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2022 KDCA Report on Harmful Effects of Tobacco: An Overview of Tobacco Use and its Effects on Health

- Executive Summary -

Korea Disease Control and Prevention Agency
TOBACCO CONTROL INTEGRATED KNOWLEDGE CENTER

Foreword

Tobacco use is a major risk factor for the development of various diseases such as cancer and heart, lung, and eye diseases. Although Korea has shown a remarkable decrease in smoking prevalence since the 1990s, the decreasing trend has slowed recently. Therefore, it is necessary to develop alternatives for improving the effectiveness of tobacco control policies.

To increase the effectiveness and feasibility of tobacco control policies, evidence-based health policies are required. Considering these points, the United States published the Surgeon General's Report in 1964, which has been actively utilized as evidence to strengthen tobacco control policies.

In response, the Korea Disease Control and Prevention Agency (KDCA) first published the "Tobacco Integrated Report: Tobacco and its Harmful Effect," which systematically reviewed and analyzed the results of research on the harmful effects of smoking over the past 10 years to solidly support the scientific basis of Korea's tobacco control policy.

Approximately 40 experts participated in writing, reviewing, and editing this report, which covered trends and factors in tobacco use, nicotine addiction, smoking cessation treatment and intervention, harmful health effects of smoking, disease burden caused by smoking, and the current status and achievement of domestic tobacco control policies.

Hopefully, this report, which is a compilation of the research on smoking and smoking cessation, will widely disseminate correct knowledge about the health effects of tobacco use and be used as evidence for strengthening tobacco control policies in Korea.

Furthermore, the KDCA plans to expand our expert network and continuously publish integrated reports on tobacco, and hopes that these efforts will contribute in a small way in “realizing a healthy and safe society without tobacco.”

Lastly, I would like to express my gratitude to the experts who contributed to the publication of this report and expressed continued interest in research development in this field.

October 2022, Kyong Ran Peck

Commissioner of the Korea Disease Control and Prevention Agency

Preface

It gives me great pleasure to announce the publication of the "Tobacco Integrated Report: Tobacco and its Harmful Effect," which presents evidence related to the harmful effects of smoking and reports the achievements attained through the implementation of tobacco control policies in Korea. Scientific evidence related to smoking and tobacco control policies enhances public awareness of the harmful effects of smoking and serves as a solid framework for adopting and reinforcing the policies. Considering that more than 8 million people worldwide die yearly from tobacco use, it is vital to regularly collect relevant evidence and establish evidence-based future policy directions to eradicate the greatest threat to public health.

This report presents the results of research from Korea and other countries on the trend in tobacco use prevalence and related factors, nicotine addiction and treatment, smoking cessation interventions, health consequences of smoking, and the effects of smoking on the national disease burden. It also presents the current status and achievements of tobacco control policies in Korea and proposes future strategies for the implementation of the "tobacco endgame," the global battle against tobacco use towards a tobacco-free world, which is a hot topic in current tobacco control policies.

Korea has entered the last stage of the tobacco epidemic. Based on the combined evidence presented in this report, we must focus on supporting smoking cessation and counteracting the health consequences induced by exposure to tobacco smoke. The information contained in this report will serve as an important resource for public health policymakers, public health project managers, researchers, students, journalists, and the general public.

I would like to extend my deepest gratitude to the Health Hazard Response Division of the Korea Disease Control and Prevention Agency for their support in the publication of this report, the compendium of evidence on the risk of smoking and the achievements of our tobacco control policies, and the researchers who put much effort into writing and editing this report. In addition, we sincerely thank the 15 advisors who reviewed this manuscript. It is hoped that the publication of this first issue of the "Tobacco Integrated Report" will be followed by its sequels for the years to come and push forward our concerted efforts towards a tobacco-free world.

