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REVIEW ARTICLE

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Smoking and Non-Communicable Diseases: Part I Cardiovascular Diseases, Respiratory Diseases, Obesity, Depression, Liver Diseases

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Abstract

Smoking tobacco is popular all over the world. It is however full of toxic chemicals, with many of them being carcinogenic. These chemicals affect every organ in the human body, leading to a wide array of disorders. This results in considerable suffering. frequent disability, and premature mortality. It is estimated that smokers lose several years of healthy life. Smoking hookah or e-cigarettes is also harmful. Smoking remains the number one preventable cause of several non-communicable diseases.

Keywords: smoking, non-communicable diseases, cardiovascular diseases, respiratory diseases, obesity, depression, liver diseases

1 | INTRODUCTION

Tobacco smoking is a major modifiable risk factor for a wide array of diseases[1]. Besides nicotine, tobacco smoke also contains several thousand chemical compounds, either gaseous or particulate, and many of these are toxic[2]. In addition to the major non-communicable diseases discussed in this two-part manuscript, tobacco smoke has been associated with complications of pregnancy and sudden infant death syndrome[3]. Infants exposed to cigarette smoke either prenatal or after birth also increase their risk of orofacial clefts, periodontal disease, and dental caries[4]. Smoking increases the risk of dental implant failure[5]. It also enhances aging, causing premature wrinkles[6]. It is estimated that 16 million adults are currently living with smoking-related diseases in the United States[7].

Smoking cessation reduces the risk of major chronic diseases[8]. Cessation also helps reduce the severity of

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the disease[9], improves the quality of life[10], increases disease-free life[11], and augments life expectancy[12]. Smoking is the leading preventable cause of death worldwide[13].

2 | DISCUSSION

CDC defines chronic diseases as "conditions that last 1 year or more and require ongoing medical attention or limit activities of daily living or both"[14]. Most chronic diseases are noncommunicable. The five major diseases discussed in this part are cardiovascular diseases (CVD), respiratory diseases, obesity, depression, and liver diseases. CVDs include coronary heart disease, high blood pressure (BP), stroke, heart failure, cardiac arrhythmias (including sudden cardiac death), peripheral arterial disease, deep vein thrombosis, and vasculogenic erectile dysfunction. They are a leading cause of morbidity and mortality, globally[15]. Smoking remains the main modifiable lifestyle factor responsible for most of these diseases[16]. Even low-tar cigarettes and smokeless tobacco have been shown to increase the risk of cardiovascular events in comparison to nonsmokers[17]. The main respiratory diseases are chronic obstructive pulmonary disease (COPD), asthma, respiratory infections, and cancer. COPD is a progressive and debilitating disease that causes a decline in lung function leading to cor-pulmonale, respiratory failure, and premature death[18]. It is responsible for over 3 million deaths annually[19]. The World Health Organization (WHO) predicts that COPD will be the third leading cause of death, worldwide, in 2030[20]. Obesity is a pandemic and is associated with increased morbidity and mortality[21]. Bodyweight classification is generally based on the calculation of body mass index (BMI)[22]. Normal BMI is 18.5–24.9 kg/m2, overweight is a BMI 25 to 29.9 kg/m2, and obesity is a BMI >30 kg/m2[23]. Central obesity (visceral or abdominal obesity) often confers worse health effects, even with a normal BMI[24]. This type of obesity can be determined by waist circumference, waist hip-ratio, or waist-height ratio[25,26]. Depression is characterized by sadness, loss of interest and pleasure, feelings of guilt, feeling of worthlessness, low appetite, fatigue, and poor concentration[27]. It is estimated that it affects 350 million people worldwide[28]. Depression increases the risk of physical ailments, especially cardiovascular diseases[29]. The Global Burden of Disease Study 2016 reported that depression is a major cause of disability[30]. It also increases suicide and all-cause mortality[31]. Liver diseases are on the rise worldwide and are responsible for a considerable amount of morbidity and mortality[32]. They include non-alcoholic fatty liver (NAFLD), alcoholic liver disease, cirrhosis, and liver cancer[33]. Hepatocellular carcinoma is highly lethal, with less than 10% living beyond 5 years[34].

