

AIR POLLUTION AND BRAIN DAMAGE

A REVIEW OF THE PSYCHOLOGICAL AND NEUROLOGICAL
IMPLICATIONS OF PM_{2.5} IN THE CONTEXT OF
KATHMANDU



-PRAGATI PARAJULI

01. AIR POLLUTANTS

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06. IMPLICATION AND FUTURE RESEARCH

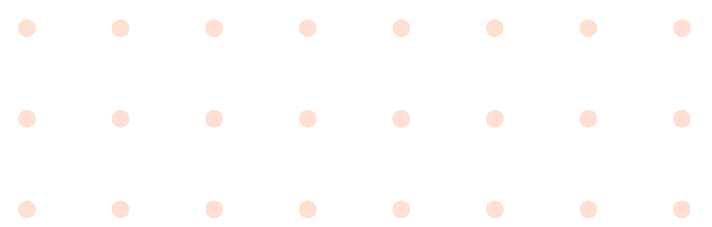


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WHAT IS AIR POLLUTION?

TYPES OF POLLUTANT

PARTICLE POLLUTION

- MIXTURE OF LIQUID DROPLETS AND SOLID PARTICLES IN THE AIR
- (SULFURIC ACID, AMMONIUM NITRATE, SOOT, DUST, AND METALS)
- CAN GET DEEP INTO LUNGS AND SOME MAY EVEN GET INTO THE BLOODSTREAM.

TRAP (TRAFFIC RELATED AIR POLLUTION)

- MIXTURE OF VEHICLE EXHAUSTS & EMISSION, SECONDARY POLLUTANTS IN THE ATMOSPHERE, AND NON-COMBUSTION EMISSIONS (E.G., ROAD DUST, TIRE WEAR)
- ASSOCIATED WITH A WIDE RANGE OF ADVERSE HUMAN HEALTH EFFECTS.