October 2022, Cho Sung-il

Director of the Tobacco Control Integrated Knowledge Center

Tobacco Integrated Report: Tobacco and its Harmful Effect

- Executive Summary -

Ⅰ. Introduction

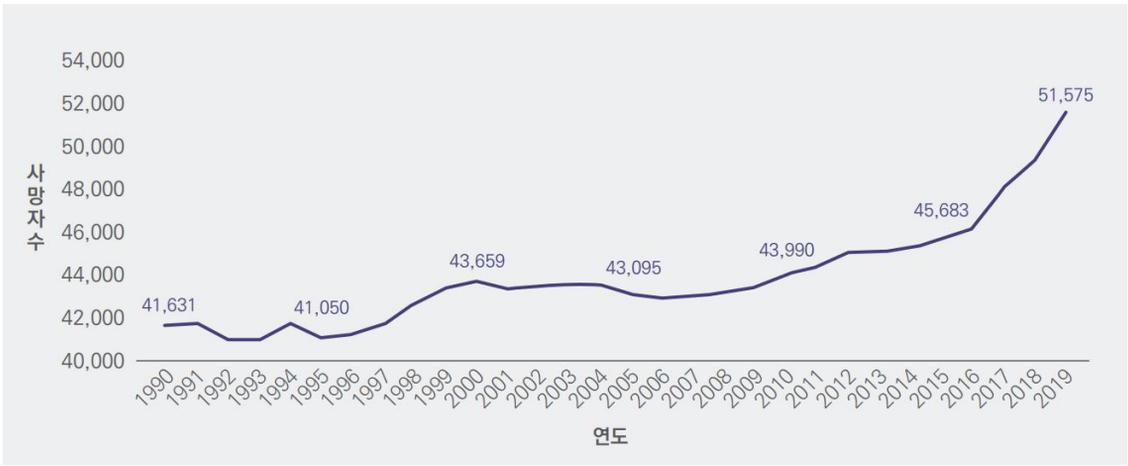
Smoking has killed more than 8 million people as of 2019, including 1.2 million deaths from exposure to secondhand smoke (Institute for Health Metrics and Evaluation, 2019). Tobacco has harmful effects on almost every organ in the body and causes various diseases, including cancer, heart disease, lung disease, eye disease, and diabetes (US Department of Health and Human Services, 2014). This means that tobacco use takes a very high priority among public health interventions, given the magnitude of its mortality and morbidity rates. Based on the Framework Convention on Tobacco Control (FCTC), adopted in 2003 and implemented in 2005 by the World Health Organization (WHO), the international community is responding jointly to reduce tobacco use and its risks.

Tobacco use is a serious threat to public health. The smoking prevalence of Korean adults, which reached 35% in 1998 (66% males, 7% females), was reduced as a result of tobacco control policies, such as designating non-smoking areas, health warning labels, smoking cessation treatment, and taxation policy (Korea Disease Control and Prevention Agency/Ministry of Health and Welfare, 2022). However, 20.6% of the total population (34.0% men, 6.6% women) still uses cigarettes, and the overall prevalence of tobacco or nicotine products, including novel tobacco products, such as electronic nicotine delivery systems (ENDS) and heated tobacco products (HTPs), is estimated to be higher than that of cigarettes. The prevalence of smoking among youth also decreased significantly from 12.1% (17.2% males, 6.5% females) in 2011 to 4.5% (6.0% males, 2.9% females) in 2021 (Korea Disease Control and Prevention Agency/Ministry of Education/Ministry of Health and Welfare, 2022), which remins high considering the health consequences of young smokers, as well as the ban on tobacco sales to minors, stipulated in the Youth Protection Act.

Smoking remains to be the leading risk factor for mortality in Korea. Smoking-related deaths have continued to increase from 44,000 in 2010 to 52,000 in 2019 (Figure 1.1), and smoking has been the leading cause of death since 1998 (Institute

for Health Metrics and Evaluation, 2019). The increasing number of smoking-related deaths despite a significant decrease in smoking prevalence is attributable to the health effects of tobacco use that persist for several years or decades at the population level. The socioeconomic costs of smoking also occupy a larger proportion compared with that of other risk factors, with 12 trillion won as of 2019, of which 4.6 trillion won were spent on direct costs, including medical, transportation, and nursing expenses, and 7.6 trillion won on indirect costs in the form of loss of productivity due to premature deaths and medical leaves (Cho et al., 2021). Therefore, to reduce the number of deaths and socioeconomic costs associated with tobacco use, it is necessary to promote and periodically evaluate evidence-based tobacco control policies to maximize their effectiveness.

Figure 1.1. Thirty-year trend (1990 to 2019) in the number of tobacco deaths in Korea



(Source: Institute for Health Metrics and Evaluation, Global Burden of Disease Study, 2019)

Evidence-based public health, which makes decisions based on objective evidence, enhances policy feasibility and efficacy of resource allocation (Brownson et al., 2017). Tobacco control policy measures should also be promoted based on cumulative epidemiological evidence, and a prerequisite for evidence-based policy implementation is data generation, enabling the synthesis of all existing research and policy results. The existing body of literature, including policy evaluation cases accumulated so far, is large enough to serve as the basis for synthesizing research

and reporting outcomes in Korea. The number of research projects and papers regarding tobacco use or smoking has been growing in recent years, particularly since cigarette prices increased in 2015. Over the past 10 years, research has covered a wide range of topics, including factors affecting tobacco use, health risks of smoking, and the effects of tobacco control policies.

