Contents

Preface ................................................................. i
Authors and Acknowledgements ................................... v
Executive Summary .................................................. ES-1
Attachment I: Scientific Review Panel Findings ................. ES-10

1 Introduction

1.0 Impact of ETS on the Health of Californians ................. 1
1.1 Organization of the Report .................................... 3
1.2 Definition of ETS .............................................. 3
1.3 Methodology ................................................... 3
1.4 Weight-of-Evidence Evaluations .............................. 7
References .............................................................. 9

2 Exposure Measurement and Prevalence

2.1 Introduction .................................................... 11
2.2 Properties of ETS and Its Constituents ....................... 12
2.3 Exposure Measurement: ETS Concentrations
   in Indoor Environments ........................................ 18
2.4 Exposure Measurement: Biological Markers ................. 25
2.5 Exposure Measurement: Use of Questionnaires ............. 41
2.6 Exposure Prevalence and Determinants ...................... 45
2.7 Chapter Summary and Conclusions .......................... 66
References .............................................................. 68

3 Developmental Toxicity I: Perinatal Manifestations

3.1 Introduction .................................................... 75
3.2 Fetal Growth ................................................... 75
3.3 Spontaneous Abortion and Perinatal Mortality .......... 106
3.4 Congenital Malformations .................................. 112
3.5 Chapter Summary and Conclusions ......................... 119
References .............................................................. 130
4 Developmental Toxicity II: Postnatal Manifestations

4.1 Introduction ................................................................. 125
4.2 Sudden Infant Death Syndrome ................................. 126
4.3 Cognition and Behavior in Children ......................... 140
4.4 Postnatal Physical Development ............................... 155
4.5 Respiratory Development and Function .................... 162
4.6 Chapter Summary and Conclusions ......................... 162
References ................................................................. 163

5 Reproductive Effects

5.1 Introduction ................................................................. 169
5.2 Female Fertility and Fecundability ......................... 169
5.3 Other Female Reproductive Effects ......................... 178
5.4 Male Reproductive Toxicity ....................................... 179
5.5 Chapter Summary and Conclusions ......................... 181
References ................................................................. 181

6 Respiratory Health Effects

6.0 Introduction ................................................................. 185
6.1 Acute Health Effects .................................................... 185
6.2 Chronic Health Effects .............................................. 219
6.3 Susceptible Populations ........................................... 246
6.4 Chapter Summary and Conclusions ......................... 253
References ................................................................. 255

7 Carcinogenic Effects

7.0 Introduction ................................................................. 265
7.1 All Cancers (combined) ............................................. 267
7.2 ETS and Lung Cancer .............................................. 282
7.3 ETS and Cancer Sites Other Than Lung
    that are Associated with Active Smoking:
    Nasal Sinus, Cervical and Bladder ..................... 309
7.4 ETS and Cancer Sites Where Evidence
    for the Role of Active Smoking is Equivocal ........ 323
7.5 Chapter Summary and Conclusions ......................... 346
References ................................................................. 348
8 Cardiovascular Effects

8.0 Introduction ................................................................. 359
8.1 Description of Epidemiologic Studies ........................... 362
8.2 Discussion of Epidemiologic Studies .............................. 398
8.3 Other Supportive Evidence ............................................. 403
8.4 Chapter Summary and Conclusions ............................... 425
References ............................................................................. 426

List of Tables and Figures by Chapter

Executive Summary

Table ES.1 Health Effects Associated with Exposure to Environmental Tobacco Smoke

Table ES.2 Estimated Annual Morbidity and Mortality in Nonsmokers Associated with ETS Exposure

1 Introduction

Table 1.1 Estimated Annual Morbidity and Mortality in Nonsmokers Associated with ETS Exposure

2 Exposure Measurement and Prevalence

List of Figures:

Figure 2.1 Plasma Cotinine Concentrations in Self-Reported Smokers and Nonsmokers

Figure 2.2 Urinary Cotinine of Breast-Fed Infants in Relation to Maternal Cigarette Smoking

Figure 2.3 Percent of Nonsmokers in California Reporting ETS Exposure

Figure 2.4 Reported Average Daily ETS Exposure Duration in California

Figure 2.5 Relative Person-Minutes of ETS Exposure in Different Environments

Figure 2.6 Adult Smoking Prevalence: California and the United States (1965-1995)

Figure 2.7 Linear Trend in Per Capita Consumption of Cigarettes in California Before and After Proposition 99 and Taxation Program
List of Tables:

Table 2.1 Influence of Puff Volume and Filter Ventilation on Deliveries of Particulate Matter and Carbon Monoxide in Mainstream and Sidestream Smoke

Table 2.2 Chemical Constituents of Tobacco Smoke that Have Been Classified or Identified as to Their Carcinogenicity, Reproductive Toxicity or Other Health Hazard

Table 2.3 Mean Concentrations of Nicotine and Cotinine in the Saliva, Plasma, and Urine of ETS-Exposed Volunteers

Table 2.4 Comparison of Biomarkers in Unexposed and ETS-Exposed Nonsmokers, and Active Smokers

Table 2.5 Cut-Off, Sensitivity, and Specificity of Biomarkers for Discriminating True Smoking Status

Table 2.6 Studies of Cotinine Measurements in Self-Reported Nonsmokers and Criteria Used to Distinguish Smokers From Nonsmokers

