Data Analysis Project

Particulate Matter Across the 2010's: A Global Perspective

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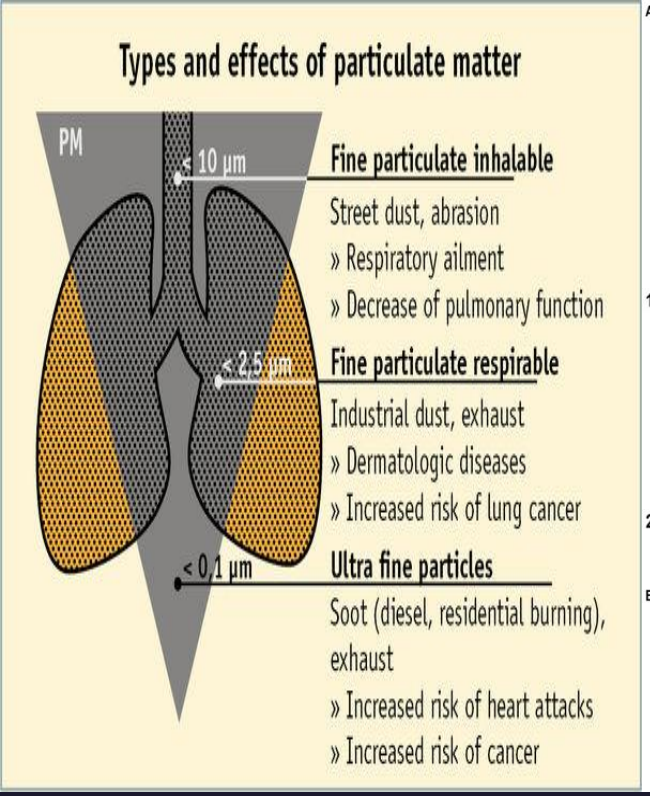
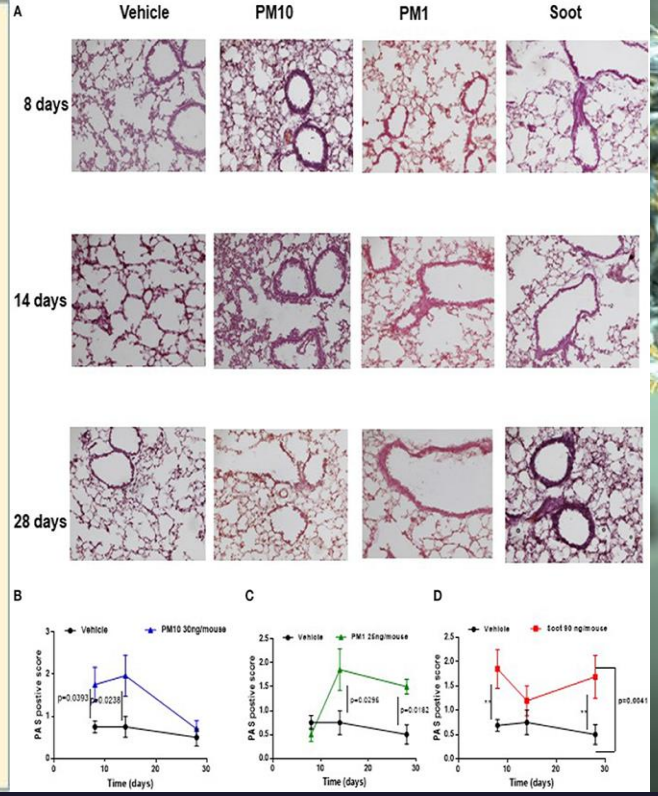
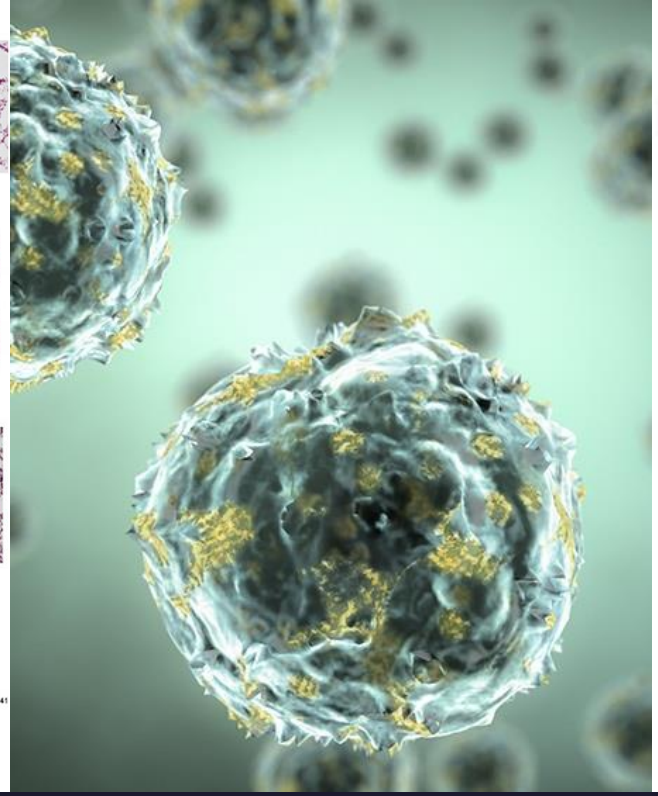
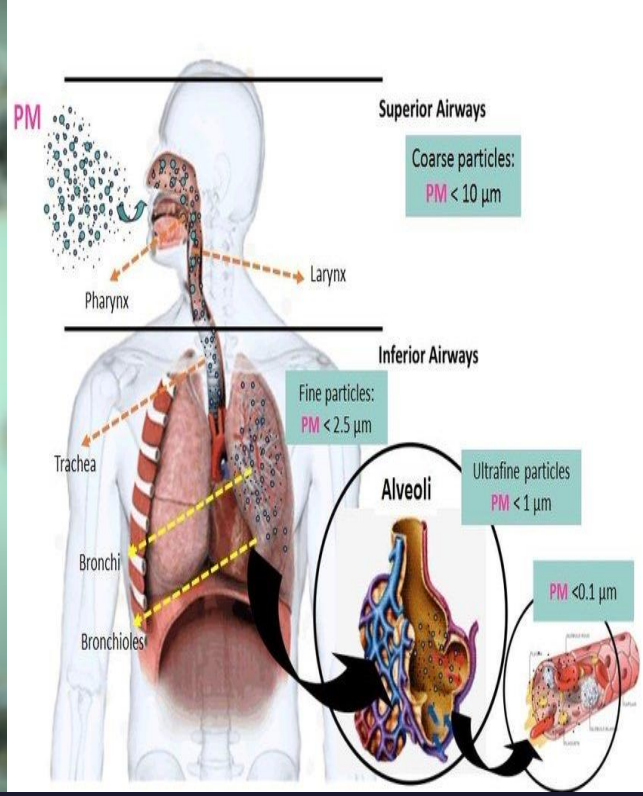