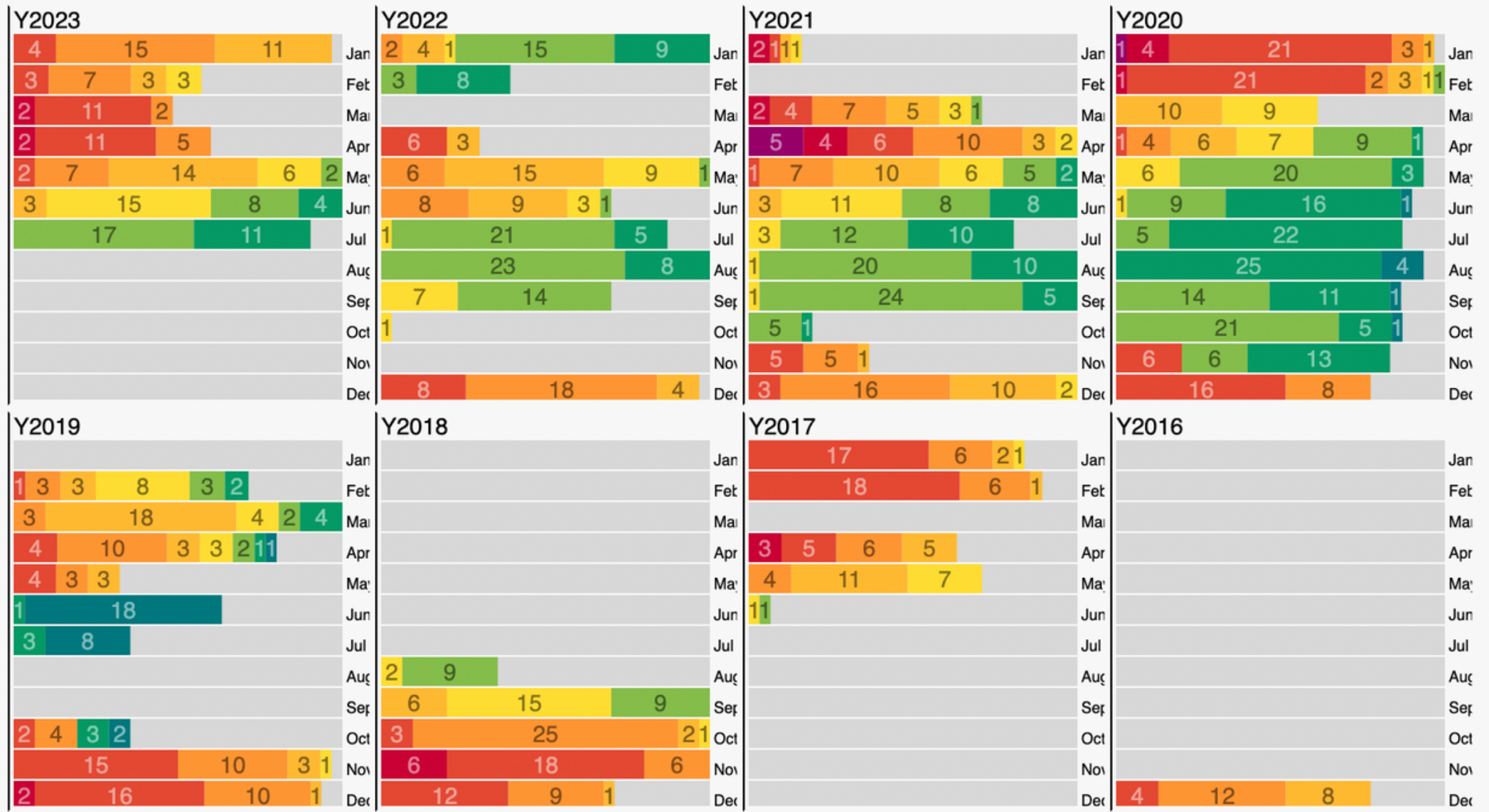
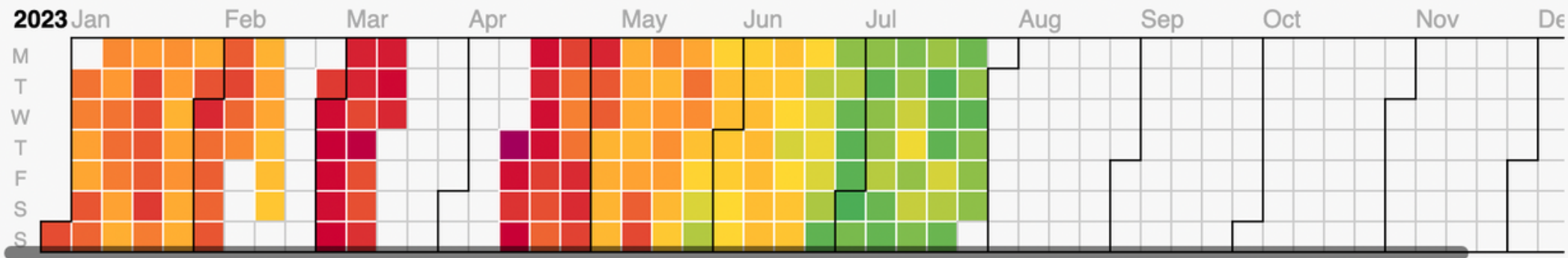
IN CONTEXT OF NEPAL...

