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Impact of Air Quality Index Awareness on Outdoor Activity Levels

BACKGROUND

The effects of fine particulate matter (PM) and ozone as hazardous pollutants are well documented. Exposure to outdoor air pollutants is linked to increased:

- hospitalizations and emergency department visits for asthma,^{1,2}
- respiratory mortality,³
- air-pollution related cardiovascular events in Type-2 diabetics,⁴
- stroke mortality,⁵
- acute coronary events, especially in people with underlying coronary artery disease,⁶
- school and work absenteeism.⁷

Older adults and other vulnerable populations are especially sensitive and at high risk for being affected by toxic exposures to substances in the air. Such populations include:

- younger children,
- pregnant women,
- individuals with chronic conditions, and
- those individuals who work and/or exercise outdoors.⁸

AIR QUALITY INDEX

The Air Quality Index (AQI)⁹ is a tool developed by the US Environmental Protection Agency (EPA) to educate the public in real-time on how clean or dirty the air is and what health effects may be associated with exposure. The AQI focuses on health effects that may be experienced within a few hours or days after breathing polluted air. The AQI is calculated for five major air pollutants:

- ground-level ozone,
- particle pollution (also known as particulate matter),
- carbon monoxide,
- sulfur dioxide, and
- nitrogen dioxide.

Air Quality Index (AQI) Values	Levels of Health Concern and Color	Meaning
0 to 50	Good (green)	Air quality is considered satisfactory, and air pollution poses little or no risk.
51 to 100	Moderate (yellow)	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101 to 150	Unhealthy for sensitive groups (orange)	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 to 200	Unhealthy (red)	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
201 to 300	Very unhealthy (purple)	Health alert: everyone may experience more serious health effects.
> 300	Hazardous (maroon)	Health warnings of emergency conditions. The entire population is more likely to be affected.

REFERENCES:
 1 Katsouyian K. Ambient Air Pollution and Health. *British Medical Journal* 2003;326: 143-156.
 2 Fauriol B, Samet M, Ouanes J, Lemerle C, et al. Ozone: a trigger for hospital pediatric asthma emergency room visits. *Pediatr Pulmonol* 2000;30:41-46.
 3 Zanobetti A, Schwartz J, Samoli E, et al. The temporal pattern of respiratory and heart disease mortality in response to air pollution. *Environ Health Perspect* 2003;111:1189-1193.
 4 O'Neill MS, Veves A, Samat JA, Zanobetti A, Gold DR, Economides PA, Horton ES, Schwartz J. Air pollution and inflammation in type 2 diabetes: a mechanism for susceptibility. *Occup Environ Med* 2006;64: 373-378.
 5 Kettunen J, Lanki T, Tiliainen P, et al. Associations of fine and ultrafine particulate are pollution with stroke mortality in an area of low air pollution levels. *Stroke* 2007;38:16-22.
 6 Pope CA, Muirhead JB, May HT, et al. Ischemic heart disease events triggered by short-term exposure to fine particulate air pollution. *Circulation* 2006;114:23-2443-6.
 7 Park H, Lee B, He SH, et al. Association of air pollution with school absenteeism due to illness. *Arch Pediatr Adolesc Med* 2002;156:1235-1239.
 8 US EPA. Available at: <http://www.epa.gov>

METHODS

Question 1

Please think of the past 12 months. How many times did you reduce or change your outdoor activity level because you thought the air quality was bad or was affecting how well you felt? For example, avoiding outdoor exercise or strenuous outdoor activity. Please do not include times when you made changes because of high pollen levels.

Question 2

The government routinely collects information on air quality that may be distributed by local radio, TV and newspapers to help inform the public about air pollution levels. Have you ever heard or read about the air quality index or air quality alerts where you live? Please do not include times when you may have heard or read about high pollen counts.

Question 4

Has a doctor, nurse, or other health professional ever told you to reduce your outdoor activity level when the air quality is bad?

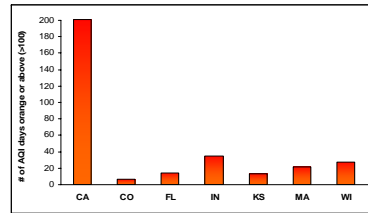
No, skip to Q4

Question 3

Please think of the past 12 months. How many times did you reduce or change your outdoor activity level based on the air quality index or air quality alerts? For example, avoiding outdoor exercise or strenuous outdoor activity. Please do not include times when you may have heard or read about high pollen counts.

- In 2005, four questions related to outdoor air quality and outdoor activity level and air quality were added to the BRFSS in seven states. These states were included because of their willingness to participate.
- A multiple logistic regression test was conducted for each question including the factors that were significant in a univariate logistic regression.

RESULTS



- Among participating states, there are differences in the number of AQI days that reach an orange level or above.
- This variation is taken into account by adding State to the logistic regression model.
- Data are from the US EPA Air Quality System for 2005.

