

Health Risks and Worker Density

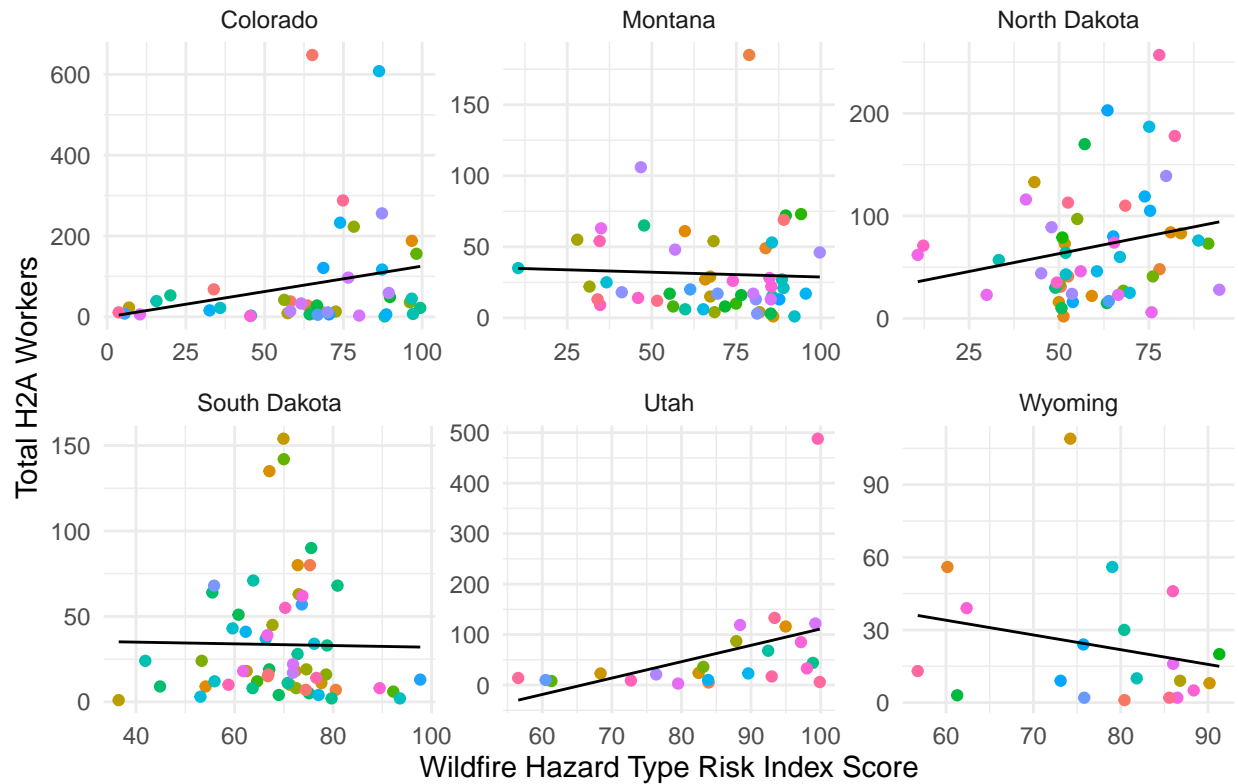
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10 February 2025

