CONTENTS

NOTE TO THE READER .............................................................................................................. 1

LIST OF PARTICIPANTS .................................................................................................................. 3

PREAMBLE ...................................................................................................................................... 7

A. GENERAL PRINCIPLES AND PROCEDURES ........................................................................ 7
   1. Background ................................................................................................................................. 7
   2. Objective and scope .................................................................................................................... 8
   3. Selection of agents for review ................................................................................................... 9
   4. Data for the Monographs ......................................................................................................... 10
   5. Meeting participants ............................................................................................................... 11
   6. Working procedures ............................................................................................................... 12

B. SCIENTIFIC REVIEW AND EVALUATION ............................................................................ 13
   1. Exposure data .......................................................................................................................... 14
   2. Studies of cancer in humans .................................................................................................... 16
   3. Studies of cancer in experimental animals ............................................................................. 20
   4. Mechanistic and other relevant data ...................................................................................... 23
   5. Summary .................................................................................................................................. 27
   6. Evaluation and rationale ......................................................................................................... 28

References ...................................................................................................................................... 33

GENERAL REMARKS ..................................................................................................................... 37

CONSUMPTION OF ALCOHOLIC BEVERAGES ......................................................................... 41
   1. Exposure Data ............................................................................................................................ 41
      1.1 Types and ethanol contents of alcoholic beverages ............................................................. 41
      1.2 Production and trade of alcoholic beverages ......................................................................... 42
      1.3 Trends in consumption ......................................................................................................... 50
      1.4 Sociodemographic determinants of alcoholic beverage consumption .......................... 71
      1.5 Non-beverage alcohol consumption .................................................................................... 77
      1.6 Chemical composition of alcoholic beverages, additives and contaminants .................. 79
