

AIR QUALITY CONTROL IN THE URBAN CITY OF SIDDHARTHANGAR

A QUANTITATIVE STUDY

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INTRODUCTION & MOTIVATION

- ▶ Urbanization throughout all parts of the world has brought an ever-increasing need for motor vehicles and efficient energy sources.
- ▶ Traffic-related air pollution decreases as a function of the distance one lives from roads.
- ▶ Previous studies have shown that traffic noise is associated with adverse health issues such as metabolic disorders and cardiovascular disease.
- ▶ Traffic noise has also been shown to have a negative impact on sleep patterns, which in turn has been associated with health complications such as larger waistlines and increased food intake.

INTRODUCTION & MOTIVATION (CONT.)

- ▶ Low-income and minority individuals, in general, live closer to major roadways.
- ▶ In some civilizations, the number of respiratory disease-related deaths has more than *doubled over the past twenty years*.
- ▶ Nearly 89% of humans on Earth reside in areas where the amount of fine, particulate matter less than $2.5 \mu\text{m}$ exceeds air quality standards set by the World Health Organization.
- ▶ Ambient air pollution is responsible for approximately *3.3 million premature deaths per year*.

RESEARCH QUESTION

- ▶ Is there a relationship between air quality and physical health in the urban region of Siddharthanagar?

METHODOLOGY

- ▶ *Danda River Management Practices, Environmental Pollution, Household Water Quality and Health Risks: A Knowledge, Attitude, Behavior and Choice Experiment Survey.*
 - ▶ Taken March 30th, 2016.
 - ▶ Data from Siddharthanagar.
- ▶ *Two-sample t-tests.*
- ▶ OLS regression.

