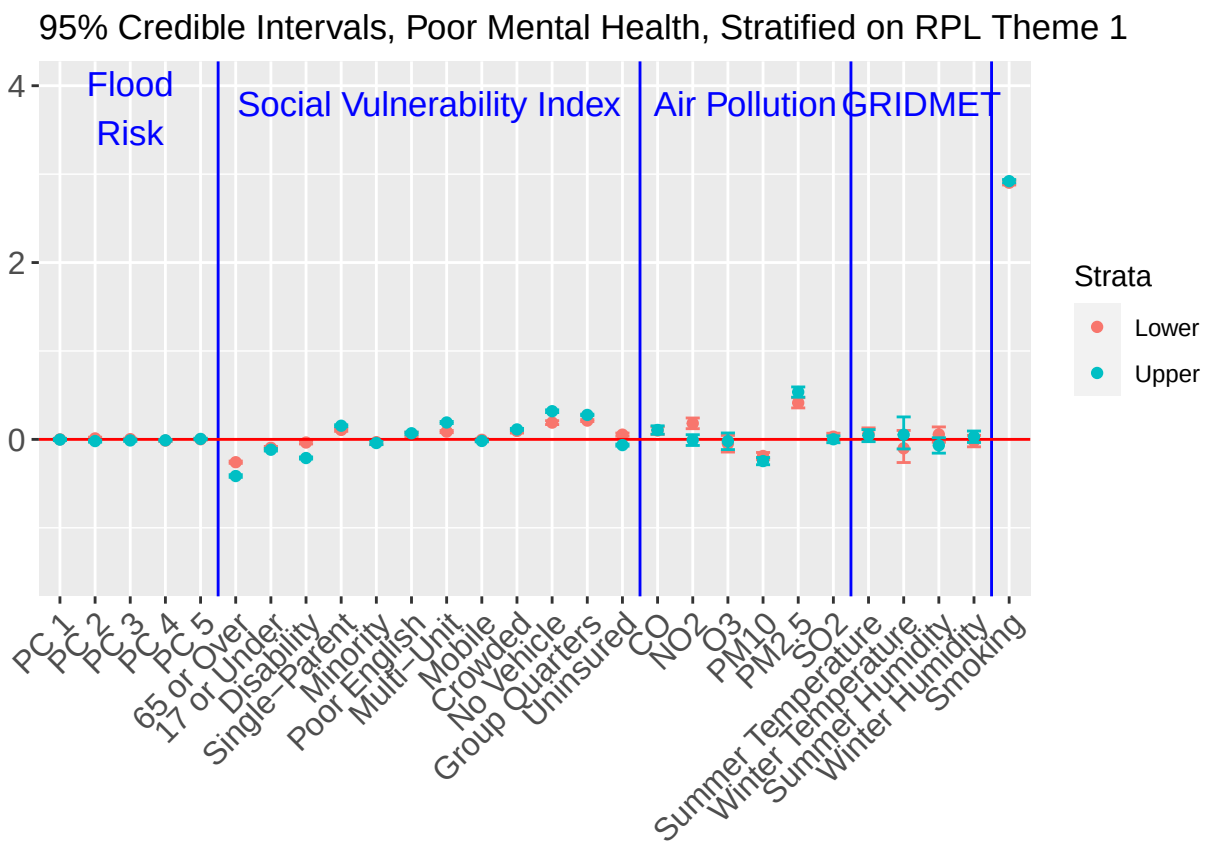
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1.5, 4)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 17.5, 23.5, 27.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
```

```
  annotate(geom = "text", x = 3, y = 3.75, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11.5, y = 3.8, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 20.5, y = 3.8, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 25.5, y = 3.8, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Poor Mental Health, Strati
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)
p
```




```
ggsave(here("figures/final_figures/stratified_analysis/MHLTH_CI_rpl1.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME2

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl2_MHLTH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     14.30661 14.29818 14.31510
## strat0:flood_risk_pc1       0.02131  0.01121  0.03139
## strat0:flood_risk_pc2      -0.00723 -0.01869  0.00427
## strat0:flood_risk_pc3      -0.00211 -0.01066  0.00646
## strat0:flood_risk_pc4      -0.01781 -0.02568 -0.00989
## strat0:flood_risk_pc5       0.00422 -0.00343  0.01189
## strat0:EP_POV               1.06868  1.05384  1.08340
## strat0:EP_UNEMP             0.08676  0.07541  0.09805
## strat0:EP_PCI              -0.35894 -0.37085 -0.34691
## strat0:EP_NOHSDP           -0.00128 -0.02055  0.01830
## strat0:EP_MINRTY           -0.08711 -0.10538 -0.06895
## strat0:EP_LIMENG            0.01373 -0.00285  0.03026
## strat0:EP_MUNIT             0.05483  0.04546  0.06419
## strat0:EP_MOBILE           -0.08832 -0.10013 -0.07657
## strat0:EP_CROWD             0.13251  0.12000  0.14508
## strat0:EP_NOVEH            -0.09704 -0.11272 -0.08142
## strat0:EP_GROUPQ            0.25105  0.24483  0.25724
## strat0:EP_UNINSUR           0.05375  0.04098  0.06657
## strat0:co                   0.13064  0.09276  0.16831
## strat0:no2                 -0.07947 -0.13176 -0.02815
## strat0:o3                  -0.00886 -0.09103  0.07275
## strat0:pm10                -0.04927 -0.08430 -0.01413
## strat0:pm25                 0.30198  0.25146  0.35266
## strat0:so2                  0.06000  0.02475  0.09453
## strat0:summer_tmmx          0.13605  0.07791  0.19191
## strat0:winter_tmmx         -0.06092 -0.19971  0.10337
## strat0:summer_rmax          0.08365  0.00775  0.15828
## strat0:winter_rmax         -0.03945 -0.09559  0.01713
## strat0:Data_Value_CSMOKING  2.13351  2.11127  2.15590
## strat1                     14.12187 14.11308 14.13073
## strat1:flood_risk_pc1       