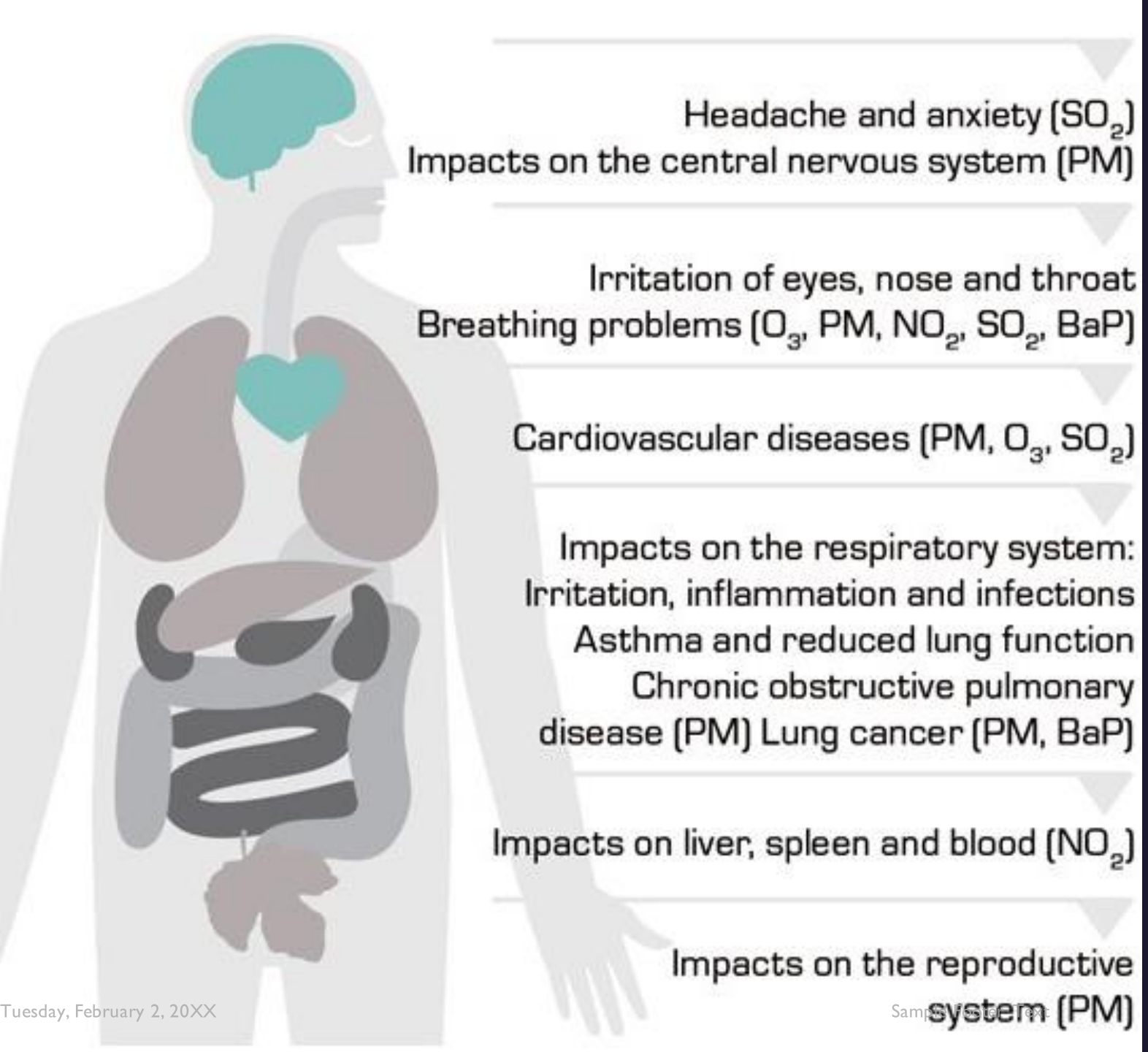






Introduction:

Particulate matter has a strong, positive correlation with worsened respiratory health including but not limited to lung failure, infections, decreased lung function, and premature mortality. PM2.5, PM10, and NO2 are types of particulate matter of particular interest by health officials as they have greater association with the onset of respiratory symptoms.