The framework for evaluating tobacco control policies is well-established. MPOWER[1], presented by the WHO as an implementation strategy for promoting the FCTC, provides detailed guidelines for tobacco control policy measures, such as tobacco price increases and smoking cessation support, and can hence be used as a basic framework for evaluating tobacco control policies. Furthermore, parties to the FCTC submit reports every other year to the FCTC Secretariat. Based on these reports, the FCTC Secretariat prepares a global progress report on implementation, facilitating an inter-state comparison of the implementation status of tobacco control policies. Since the 2005 ratification of the FCTC, Korea has continuously adopted and reinforced tobacco control policies. The FCTC country reports and the International Tobacco Control Policies Evaluation Project (ITC Project) serve as basic data to evaluate tobacco control policies in Korea.

However, despite the large body of previous studies on behavioral changes, influencing factors, and health risks associated with tobacco use in Korea, limited attention has been paid to generating comprehensive data covering the entire landscape of tobacco use and control. In the United States, the Surgeon General's Report (SGR) issued regularly provides the latest statistics, such as tobacco use, its health consequences, the socioeconomic costs of tobacco use and exposure to secondhand smoke, and the effects of public health policies to counter smoking-induced damages in great detail. In particular, the landmark 1964 Surgeon General's Report: Smoking and Health (1964 SGR), one of the first research documents to

1) WHO FCTC "MPOWER"
- M : Monitor tobacco use and prevention policies
- P : Protect People from tobacco smoke
- O : Offer help to quit tobacco use
- W : Warn about the dangers of tobacco
- E : Enforce bans on tobacco advertising, promotion and sponsorship
- R : Raise taxes on tobacco

report the causal relationship between smoking and diseases such as lung cancer and cardiovascular disease, attracted great public and media attention immediately after its publication and was used as the basis for various tobacco control policies. After the release of the 1964 SGR, tobacco consumption per capita decreased in the United States, and the regular issues of SGR have contributed to strengthening tobacco control policies and reducing the health consequences of tobacco use (US Department of Health and Human Services, 2014). In Korea, there is a need to produce important and authoritative data at the level of the SGR for tobacco control, which would inform stakeholders and the general population of the harmful effects of tobacco use and contribute to the adoption and reinforcement of tobacco control policies by establishing comprehensive research evidence related to the risk of smoking and the effectiveness of tobacco control policies. Following the example of the US SGR on smoking and health, it appears a reasonable approach to preliminarily release a report that integrates previous evidence and then releases successive reports on a regular basis with periodically aggregated new evidence, which would intensify the momentum of tobacco control policies based on scientific evidence.

"Tobacco Integrated Report: Tobacco and its Harmful Effects" aims to provide evidence for strengthening future tobacco control policies by comprehensively analyzing and publishing research outcomes and achievements of tobacco control policy implementation so far. By focusing on domestic research and policy achievements, it is intended to integrate the achievements acquired through the implementation of tobacco control policies within the domestic context, such as Korea-specific tobacco use behaviors and health consequences.

Ⅱ. Major Conclusions

Chapter conclusions (Chapters 2 through 7) are summarized as follows:

1. In 2020, the cigarette smoking prevalence among adult men (66.3%) in Korea was reduced to half compared with that in 1998 (34.0%).
2. In 2021, the overall cigarette smoking prevalence among adolescents (12.1%) in Korea reduced to one-third of that in 2011 (4.5%).
3. After the Korean market entry of ENDS in 2008 and HTPs in 2017, the number of users fluctuated yearly; however, recent years have seen an increase in the number of both adolescent and adult users.
4. In 2021, the lifetime prevalence of nicotine dependence[2] in Korea was 15.0% for men and 1.1% for women.
5. According to the findings of Korean studies, tobacco use increases the risk of lung cancer, esophageal cancer, pancreatic cancer, stomach cancer, colorectal cancer, cervical cancer, myocardial infarction, ischemic heart disease, stroke, chronic obstructive pulmonary disease (COPD), asthma, tuberculosis, Crohn's disease, irritable bowel syndrome, gastroesophageal reflux disease (GERD), periodontal disease, diabetes, and rheumatoid arthritis.
6. Some Korean studies have reported that tobacco use increases the risk of birth defects such as fetal growth restriction, congenital heart disease, cleft lip, and cleft palate.
7. Continuous exposure[3] to secondhand smoke leads to harmful health effects similar to those of 5-10 cigarettes smoked per day.
8. Exposure to secondhand smoke affects female reproductive function and increases the risk of lung cancer, coronary artery disease, and stroke in adults.
9. Exposure to secondhand smoke increases the risk of otitis media; pulmonary symptoms, such as pulmonary insufficiency, upper respiratory tract infection,