PREVIOUS RESEARCH BY GIRI ET AL., 2023

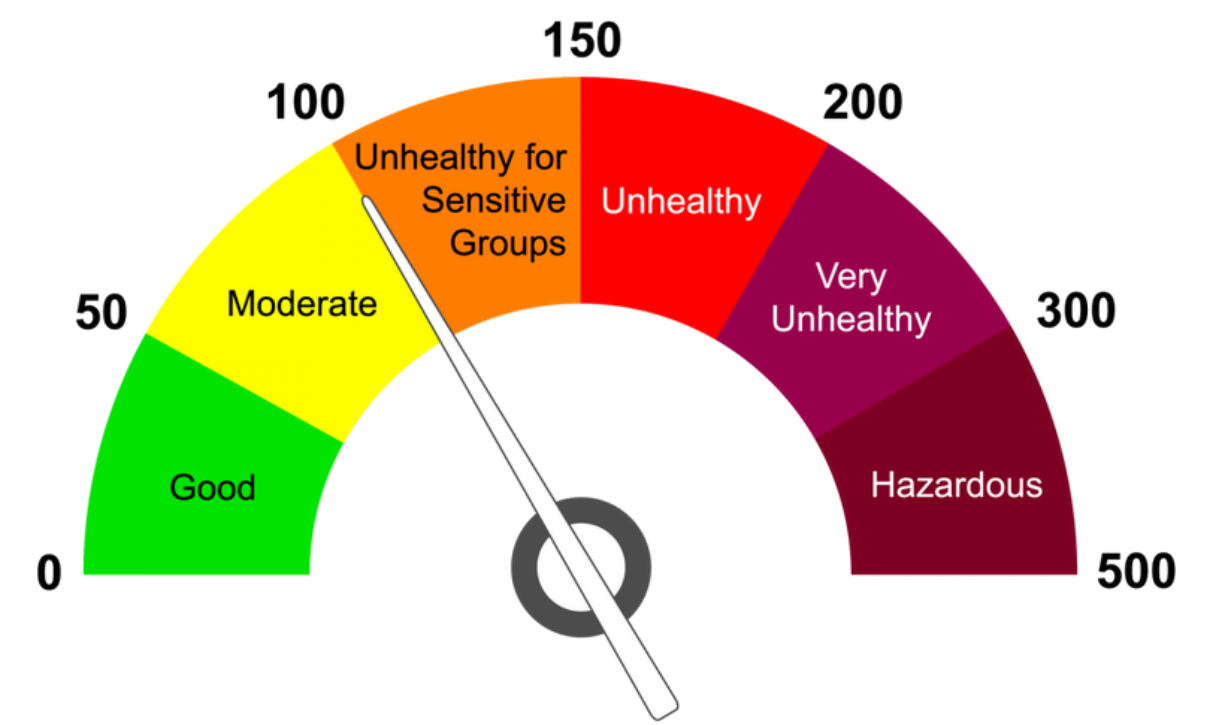
SEVERE CLASSES OF HEALTH PROBLEMS THAT CAN BE LINKED TO AIR POLLUTANTS.

- 1. ORGAN DYSFUNCTION OR DAMAGE: OBSTRUCTION OR DAMAGE IN THE RESPIRATORY TRACT AND CARDIOVASCULAR SYSTEM: DIVERSE HEALTH PROBLEMS INCLUDING COPD, PNEUMONIA, BRONCHITIS, TUBERCULOSIS ETC.,**
- 2. ORGAN DISORDER: REPRODUCTIVE AND GASTROINTESTINAL MALFUNCTIONING;**
- 3. ALLERGY EFFECTS: DISORDER ON OPHTHALMIC, NASAL AND SURFACE SENSES.**

PM_{2.5} PM₁₀



- NEPAL'S URBAN AIR QUALITY HAS BEEN CLASSIFIED AS ONE OF THE WORST IN THE GLOBE
- KATHMANDU VALLEY WAS IDENTIFIED AS A MOST POLLUTED METROPOLITAN CITY IN THE WORLD, WITH THE "AIR QUALITY INDEX" (AQI) OF 154 AND A PM2.5 VALUE OF 488 µG/M3 ON APRIL 5, 2021



RATES OF MENTAL ILLNESS IN NEPAL

- THE PREVALENCE OF MENTAL DISORDERS IS AROUND 12.9%.
- WOMEN AND OLDER POPULATION A HIGHER PREVALENCE OF MDD (4.3%)
- SUICIDE (16%) WAS THE LEADING CAUSE OF DEATH AMONG WOMEN OF REPRODUCTIVE AGE
- 21% OF SUICIDE OCCURRING BELOW THE AGE OF 18 YEARS.
- MEN IN NEPAL HAVE A HIGHER SUICIDE RATE THAN WOMEN (20.7/100,000 POPULATION).
- THERE IS INDICATION OF A 14% INCREASE IN THE RATES OF SUICIDE LAST YEAR