Table 1. Weighted percents of the state-added questions (N = 29,655)

BRFSS Question	Frequency	Weighted percent	95% CI
Reduce/change based on thoughts (Q1)			
Yes	4745	19.8	18.9,20.6
No	24910	80.2	79.4,81.1
Heard/read Air Quality Index or alerts (Q2)			
Yes	16266	55.2	54.2,56.2
No	13389	44.8	43.8,45.8
Reduce/change based on alerts (Q3)			
Yes	3527	25.0	23.7,26.2
No	12679	75.0	73.8,76.3
Advice from health care professional (Q4)			
Yes	1962	8.1	7.5,8.7
No	27693	91.9	91.3,92.5

Table 2. Adjusted odds ratios for reduction/change of outdoor activity level (Q1) based on thoughts that the AQ is bad (N = 29,655)

Independent Variable	aOR	95% CI	
		Lower Limit	Upper Limit
Ever heard/read the Air Quality Index/air quality alerts			
Yes vs. No	1.46-3.01	sig in all states	
Advised by professional to reduce outdoor activity			
Yes vs. No	3.66	3.00	4.48
Gender			
Female vs. Male	1.38	1.22	1.57
Annual Income			
< \$15,000	-	-	-
\$15,000 - < \$25,000	0.91	0.71	1.18
\$25,000 - < \$35,000	0.86	0.65	1.13
\$35,000 - < \$50,000	0.81	0.62	1.07
≥ \$50,000	0.68	0.52	0.89
Activities limited by health problem			
Yes vs. No	1.35	1.15	1.59
Arthritis			
Yes vs. No	1.00-1.72	sig in 2 states	
Asthma			
Yes vs. No	1.04-2.99	sig in 5 states	
Stroke			
Yes vs. No	1.68	1.16	2.43

CI = Confidence Interval; aOR = Adjusted Odds Ratio. Adjusted for all variables in the table and age, race/ethnicity, employment, general health status, marital status, heart disease, diabetes, and state. Interactions between state and ever heard/read air quality index/air quality alerts, education, arthritis, and asthma.

Overall:

- Over half of the sample reported ever hearing/reading the AQI.
- A higher percentage of individuals change their behavior based on AQI awareness, than those changing behavior based on perception alone (Table 1).

RESULTS

Table 3. Adjusted odds ratios for having ever heard/read the AQI (Q2) by demographics and other covariates in 2005 (N = 29,655)

Independent Variable	aOR	95% CI	
		Lower Limit	Upper Limit
Advised by a health professional to reduce outdoor activity			
Yes vs. No	2.54	2.02	3.19
Age			
18 - 24	-	-	-
25 - 34	1.01-1.93	sig in 3 states	
35 - 44	1.39-3.29	sig in 6 states	
45 - 54	1.44-5.20	sig in 6 states	
55 - 64	1.88-5.24	sig in all states	
65 +	1.73-4.26	sig in all states	
Gender			
Female vs. Male	0.72	0.65	0.79
Education			
Not graduated from high school	-	-	-
High school graduate	1.38	1.14	1.66
Attended college	2.00	1.65	2.42
College graduate/higher degree	2.40	1.98	2.90
Current asthma			
Yes vs. No	1.25	1.06	1.48

CI = Confidence Interval; aOR = Adjusted Odds Ratio. Adjusted for all variables in the table and age, race/ethnicity, employment, general health status, marital status, heart disease, diabetes, and state. Interactions between state and ever heard/read air quality index/air quality alerts, education, arthritis, and asthma.

Table 4. Adjusted odds ratios for the relationship between the reduction/change of the outdoor activity level (Q3) based on AQI/Air Quality Alerts (Q2) (N=16,206)

Independent Variable	aOR	95% CI	
		Lower Limit	Upper Limit
Advised by health professional to reduce outdoor activity			
Yes vs. No	5.18	4.18	6.43
Gender			
Female vs. Male	1.38-2.39	sig in all states	
Race/Ethnicity			
White/Non-Hispanic	-	-	-
Black/Non-Hispanic	1.10	0.76	1.59
Others	1.45	1.20	1.76
Current asthma			
Yes vs. No	0.98-2.38	sig in 4 states	
Stroke			
Yes vs. No	1.89	1.24	2.87

CI = Confidence Interval; aOR = Adjusted Odds Ratio. Adjusted for all variables in the table and age, race/ethnicity, employment, general health status, activities limited by a health problem, arthritis, hypertension, and state. Interactions with gender, education, and current asthma.

Table 5. Adjusted odds ratios for the advice received from a professional to reduce outdoor activity when the air quality is bad (Q4) (N = 29,655)

Independent Variable	aOR	95% CI	
		Lower Limit	Upper Limit
Race/Ethnicity			
White/Non-Hispanic	-	-	-
Black/Non-Hispanic	0.71-3.01	sig in 1 state	
Others	0.98-2.33	sig in 3 states	
Activities limited by health problem			
Yes vs. No	1.34-3.21	sig in 5 states	
Arthritis			
Yes vs. No	1.27	1.04	1.54
Current asthma			
Yes vs. No	3.99-10.71	sig in all states	
Heart attack or myocardial infarction			
Yes vs. No	1.64	1.11	2.44

CI = Confidence Interval; aOR = Adjusted Odds Ratio. Adjusted for all variables in the table and age, gender, education, marital status, employment, annual income, general health status, coronary heart disease, stroke, diabetes, hypertension, and state and interactions between state, race, activities limited by a health problem, and current asthma.

DISCUSSION AND RECOMMENDATIONS

- Increase education among high-risk groups regarding the need for activity reduction when the AQ is bad among males, those with a history of hypertension, and myocardial infarction.
- Increase awareness of the AQI among the less educated, low income, individuals 65 and over, females, Whites, individuals with hypertension, heart attack, stroke, and arthritis.
- Advisement by a health professional to reduce outdoor activity when the AQ is bad had an effect on behavior change, therefore increased physician education on the effectiveness of their recommendations to certain populations is needed.
 - High-risk populations include those with hypertension and a history of stroke who are not receiving advice from their health professional.
- Females are more likely to change their behavior based on perception and based on the AQI, however, they are less likely to report hearing/reading the AQI. Exploring the reasons for complacency in this group is needed.
- Explore intervention programs for current asthmatics because this group has consistently reported awareness and behavior change based on perceptions and awareness. This group is also much more likely to receive advice from a health professional.
- Further explore individual state data, and the effects of the predictors on awareness and its impact on behavior change.
- Increase data collection on the level of outdoor physical activity.

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