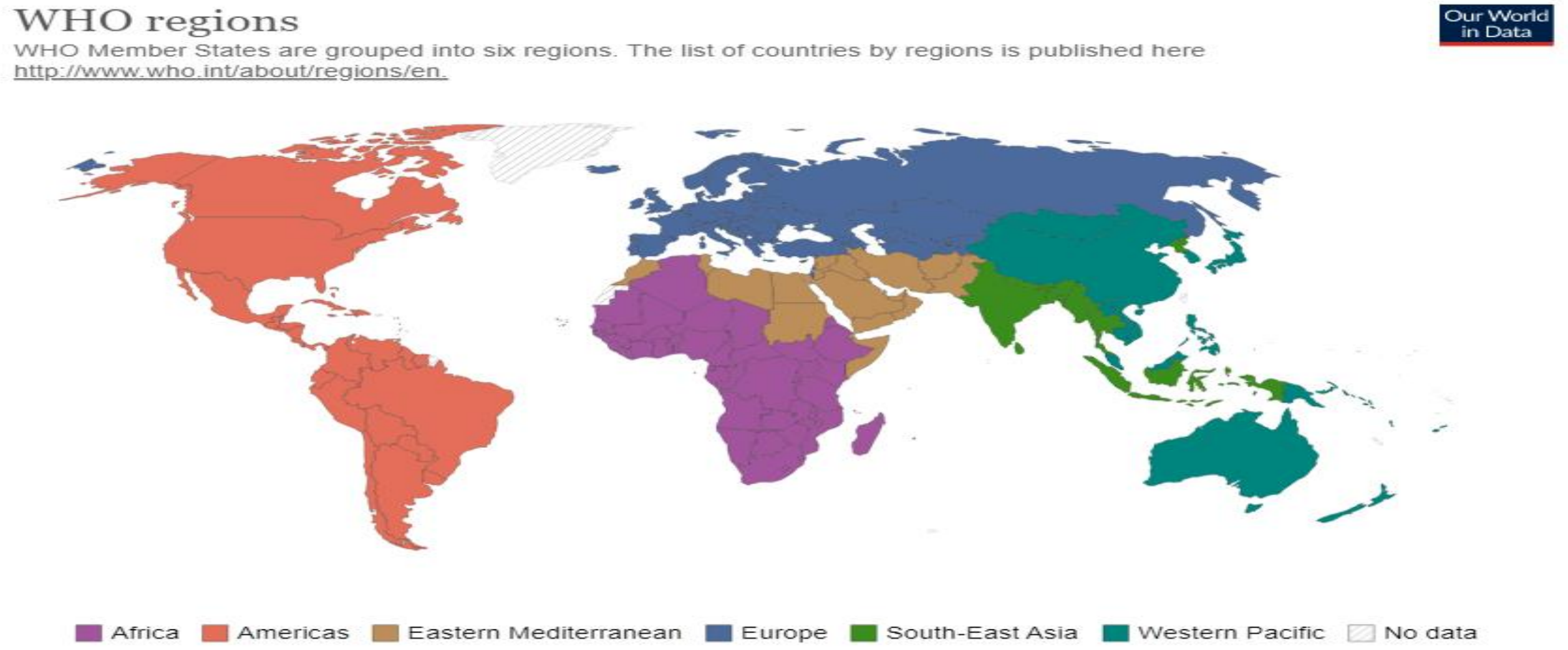


Primary Culprits

- PM2.5 is derived from various emission sources including the burning of gasoline, oil, wood, etc.
- PM10 is emitted from dust on construction sites, landfills, agriculture, wildfires, etc.
- Nitrogen dioxide is emitted from combustion sources, however it is often a byproduct of nitric oxide combining with other air pollutants.

Background of Study

Between 2010 and 2020, there has been a high increase in environmental policy enactment worldwide to decrease levels of air pollution by a significant amount by 2030. The purpose of this study is to determine if the rise of policy and public interest in air pollution has altered levels of particulate matter from 2010 to 2020. Furthermore, it seeks to determine if levels of particulate matter is or has been higher in specific WHO regions than others.