2) The lifetime prevalence of nicotine dependence is the proportion of people who have experienced nicotine dependence at any point in their life.
3) In this report, secondhand smoke is limited to exposure to cigarette smoke.

lower respiratory tract infection, cough, dyspnea in adolescents and young children; and sudden infant death syndrome (SIDS) in newborns.

10. Ten to twenty years after quitting smoking, former smokers' risk of developing lung and pancreatic cancer is similar to that of non-smokers.
11. Tobacco use reduces life expectancy and increases the risk of death.
12. In 2016, the loss of healthy life years due to secondhand smoking in Korea was estimated at 44,000 disability-adjusted life years (DALYs), an above-average level among high-income countries in the Asia-Pacific region.
13. In 2019, the number of deaths caused by smoking totaled approximately 60,000, including approximately 51,000 men and 7,000 women aged 30 years and above.
14. In 2017, the number of users of the annual smoking cessation service in Korea totaled 770,000, and the service use rate accounted for 9.6% of smokers, with an average 1-year success rate of 34% of the service users.
15. Designation of non-smoking areas effectively reduces the smoking prevalence and tobacco consumption, as well as non-smokers' experience of exposure to secondhand smoke.
16. Graphic health warning labels effectively motivate smokers to quit smoking, strengthen their will to quit smoking, and prevent non-smokers from smoking initiation.
17. Taxation policies are effective in reducing the smoking prevalence, smoking amount, and increasing smoking cessation attempts.
18. Korea declared the tobacco endgame in 2019 but without specifying the goal.

Ⅲ. Preparation of the Report

This report was compiled using domestic and international research published between 1995 and 2021. In an international literature search, considering that the 2014 SGR on the health consequences of smoking covered all issues regarding tobacco use and related health risks in great detail, only meta-analyses or systematic reviews published after 2015 were included in the analysis. In the domestic literature search, all studies published between 1995 and 2021 were included without any specific restrictions on the type of literature. Irrespective of the scope of the literature search in terms of publication year and literature type, any documents judged suitable to summarize current achievements were used for the preparation of this report. Regarding tobacco control policy outcomes, those released by reliable public entities, such as international organizations and government departments, were included in this report, provided that it was possible to use them for international or time-series comparisons of the effectiveness of tobacco control policies. Although the screening and selection of the literature search results did not follow the elaborately designed systematic literature review methodology, important contents were derived and organized to best reflect the current level of knowledge and achievements of Korean tobacco control policies.

The principles for preparing this report are as follows:

1. Details covered in domestic and international research reports within the past 5 years have not been repeated as much as possible; however, abstracts and references may be presented as background information.
2. Domestic research and policy achievements are prioritized over international ones, of which abstracts and references may be presented as background information.
3. The composition of the 2020 SGR was adopted for this report; however, it expanded the topic coverage from smoking cessation to overall research related to smoking and tobacco control policies.

4. Contents and emissions of tobacco products are not included in this report.
5. Wherever applicable, the distinction is made between smoking and exposure to secondhand smoke.
6. Regarding tobacco-related English terms translated into different Korean words, only one is used consistently.

Ⅳ. Chapter Summaries and Conclusions

1. Chapter 2 – Trends of tobacco use prevalence and the factors related to tobacco use initiation and changes in tobacco use behavior

Chapter 2 describes the trends in tobacco use prevalence among Korea and other countries and the factors affecting tobacco use initiation and changes in tobacco use behavior.

The data that we used for Chapter 2 were as below. First, to observe the trends of tobacco use prevalence among both Korean adults and adolescents, we used the Korea National Health and Nutrition Examination Survey (KNHANES) and the Korea Youth Risk Behavior Survey (KYRBS). In addition, we reviewed the WHO Report on the Global Tobacco Epidemic and the OECD Health Statistics to understand the global tobacco use prevalence. Second, the factors that affect the initiation of smoking among adolescents were identified based on the US SGR, which defined the determinants of the initiation of tobacco use among adolescents, and on the Korean literature that examined the factors related to smoking initiation. Third, we describe the factors that affect the switching of tobacco products based on the related national and global literature.