      1.7 Biomarkers, biomonitoring and aspects of survey measurement ....................................... 137
      1.8 Regulations on alcohol ......................................................................................................... 140
   2. Studies of Cancer in Humans .................................................................................................. 171
      Assessment of alcoholic beverage intake in case–control and cohort studies ..................... 172
      2.1 Description of cohort studies .............................................................................................. 174
<table>
<thead>
<tr>
<th>2.1.1</th>
<th>Studies in general populations</th>
<th>174</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.2</td>
<td>Studies in special populations</td>
<td>231</td>
</tr>
<tr>
<td>2.2</td>
<td>Cancer of the oral cavity and pharynx</td>
<td>237</td>
</tr>
<tr>
<td>2.2.1</td>
<td>Cohort studies</td>
<td>237</td>
</tr>
<tr>
<td>2.2.2</td>
<td>Case–control studies</td>
<td>247</td>
</tr>
<tr>
<td>2.2.3</td>
<td>Types of alcoholic beverage</td>
<td>275</td>
</tr>
<tr>
<td>2.2.4</td>
<td>Joint effects</td>
<td>275</td>
</tr>
<tr>
<td>2.2.5</td>
<td>Effect of cessation of alcoholic beverage consumption</td>
<td>315</td>
</tr>
<tr>
<td>2.2.6</td>
<td>Effect of alcoholic beverage consumption in nonsmokers</td>
<td>315</td>
</tr>
<tr>
<td>2.3</td>
<td>Cancer of the larynx</td>
<td>329</td>
</tr>
<tr>
<td>2.3.1</td>
<td>Cohort studies</td>
<td>330</td>
</tr>
<tr>
<td>2.3.2</td>
<td>Case–control studies</td>
<td>333</td>
</tr>
<tr>
<td>2.3.3</td>
<td>Subsites of the larynx</td>
<td>333</td>
</tr>
<tr>
<td>2.3.4</td>
<td>Types of alcoholic beverage</td>
<td>347</td>
</tr>
<tr>
<td>2.3.5</td>
<td>Joint effects</td>
<td>349</td>
</tr>
<tr>
<td>2.3.6</td>
<td>Effect of cessation of alcoholic beverage consumption</td>
<td>350</td>
</tr>
<tr>
<td>2.3.7</td>
<td>Effect of alcoholic beverage consumption in nonsmokers</td>
<td>350</td>
</tr>
<tr>
<td>2.4</td>
<td>Cancer of the oesophagus</td>
<td>351</td>
</tr>
<tr>
<td>2.4.1</td>
<td>Cohort studies</td>
<td>352</td>
</tr>
<tr>
<td>2.4.2</td>
<td>Case–control studies</td>
<td>370</td>
</tr>
<tr>
<td>2.4.3</td>
<td>Histological types</td>
<td>370</td>
</tr>
<tr>
<td>2.4.4</td>
<td>Type of alcoholic beverage</td>
<td>389</td>
</tr>
<tr>
<td>2.4.5</td>
<td>Evidence of a dose–response</td>
<td>389</td>
</tr>
<tr>
<td>2.4.6</td>
<td>Effect of cessation of alcoholic beverage consumption</td>
<td>389</td>
</tr>
<tr>
<td>2.4.7</td>
<td>Effect modification</td>
<td>399</td>
</tr>
<tr>
<td>2.5</td>
<td>Cancer of the liver</td>
<td>399</td>
</tr>
<tr>
<td>2.5.1</td>
<td>Cohort studies</td>
<td>404</td>
</tr>
<tr>
<td>2.5.2</td>
<td>Case–control studies</td>
<td>404</td>
</tr>
<tr>
<td>2.5.3</td>
<td>Meta-analyses</td>
<td>415</td>
</tr>
<tr>
<td>2.5.4</td>
<td>Interaction with hepatitis viral infection</td>
<td>415</td>
</tr>
<tr>
<td>2.5.5</td>
<td>Interaction with tobacco smoking</td>
<td>418</td>
</tr>
<tr>
<td>2.6</td>
<td>Breast cancer</td>
<td>418</td>
</tr>
<tr>
<td>2.6.1</td>
<td>Pooled and meta-analyses</td>
<td>418</td>
</tr>
<tr>
<td>2.6.2</td>
<td>Additional cohort studies</td>
<td>419</td>
</tr>
<tr>
<td>2.6.3</td>
<td>Additional case–control studies</td>
<td>419</td>
</tr>
<tr>
<td>2.6.4</td>
<td>Measurements of alcoholic beverage intake</td>
<td>419</td>
</tr>
<tr>
<td>2.6.5</td>
<td>Tumour type</td>
<td>463</td>
</tr>
<tr>
<td>2.6.6</td>
<td>Types of alcoholic beverage</td>
<td>479</td>
</tr>
<tr>
<td>2.6.7</td>
<td>Subgroups of women</td>
<td>479</td>
</tr>
<tr>
<td>2.6.8</td>
<td>Male breast cancer</td>
<td>479</td>
</tr>
</tbody>
</table>
## CONTENTS