Hypotheses:

Null Hypothesis:

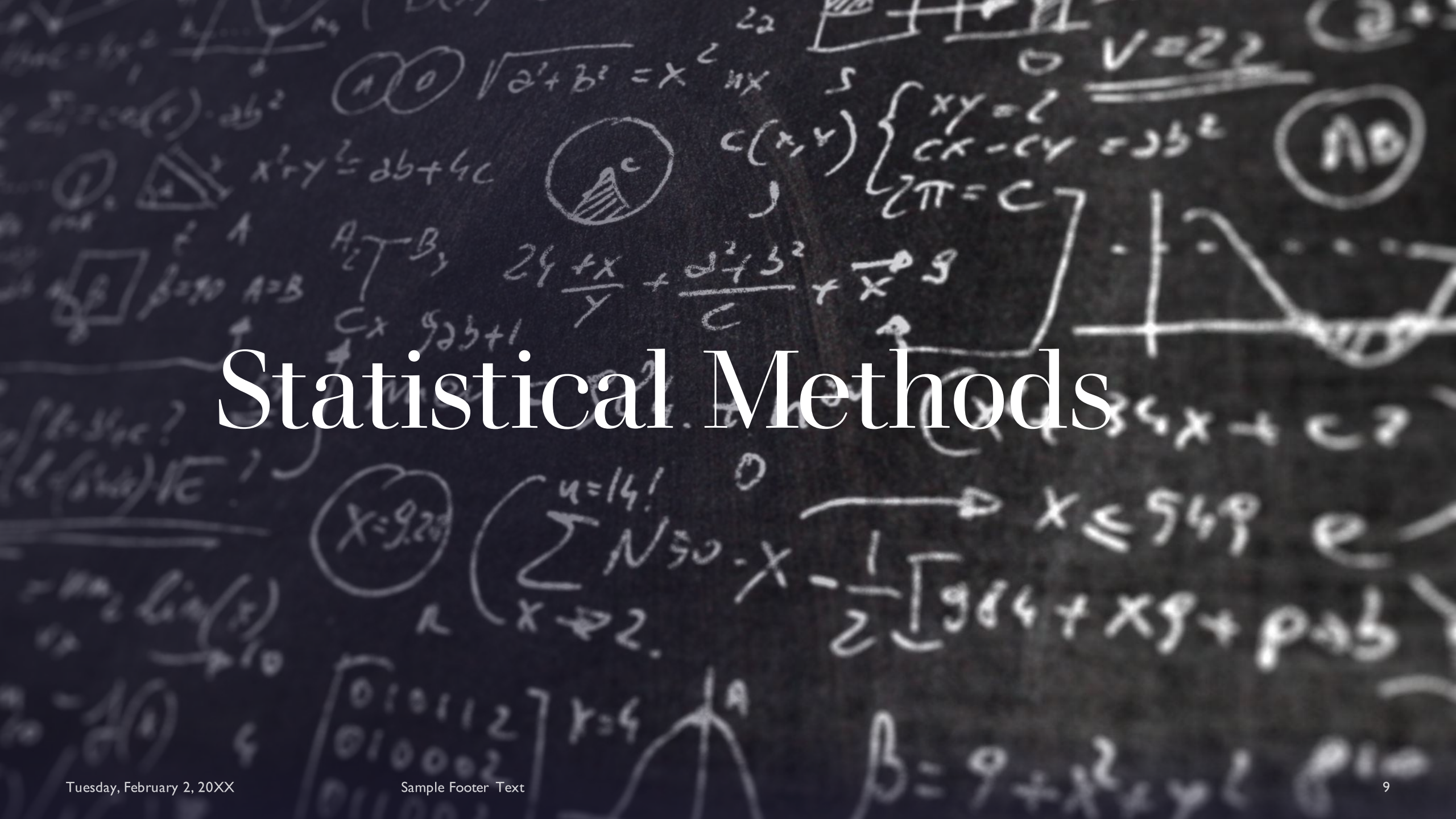
There has been no significant change in particulate matter levels over the last decade. Furthermore, there is no region that is experiencing unequal levels of particulate matter than any other.*