The summary of this chapter is as follows:

1) The overall smoking rate among Korean adults (≥ 19 years) decreased from 35.1% (66.3% males, 6.5% females) in 1998 to 20.6% (34.0% males, 6.6% females) in 2020.
2) The smoking rate for Korean adolescents has also decreased from 12.1% (17.2% males, 6.5% females) in 2011 to 4.5% (6.0% males, 2.9% females) in 2021.
3) After the entry of electronic cigarettes (e-cig or ENDS) in 2008 and HTPs in 2017 in the Korean tobacco market, the number of e-cig and HTP users has increased

among both adolescents and adults. The number of users of these novel tobacco products, particularly multi-tobacco users, has also increased.

4) Determinants of the initiation of tobacco use include environmental factors, such as smoking peers, smoking parents, exposure to smoking scenes in the home and media; biological and genetic factors, such as smoking mothers during pregnancy; mental health factors, such as depression, anger, stress, and drinking; and other factors, such as sex, income, education level, residential area, academic performance, and self-efficacy.
5) The factors associated with changes in tobacco use behavior among Korean smokers were the market entrance of novel tobacco products, such as e-cigs and HTPs, and the increase of multi-tobacco product users.
6) Multi-tobacco use among adolescents is related to sex, age, residential environment, economic level, exposure to secondhand smoke, whether or not to smoke cigarettes or current use, alcohol consumption, stress, and academic performance.
7) Multi-tobacco use among adults is related to sex, age, high education level, cigarette use, excessive alcohol consumption, and discrete use of novel tobacco products in non-smoking areas.

2. Chapter 3 – Nicotine addiction, treatment, and smoking cessation interventions

Chapter 3 presents evidence-based research on smoking cessation interventions and their effectiveness, as well as nicotine addiction and its treatment in Korea. To obtain the necessary data, a literature search was conducted in PubMed, Korean Association of Medical Journal database (KoreaMed), and Research Information Service System (RISS) using the search terms “smoking,” “tobacco smoking,” and “nicotine dependence.” The search scope was set as research reports and full-text academic studies on human participants published from 1995 to the date of retrieval. Studies on the prevalence of simple tobacco use, related factors, and non-Korean

participants were excluded. The retrieved documents were screened based on their title and abstract, and the full text was checked if necessary. Among the selected literature, research results were reviewed for the contents covering treatments with drugs or interventions.

The summary of this chapter is as follows:

1) Nicotine addiction is defined as uncontrolled tobacco use resulting from repeated smoking.
2) According to the 2021 Mental Health Survey, the lifetime prevalence of nicotine dependence among Koreans was estimated to be 8.1% (15.0% males, 1.1% females).
3) Nicotine addiction is attributable to the mechanism by which nicotine releases dopamine through the reward circuit of the brain during smoking, and its major clinical features include tolerance, withdrawal, and craving.
4) The key vulnerability factors for nicotine addiction are genetic factors, which are responsible for 40–75% of cases. In particular, serotonin transfer genes, the nicotinic acetylcholine receptor, CYP1A1, and CYP2A6 are associated with nicotine addiction.
5) The Fagerström Test for Nicotine Dependence (FTND) is the most widely used method for assessing nicotine dependence. Among all FTND questionnaires, two questionnaires, “time to first cigarette of the day” and “the number of cigarettes per day,” can also be used to measure the level of dependence. Exhaled carbon monoxide and cotinine tests were used to determine smoking cessation status.
6) Non-pharmacological treatments (e.g., cognitive behavioral therapy), nicotine replacement therapy, and medication (bupropion or varenicline) are effective treatment options for nicotine dependence.

3. Chapter 4 – Health harms from tobacco use

Chapter 4 presents the health hazards of tobacco use and exposure to secondhand smoke, with a comprehensive review of the evidence from previous studies. It

includes summaries on health hazards from major smoking-related diseases such as cancer, cardio-cerebrovascular diseases (CCDs), respiratory diseases, and diseases of the reproductive system. Furthermore, other diseases covered and suggested as smoking-related health hazards in major international reports were also included under the category of "other diseases." The summary of smoking-related health hazards composed of five components: biological mechanisms of disease development, risk evaluation at the population level, factors associated with interactions with other potential risk factors on disease development, effects on disease treatment and prognosis, and risk reduction with smoking cessation.

