

Public Health Benefits of the AQI: What Do We Know?

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Overview

- Overview of the AQI
 - What it is
 - Objectives
- Indicators of public health protection
 - Changes in behavior
 - Surveys
 - Measured changes
 - Changes in health outcomes

Air Quality Index

Descriptors	Cautionary Statement
Good 0 – 50	No message
Moderate 51 – 100	Unusually sensitive individuals
Unhealthy for Sensitive Groups 101 - 150	Identifiable groups at risk - different groups for different pollutants
Unhealthy 151 - 200	General public at risk; sensitive groups at greater risk
Very Unhealthy 201 - 300	General public at greater risk; sensitive groups at greatest risk

Air Quality Index

- Pollutant-specific health effects and cautionary statements address question “who will be affected”

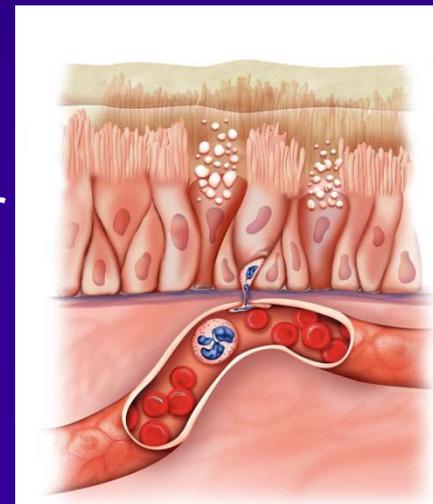
Dose = Concentration x Ventilation rate x Time