FINDINGS RELATED TO PM2.5 & TRAP EXPOSURE

PM2.5, BLACK CARBON OR NO2 ASSOCIATED WITH

- HIGHER ODDS OF SUBOPTIMAL VITALITY, HIGHER ODDS OF PSYCHOLOGICAL DISTRESS
- POOR SELF-RATED HEALTH,
- DEPRESSIVE & GENERALIZED ANXIETY DISORDER
- REDUCED WM AND GM IN THE BRAIN

TRAFFIC-RELATED AIR POLLUTION (TRAP) ASSOCIATED WITH

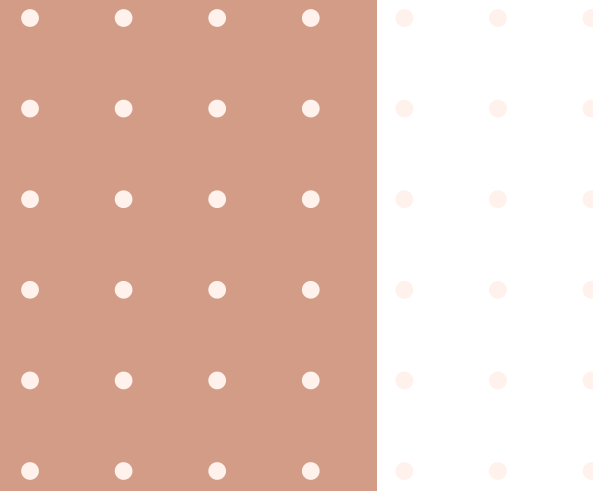
- ADVERSE EFFECTS ON COGNITIVE, BEHAVIOR, AND PSYCHOMOTOR DEVELOPMENT IN CHILDREN,
- COGNITIVE DECLINE AND HIGHER RISK OF DEMENTIA IN THE ELDERLY.



MECHANISM OF MENTAL DISORDERS

AND

NEURODEGENERATIVE DISEASES



AIR POLLUTION & ALZHEIMER'S DISEASE

AD BEGINS WITH AN ASYMPTOMATIC PHASE WITH MILD B AMYLOID (AB) AND TAU PATHOLOGY IN THE BRAIN APPROXIMATELY 20 YEARS PRIOR TO ONSET OF MILD COGNITIVE IMPAIRMENT

LINK BETWEEN COGNITIVE DECLINE AND TRAFFIC POLLUTION, BLACK CARBON, MANGANESE, THE AIR POLLUTION INDEX, AND PM2.5.



PREVIOUS RESEARCH HAS SHOWN...

MUTANT MICE EXPOSED TO FINE DUST HAD:

- numbers of dopamine cells decreased by 29%
- early decline of immediate free recall/new learning abilities
- progressive atrophy of gray matter

INCREASED CONCENTRATIONS OF TRAP ASSOCIATED WITH:

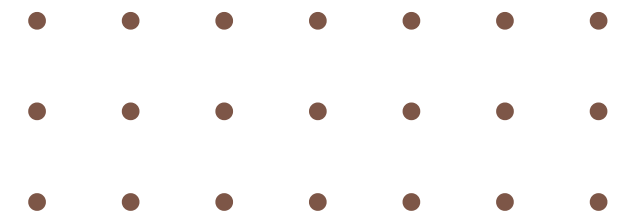
- Increase of ADHD, autism,
- Affect cognitive development

INCREASED CONCENTRATIONS OF PM2.5:

- affected adults cognition (episodic memory),
- Increased major depressive disorders.
- PM2.5 decreased the expression of BDNF in placenta

INCREASED CONCENTRATIONS OF NO2 ASSOCIATED WITH DEMENTIA

INCREASED EXPOSURE TO NOX ASSOCIATED WITH PARKINSON'S.