To summarize the evidence on health effects of tobacco use, including cancer, CCDs, respiratory diseases, and diseases of the reproductive system, literature was searched in PubMed. The search terms used were "smoking," "cigarette smoking," "tobacco," "cancer," "neoplasm," "tumor," and "malignancy" in the case of cancer. The search scope was narrowed to meta-analyses and systematic literature reviews on human participants published in English language from January 1, 2015 to the date of retrieval.

A literature search of relevant Korean studies was conducted using the search engines KoreaMed, RISS, Policy Research and Management System, National Knowledge Information System, Institute for Health and Social Affairs, Korea Health Promotion and Development Institute, and Ministry of Health and Welfare. The main search terms used include "smoking," "cigarette smoking," "tobacco," "cancer," "neoplasm," "tumor," "malignancy," "smoking," "cigarette," and "cancer," identical to those used for the literature search of non-Korean studies. There were no restrictions on the publication period.

Among the literature searched, studies on biological mechanisms, current status, associated factors, risk at the population level, and survival period of diseases related to smoking or secondhand smoke exposure were included, while studies that did not consider exposure to smoking or secondhand smoke as the main topics were excluded.

The summary of this chapter is as follows:

1) Tobacco use and secondhand smoking reduce life expectancy and increase the risk of death.
2) Approximately 30% of all cancers are caused by tobacco use, which increases the risk of cancer incidence in the lungs, esophagus, head and neck, pancreas, stomach, colorectum, and cervix in the population in Korea and other countries.
3) Tobacco use increases the risk of CCDs development, such as myocardial infarction, ischemic heart disease, aortic aneurysm, heart failure, disease-specific cardiac arrest, stroke, and cerebral aneurysm in the population in Korea and other countries.
4) Tobacco use increases the risk of developing respiratory diseases, such as COPD, asthma, and tuberculosis in the population in Korea and other countries.
5) Smoking increases the risk of developing gastrointestinal diseases such as Crohn's disease, irritable bowel syndrome, and GERD in the population in Korea and other countries.
6) Tobacco use increases the risk of pregnancy-related problems and diseases of the reproductive system, such as congenital anomalies, fetal growth restriction, hypertension during pregnancy, and male sexual dysfunction in the population in Korea and other countries.
7) Smoking increases the risk of cataracts and age-related macular degeneration, while it has a protective effect on the development of pterygium in the population in Korea and other countries.
8) Tobacco use increases the risk of developing periodontal disease in the population in Korea and other countries.
9) Tobacco use increases the risk of developing diabetes and rheumatoid arthritis in the population in Korea and other countries.
10) Tobacco use increases the risk of mortality due to lung cancer, esophageal cancer, head and neck cancer, pancreatic cancer, myocardial infarction, angina, aortic aneurysm, and cerebral hemorrhage in the population in Korea and other countries.

11) The risk of morbidity and mortality caused by tobacco use is increased with an increase in the amount and duration of smoking.

12) Among patients diagnosed with lung cancer, angina pectoris, myocardial infarction, aortic aneurysm, stroke, cerebral hemorrhage, and tuberculosis (males), smokers have a higher risk of readmission, recurrence, and death than that of non-smokers, and continued smoking after the diagnosis worsens the prognosis due to decreased responsiveness to treatment.

13) Smoking combined with other risk factors, such as exposure to asbestos, alcohol consumption, obesity/overweight, and lack of physical activity, increases the risk of disease through the interaction of two or more risk factors.

14) Exposure to secondhand smoke means exposure to at least 250 known harmful chemicals, including more than 50 carcinogens.

15) Exposure to secondhand smoke can be assessed in various ways, such as surveys, environmental measurements, and biomarker measurements using bio-samples, but these methods have their respective limitations in terms of measurement accuracy, cost-effectiveness, and ease of measurement.

16) The 2020 KNHANES revealed that 10.3%, 3.9%, and 12.0% of adults are exposed to secondhand smoke at work, home, and public places, respectively.

17) The 2021 KYRBS revealed that adolescents are most frequently exposed to secondhand smoke in public places (32.8% males, 47.7% females), followed by at home (22.3% males, 24.4% females) and school (8.4% males, 7.4% females).

18) Continuous exposure to secondhand smoke can increase health risks, such as reduced lung function, which is equivalent to the level of smokers who smoke 5–10 cigarettes a day. Long-term exposure to secondhand smoke can lead to various diseases, including death.