Cardiovascular Diseases

Cigarette smoking is a major cause of CVDs[35]. Most CVDs are due to atherosclerosis[36]. Smoking accelerates this process by several mechanisms, including activation of inflammatory factors, dysregulation of the lipid metabolism, an increase in oxidative stress, and causing endothelial dysfunction[37–39]. Smoking acutely elevates blood pressure[40] through the stimulation of the sympathetic nervous system[41]. It also increases the risk of renovascular[42], malignant[43], and masked hypertension[44]. The causal impact of smoking on chronic hypertension is however unclear[45]. Passive smoking has been associated with an increased risk of hypertension among adults[46]. Several epidemiologic studies have indicated that there is an increase in the incidence of myocardial infarction and fatal coronary artery disease with smoking[47,48]. Smoking raises the risk of coronary plaque rupture47, and this generates thrombosis at the site[48]. Smoking is also associated with an increase in coronary spasms[49,50]. Passive smoking also increases the risk of coronary artery disease[51]. In a meta-analysis of 29 prospective cohort studies, Aune et al. found that smoking increased the relative risk of heart failure by 44%[52]. Lu et al. confirmed this increased propensity in a recent Mendelian randomization analysis study[53]. Cigarette smoking is causally connected with 12.4% of acute strokes[54]. Pre-stroke smoking also appears to worsen its prognosis when compared to never smokers[55]. Smoking is also directly associated with a more than a two-fold increased risk of atrial fibrillation[56]. Smoking cessation lowers this risk[56]. Sudden cardiac death

is usually due to ventricular arrhythmias[57], and this is also increased in smokers[58]. Smoking has been linked with an increase in the risk of peripheral artery disease[59,60] and abdominal aortic aneurysms[61,62]. Smoking cessation is associated with a reduced rate of aneurysmal growth[63]. Smoking can induce erectile dysfunction[64] through multiple pathways, with disturbed nitric oxide signal transduction pathway being the main one[65−68]. Smokers are also at an increased risk of venous thromboembolism[69]. This risk is partially increased by physical inactivity[70] and the occurrence of smoking-related diseases in these patients[71].

Smoking cessation reduces cardiovascular events[72]. It reduces these risks and mortality even if cessation happens after the development of a CVD[73]. Smoking promotes atherosclerosis via vasomotor dysfunction, increased inflammation, and modification of lipids[74]. It also enhances thrombosis, via prothrombotic alterations in platelet function, antithrombotic/prothrombotic activity, and fibrinolytic factors[75].

Respiratory Diseases

Cigarette smoking is a major cause of COPD[76,77]. COPD is one of the most common and dangerous noncommunicable health disorders[78]. The lifetime risk for smokers getting COPD is estimated to be over 20%[79], with one recent study estimating the risk to be as high as 50%[80]. Passive smokers are also at an increased risk of developing COPD[81]. COPD smokers, both current and past, exhibit an increased risk for lung cancer, CVDs, and diabetes mellitus[82−84.] Smoking cessation, especially at an early age, greatly helps reduce the symptoms and the rate of pulmonary function decline in these patients[85,86]. Their quality of life also improves[87], and mortality is reduced[88]. Besides COPD, asthma is also a major disease affecting the respiratory tract[89]. Smoking increases the risk of developing asthma by 33% to 81%, when compared to nonsmokers[90]. Continued smoking also increases the incidence of exacerbations and poor control in these patients[91]. It can also lead to a more severe pulmonary disease like COPD[92]. Second-hand smoke exposure, especially in children, also exacerbates asthma-related hospitalizations[93,94]. Smoking has also been associated with chronic bronchitis and several interstitial lung diseases[85,96]. It is estimated that almost 90% of lung cancers are related to smoking[97]. Secondhand smoke exposure also increases the risk of lung cancer in non-smokers[98]. Smokers are also more susceptible to bacterial and viral pulmonary infections[99−101.] These include viral influenza and tuberculosis[99,100]. Smoking also increases the risk of acute respiratory distress syndrome in COVID infections[101].

Tobacco smoke affects the lungs in several ways – it induces oxidative stress and apoptosis[102−104], increases secretions from mucous glands[105,106], and alters the histologic alveolar histology[107,108]. Epigenetic factors may also be involved[109].