Alternative Hypothesis:

Levels of particulate matter have significantly changed over the last decade. Some regions experience significantly more or less levels of particulate matter than others.*

Area of Study:

- For both hypotheses, region refers to the following 6 WHO regions:
- Africa
- Americas
- Eastern Mediterranean
- Europe
- South-East Asia
- Western Pacific

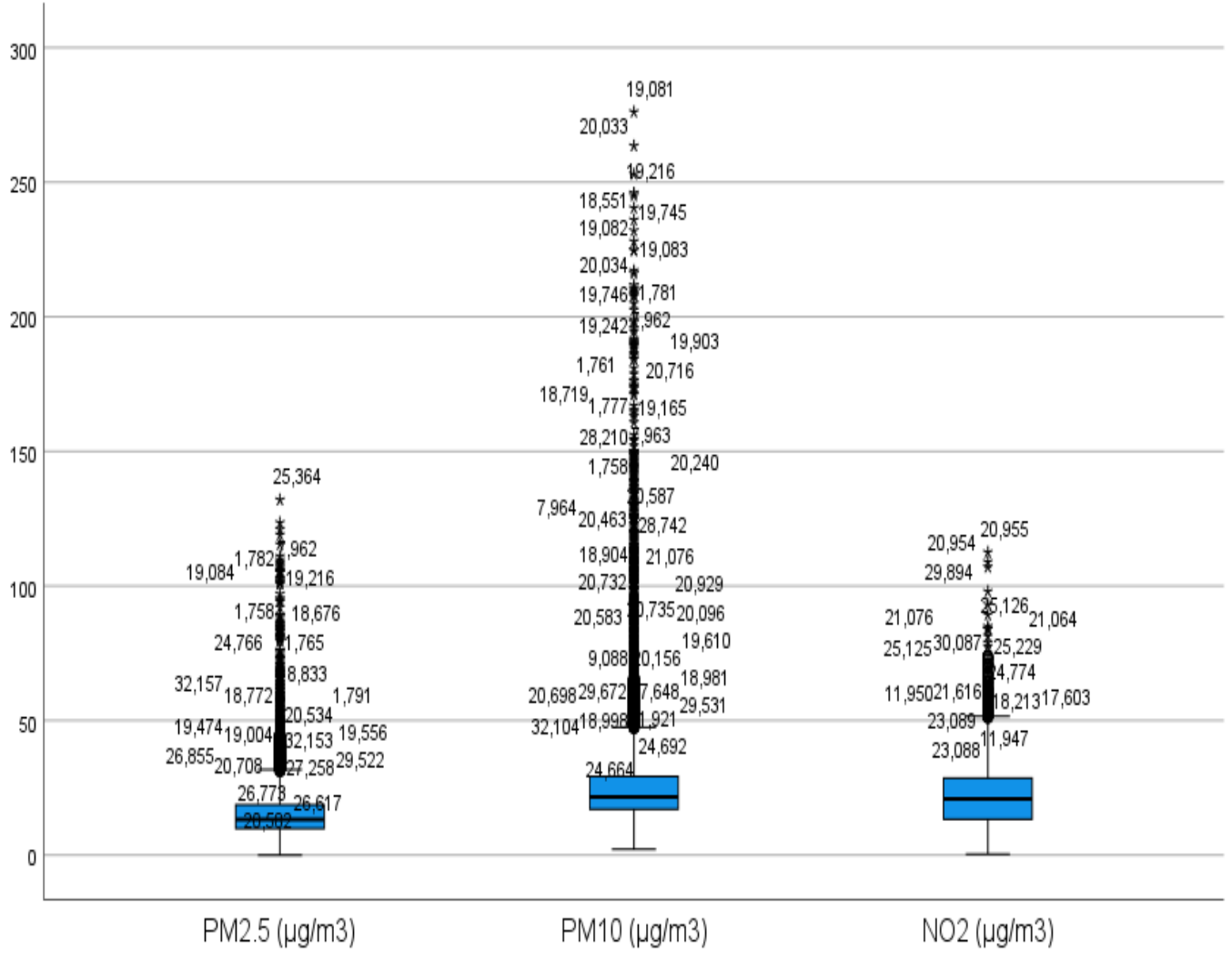


Statistical Methods

Five Number Summary & Box Plot

Statistics

		PM2.5 (µg/m3)	PM10 (µg/m3)	NO2 (µg/m3)
N	Valid	15048	21109	22200
	Missing	17143	11082	9991
Median		16.0000	22.0000	18.8000
Minimum		.01	1.04	.00
Maximum		191.90	540.00	210.68
Percentiles	25	10.3500	16.9750	12.0000
	50	16.0000	22.0000	18.8000
	75	31.0000	31.3000	27.1600



Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
PM2.5 (µg/m3)	Equal variances assumed	7.310	.007	.294	847	.385	.769	.33087	1.12674	-1.88067	2.54240
	Equal variances not assumed			.281	154.109	.389	.779	.33087	1.17602	-1.99233	2.65406
PM10 (µg/m3)	Equal variances assumed	21.088	<.001	.559	2284	.288	.576	1.21623	2.17507	-3.04909	5.48155
	Equal variances not assumed			.472	143.324	.319	.638	1.21623	2.57652	-3.87665	6.30911
NO2 (µg/m3)	Equal variances assumed	1.976	.160	1.657	2445	.049	.098	1.74857	1.05554	-.32127	3.81841
	Equal variances not assumed			1.587	146.111	.057	.115	1.74857	1.10206	-.42946	3.92661

