

# Subject Index

## A

- Adaptation, 14, 20, 103–104
  - ambient, 14, 20–21
  - effects of concentration on, 22
  - laboratory, 21–22
  - ozone and SO<sub>2</sub> threshold level exposures, 21–22
- Aerosols
  - breath-holding test, respiratory maneuver, 62
  - decay curves during rebreathing, 66
  - measuring mucociliary clearance, 66–70
  - screening tests for airway obstruction, 65–66
  - used as probes of airway and air space dimensions, 62–65
- Age, effect on response to pollutants, 14, 19–20
- Air quality criteria document, 2
- Air spaces
  - aerosols as probes of, 62–65
  - mean effective dimension of, 64
  - size, intersubject coefficient of variation, 61
- Airway
  - asthmatic subjects, 45, 53
  - baseline caliber differences, 57
  - change in conductance from sulfate aerosol exposure, 49–50
  - defenses, 41
  - deposition of tagged particles, 61
  - inflammation of, 54
  - nasal, 39
  - obstruction, aerosol use as screening tests, 65–66
  - oronasal, 39
  - peripheral function, 48
  - reactivity, 44–45
- Airway resistance, 54
  - asthmatics, SO<sub>2</sub>
    - encumbered breathing, 133
    - exercising, 132
    - unencumbered breathing, 124, 136
  - correlation with symptom dose-response relationship, 79–80
  - effects of exercise in asthmatics, 123, 125–127, 129
  - measurement of, 46–47
  - regression equations for, 114
- Airway responsiveness
  - acute effects of pollution on, 55–57
    - change measurement, 56
    - inhaled agents, 54
  - bronchoconstrictor stimuli, 54–55
  - hyperresponsiveness of asthmatic subjects, 53
  - measurement, 53–57
    - methods, 54–55
  - transient alteration, 56
- Airway space
  - aerosols as probes, 62–65
  - size
    - intersubject coefficient of variation, 61
    - measurement with aerosols, 60
    - variability among healthy people, 63
- Ambient adaptation, effect of season on, 14, 20–21

Arachidonate metabolism and ozone,  
101, 104

#### Asthmatic subjects

adolescents, exercise-induced bronchospasm, susceptibility to inhaled  $\text{SO}_2$ , 85, 87

airway resistance (*see* Airway resistance)

airway responsiveness, 53

bronchoconstriction and drug concentrations, 55

comparison of individual and group mean values, 130

#### exercising

regression results, 139

$\text{SO}_2$  response, 85, 87

mean and standard deviation per subject, 131

measurement of respiratory impedance by forced white noise, 12

relationship between airway reactivity and responsiveness to  $\text{H}_2\text{SO}_4$ , 45

#### Atopic adolescents

classification, 86

effects of pollutants on, without exercise-induced bronchospasm, 90

incidence, 90

### B

Behavioral responses, 44

Blood biochemistry, as index of pulmonary response, 44

Bonferroni inequality correction, 12

Bronchodilator drugs, effect on airway responsiveness, 56

#### Bronchoconstriction

cold dry air effects on, 16

enhancement of response by ozone, 103

stimuli producing, 54–55

### C

#### Chronic lung disease

deposited particles, 103

inflammatory response, 104

modulation, 103

pathogenesis, 100–105

potential role of environmental agents, 101

#### Chronic obstructive pulmonary disease, exposure studies, 92–98

bronchial hyperreactivity as predisposition to, 45–46

characteristics of, 92–93

#### exposure studies

intercurrent medication usage, 95–96

limited tolerance to secondary stresses, 95

noise level minimization, 96

priorities of concern, 92, 94

smokers, value of studies of, 96

subject selection and characterization, 94–95

problems in studying people, 93–96

risk of harm, 93–94

#### Circadian variations, effect on response to pollutants, 14, 17

#### Clean Air Act

background, 4–5

purpose, 85

#### Clean air exposure, hot conditions, 15

#### Clinical research

basic and applied, 2

Data aggregation (*see* Data aggregation)

experimental design (*see* Experimental design)

extrapolation of data, 101

host factors, 102

overview, 2

respiratory epithelium, 104–105

secondary effects of reactions to environmental agents, 101

use of special animal models, 104  
 CO (carbon monoxide)  
     breath concentrations, 97  
     effects of age on response to, 19  
     studies in smokers and people with  
         COPD, 92–98  
 Consensus protocols, 9–10  
 COPD (*see* Chronic obstructive pulmonary disease)  
 Criteria document, 2, 5