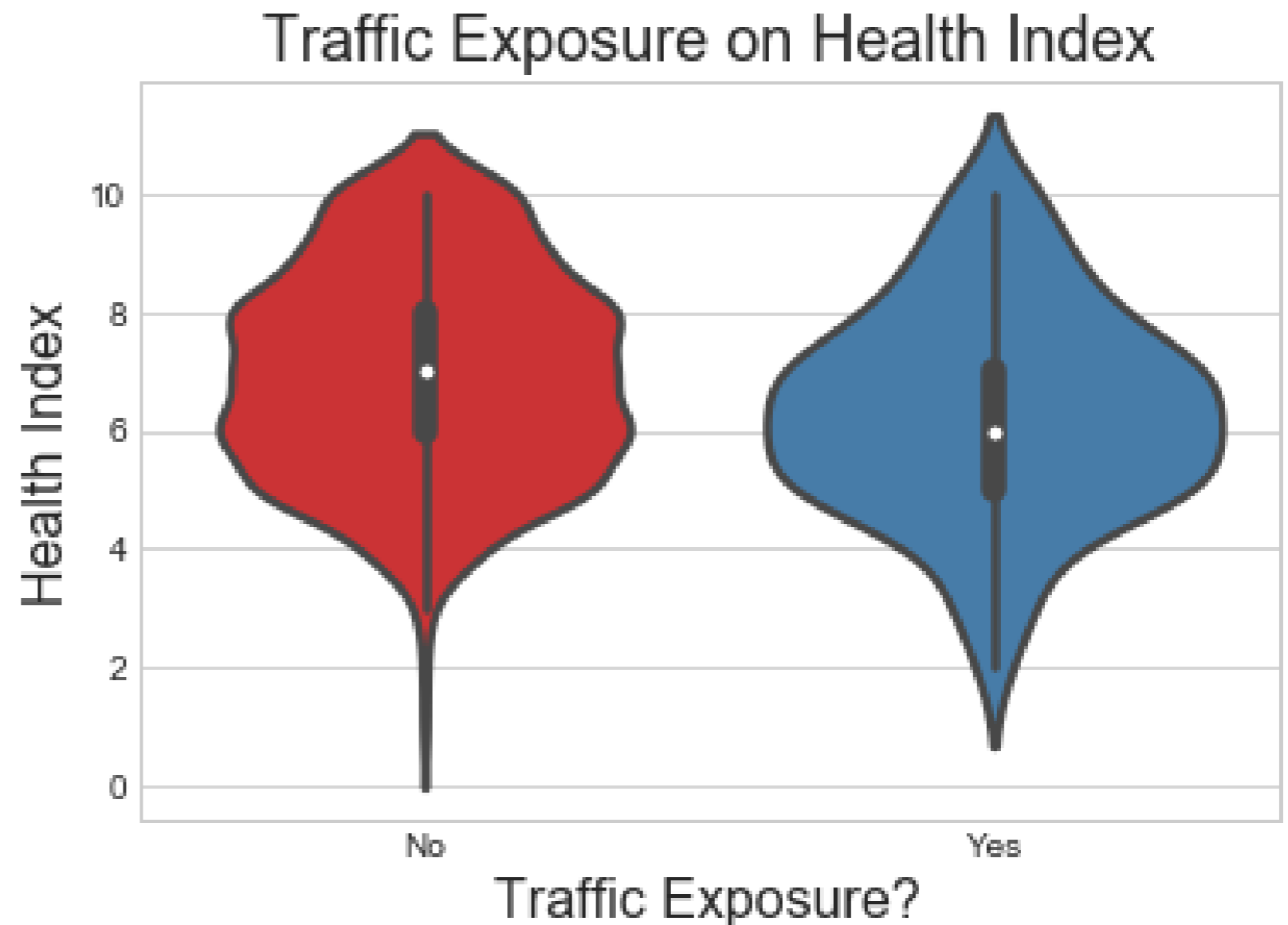
VARIABLES

Table 1: Variables

Variable Name	Description	Range	Mean	Median	Proportions
HealthRating	How well do you perceive your health?	1-10	6.76	7	N/A
NoisePollutionEffect	How much does noise pollution affect you?	1-5	2.42	2	N/A
TrafficEffect	How much does traffic negatively affect you?	1-5	2.35	2	N/A
AirPollutionEffect	How much does air pollution negatively affect you?	1-5	2.57	3	N/A
WaterIndex	Index of water contamination.	1-5	2.44	3	N/A
AssetIndex	Index of material wealth.	1-10	5.78	6	N/A
Age	Age of respondent (in years).	1-99	42.63	40.5	N/A
Gender	Gender of respondent.	"Male" or "Female"	N/A	N/A	Male = 27.27%, Female = 72.73%
Caste	Caste/Ethnicity of the head of household.	1 = Brahman/Chhetri, 0 = other	N/A	N/A	Brahman/Chhetri = 25%, other = 75%