0.01306  0.00266  0.02355
## strat1:flood_risk_pc2       0.00942 -0.00206  0.02085
## strat1:flood_risk_pc3       0.00637 -0.00319  0.01585
## strat1:flood_risk_pc4      -0.00517 -0.01355  0.00334
## strat1:flood_risk_pc5       0.00437 -0.00407  0.01278
## strat1:EP_POV               0.44656  0.43089  0.46211
## strat1:EP_UNEMP             0.02534  0.01647  0.03424
## strat1:EP_PCI              -0.29838 -0.32087 -0.27575
## strat1:EP_NOHSDP            0.17839  0.16106  0.19565
## strat1:EP_MINRTY            0.11621  0.09915  0.13309
## strat1:EP_LIMENG            0.00374 -0.01255  0.01992
## strat1:EP_MUNIT             0.10365  0.09042  0.11677
## strat1:EP_MOBILE           -0.05947 -0.06819 -0.05084
```

```
## strat1:EP_CROWD             0.09810  0.08590  0.11044
## strat1:EP_NOVEH            -0.00152 -0.01721  0.01423
## strat1:EP_GROUPQ           -0.11601 -0.13282 -0.09913
## strat1:EP_UNINSUR           0.01266  0.00078  0.02457
## strat1:co                   0.04578  0.00303  0.08824
## strat1:no2                  0.04898 -0.00595  0.10289
## strat1:o3                  -0.01080 -0.09281  0.07078
## strat1:pm10                -0.02841 -0.06330  0.00618
## strat1:pm25                 0.23900  0.18871  0.28906
## strat1:so2                  0.01775 -0.01658  0.05192
## strat1:summer_tmmx          0.04003 -0.01864  0.09627
## strat1:winter_tmmx          0.09914 -0.04064  0.26309
## strat1:summer_rmax         -0.03122 -0.10693  0.04379
## strat1:winter_rmax          0.00374 -0.05216  0.05981
## strat1:Data_Value_CSMOKING  2.64618  2.62452  2.66777
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/MHLTH_rpl2
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc4"     "strat0:EP_POV"
##  [5] "strat0:EP_UNEMP"           "strat0:EP_PCI"
##  [7] "strat0:EP_MINRTY"          "strat0:EP_MUNIT"
##  [9] "strat0:EP_MOBILE"          "strat0:EP_CROWD"
## [11] "strat0:EP_NOVEH"           "strat0:EP_GROUPQ"
## [13] "strat0:EP_UNINSUR"         "strat0:co"
## [15] "strat0:no2"                "strat0:pm10"
## [17] "strat0:pm25"               "strat0:so2"
## [19] "strat0:summer_tmmx"        "strat0:summer_rmax"
## [21] "strat0:Data_Value_CSMOKING" "strat1"
## [23] "strat1:flood_risk_pc1"     "strat1:EP_POV"
## [25] "strat1:EP_UNEMP"           "strat1:EP_PCI"
## [27] "strat1:EP_NOHSDP"          "strat1:EP_MINRTY"
## [29] "strat1:EP_MUNIT"           "strat1:EP_MOBILE"
## [31] "strat1:EP_CROWD"           "strat1:EP_GROUPQ"
## [33] "strat1:EP_UNINSUR"         "strat1:co"
## [35] "strat1:pm25"               "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
```