## D

Data aggregation, 117–147  
     choice of effects parameters, 121–122  
     consideration of dose, 120  
     determination of effects, 122–129  
     development of a unified integrative format, 120–122  
     independent confirmation, 119  
     quantitative rigor, 118–119  
     real-world relevance, 119  
     replicability, 119–120  
     response of FEV to ozone in normal exercising subjects, 140–144  
     response of  $G_{aw}$  to ozone, 144–146  
     response of specific airway resistance to  $SO_2$ , 132–140  
     results out of line, 120  
     sham percentage of change, 122, 124, 129  
         versus sham exposure, 124, 128  
     study selection, 118–120  
     use of group mean versus individual subject data, 129–132  
 Deposition patterns of inhaled toxicants, 61–62  
 Discomfort meter, 80  
 Dose-response relationship, 10–11  
     biological significance, 11  
     individual variance, 13  
     influence of nondisease factors, 14–22

Double-blind protocol, 50

## E

Environmental stress, effects on response to pollutants, 102  
 Exercise, effect on air resistance in asthmatics, 123, 125–127, 129  
 Exercise protocols (*see also* Ventilation) 25–34  
     continuous and intermittent, effects on pulmonary functions, 26  
     duration in relation to maximum aerobic capacity, 29, 32  
     effects of prior exercise and timing of measurements, 26–27  
     examples, 30–31  
     factors that influence results and interpretations, 29  
     intensity of exercise, 34  
     major considerations, 29  
     timing of physiological measurements, 34  
     work load selection, 32  
 Experimental design, 9–13, 101  
     Bonferroni inequality correction, 12  
     combining studies, 115  
     comparison of individual responses, 11  
     consensus protocols, 9–10  
     designing comparison studies, 110–113  
     double-blind protocol, 50  
     exercise protocols (*see* Exercise protocols)  
     experimental protocols, 9  
     hypothesis testing, types of, 10  
     inference issues, 115  
     measuring the response, 3  
     mechanism elucidation versus descriptive study, 11–12  
     mechanism of pollutant action studies, 9  
     mechanistic studies, 11

Experimental design (*cont.*)  
 paired and unpaired designs, 110–111  
 protocol development, 50–51  
 randomized block design (*see* Randomized block design)  
 regression studies, 113–114  
 sample size, 109, 113  
 scientific method, 9  
 statistical considerations, 3–4, 109–116  
 statistical power of study, 12  
 subpopulations, 114  
 techniques and tests, 12  
*t*-test results to ozone in normal exercising subjects, 143  
 Extrapolation of data, soundness of, 101

## F

Forced expiratory volume, response to ozone in normal exercising subjects, 140–144  
 Forced vital capacity  
 measurements of, 47–48  
 reduction with heat exposure or prolonged exercise, 16  
 wet-bulb globe temperature index analysis, 15  
 Formaldehyde, impairment of nasal function, 41

## G

Gender, effect on response to pollutants, 14, 17–19  
 amount of pollutant in relation to lung size, 17–18  
 female susceptibility, 18  
 oxidant response in relation to, 25

## H

Hardwood dust, impairment of nasal function, 41

Histamine, bronchoconstrictor responses, 55  
 Homeostatic mechanism, 101–102  
 $\text{H}_2\text{SO}_4$   
 airway reactivity and responsiveness to, 45  
 effects on mucociliary clearance, 68–69  
 Humidity, effect on response to pollutant exposure, 14–16  
 Hypothesis testing, types of, 10

## I

Index of dispersion, comparison in smokers and nonsmokers, 65  
 Inspiratory path to lungs, 39–42  
 air modification during oronasal breathing, 41  
 nasal, 40–41  
 oral, 40–41  
 oronasal, 40–41

## L

Leukocytes, polymorphonuclear, accumulation and ozone exposure, 104  
 Leukotriene  $\text{B}_4$ , 104  
 Lungs  
 chronic disease of (*see* Chronic lung disease; Chronic obstructive pulmonary disease)  
 inspiratory path, 39–42

## M

Maximal expiratory flow, 54  
 Mechanistic studies, 11  
 Methacholine, bronchoconstrictor responses to, 55  
 Mucociliary clearance  
 aerosols, use for measuring, 66–70  
 alteration of rates, 44  
 animal studies, 69–70

deposition of tagged particles, 61  
 effects of  $\text{H}_2\text{SO}_4$  on, 68–69  
 significance of pollutant-induced alterations, 70  
 thoracic retention, 67–68  
 use of aerosols for measuring, 60

## N

### NaCl aerosol

change in pulmonary function, exercise tests, 88  
 inhalation effects in adolescents, 89