C - be active outdoors when air quality is better

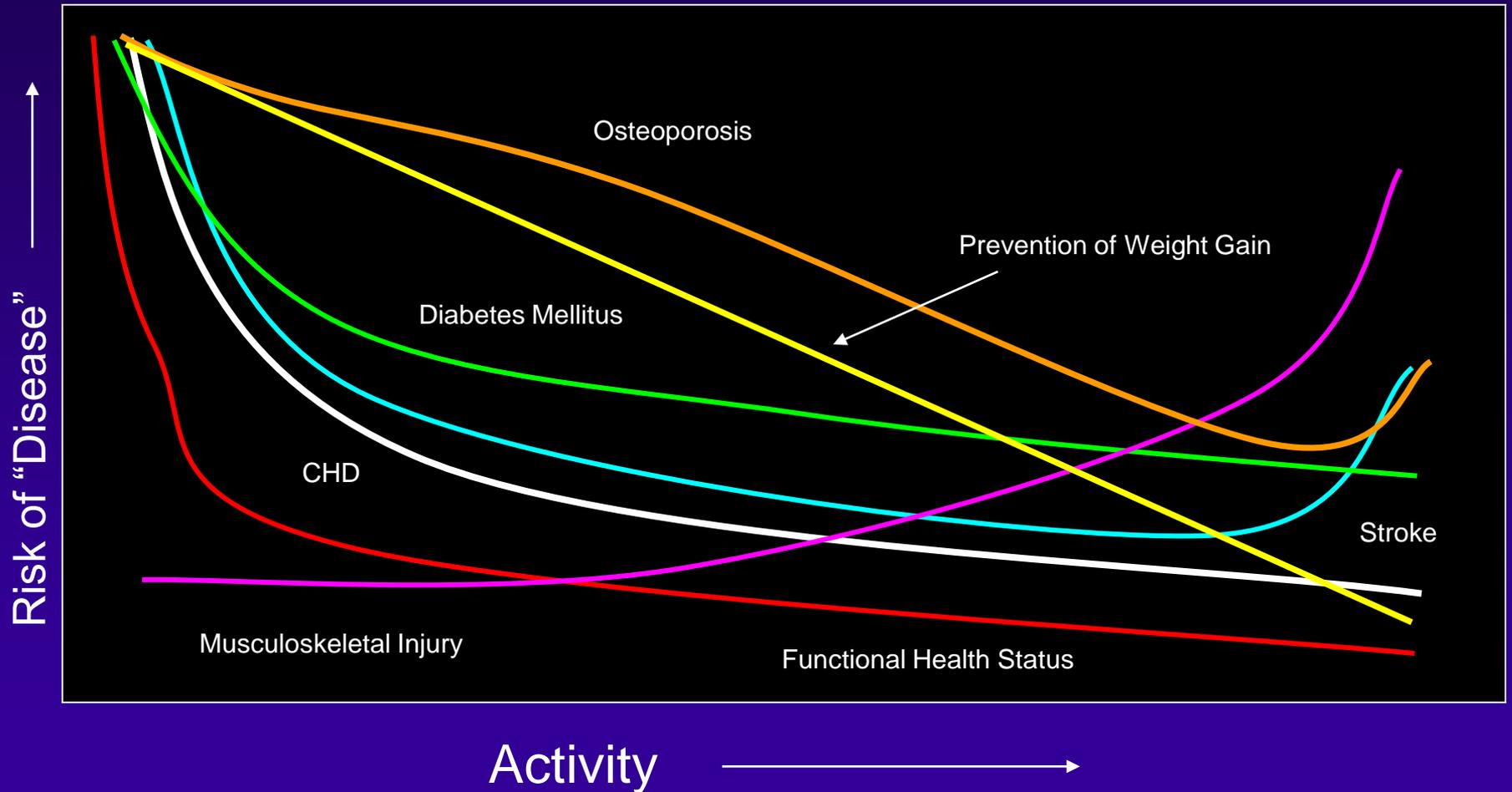
V - take it easier when active outdoors

T - spend less time being active outdoors

- Reduce these factors (C,V,T) to reduce dose
- Pay attention to symptoms
- People with asthma – follow asthma action plan
- Coaches – rotate players frequently
- People with heart disease – check with your doctor



Physical Activity and Health



Source: HW Kohl, University of Texas School of Public Health

Surveys

- “End of the Season” Surveys
 - Conducted by State and Local air agencies and EPA
 - Large proportion respondents report awareness of the AQI
 - Proportion has been increasing since first surveys (50% to 75 - 80%)
 - Of those who were aware, about 50% report taking action
 - Since demographic information rarely collected, can’t assess whether reaching target audience
- Surveys that include demographic information
 - Allow us to assess whether reaching target audiences
 - Allow us to assess whether the messages are effective

RTI/KN Health and Aging Survey

- Nationally representative, web-TV based panel (Knowledge Networks), N=6,300 *not all lived in areas that used the AQI
- 33% had heard of the color-based alert system
- 54% correctly reported that their county had experienced a code orange day during that summer
- Factors affecting awareness, respondents more likely to be aware:
 - Older adults
 - Females
 - African-Americans and Whites
 - More educated
 - Better overall health
 - Employed full time or students, homemakers or retired persons
 - Higher ozone in current summer
 - History of higher ozone

RTI/KN Health and Aging Survey

- Factors affecting behavior, respondents more likely to report staying indoors or reducing outdoor time if:
 - Older
 - Female
 - Not white
 - Households with income less than \$75,000
 - Fair or poor health status
 - In county with at least 1 purple day in current summer

2005 BRFSS Survey (Wen et al., 2009)

- Behavioral Risk Factor Surveillance Survey (BRFSS)
 - Standardized state-based telephone survey designed to collect data on health risk behaviors and health conditions in adults ≥ 18 years of age
 - Conducted by State health departments with assistance by CDC
- In the 2005 BRFSS, 6 states (CO, FL, IN, KS, MA and WI) asked questions related to reductions or changes in outdoor activity
 - Have you ever heard/read about air quality index or air quality alerts where you live? If yes, then
 - How many times did you reduce or change outdoor activity levels based on air quality alerts?
 - Has a doctor, nurse, or other health professional told you to reduce outdoor activity levels when air quality is bad?

2005 BRFSS Survey: Results

- Almost 31% of respondents with lifetime asthma and 16% of those without asthma reported changes in outdoor activities because of media alerts of air quality ($P < 0.0001$)
 - Women and those who reported disability had high and statistically significant percentages of change in outdoor activities
 - Respondents with lifetime asthma at age 55 years and older reported activity changes but it was not statistically significant
- Among respondents who ever received a health professional's advice to reduce outdoor activity, about 51% of those without asthma and 57% of those with lifetime asthma reported media-alert based outdoor activity change or reduction ($P < 0.001$)

Evidence of Behavior Change: Neidell (2009)

- Daily attendance (1989-1997) two major outdoor facilities in Southern California: the Los Angeles Zoo and Griffith Park Observatory
- Evaluated the causal effect of PSI and smog alerts on daily outdoor activities
 - Zoo charges varying admission fees based on age (ages: <2; 2-12; adults; and seniors aged ≥ 62)
 - Controlled for weather and day of the week
 - Compared to attendance at baseball games (Dodgers and Angels) where attendance is a sedentary activity and games often occur when ozone levels are lower