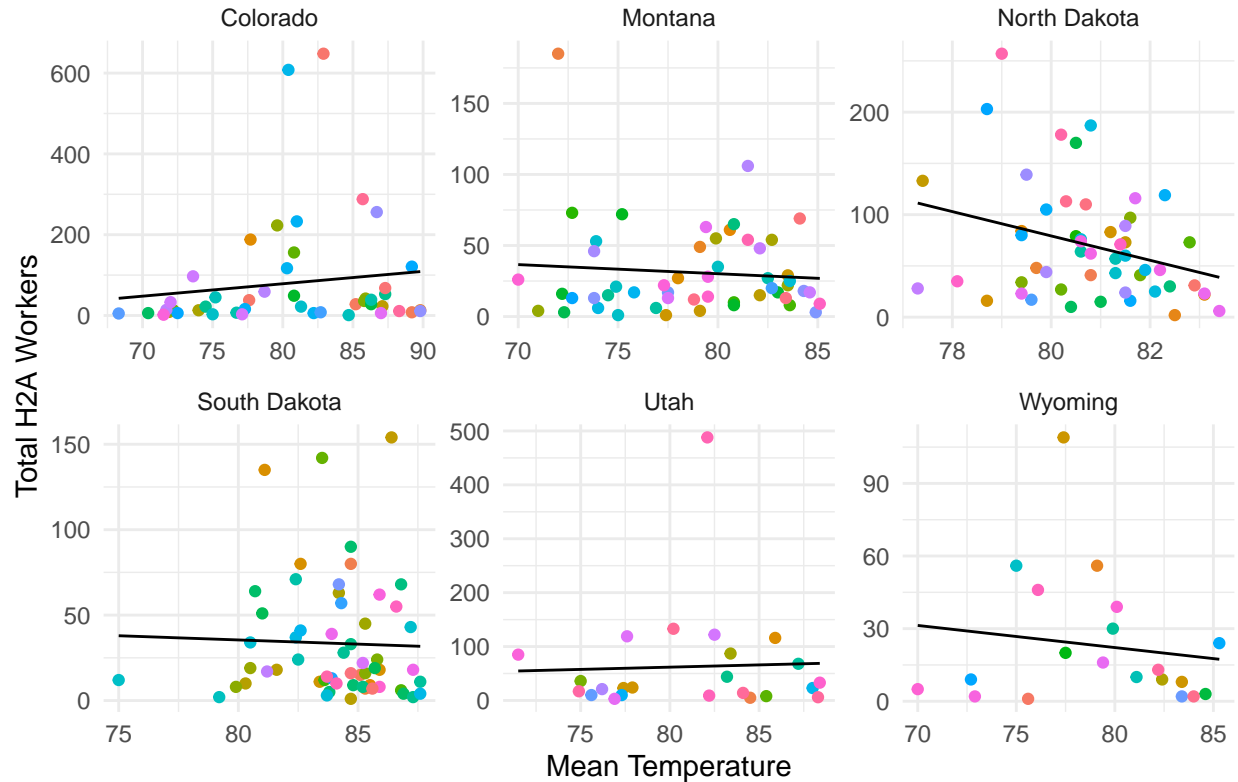
(1) What is the relationship between health risk factors and worker densities in the HICAHS area?

Goal: Calculate unconditional correlations of worker concentrations (total workers) with heat exposure, wildfire exposure, and any other similar correlations of importance. I started by observing the shape of the data by plotting the total number of workers against variables of interest. Below is a visual examination of the relationship between total workers and two variables of interest: 'Wildfire Risk Score' and 'Average Temperature'.

Wildfire Risk Score and Worker Totals



Average Temperature and Worker Totals



For the rest of my work, I also focused on Wildfire Hazard Type Risk Index Score along with the previous variables.

Following my graphical examination, I calculated correlations using three methods in R. The first method directly calculates only the correlation between two variables. The results can be found below. The second method calculates the correlation between a pair of variables and the significance level. The last creates a linear model with the response variable being total workers, from which I extracted the R^2 value.

Linear Model Summaries:

Linear Model of Average Temperature and Worker Totals (All States):

```
##
## Summary Statistics of Coefficients
## =====
##                               Dependent variable:
##                               -----
##                               total_workers
## -----
## wildfire_exposure_total      0.000***
##                               (0.000)
##
## Constant                     41.902***
##                               (5.085)
## -----
## Observations                 252
## R2                           0.080
```

```

## Adjusted R2                0.076
## Residual Std. Error        74.599 (df = 250)
## F Statistic                21.704*** (df = 1; 250)
## =====
## Note:                      *p<0.1; **p<0.05; ***p<0.01

##
## Linear Model of Wild Fire Hazard Index Score and Worker Totals (All States):

##
## Summary Statistics of Coefficients
## =====
##                               Dependent variable:
##                               -----
##                               total_workers
## -----
## wildfire_hazard_type_risk_index_score      0.476*
##                                              (0.246)
##
## Constant                                  18.508
##                                              (17.431)
## -----
## Observations                            252
## R2                                       0.015
## Adjusted R2                             0.011
## Residual Std. Error                    77.192 (df = 250)
## F Statistic                            3.757* (df = 1; 250)
## =====
## Note:                                  *p<0.1; **p<0.05; ***p<0.01

##
## Linear Model of Fire Exposure Total and Worker Totals (All States):

##
## Summary Statistics of Coefficients
## =====
##                               Dependent variable:
##                               -----
##                               total_workers
## -----
## wildfire_exposure_total      0.000***
##                             (0.000)
##
## Constant                    41.902***
##                             (5.085)
## -----
## Observations                252
## R2                          0.080
## Adjusted R2                  0.076
## Residual Std. Error         74.599 (df = 250)
## F Statistic                 21.704*** (df = 1; 250)
## =====
## Note:                      *p<0.1; **p<0.05; ***p<0.01