National ambient air quality standards, 4–5

Neurophysiologic responses, 44

$\text{NO}_2$ , effects of age on response to, 19

Nodulation, significance of, 103

### Nose

clearance, 41  
 defenses, screening of workers for effectiveness of, 41–42  
 impaired function and pollutants, 41  
 inspired air modification, 39  
 physiology, 40  
 proportion of airflow, 40

## O

### Oxidants

arachidonate metabolism, 101, 104  
 effects on response to environmental agents, 102  
 episodes, during summer inversions, 15  
 response to and gender, 25

### Ozone

adaptation to, 11, 20  
 and chronic lung disease, 100  
 diphasic response pattern to, 103–104  
 dose-response studies, symptom-score results, 79–80

effects of age on response to, 19  
 enhancement of airway response to bronchoconstrictors, 103  
 importance of activity during exposure to, 26  
 interindividual variability in decrease of vital capacity, 102  
 laboratory adaptation to, 21  
 mucociliary clearance effects of, 70  
 no-effects level of, 11  
 polymorphonuclear leukocyte accumulation, 104  
 response in normal exercising subjects, 140–144  
 response of  $G_{aw}$  to, 144–146  
 resting exposure to and gender, 18  
 studies of effects of  
   on people with COPD, 94  
   on smokers, 97  
 symptom data, 73  
*t*-test results, 143

## P

Particle deposition, 103

mechanisms of, 61–62

Peroxyacetyl nitrate, effects of age on response to, 19

### Pulmonary function

changes, 12–13  
 choice of tests, 48–49  
 continuous and intermittent exercise effects on, 26  
 decrements in active individuals, 25  
 exercise protocols, 25  
 interpretation of changes, 44–46  
 parameters, 43–51  
 tests  
   double-blind protocol, 50  
   exposure-response relationship, 49  
   protocol development, 50–51  
   timing and measurement and effects of exercise on, 27

**R**

- Randomized block design, 109, 111
  - alternative *t*-tests, power comparisons, 112
  - one factor at four levels, 112
  - two factors at two levels, 111–112
  - use of, 113
- Regression analysis, 109
- Regression equations, relating airway resistance to exposure, 114
- Regression studies, 113–114
- Respiratory epithelium, 104–105
- Responsiveness, diminished (*see* Adaptation)

**S**

- Sample size, 109
  - power considerations for, 113
- Sham exposure method, 122, 124
- Smokers (*see also* Chronic obstructive pulmonary disease)
  - exposure studies, 92–98
  - problems in studying, 96–97
- Smoking
  - pulmonary health effects, 102–103
  - stopping before and during exposure, 97
- SO<sub>2</sub>
  - adaptation to, 20
  - asthmatics, response to, 123, 125–127, 129
    - airway resistance in individual exercising asthmatics, 132
  - atopic adolescents, response to, 85–91
  - change in pulmonary function, exercise tests, 88
  - combined with cold air, 16
  - dose-response studies, symptom-score results, 81
  - effects of age on response to, 19
  - episodes, association with cool or cold conditions, 15

- healthy adolescents, response to, 87, 89
- impairment of nasal function, 41
- individual symptom score changes, 80
- laboratory adaptation to, 21
- methods of symptom reporting, 75
- response of specific airway resistance to, 132
- responses of exercising asthmatics to, 137–138
- symptom data, 73
- Spirometry, confounding problem with, 48
- Susceptibility
  - defined, 19
  - of individuals, study of, 3
- Symptom data
  - collection and analysis, 73–81
  - dose-response studies with ozone and SO<sub>2</sub>, 79–81
  - evaluation methods, 74–76
  - multiple-symptom, ordinal scoring procedure, 76–79
  - reliability, 74
  - response to irritant gases, 77
  - scoring procedure, 78
  - statistical analysis, 78

**T**

- Temperature, effect on response to pollutant exposure, 14–16
- Thoracic resistance, measurement of, 47
- Threshold level exposures, adaptation to, 22
- Tracheobronchial clearance, 41
- Trend test, 113

**V**

- Ventilation, 25

duration of measurement period, 29,  
32  
failure to measure exercise loads, 27–  
28  
minute  
    difficulty in utilizing measure-  
    ment with repeated or contin-  
    uous exercise, 32  
    guestimates based on work load,  
    33

    shift of patterns, 28  
    technical details of measurement  
    during exercise, 29  
Viral upper respiratory tract infections,  
    effect on airway responsive-  
    ness, 56

## W

White noise, forced, for measurement  
    of respiratory impedance, 12