Table 2.7 Concentrations of Nicotine and Cotinine in Mothers’ Milk

Table 2.8 Studies with Information on ETS Exposure Prevalence in California and the U.S.: Adults and Adolescents

Table 2.9 Studies with Information on ETS Exposure Prevalence in California and the U.S.: Infants and Children

3 Developmental Toxicity I: Perinatal Manifestations

List of Figures:

Figure 3.1 Summary of Differences in Mean Birthweight and 95% Confidence Intervals Between ETS Exposed and Unexposed Pregnancies, by Definition of ETS and Study Size

Figure 3.2 Odds Ratio (Log Scale) and 95% Confidence Interval for the Association of Low Birthweight and ETS, by Definition of ETS and Study Size

List of Tables:

Table 3.1 Studies of Birthweight and ETS Exposure Defined by Paternal Smoking Status

Table 3.2 Studies of Fetal Growth and ETS Exposure at Home Defined by Paternal Smoking Status
Table 3.3 Studies of Fetal Growth and ETS Exposure of Maternal Non-Smokers from Multiple ETS Sources
Table 3.4 Studies of Fetal Growth and ETS Exposure Determined by Biomarkers
Table 3.5 ETS Exposure in Relation to Spontaneous Abortion and Perinatal Death
Table 3.6 ETS Exposure and Congenital Malformations
Table 3.7 Animal Studies of Tobacco Smoke Exposure and Fetal Growth

4 Developmental Toxicity II: Postnatal Manifestations

Table 4.1 Sudden Infant Death Syndrome (SIDS): Studies that Assessed Some Source of Postnatal ETS Exposure
Table 4.2 Cognition in Children: Studies that Assessed Some Source of Postnatal ETS Exposure
Table 4.3 Behavior in Children: Studies that Assessed Some Source of Postnatal ETS Exposure
Table 4.4 Height Growth in Children: Studies that Assessed Some Source of Postnatal ETS Exposure

5 Reproductive Effects

Table 5.1 ETS Exposure and Infertility or Fecundability: Adult Exposure
Table 5.2 ETS Exposure and Infertility or Fecundability: Childhood Exposure

6 Respiratory Health Effects

List of Figures:

Figure 6.1 Reported risk ratios and 95% confidence intervals for studies that used clinically recognized asthma as an outcome
Figure 6.2 Reported risk ratios and 95% confidence intervals for studies that used “wheezing bronchitis” or “chronic wheezing/whistling in the chest” as an outcome
List of Tables:

Table 6.1 Studies Cited by U.S. EPA (1993) as Evidence Supporting a Causal Relation Between ETS Exposure and Increased Episodes and Severity of Asthma in Children

Table 6.2 Controlled Exposures of Asthmatic Subjects to ETS

Table 6.3 Studies of Middle Ear Effusion (MEE) and Otitis Media (OM) vs. ETS Exposure Reviewed by the Surgeon General (1986), NRC (1986), or U.S. EPA (1992).

Table 6.4 Studies of Middle Ear Effusion (MEE) or Otitis Media (OM) vs. ETS Exposure Not Reviewed by the Surgeon General (1986), NRC (1986), or U.S. EPA (1992).

Table 6.5 Studies Excluded from Meta-Analysis of ETS and Childhood Asthma Induction

Table 6.6 ETS Exposure Relationship with Pulmonary Function, Hospitalizations and Disease Severity in Children with Cystic Fibrosis

7 Carcinogenic Effects

List of Tables:

Table 7.1 Exposure to Spouse's Smoking and Relative Risk (RR) of All Cancers in Adults

Table 7.2A Hair Concentrations of Nicotine and Cotinine in Women and Their Newborn Infants

Table 7.2B 4-Aminobiphenyl Hemoglobin Adduct Concentrations in Pregnant Women and Fetuses by Exposure to Tobacco Smoke

Table 7.2C Cotinine and PAH-Albumin Levels in Mothers and Their Preschool Children

Table 7.3 Maternal Smoking During Index Pregnancy and Risk of All Childhood Cancers Combined

Table 7.4 Study Characteristics of the Four U.S. Case-Control Studies of Lung Cancer and ETS Published Since 1991

Table 7.5 Association Between Risk of Lung Cancer in Lifetime Nonsmoking Females and Exposure to Spousal Smoking
8 Cardiovascular Effects

List of Tables:

Table 8.1 Cohort Studies on ETS Exposure and Heart Disease
Table 8.2 Case-control Studies on ETS Exposure and Heart Disease
Table 8.3 Risks of Heart Disease and Active Smoking in Women
Table 8.4 Risks of Heart Disease and Active Smoking in Women By Age
Table 8.5 Effect of Exposure to ETS on Exercise Tolerance

Table 8.6 Effect of Exposure to ETS on Lipid Profile in Children

Table 8.7 Platelet Sensitivity to Antiaggregatory Prostaglandins Before and After Exposure to ETS

Table 8.8 Measures of Platelet Function in Relation to Exposure to Active Smoking and Passive Smoking

Table 8.9 Carotid Artery Intimal-Medial Thickness (IMT) as Measured by B-mode Ultrasound in Current Smokers, Ex-smokers, and Never-Smokers

Table 8.10 Endothelium-Dependent Arterial Dilatation in Active Smokers, Never-Smokers exposed to ETS, and Never-Smokers Not Exposed