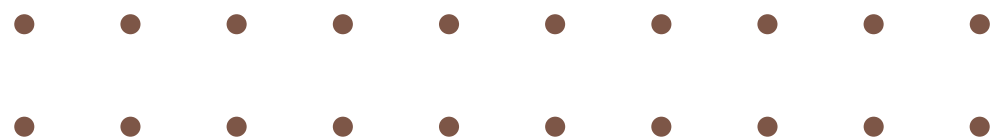
MECHANISM OF NEUROINFLAMMATION AND CNS DISEASE

AIR POLLUTION

Neuroinflammation

**Reactive oxygen species
(ROS)**

**neuropathology instigating CNS
disease.**



NEUROINFLAMMATION HYPOTHESIS



RESIDENT INNATE IMMUNE CELLS, MICROGLIA, AND NEUROINFLAMMATION CULPABLE IN AIR POLLUTION-INDUCED CNS EFFECTS THAT LEAD TO NEURODEGENERATIVE DISEASES.

- **Air pollutants get in the brain - disrupt BBB**
- **Initiates compensatory responses - Microglia**
- **Secretes inflammatory mediators - cytokines and ROS**
- **Mediates the deleterious effects of air pollution on the CNS**
- **Amyloid precursor protein (APP) is produced by microglia as part of their inflammatory response**



STRESS AND ANXIETY

INCREASED RISK OF NEURODEGENERATIVE DISEASES

IMPACT ON VULNERABLE POPULATIONS; CHILDREN, ELDERLY

ALTERED BRAIN STRUCTURE

BEHAVIORAL CHANGES

SO WHAT DOES THIS MEAN IN CONTEXT OF NEPAL...

PHYSIOLOGICAL HEALTH IMPACTS

NEUROTRANSMITTER IMBALANCE

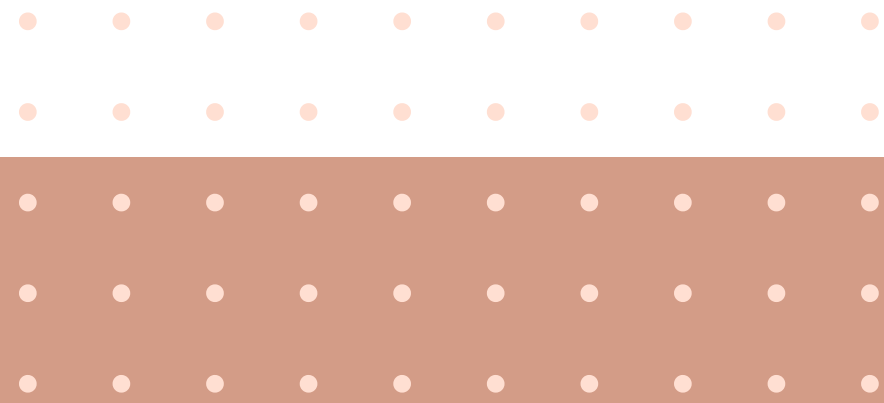
INCREASED RATE PSYCHIATRIC DISORDERS

NEURODEVELOPMENTAL EFFECTS

COGNITIVE IMPAIRMENT

WHAT'S CAN BE DONE?

- AIR QUALITY MONITORING
- REDUCE EMISSIONS
- PROMOTE PUBLIC TRANSPORTATION
- GREEN SPACES AND URBAN PLANNING
- EDUCATION AND AWARENESS
- HEALTHCARE AND SCREENING
- PROTECT VULNERABLE GROUPS
- RESEARCH AND DATA COLLECTION
- REGIONAL COLLABORATION
- POLICY AND REGULATION ENFORCEMENT
- PUBLIC PARTICIPATION:
- ENCOURAGE CLEAN ENERGY USE



THANK YOU



CITATIONS