Independent Samples t-test

To test the first part of our hypothesis, we performed an independent t-test to compare the sample means of different types of particulate matter in 2010 and 2020 to test significance of average PM levels over two points of time between the samples.

ANOVA One-Sided Test

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PM2.5 (µg/m3)	Between Groups	2502332.165	5	500466.433	3226.972	.000
	Within Groups	2332842.261	15042	155.089		
	Total	4835174.426	15047			
PM10 (µg/m3)	Between Groups	9199802.362	5	1839960.472	4344.590	.000
	Within Groups	8936826.063	21102	423.506		
	Total	18136628.425	21107			
NO2 (µg/m3)	Between Groups	230378.522	5	46075.704	336.619	.000
	Within Groups	3037729.526	22193	136.878		
	Total	3268108.048	22198			

For the second part of our hypothesis, we performed an ANOVA one-sided test to analyze the mean levels of PM in the six WHO regions.

Tukey's HSD Post-Hoc Test

Tukey's HSD post-hoc test was chosen because we wanted to further test and determine if any regions did or did not have a statistically significant difference in particulate matter levels.

Findings:

- *0: African Region*
- *1: Eastern Mediterranean Region*
- *2: European Region*
- *3: Region of the Americas*
- *4: South East Asia Region*
- *5: Western Pacific Region*