```

Correlation Coefficients by State:

Table 1: Correlation between Total Workers and Predictors by State

State	Predictor	Model_R_sq	Spearman_Corr	P_Value
Colorado	mean_temperature	0.0188	0.2570	0.0847
Colorado	wildfire_hazard_type_risk_index_score	0.0595	0.2681	0.0717
Colorado	wildfire_exposure_total	0.0217	0.3792	0.0094
Montana	mean_temperature	0.0073	0.0690	0.6267
Montana	wildfire_hazard_type_risk_index_score	0.0020	-0.0808	0.5690
Montana	wildfire_exposure_total	0.0337	0.0698	0.6227
Wyoming	mean_temperature	0.0217	-0.1493	0.5299
Wyoming	wildfire_hazard_type_risk_index_score	0.0569	-0.2947	0.2073
Wyoming	wildfire_exposure_total	0.0419	-0.1650	0.4869
Utah	mean_temperature	0.0017	-0.0083	0.9694
Utah	wildfire_hazard_type_risk_index_score	0.1822	0.5437	0.0060
Utah	wildfire_exposure_total	0.4664	0.5781	0.0031
North Dakota	mean_temperature	0.0924	-0.2742	0.0492
North Dakota	wildfire_hazard_type_risk_index_score	0.0485	0.2194	0.1182
North Dakota	wildfire_exposure_total	0.0328	0.4063	0.0028
South Dakota	mean_temperature	0.0012	-0.1401	0.2943
South Dakota	wildfire_hazard_type_risk_index_score	0.0003	-0.1058	0.4295
South Dakota	wildfire_exposure_total	0.0008	0.0562	0.6754

According to these Table 1, only a few of the relationships are significantly correlated.

Number of Significant Correlations ($p < 0.05$): 5

Table 2: Significant Correlations Found ($p < 0.05$)

	State	Predictor	Model_R_sq	Spearman_Corr	P_Value
3	Colorado	wildfire_exposure_total	0.0217	0.3792	0.0094
11	Utah	wildfire_hazard_type_risk_index_score	0.1822	0.5437	0.0060
12	Utah	wildfire_exposure_total	0.4664	0.5781	0.0031
13	North Dakota	mean_temperature	0.0924	-0.2742	0.0492
15	North Dakota	wildfire_exposure_total	0.0328	0.4063	0.0028

To analyze all possible correlations within the data, I calculated the correlation coefficient for total workers against all other variables, and created a correlogram. According to the graph, worker totals is very correlated with the mean temperature of the county.