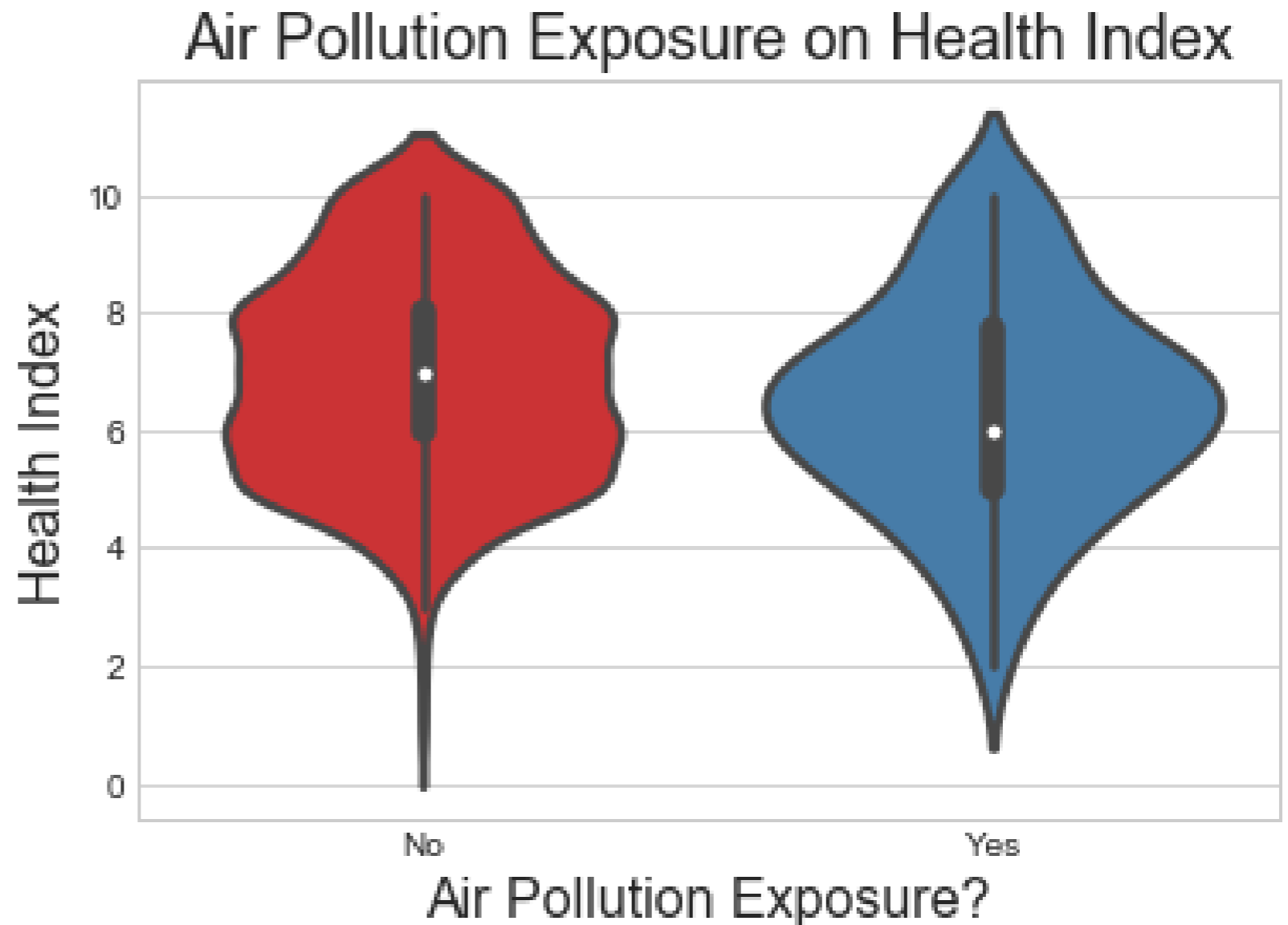
EMPIRICAL RESULTS: PART 1

- ▶ No = TrafficEffect less than or equal to 3.
- ▶ Yes = TrafficEffect greater than 3.
- ▶ Those exposed to high levels of traffic show lower mean health ratings. ($p = 0.01473$)



EMPIRICAL RESULTS: PART 1

- ▶ No = AirPollutionEffect less than or equal to 3.
- ▶ Yes = AirPollutionEffect greater than 3.
- ▶ Those exposed to high levels of air pollution exhibit lower mean health ratings ($p = 0.0642$).



EMPIRICAL MODEL

$$\begin{aligned} \text{HealthRating}_t = & \beta_0 + \beta_1 \text{AirExposure}_t + \\ & \beta_2 \text{WaterIndex}_t + \\ & \beta_3 \text{asset_index}_t + \beta_4 \text{Age}_t + \\ & \beta_5 \text{Caste}_t + \beta_6 \text{Gender}_t + u_t \end{aligned}$$

Where *AirExposure* is *AirPollutionEffect_t*, or *NoisePollutionEffect_t* or *TrafficEffect_t*

or a composite index.

EMPIRICAL RESULTS: PART 2 (AIR POLLUTION)

Table 3: Empirical Results (Air Pollution)

	<i>Dependent variable:</i>		
	HealthRating		
	(1)	(2)	(3)
AirPollutionEffect	-0.151 (0.100)	-0.194* (0.100)	-0.220** (0.100)
WaterIndex	0.0001 (0.001)	-0.0001 (0.001)	-0.0002 (0.001)
AssetIndex		0.372*** (0.122)	0.370*** (0.122)
Age		-0.006 (0.008)	-0.007 (0.008)
Gender			-0.410 (0.259)
Caste			0.131** (0.056)
Constant	7.154*** (0.282)	7.459*** (0.451)	7.671*** (0.592)
Observations	264	264	264
Log Likelihood	-535.351	-530.707	-527.300
Akaike Inf. Crit.	1,076.702	1,071.414	1,068.600

Note:

*p<0.1; **p<0.05; ***p<0.01

EMPIRICAL RESULTS: PART 2 (TRAFFIC)

Table 4: Empirical Results (Traffic)

	<i>Dependent variable:</i>		
	HealthRating		
	(1)	(2)	(3)
TrafficEffect	-0.277*** (0.095)	-0.326*** (0.094)	-0.342*** (0.094)
WaterIndex	0.00001 (0.001)	-0.0003 (0.001)	-0.0003 (0.001)
AssetIndex		0.404*** (0.121)	0.403*** (0.120)
Age		-0.006 (0.008)	-0.006 (0.008)
Gender			-0.432* (0.254)
Caste			0.129** (0.055)
Constant	7.417*** (0.249)	7.705*** (0.412)	7.920*** (0.553)
Observations	264	264	264
Log Likelihood	-532.232	-526.649	-523.083
Akaike Inf. Crit.	1,070.464	1,063.298	1,060.167

Note:

*p<0.1; **p<0.05; ***p<0.01

EMPIRICAL RESULTS: PART 2 (NOISE)

Table 2: Empirical Results (Noise Pollution)

	<i>Dependent variable:</i>		
	HealthRating		
	(1)	(2)	(3)
NoisePollutionEffect	-0.183* (0.099)	-0.230** (0.099)	-0.248** (0.099)
WaterIndex	-0.0002 (0.001)	-0.001 (0.001)	-0.001 (0.001)
AssetIndex		0.368*** (0.120)	0.384*** (0.122)
Age			-0.006 (0.008)
Gender			-0.411 (0.258)
Caste			0.126** (0.055)
Constant	7.208*** (0.265)	7.253*** (0.262)	7.687*** (0.572)
Observations	264	264	264
Log Likelihood	-534.777	-530.063	-526.548
Akaike Inf. Crit.	1,075.554	1,068.125	1,067.095