19) Exposure to secondhand smoke in adults increases the risk of developing lung cancer, coronary artery disease, and stroke, affects female reproductive function, and causes nasal irritation. Exposure to secondhand smoke can lead to fatal consequences, such as death in patients with underlying diseases, such as allergy, asthma, lung disease, and heart disease.

20) Exposure to secondhand smoke in adolescents and infants increases the risk of developing pulmonary insufficiency, influenza, pneumonia, infection, lower respiratory tract diseases such as acute lower respiratory tract infection, respiratory symptoms such as coughing and dyspnea, and otitis media, and perinatal exposure to secondhand smoke increases the risk of SIDS in newborns.
21) Ten to twenty years after quitting smoking, former smokers' risk of developing lung and pancreatic cancer becomes similar to that of non-smokers.

4. Chapter 5 – Disease burden associated with smoking and secondhand smoking

The objectives of Chapter 5 are to estimate smoking-related morbidity, mortality, and related socioeconomic costs in Korea and elsewhere and to determine the current status of the burden of diseases, including the number of deaths due to exposure to secondhand smoke, population attributable fraction (PAF), DALYs, and socioeconomic costs due to premature deaths and loss of productivity. The socioeconomic costs of related premature deaths and lost productivity were examined. Smoking-induced morbidity, mortality, and socioeconomic burden in Korea were determined based on research evidence from global data sources and literature collected by systematic review.

Compared with that of smoking, there are limited documents regarding exposure to secondhand smoke, assessment of the related risk of developing diseases, and calculation of disease burden based on PAF. However, efforts are being made to estimate the extent of non-smokers' exposure to secondhand smoke based on the fraction and number of smokers in each country and the socioeconomic costs related to the risk of diseases in which causal relations with exposure to secondhand smoke have been proven. Therefore, related research results were summarized.

The summary of this chapter is as follows (1-3 on smoking and 4-7 on exposure to secondhand smoke):

1) In 2015, the PAF of smoking-induced diseases accounted for 9.2% of colon cancer and 21.8% of rectal cancer in male patients, equivalent to approximately 800 colon cancer and 1,600 rectal cancer cases in Korea.
2) In 2019, the number of deaths due to smoking totaled approximately 60,000, including approximately 51,000 men and 7,000 women aged 30 years and above.
3) In 2013, the socioeconomic cost of smoking amounted to approximately 7.1 trillion won, of which approximately 2.4 trillion won is the portion assumed by health insurance.
4) The disease that contributed the most to the disease burden attributable to exposure to secondhand smoke shifted from lower respiratory tract infection (as of 2007) to ischemic heart disease (as of 2017).
5) Research on the burden of diseases in adults due to exposure to secondhand smoke is related to lung cancer, ischemic heart disease, stroke, asthma, COPD, and breast cancer.
6) Research on the burden of pediatric diseases due to exposure to secondhand smoke is related to lower respiratory tract infections, otitis media, asthma, SIDS, and low birth weight.
7) According to a systematic review published in 2016, the loss of healthy life years due to secondhand smoking in Korea was estimated at 44,000 DALYs, the above-average level among high-income countries in the Asia-Pacific region.

5. Chapter 6 – Tobacco control policy status and achievements in Korea

This chapter describes the strategies and methodologies for tobacco control policy, drawing on the FCTC, and reviews the achievements of the core strategies. Among the major FCTC strategies, this chapter covers smoking cessation support projects, the designation of non-smoking areas, graphic warnings, and taxation policies.

The summary of this chapter is as follows:

(1) Taxation policies

1) Korea levies amount-specific excise tax on tobacco consumption tax.
2) The average price of cigarettes increased from 900 won in 1994 to 4,500 won in 2015 on seven occasions over the past 20 years, while the actual unit production price of cigarettes has decreased since 2015.
3) The tobacco excise tax burden in Korea is 74%, which is lower than 75% recommended by the WHO.
4) The tobacco price policy effectively improves smoking behavior, such as reducing the smoking prevalence at the population level, reducing the amount of smoking, and increasing attempts to quit smoking.
5) Tobacco tax policy reduces the amount of smokingor prevalence and increases the intention to quit smoking among adolescents and young adults.