##

##

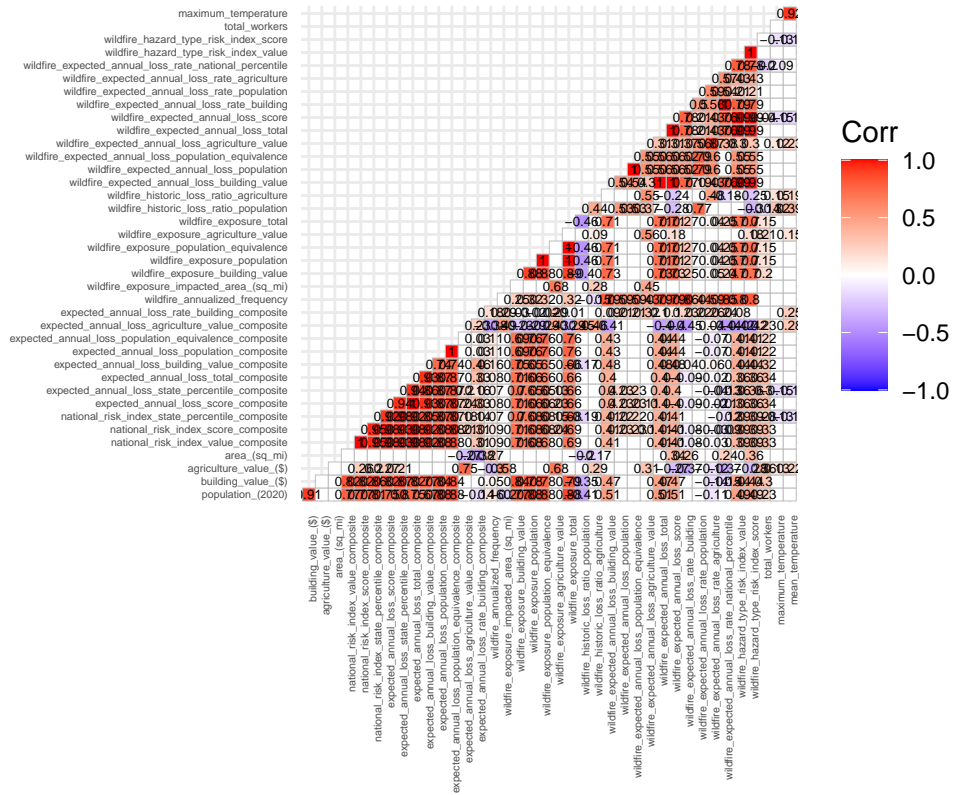
Correlation of all Variables with Total Workers

A tibble: 39 x 2

Predictor	Correlation
<chr>	<dbl>
1 agriculture_value_(\$)	0.359
2 expected_annual_loss_score_composite	0.343
3 expected_annual_loss_total_composite	0.343
4 national_risk_index_value_composite	0.325
5 national_risk_index_score_composite	0.325

## 6	expected_annual_loss_building_value_composite	0.324
## 7	wildfire_exposure_impacted_area_(sq_mi)	0.302
## 8	building_value_(\$)	0.299
## 9	expected_annual_loss_state_percentile_composite	0.298
## 10	national_risk_index_state_percentile_composite	0.281
## 11	population_(2020)	0.234
## 12	expected_annual_loss_agriculture_value_composite	0.233
## 13	expected_annual_loss_population_composite	0.223
## 14	expected_annual_loss_population_equivalence_composite	0.223
## 15	wildfire_exposure_agriculture_value	0.213
## 16	wildfire_exposure_building_value	0.201
## 17	wildfire_exposure_total	0.149
## 18	wildfire_exposure_population	0.146
## 19	wildfire_exposure_population_equivalence	0.146
## 20	expected_annual_loss_rate_building_composite	0.133
## 21	wildfire_historic_loss_ratio_agriculture	0.0661
## 22	wildfire_expected_annual_loss_agriculture_value	0.0598
## 23	wildfire_expected_annual_loss_building_value	0.0434
## 24	wildfire_expected_annual_loss_total	0.0424
## 25	wildfire_expected_annual_loss_score	0.0424
## 26	wildfire_hazard_type_risk_index_value	0.0208
## 27	wildfire_hazard_type_risk_index_score	0.0208
## 28	area_(sq_mi)	0.0139
## 29	mean_temperature	-0.00785
## 30	maximum_temperature	-0.0584
## 31	wildfire_expected_annual_loss_population	-0.0711
## 32	wildfire_expected_annual_loss_population_equivalence	-0.0712
## 33	wildfire_annualized_frequency	-0.0934
## 34	wildfire_expected_annual_loss_rate_agriculture	-0.112
## 35	wildfire_historic_loss_ratio_population	-0.143
## 36	wildfire_expected_annual_loss_rate_building	-0.197
## 37	wildfire_expected_annual_loss_rate_national_percentile	-0.203
## 38	wildfire_expected_annual_loss_rate_population	-0.241
## 39	wildfire_historic_loss_ratio_buildings	NA

Correlation Plot



See 'correlogram.png' for a clearer image.