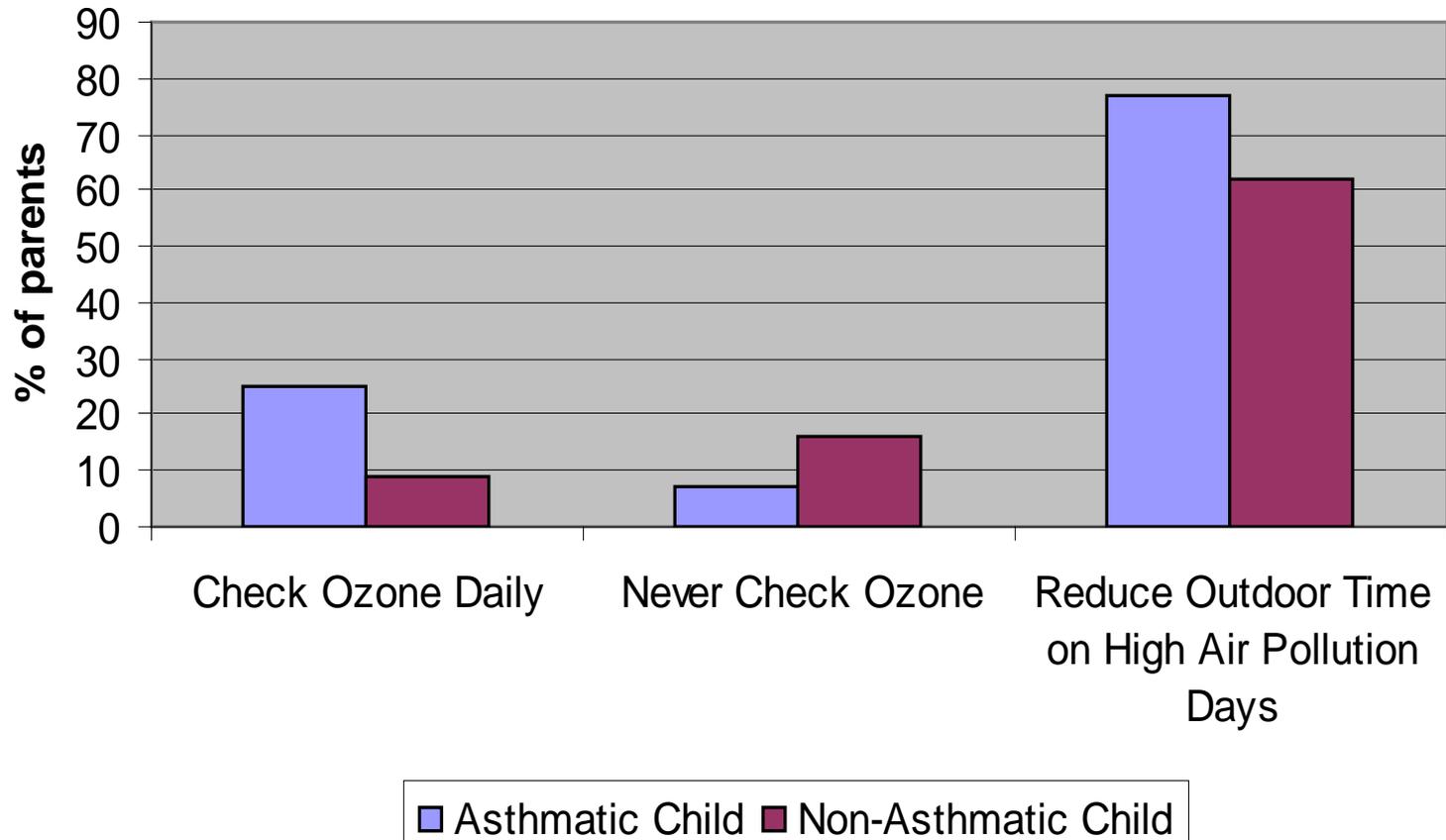
Evidence of Behavior Change: Neidell (2009)

- Attendance drop of 13-15% at the Los Angeles Zoo
 - Attendance for children (19%) and seniors (24%), two groups specifically targeted by air quality information, displayed greater responses to alerts
 - Information is valued by potentially susceptible populations
- Attendance drop of 3-6% at the Griffith Park Observatory
 - Smaller magnitude of change consistent with Observatory including night hours when ozone levels are lower
- Attendance at baseball games not affected by alert status
 - Changes are based on health concern rather than altruism