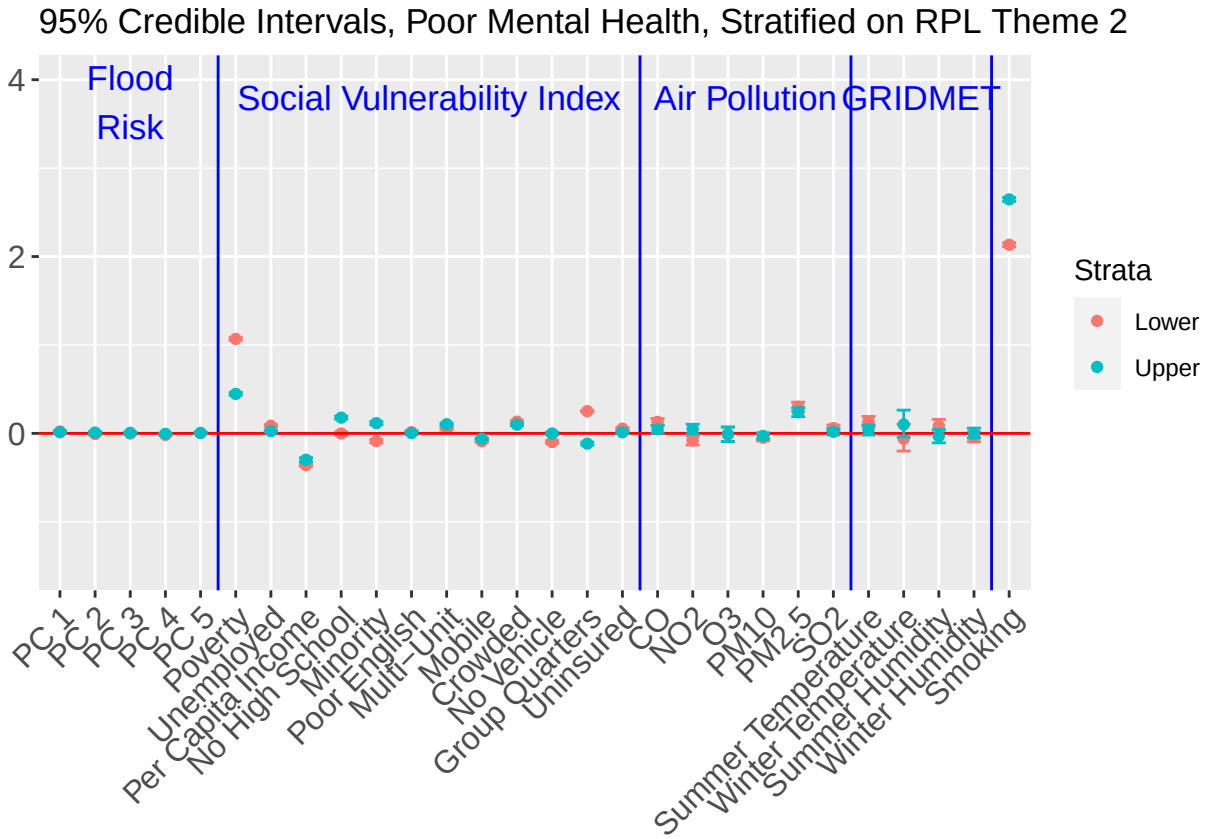
```
                                        rep("Upper", (nrow(beta_inference_df)/2))))
```

Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1.5, 4)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 17.5, 23.5, 27.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.75, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11.5, y = 3.8, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 20.5, y = 3.8, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 25.5, y = 3.8, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Poor Mental Health, Strati
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/MHLTH_CI_rpl2.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME3

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl3_MHLTH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                              50%     2.5%    97.5%
## strat0                   14.28926 14.27427 14.30418
## strat0:flood_risk_pc1     0.00390 -0.00648  0.01428
## strat0:flood_risk_pc2    -0.00250 -0.01452  0.00958
## strat0:flood_risk_pc3    -0.01699 -0.02619 -0.00783
## strat0:flood_risk_pc4    -0.01200 -0.02138 -0.00273
## strat0:flood_risk_pc5    -0.00610 -0.01517  0.00293
## strat0:EP_POV             0.89232  0.87655  0.90803
## strat0:EP_UNEMP           0.05196  0.04153  0.06237
```

```
## strat0:EP_PCI              -0.27425 -0.28673 -0.26184
## strat0:EP_NOHSDP            0.17846  0.15526  0.20149
## strat0:EP_AGE65            -0.34326 -0.35439 -0.33214
## strat0:EP_AGE17            -0.14710 -0.16003 -0.13434
## strat0:EP_DISABL           -0.14073 -0.15299 -0.12851
## strat0:EP_SNGPNT            0.02235  0.00984  0.03485
## strat0:EP_MUNIT             0.08846  0.07477  0.10212
## strat0:EP_MOBILE            0.01209  0.00241  0.02172
## strat0:EP_CROWD             0.07511  0.05403  0.09599
## strat0:EP_NOVEH             0.02480  0.00658  0.04309
## strat0:EP_GROUPQ            0.29620  0.28736  0.30495
## strat0:EP_UNINSUR          -0.03581 -0.05005 -0.02152
## strat0:co                   0.02040 -0.01718  0.05804
## strat0:no2                 -0.13499 -0.18633 -0.08400
## strat0:o3                   0.01962 -0.05440  0.10557
## strat0:pm10                -0.09122 -0.12412 -0.05837
## strat0:pm25                 0.32304  0.27457  0.37051
## strat0:so2                  0.01807 -0.01585  0.05185
## strat0:summer_tmmx          0.06644  0.01394  0.11827
## strat0:winter_tmmx          0.02744 -0.11092  0.15412
## strat0:summer_rmax          0.05653 -0.01453  0.12300