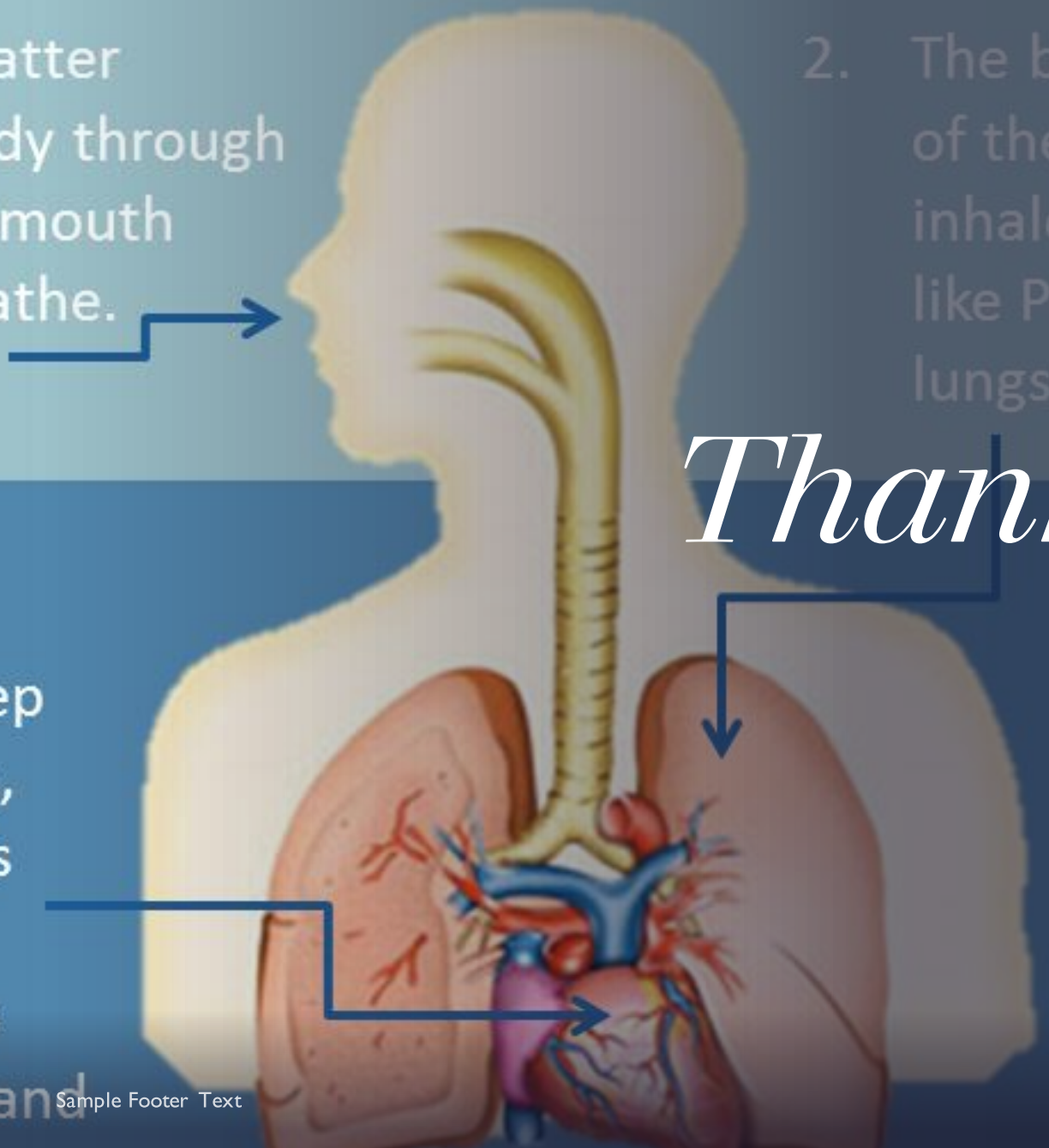
Results:

- **Reject null hypothesis for all groups except the following where we fail to reject null:**
- **PM2.5**
  - **Region 1,5 p-value=0.089 → Eastern Mediterranean/Western Pacific**
- **PM10**
  - **Region 3,5 p-value=0.170 → Americas/Western Pacific**
- **NO2**
  - **Region 0,2 p-value=0.091 → Africa/Europe**
  - **Region 0,4 p-value=0.924 → Africa/South East Asia Region**

1. Particulate matter enters the body through the nose and mouth when we breathe.

2. The body eliminates most of the larger particles we inhale. Smaller particles like PM2.5 continue to the lungs.

3. PM2.5 can penetrate deep into the lungs, having serious health consequences for the lungs and



Thank You