2.7 Cancer of the stomach ............................... 486
   2.7.1 Cohort studies .................................. 486
   2.7.2 Case–control studies .............................. 498
   2.7.3 Anatomic subsite and histological type ........ 498
   2.7.4 Type of alcoholic beverage ....................... 535
   2.7.5 Effect modification ............................... 535
2.8 Cancers of the colon and/or rectum ................. 542
   2.8.1 Cohort studies .................................. 542
   2.8.2 Case–control studies .............................. 564
   2.8.3 Potential confounding ............................ 600
   2.8.4 Effect modification ............................... 601
   2.8.5 Conclusion ........................................ 602
2.9 Cancer of the pancreas ............................... 602
   2.9.1 Cohort studies .................................. 602
   2.9.2 Case–control studies .............................. 617
2.10 Cancer of the lung .................................. 617
   2.10.1 Total alcoholic beverage consumption ......... 632
   2.10.2 Histological type ................................ 679
   2.10.3 Types of alcoholic beverage ....................... 679
   2.10.4 Studies stratified by tobacco-smoking status ... 700
   2.10.5 Studies among nonsmokers ....................... 714
   2.10.6 Population characteristics ....................... 714
2.11 Cancer of the urinary bladder ....................... 720
2.12 Cancer of the endometrium ......................... 741
   2.12.1 Cohort studies .................................. 741
   2.12.2 Case–control studies .............................. 741
   2.12.3 Evidence of a dose–response ..................... 761
   2.12.4 Types of alcoholic beverage ....................... 762
   2.12.5 Interactions ........................................ 762
2.13 Cancer of the ovary ................................ 762
   2.13.1 Cohort studies .................................. 762
   2.13.2 Case–control studies .............................. 770
   2.13.3 Evidence for a dose–response ..................... 770
   2.13.4 Types of alcoholic beverage ....................... 770
   2.13.5 Interactions ........................................ 770
2.14 Cancer of the uterine cervix ....................... 787
   2.14.1 Cohort studies .................................. 787
   2.14.2 Case–control studies .............................. 787
   2.14.3 Evidence of a dose–response ..................... 802
   2.14.4 Types of alcoholic beverage ....................... 802
   2.14.5 Interactions ........................................ 802
## CONTENTS

**ETHYL CARBAMATE** .............................. 1281

1. Exposure Data .................................................. 1281
   1.1 Chemical and physical data .......................... 1281
   1.2 Production and use .................................. 1288
   1.3 Occurrence and exposure .......................... 1289
   1.4 Regulations, guidelines and preventive actions .... 1289

2. Studies of Cancer in Humans .............................. 1308

3. Studies of Cancer in Experimental Animals ............. 1309
   3.1 Oral administration .................................. 1310
   3.2 Skin application ....................................... 1313
   3.3 Inhalation exposure .................................. 1313
   3.4 Other exposures ....................................... 1315
   3.5 Metabolites of ethyl carbamate ...................... 1318

4. Mechanistic and Other Relevant Data ..................... 1343
   4.1 Absorption, distribution, metabolism and excretion ... 1343
   4.2 Toxic effects ........................................... 1345
   4.3 Reproductive toxicity and teratogenicity ............ 1346
   4.4 Genetic and related effects .......................... 1352
   4.5 Mechanistic considerations .......................... 1361

5. Summary of Data Reported ................................. 1375
   5.1 Exposure data ........................................... 1375
   5.2 Human carcinogenicity data .......................... 1375
   5.3 Animal carcinogenicity data .......................... 1375
   5.4 Mechanistic and other relevant data ................ 1377

6. Evaluation and Rationale ................................. 1378

**GLOSSARY** .................................................. 1379

**LIST OF ABBREVIATIONS** ............................... 1381

**CUMULATIVE INDEX TO THE MONOGRAPHS SERIES** .......... 1385
NOTE TO THE READER

The term ‘carcinogenic risk’ in the IARC Monographs series is taken to mean that an agent is capable of causing cancer under some circumstances. The Monographs evaluate cancer hazards, despite the historical presence of the word ‘risks’ in the title.

Inclusion of an agent in the Monographs does not imply that it is a carcinogen, only that the published data have been examined. Equally, the fact that an agent has not yet been evaluated in a Monograph does not mean that it is not carcinogenic.

The evaluations of carcinogenic risk are made by international working groups of independent scientists and are qualitative in nature. No recommendation is given for regulation or legislation.

Anyone who is aware of published data that may alter the evaluation of the carcinogenic risk of an agent to humans is encouraged to make this information available to the Section of IARC Monographs, International Agency for Research on Cancer, 150 cours Albert Thomas, 69372 Lyon Cedex 08, France, in order that the agent may be considered for re-evaluation by a future Working Group.

Although every effort is made to prepare the monographs as accurately as possible, mistakes may occur. Readers are requested to communicate any errors to the Section of IARC Monographs, so that corrections can be reported in future volumes.