## strat0:winter_rmax         -0.04551 -0.09817  0.00690
## strat0:Data_Value_CSMOKING  2.14141  2.11669  2.16593
## strat1                     14.19656 14.18708 14.20603
## strat1:flood_risk_pc1       0.00445 -0.00561  0.01457
## strat1:flood_risk_pc2       0.00978 -0.00082  0.02036
## strat1:flood_risk_pc3       0.00709 -0.00150  0.01570
## strat1:flood_risk_pc4      -0.00266 -0.00972  0.00442
## strat1:flood_risk_pc5       0.00408 -0.00277  0.01090
## strat1:EP_POV               0.71301  0.69968  0.72637
## strat1:EP_UNEMP             0.06574  0.05728  0.07421
## strat1:EP_PCI              -0.36337 -0.37826 -0.34842
## strat1:EP_NOHSDP            0.21765  0.20439  0.23094
## strat1:EP_AGE65            -0.32917 -0.34187 -0.31644
## strat1:EP_AGE17            -0.08938 -0.10149 -0.07717
## strat1:EP_DISABL           -0.17414 -0.18563 -0.16271
## strat1:EP_SNGPNT            0.07475  0.06504  0.08444
## strat1:EP_MUNIT             0.08736  0.07826  0.09650
## strat1:EP_MOBILE           -0.01952 -0.02870 -0.01037
## strat1:EP_CROWD             0.02481  0.01478  0.03484
## strat1:EP_NOVEH             0.08222  0.06848  0.09591
## strat1:EP_GROUPQ            0.05077  0.04238  0.05907
## strat1:EP_UNINSUR          -0.03719 -0.04783 -0.02660
## strat1:co                   0.06368  0.02280  0.10397
## strat1:no2                 -0.04470 -0.09523  0.00496
## strat1:o3                   0.06111 -0.01379  0.14775
## strat1:pm10                -0.19566 -0.23011 -0.16099
## strat1:pm25                 0.33667  0.28771  0.38493
## strat1:so2                 -0.03032 -0.06626  0.00492
## strat1:summer_tmmx          0.06793  0.01436  0.12117
## strat1:winter_tmmx          0.10097 -0.03801  0.22729
## strat1:summer_rmax         -0.00928 -0.08060  0.05739
## strat1:winter_rmax          0.03510 -0.01828  0.08824
## strat1:Data_Value_CSMOKING  2.24508  2.22421  2.26599
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/MHLTH_rpl3
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc3"
##  [3] "strat0:flood_risk_pc4"     "strat0:EP_POV"
##  [5] "strat0:EP_UNEMP"           "strat0:EP_PCI"
##  [7] "strat0:EP_NOHSDP"          "strat0:EP_AGE65"
##  [9] "strat0:EP_AGE17"           "strat0:EP_DISABL"
## [11] "strat0:EP_SNGPNT"          "strat0:EP_MUNIT"
## [13] "strat0:EP_MOBILE"          "strat0:EP_CROWD"
## [15] "strat0:EP_NOVEH"           "strat0:EP_GROUPQ"
## [17] "strat0:EP_UNINSUR"         "strat0:no2"
## [19] "strat0:pm10"               "strat0:pm25"
## [21] "strat0:summer_tmmx"        "strat0:Data_Value_CSMOKING"
## [23] "strat1"                    "strat1:EP_POV"
## [25] "strat1:EP_UNEMP"           "strat1:EP_PCI"
## [27] "strat1:EP_NOHSDP"          "strat1:EP_AGE65"
## [29] "strat1:EP_AGE17"           "strat1:EP_DISABL"
## [31] "strat1:EP_SNGPNT"          "strat1:EP_MUNIT"
## [33] "strat1:EP_MOBILE"          "strat1:EP_CROWD"
## [35] "strat1:EP_NOVEH"           "strat1:EP_GROUPQ"
## [37] "strat1:EP_UNINSUR"         "strat1:co"
## [39] "strat1:pm10"               "strat1:pm25"
## [41] "strat1:summer_tmmx"        "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

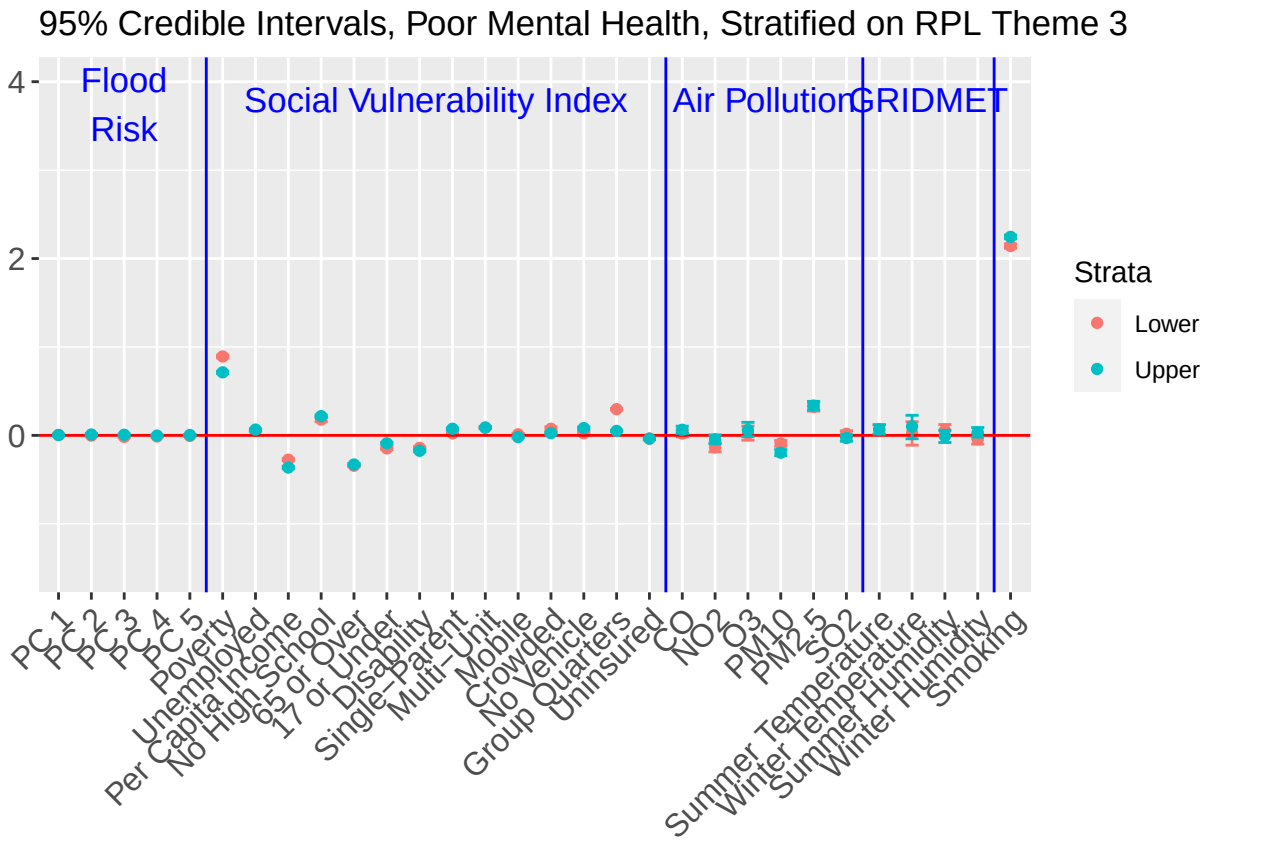
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1.5, 4)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
```

```
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 19.5, 25.5, 29.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.75, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 3.8, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 22.5, y = 3.8, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 27.5, y = 3.8, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Poor Mental Health, Strati
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/MHLTH_CI_rpl3.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEME4

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl4_MHLTH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                                50%     2.5%    97.5%
## strat0                     14.21734 14.20999 14.22465
## strat0:flood_risk_pc1      -0.01174 -0.02180 -0.00157
## strat0:flood_risk_pc2       0.01768  0.00636  0.02904
## strat0:flood_risk_pc3       0.00610 -0.00257  0.01473
## strat0:flood_risk_pc4      -0.01267 -0.02104 -0.00424
## strat0:flood_risk_pc5       0.00824  0.00016  0.01634
## strat0:EP_POV               0.74585  0.72932  0.76247
## strat0:EP_UNEMP             0.07704  0.06659  0.08744
```

```
## strat0:EP_PCI              -0.28154 -0.29413 -0.26894
## strat0:EP_NOHSDP            0.23445  0.21453  0.25439
## strat0:EP_AGE65            -0.36436 -0.37532 -0.35331
## strat0:EP_AGE17            -0.19197 -0.20313 -0.18073
## strat0:EP_DISABL           -0.11405 -0.12664 -0.10146
## strat0:EP_SNGPNT            0.06362  0.05168  0.07565
## strat0:EP_MINRTY           -0.07618 -0.09372 -0.05865
## strat0:EP_LIMENG            0.03339  0.01309  0.05363
## strat0:EP_UNINSUR          -0.04488 -0.05832 -0.03138
## strat0:co                   0.11777  0.07659  0.15884
## strat0:no2                  0.00035 -0.05211  0.05285
## strat0:o3                   0.02721 -0.04741  0.10600
## strat0:pm10                -0.07674 -0.11013 -0.04381
## strat0:pm25                 0.19068  0.14328  0.23867
## strat0:so2                 -0.00485 -0.03920  0.02879
## strat0:summer_tmmx          0.05316 -0.00258  0.10750
## strat0:winter_tmmx          0.05980 -0.07978  0.21843
## strat0:summer_rmax          0.04663 -0.02054  0.11677
## strat0:winter_rmax         -0.06972 -0.12432 -0.01801
## strat0:Data_Value_CSMOKING  2.27176  2.24821  2.29550
## strat1                     14.28544 14.27852 14.29236
## strat1:flood_risk_pc1      -0.00071 -0.01040  0.00901
## strat1:flood_risk_pc2      -0.00007 -0.01086  0.01076
## strat1:flood_risk_pc3      -0.00518 -0.01375  0.00343
## strat1:flood_risk_pc4      -0.00403 -0.01158  0.00355
## strat1:flood_risk_pc5      -0.00422 -0.01185  0.00328
## strat1:EP_POV               0.94023  0.92783  0.95259
## strat1:EP_UNEMP             0.08296  0.07391  0.09193
## strat1:EP_PCI              -0.53814 -0.55388 -0.52233
## strat1:EP_NOHSDP            0.32007  0.30413  0.33601
## strat1:EP_AGE65            -0.42984 -0.44167 -0.41807
## strat1:EP_AGE17            -0.23675 -0.24755 -0.22593
## strat1:EP_DISABL           -0.21525 -0.22651 -0.20395
## strat1:EP_SNGPNT            0.10110  0.09039  0.11176
## strat1:EP_MINRTY           -0.22441 -0.24139 -0.20745
## strat1:EP_LIMENG           -0.07023 -0.08407 -0.05643
## strat1:EP_UNINSUR          -0.06241 -0.07332 -0.05154
## strat1:co                   0.13889  0.10246  0.17512
## strat1:no2                 -0.03073 -0.07980  0.01813
## strat1:o3                   0.05685 -0.01757  0.13574
## strat1:pm10                -0.10769 -0.14189 -0.07419
## strat1:pm25                 0.19533  0.14841  0.24311
## strat1:so2                  0.03851  0.00498  0.07147
## strat1:summer_tmmx          0.07522  0.01989  0.12849
## strat1:winter_tmmx          0.07123 -0.06700  0.22945
## strat1:summer_rmax          0.05240 -0.01416  0.12310
## strat1:winter_rmax         -0.04582 -0.09999  0.00553
## strat1:Data_Value_CSMOKING  1.98123  1.96047  2.00200
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/MHLTH_rpl4
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                     "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"      "strat0:flood_risk_pc4"