RTI STAR Grant Study (Mansfield et al., 2006)

- Questions included: do parents change their children's behavior on high ozone days; do parents with asthmatic children behave differently; and what determines parents' awareness of alerts?
- Inclusion criteria: 35 highest ozone MSA's; child 2 to 12 years old; one stay-at-home parent to supervise child during July/August 2002
- Timing: target 3 red + 3 green days in July-September
- Child's daytime activities: activity type; duration; level of activity; indoor/outdoor, home/away; daily symptoms and medicine use; asthma status over last week
- Survey of awareness and reported behavior at conclusion of study

RTI STAR Grant Study: Awareness and Reported Behavior

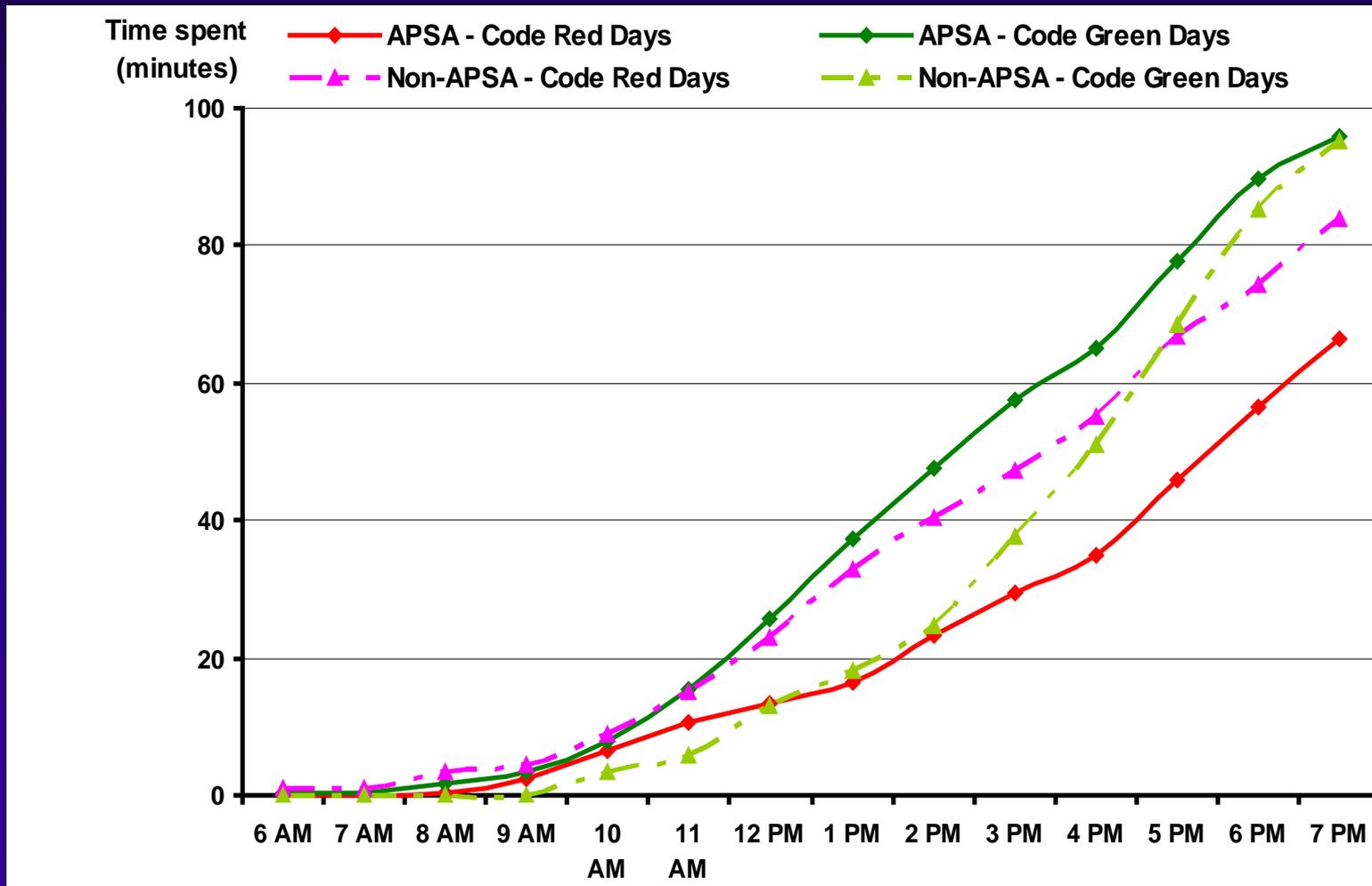


RTI STAR Grant Study

- Determinants of parents' ozone forecast monitoring
 - Parents of asthmatics more likely to report checking AQI forecast frequently
 - More serious asthma = more frequent checking
 - More children = less frequent checking
 - White parent = less frequent checking
- Summary of results on time outdoors provides evidence that
 - Air pollution sensitive asthmatics reduce time outdoors on code red days (based on daily diaries)
 - 30+ minute reduction in time outdoors on Code Red day relative to non-Code Red day

RTI STAR Grant Study Activity Diaries for Air Pollution Sensitive vs Not Sensitive Asthmatic Children

Source: Carol Mansfield, RTI



National Scale Activity Survey (N-SAS)

EPA and RTI

- 1,600 individuals age 35 or older who meet minimal activity requirements
- Washington, D.C.; Sacramento (also other cities in San Joaquin Valley -- San Joaquin, Stanislaus, Merced, Madera, Fresno), Chicago, Dallas, Houston, Atlanta, Philadelphia, and St. Louis
- Data collected in 2009 through Knowledge Network's web panel
 - Initial activity screening (BRFSS)
 - Activity diaries (plan for nine per city)
 - Follow-up survey about awareness and behaviors
- Activity data are being entered into EPA's Consolidated Human Activity Database (CHAD)

Asthma Hospitalizations in Los Angeles (Neidell and Kinney, 2010)

- Companion to analysis of attendance at Los Angeles Zoo and Griffith Park Observatory (Neidell 2009)
- Analysis of California Hospital Discharge Data for asthma hospitalizations (1989-1997) with and without consideration of PSI and smog alerts
- Including PSI and smog alerts in analysis increases estimates of ozone effects by ~ 200% in children and 40% in the elderly, but has no effect on estimates for adults