Note:

*p<0.1; **p<0.05; ***p<0.01

EMPIRICAL RESULTS: PART 2 (COMPOSITE)

Table 5: Empirical Results (Composite)

	<i>Dependent variable:</i>		
	HealthRating		
	(1)	(2)	(3)
AirIndex	0.177** (0.069)	0.220*** (0.069)	0.238*** (0.069)
WaterIndex	-0.0002 (0.001)	-0.001 (0.001)	-0.001 (0.001)
AssetIndex		0.411*** (0.122)	0.413*** (0.121)
Age		-0.007 (0.008)	-0.007 (0.008)
Gender			-0.462* (0.256)
Caste			0.131** (0.055)
Constant	6.765*** (0.112)	6.971*** (0.341)	7.186*** (0.491)
Observations	264	264	264
Log Likelihood	-533.159	-527.460	-523.714
Akaike Inf. Crit.	1,072.318	1,064.919	1,061.427

Note:

*p<0.1; **p<0.05; ***p<0.01

EMPIRICAL RESULTS: PART 2 (DISCUSSION)

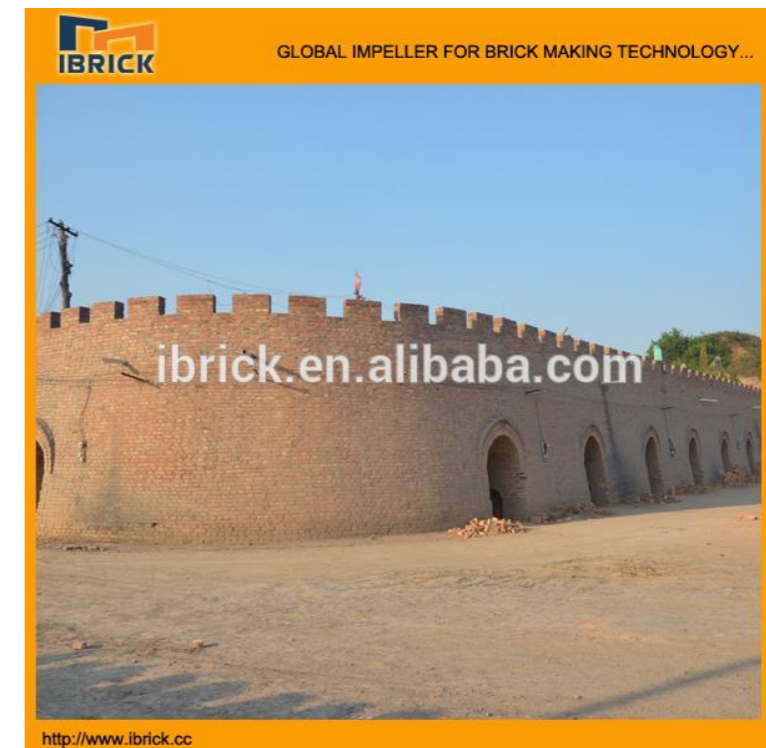
- ▶ Air pollution, noise and traffic are significant variables in relation to health.
- ▶ Air exposure, as a whole, is a statistically significant indicator of health in Siddharthanagar.
- ▶ Wealth (*asset_index*) and how many material possessions an individual owns is also significantly related to health.

CURRENT SOLUTIONS

- ▶ Peru has received a US \$40 million loan to expand air quality monitoring networks to serve new areas of the country and improve dissemination of information and analysis.
 - ▶ Trujillo, Chiclayo, Iquitos, Huancayo, Cusco, Piura
- ▶ All subsidies towards fossil fuel-ran industry have been phasing out since 2012 in Morocco.
 - ▶ Renewable energy sources are now more competitive than ever before.

MOVING FORWARD

- ▶ Modernized brick kilns have contributed to halved levels of air pollutants in Bangladesh.
- ▶ Hybrid Hoffman Kiln
- ▶ Costs 15 times as much to build compared to traditional kilns but reduces pollution by 50%.



NEXT STEPS & FUTURE RESEARCH

- ▶ Kaiterra's Laser Egg device delivers real-time air quality readings.
- ▶ The Nepal Study Center at UNM is currently stationing a Laser Egg in Siddharthangar.
- ▶ Real-time air quality readings will be periodically uploaded onto a dataset hosted by a website.
 - ▶ Available to the public and researchers.



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