##  [5] "strat0:flood_risk_pc5"      "strat0:EP_POV"
##  [7] "strat0:EP_UNEMP"            "strat0:EP_PCI"
##  [9] "strat0:EP_NOHSDP"           "strat0:EP_AGE65"
## [11] "strat0:EP_AGE17"            "strat0:EP_DISABL"
## [13] "strat0:EP_SNGPNT"           "strat0:EP_MINRTY"
## [15] "strat0:EP_LIMENG"           "strat0:EP_UNINSUR"
## [17] "strat0:co"                  "strat0:pm10"
## [19] "strat0:pm25"                "strat0:winter_rmax"
## [21] "strat0:Data_Value_CSMOKING" "strat1"
## [23] "strat1:EP_POV"              "strat1:EP_UNEMP"
## [25] "strat1:EP_PCI"              "strat1:EP_NOHSDP"
## [27] "strat1:EP_AGE65"            "strat1:EP_AGE17"
## [29] "strat1:EP_DISABL"           "strat1:EP_SNGPNT"
## [31] "strat1:EP_MINRTY"           "strat1:EP_LIMENG"
## [33] "strat1:EP_UNINSUR"          "strat1:co"
## [35] "strat1:pm10"                "strat1:pm25"
## [37] "strat1:so2"                 "strat1:summer_tmmx"
## [39] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

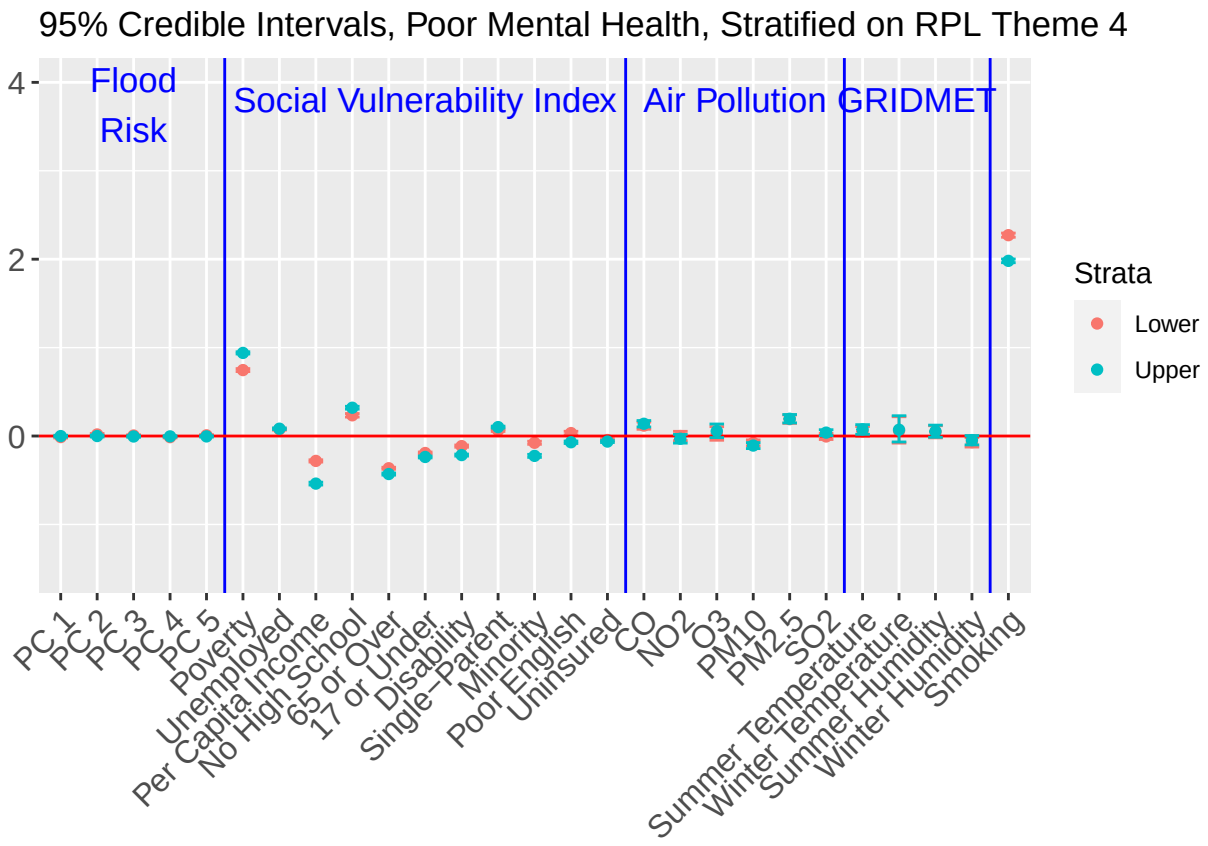
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1.5, 4)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 16.5, 22.5, 26.5), col = "blue") +
```

```
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.75, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11, y = 3.8, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 19.5, y = 3.8, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 24.5, y = 3.8, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent",
                              "Minority", "Poor English",
                              "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Poor Mental Health, Strati
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```



```
ggsave(here("figures/final_figures/stratified_analysis/MHLTH_CI_rpl4.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Stratified on RPL_THEMES

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpls_MHLTH.RData"))
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- var_names
```

```
(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                               50%     2.5%    97.5%
## strat0                    14.15367 14.14102 14.16636
## strat0:flood_risk_pc1     -0.00654 -0.02043  0.00722
## strat0:flood_risk_pc2      0.02702  0.01120  0.04267
## strat0:flood_risk_pc3      0.02546  0.01385  0.03706
## strat0:flood_risk_pc4     -0.01559 -0.02715 -0.00410
## strat0:flood_risk_pc5      0.01256  0.00163  0.02350
## strat0:EP_UNINSUR          0.01510 -0.00381  0.03411
## strat0:co                  0.41021  0.35962  0.46084
## strat0:no2                 0.46637  0.39960  0.53641
## strat0:o3                 -0.18809 -0.30441 -0.08838
## strat0:pm10               -0.04566 -0.09521  0.00282
## strat0:pm25                0.11130  0.03955  0.18006
## strat0:so2                 0.08199  0.03461  0.13069
## strat0:summer_tmmx         0.10204  0.02238  0.19816