 - This is consistent with evidence of greater behavioral responses in children and the elderly, with respect to attendance at the Los Angeles Zoo

Asthma Hospitalizations in Los Angeles (Neidell and Kinney, 2010)

Increase asthma hospitalizations per 10 ppb O₃

	All Ages	5-19	≥ 65
No control	0.017	0.016	0.022
With control	0.027	0.037	0.037
Difference	1.59**	2.31**	1.36*

**P<0.01; *P<0.10

Asthma Hospitalizations in Dallas Fort Worth (Carls, University of Michigan, 2010)

- Objectives of study were to assess:
 - If information about air quality forecasts is protective of health
 - If it alters the observed relationship between asthma exacerbations and air quality
 - And to test a new measure of asthma exacerbations, fills of oral systemic corticosteroids (OSC), along with short-acting beta-agonists (SABA)
- Estimate daily time-series models of the number of people with each outcome (hospital admissions, ER and doctor office visits, and OSC and SABA fills for asthma), as a function of ozone, ozone alerts, and control variables using data from Dallas-Fort Worth 2000-2008
- All patients in the study lived in the Dallas-Fort Worth Metroplex and were enrolled in health plans offered by over 75 large, mostly self-insured, employers

Asthma Hospitalizations in Dallas Fort Worth (Carls, University of Michigan, 2010)

- Increases in ozone were associated with worse asthma outcomes and ozone alerts were associated with better outcomes for both ER visits and inpatient stays.
- This study find evidence of the protective effect of alerts and ignoring ozone alerts can bias estimates of the association between ozone and asthma inpatient stays and ER visits by 40%-200%
- These associations were consistently statistically significant for inpatient stays
- For the lower morbidity outcomes (asthma office visits, OSC fills, and SABA fills), these relationships were not consistently observed
 - Lag models suggest that subjects may fill their quick relief medications in advance of poor quality days (red alerts) and may go to their doctor's office as follow-up after poor air quality days.
- Fine particulates did not appear to confound results; associations with ozone and ozone alerts were not sensitive to the inclusion of fine particulates in the model

Asthma Hospitalizations in Dallas Fort Worth (Carls, University of Michigan 2010)

Change in asthma hospitalizations per 20 ppb O₃

No control	7.0%
Control	11.6%*
Orange Alert	- 14.1% to -26.8% reduction in inpatient stays
Red Alert	-19.9% to -35.5% reduction in inpatient stays

*P<0.05