Obesity

The relationship between smoking and obesity is complex and published reports provide conflicting results[110−112]. While some studies have shown no significant association between smoking status and BMI[110], others have suggested that smoking may be associated with lower BMI[111] and smoking cessation with an increased BMI[112]. Most individuals believe that smoking helps weight loss[113−115], and fear of weight gain is often a cause of relapse among former smokers[116]. Both smokers and nonsmokers believe that smoking is an efficient way to control body weight[117]. Most scientific studies confirm that lower adiposity is common among active smokers[118,119]. Nicotine acutely increases energy expenditure[120] and may also help reduce appetite[121,122]. Further, scientific studies find that former smokers have a higher level of obesity[123], mainly due to an increase in BMI following smoking cessation[124−126], thereby validating the smokers' bias. However, current smokers tend to have a higher visceral (abdominal) obesity than non-smokers[127−129]. CAT scans reveal higher levels of visceral adiposity to subcutaneous adipose tissue ratio in smokers[130]. Second-hand smoke exposure also increases obesity, with adolescents having an increased 1.19 odds of obesity than those with no exposure to secondhand smoke[131]. In a study including more than 10 million participants from 239 prospective studies, all-cause mortality was minimal for persons with BMI between 20 and 25; however, each 5-unit increase in BMI above 25 was associated with a 49%, 38%, and 19% higher risk of mortality, respectively[132]. Therefore, there is a concern that

weight gain after smoking cessation could increase the risk of chronic diseases and potentially attenuate the benefits of quitting smoking[133]. However, given the serious deterioration of health from smoking, the net effect is still better health outcomes after smoking cessation[134].

Depression

Individuals with mental health conditions smoke more heavily[135] and experience up to 18 years of reduced life expectancy when compared with the general population[136]. This major decrease in longevity is primarily due to premature mortality from smoking-related diseases[137]. Depression is strongly linked with smoking – and this relationship is bidirectional[138]. In the National Longitudinal Study of Adolescent Health from the United States, Goodman and Capitman found that smoking in adolescents resulted in a higher risk of developing depressive symptoms[139]. In an Australian case-control study, the age-adjusted odds ratio (OR) for smoking more than 20 cigarettes per day and developing depression, was 2.18[140]. In a multinational study (WHO's Study on Global Ageing and Adult Health), the OR for smoking associated with incident depression was 2.06[141]. In another study, current smokers who smoked more than 20 cigarettes per day had the highest risk of developing depression[142]. A more recent systematic review of 148 studies, also found a positive association between smoking and depression[143]. Another recent large study involving 10,036 individuals (Gutenberg Health Study), found that current smoking was predictive of new-onset depression, with an OR of 1.35[144]. Secondhand smoke also increases the risk of depression, in children[145], adolescents[146], and adults[147−149]. This relationship is dose dependent[150]. Depressed people also smoke more[151−154].

It is estimated that in the United Kingdom, up to 31% of individuals with depression smoke[151] while only 14% of the general population does[152]. Depressed patients are more likely to increase their smoking over time[153], and those who continue to smoke experience worse depressive symptoms compared to their abstinent counterparts[154].

Liver Diseases

Smoking is associated with worse outcomes in patients with NAFLD[155,156]. They are more apt to develop liver fibrosis[155] and primary biliary cirrhosis[156]. Patients with Hepatitis B (HBV) who smoke increase their risk for hepatocellular cancer (HCC)[157]. Smoking is also harmful to individuals with hepatitis C (HCV), increasing the risk of steatosis, fibrosis, and HCC[158,159].Tobacco smoking has been shown to delay wound healing post-liver transplant160 and to significantly increase vascular complications in these patients[161].

HCC is also more common in smokers[162]. Lee et al. calculated that the relative risk ratio was 1.51 for this increased incidence, after conducting a meta-analysis of 38 cohort studies and 58 case-control studies, and after adjusting for HBV infection, HCV infection, and alcohol consumption[163]. Smoking also increases HCC related mortality[164]. Besides the multitude of carcinogens found in cigarette smoke, one chemical, 4-Aminobiphenyl, has been specifically shown to increase the risk of HCC[165]. Tobacco smoking has also been implicated in the reduction of p53, a tumor-suppressing gene and a common pathway of oncogenesis for many neoplasms[166]. Alcohol is extremely harmful to the liver[167]. Almost 90% of alcoholics smoke and most of them smoke at least one pack of cigarettes per day[168]. Chronic smokers are also more likely to consume alcohol in excess[169]. Smoking is also harmful in patients needing liver transplantation – a poor lung function often precludes liver transplantation[170]. Following transplantation, smoking increases the risk of de novo malignancy[171], vascular complications[172], and non-graft-associated mortality[173].

3 | CONCLUSION

Tobacco is highly addictive and extremely harmful. It increases the risk of developing and worsening the progression of several non-communicable diseases, including cardiovascular, respiratory, and liver diseases. It is also detrimentally associated with obesity and depression. There is no safe level of tobacco exposure including second-hand and third-hand exposure. Smoking cessation can be achieved and is associated with alleviation of symptoms, decrease in

disease progression, a better quality of life, and an increased life expectancy.

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