## strat0:winter_tmmx        -0.11950 -0.40562  0.11594
## strat0:summer_rmax        -0.00776 -0.10540  0.09567
## strat0:winter_rmax        -0.03034 -0.10429  0.04287
## strat0:Data_Value_CSMOKING  3.32079  3.29937  3.34239
## strat1                    14.34485 14.33398 14.35566
## strat1:flood_risk_pc1     -0.00576 -0.01906  0.00750
## strat1:flood_risk_pc2     -0.01158 -0.02618  0.00291
## strat1:flood_risk_pc3      0.00484 -0.00711  0.01663
## strat1:flood_risk_pc4     -0.00438 -0.01453  0.00567
## strat1:flood_risk_pc5      0.00522 -0.00487  0.01533
## strat1:EP_UNINSUR          0.04852  0.03593  0.06113
## strat1:co                  0.43561  0.37933  0.49160
## strat1:no2                 0.41196  0.34268  0.48262
## strat1:o3                 -0.18844 -0.30508 -0.08675
## strat1:pm10               -0.04765 -0.09893  0.00279
## strat1:pm25                0.18217  0.10949  0.24989
## strat1:so2                 0.08869  0.04188  0.13727
## strat1:summer_tmmx         0.05097 -0.02973  0.14534
## strat1:winter_tmmx        -0.01281 -0.29875  0.22034
## strat1:summer_rmax        -0.10496 -0.20402 -0.00115
## strat1:winter_rmax        -0.00588 -0.07994  0.06843
```

```
## strat1:Data_Value_CSMOKING  3.28976  3.27368  3.30569
```

```
saveRDS(beta_inference, file = here("modeling_files/stratified_analysis/beta_inference_files/MHLTH_rpls
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc2"
##  [3] "strat0:flood_risk_pc3"     "strat0:flood_risk_pc4"
##  [5] "strat0:flood_risk_pc5"     "strat0:co"
##  [7] "strat0:no2"                "strat0:o3"
##  [9] "strat0:pm25"               "strat0:so2"
## [11] "strat0:summer_tmmx"        "strat0:Data_Value_CSMOKING"
## [13] "strat1"                    "strat1:EP_UNINSUR"
## [15] "strat1:co"                 "strat1:no2"
## [17] "strat1:o3"                 "strat1:pm25"
## [19] "strat1:so2"                "strat1:summer_rmax"
## [21] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

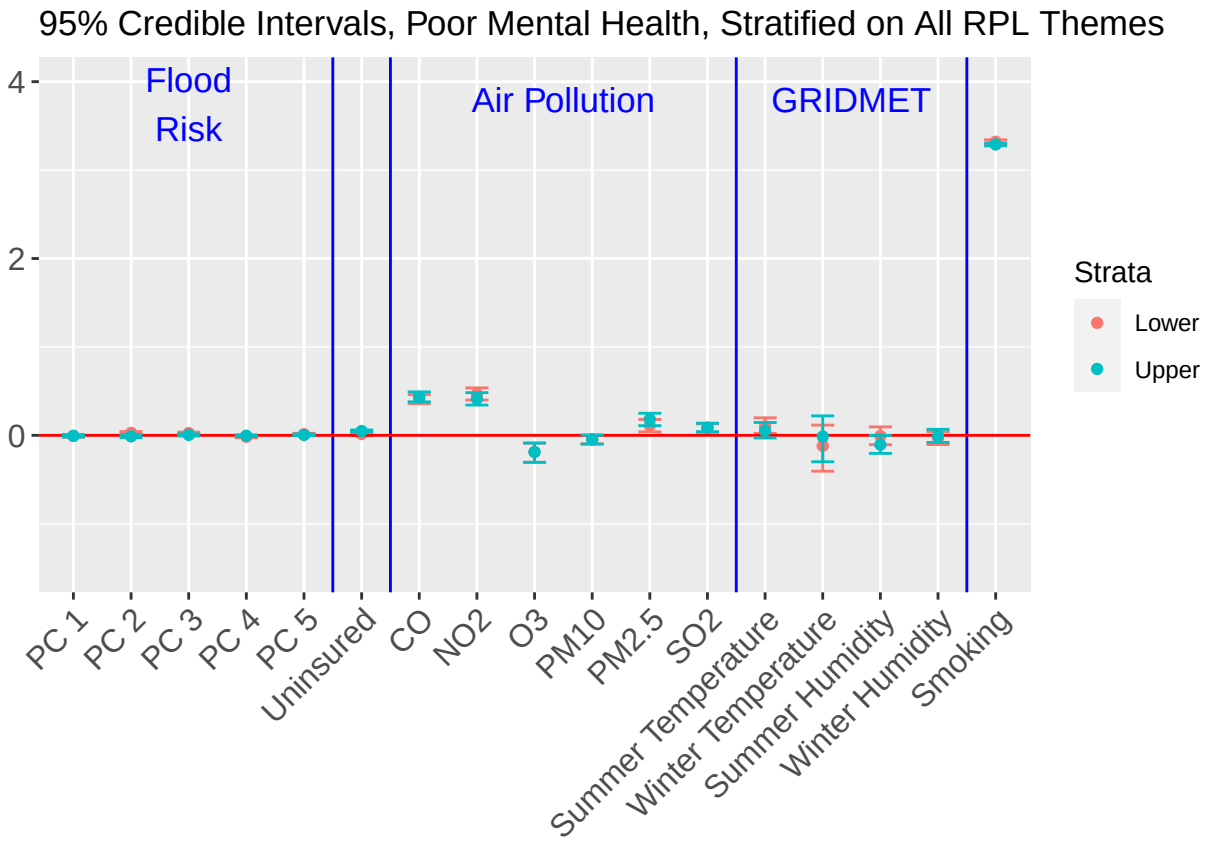
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1.5, 4)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 6.5, 12.5, 16.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 3.75, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 9.5, y = 3.8, label = "Air Pollution",
           col = "blue", size = 4.5) +
```

```
  annotate(geom = "text", x = 14.5, y = 3.8, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Poor Mental Health, Strati
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/MHLTH_CI_rpls.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```