(2) Non-smoking area

1) WHO FCTC Article 8 (Protection from Exposure to Tobacco Smoke) requires state parties to prohibit smoking in all indoor workplaces, public transport, indoor public places, and, where appropriate, other public places.
2) According to the National Health Promotion Act, the Korean government is gradually expanding its non-smoking areas. Currently, 26 types of facilities or institutions are designated as non-smoking areas, and some beaches, downtown areas, and parks are designated as non-smoking areas under local government ordinances.
3) Designation of non-smoking areas effectively reduces the smoking prevalence and the amount of tobacco consumption.
4) Designation of non-smoking areas effectively reduces the non-smokers' exposure to secondhand smoke.
5) Designation of non-smoking areas contributes to the health promotion of workers.

6) Designation of non-smoking areas effectively improves air quality.
7) Designation of non-smoking areas does not entail a decrease in cigarette sales.

(3) Graphic health warnings on tobacco products

1) FCTC Article 11 (Packaging and Labeling of Tobacco Products) prohibits state parties from displaying false, misleading, or deceptive messages on tobacco packaging and labels and obliges them to cover at least 30% of the package with health warning messages and images.
2) In Korea, warning messages were introduced in 1976, and graphic health warning labels have been displayed on at least 30% of the front and back of packages since December 2016. In addition to cigarettes, the same regulations apply to all other types of tobacco products, such as ENDS and HTPs.
3) Exposure to graphic health warning labels is effective in perceiving smoking-induced health risks.
4) Exposure to graphic health warning labels is effective in inducing smokers to quit smoking or strengthening their will to quit smoking.
5) Exposure to graphic health warning labels is effective in preventing non-smokers from starting smoking.
6) Emotions, perceptions, attitudes, and effects induced by graphic health warnings vary according to their types and combinations.

(4) Smoking cessation treatment policy

1) In compliance with the principles and recommendations of the WHO FCTC, the Korean government actively promotes and supports smoking cessation by providing, without charge, not only smoking cessation counseling aiming at behavioral change but also nicotine replacements, prescription drugs, and behavior-enhancing products by developing and implementing a wide range of smoking cessation programs. Service provision capacity and compliance rate are also high.

2) Korea's smoking cessation programs provide diversified services considering the characteristics and accessibility of the service participants, such as clinics in local public health centers, counseling hotlines, treatment support services in hospitals or clinics, camps offering general and specialized treatment, and visiting services.
3) In 2017, the annual number of smoking cessation support service users in Korea totaled 770,000, and the service use rate accounted for 9.6% of smokers, with an average 1-year success rate of 34% of the service users.

6. Chapter 7 - Future strategies for the tobacco endgame

This chapter presents the results of the studies that analyzed the effectiveness of individual strategies, social support, ethical considerations, and research gaps, focusing on the proposed tobacco endgame strategies. First, the current implementation status of the tobacco endgame was examined, focusing on countries that announced the target year for the realization of the tobacco endgame as part of their national plans. Second, the related literature and government plans were reviewed to assess Korea's efforts towards the tobacco endgame in comparison with other countries. Finally, a future strategy was proposed to ensure the realization of the tobacco endgame by collecting and synthesizing the opinions of key spearhead groups as well as domestic situations.

The summary of this chapter is as follows:

1) The tobacco endgame is an innovative strategy to end the tobacco epidemic, aiming to achieve near-zero (typically < 5%) smoking prevalence within a set time frame.
2) As prerequisites for adopting and implementing the tobacco endgame, achieving a smoking prevalence < 15%, a high level of social support, and strong political leadership were suggested.
3) The main tobacco endgame strategies are regulations on nicotine concentration in cigarettes, restrictions on tobacco retail shops, and bans on tobacco sales by birth-year (tobacco-free generation).

4) Countries that have set the target year for achieving the tobacco endgame include New Zealand (< 5% by 2025), Sweden (< 5% by 2025), Scotland (< 5% by 2034), Finland (< 2% by 2030), and Australia (< 5% by 2030).

5) Among the countries that have set goals for the realization of the tobacco endgame, New Zealand is promoting the introduction of innovative endgame strategies, such as tobacco-free generation, while Australia, Finland, and Canada are advancing towards the achievement of the tobacco endgame by implementing FCTC policy strategies.

6) Korea declared a tobacco endgame with the announcement of the Quit Smoking Program in 2019 but without specifying the target smoking rate and year. The strategies proposed for the Quit Smoking Program are based on existing FCTC policies.

7) Prior to adopting tobacco endgame strategies, a drastic reduction in smoking prevalence should be achieved through a steadfast implementation of the FCTC guidelines and recommendations, and preparations for the launch of the tobacco endgame should be made while performing legislative activities and accumulating research evidence related to the tobacco endgame.

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