Smoking, vaping and hospitalization for COVID-19

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Abstract

The study presents an analysis of the current smoking prevalence among hospitalized patients with COVID-19 in China, compared to the population smoking prevalence in China (52.1% in males and 2.7% in females). We identified 6 studies examining the clinical characteristics of hospitalized COVID-19 patients that presented data on the smoking status. The expected number of smokers was calculated using the formula Expected smokers = (males x 0.521) + (females x 0.027). An unusually low prevalence of current smoking was observed among hospitalized COVID-19 patients (9.6%, 95%CI: 8.2-11.1%) compared to the expected prevalence based on smoking prevalence in China (31.2%, 95%CI: 29.0-33.4%; z-statistic: 19.16, P < 0.0001). This preliminary analysis does not support the argument that current smoking is a risk factor for hospitalization for COVID-19, and might suggest a protective role. The latter could be linked to the downregulation of ACE2 expression that has been previously known to be induced by smoking. No studies recording e-cigarette use status among hospitalized COVID-19 patients were identified. Thus, no recommendation can be made for e-cigarette users.

Keywords. SARS-CoV-2, COVID-19, ACE2, expression, susceptibility, smoking, hospitalization, electronic cigarette.

Introduction

There is a lot of speculation about the effects of smoking on Corona Virus Disease 2019 (COVID-19). Smoking increases susceptibility to respiratory infections and media reports suggest that it may increase the risk of being infected with acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus responsible for COVID-19. SARS-CoV-2 is known to use the angiotensin converting enzyme 2 (ACE2) as a receptor for cell entry, and there is evidence that smoking downregulates ACE2 expression in the lung and other tissues.[1] China has a high prevalence of smoking (27.7%), much higher among males (52.1%)

than females (2.7%).[2] It was recently suggested that there is no strong evidence between smoking and prevalence of COVID-19 due to the low prevalence of smoking among COVID-19 patients in 2 studies compared to the population smoking prevalence in China.[3] The purpose of this study was to examine the prevalence of current smoking among Chinese hospitalized cases with COVID-19 relative to the population prevalence of current smoking in China.

Methods

To examine how the prevalence of smoking among hospitalized COVID-19 compares to the smoking prevalence of the population, we systematically searched on PubMed using the terms "(SARS-CoV-2 OR COVID-19) AND Clinical" in the title or the abstract. Out of a total of 205 studies published until March 25, 6 studies which included data about the smoking status were identified.[4-9] Prevalence of smoking among hospitalized patients was compared with the expected prevalence that was calculated based on the population smoking prevalence and gender of hospitalized cases using the formula:

Expected smokers = (males x 0.521) + (females x 0.027)

The expected prevalence was calculated separately for each study and for the sum of all cases from the 6 studies examined. The comparison between the prevalence of smoking among hospitalized COVID-19 patients and the expected prevalence was performed using the test for one proportion (z-statistic).

Results

Findings are presented in Table 1. From a total 1701 hospitalized COVID-19 cases analyzed in the 6 studies, 57.7% were males and 42.3% were females. The prevalence of current smoking was 9.6% (95%CI: 8.2-11.1%). However, the calculated expected prevalence of current smoking, considering the population prevalence in China was 31.1% (95%CI: 29.0-33.4%). The difference was statistically significant for each study and for the sum of all cases (z-statistic: 19.16, $P < 0.0001$).

Table 1. Gender and smoking prevalence among hospitalized COVID-19 patients, and expected number of smokers based on population prevalence of smoking in males (52.1%) and females (2.7%) in China.

	Hospitalized cases	Males	Females	Expected current smokers (1)	Expected current smokers	Hospitalized Current smokers	Hospitalized Current smokers	z-statistic (P value)
	N	n	n	n	% (95%CI)	n	% (95%CI)	
Guan et al.	1096	637	459	344	31.4 (28.7-34.1)	137	12.5 (10.5-14.5)	13.48 (< 0.001)
Zhou et al.	191	119	72	64	33.5 (26.8-40.2)	11	5.8 (2.5-9.1)	8.11 (< 0.001)
Mo et al.	155	86	69	47	30.3 (23.1-37.5)	6	3.9 (0.9-6.9)	7.15 (< 0.001)
Zhang et al.	140	71	69	39	27.8 (20.4-35.2)	2	1.4 (0.0-3.3)	6.97 (< 0.001)
Liu et al.	78	39	39	21	27.4 (17.5-37.3)	5	6.4 (0.1-11.8)	4.16 (< 0.001)
Huang et al.	41	30	11	16	38.8 (16.9-45.3)	3	7.3 (0.0-15.3)	4.15 (< 0.001)
Total	**1701**	**982**	**719**	**531**	**31.2 (29.0-33.4)**	**164**	**9.6 (8.2-11.1)**	**19.16 (< 0.001)**

(1) Expected number of smokers was calculated based on the prevalence of smoking in China, using the formula:
Expected smokers = (males x 0.521) + (females x 0.027)

Figure

Discussion

The current study examined for the first time the prevalence of current smoking among hospitalized patients with COVI-19 in China and compared it with the expected prevalence based on the population smoking prevalence. Care was taken to consider the large difference between genders, with current smoking being substantially more prevalent among Chinese males than females. An unusually low prevalence of current smoking among hospitalized COVID-19 cases in China was observed when considering the population smoking prevalence. The true prevalence observed in the 6 studies analyzed was approximately one-third the expected prevalence. This preliminary analysis, assuming that the reported data are accurate, does not support the argument that current smoking is a risk factor for hospitalization for COVID-19, and might even suggest a protective role. The latter could be linked to the downregulation of ACE2 expression that has been previously known to be induced by smoking. However, other factors, such as socioeconomic status, should be considered in examining if access of Chinese smokers with COVID-19 to hospital care may be different compared to the non-smoking population. At this time, it is impossible to perform a multivariate analysis or examine prevalence of COVID-19 infection according to the smoking status of the whole population. Additionally, this study examined only hospitalized cases. Thus, no conclusion can be drawn on the susceptibility of smokers to COVID-19 that would not require hospitalization.

The study has implications when examining the effect of smoking status on disease progression, complications and death among hospitalized COVID-19 patients. Smokers are more likely than non-smokers to suffer from comorbidities, such cardiovascular

disease, which are risk factors for adverse COVID-19 outcomes. It has been reported that medications such as ACE-inhibitors, which are commonly used in patients with hypertension and cardiovascular disease, upregulate ACE2.[10] It remains unclear whether smoking per se or other factors related to comorbidities may be responsible for an adverse outcome. No studies recording e-cigarette use status among hospitalized COVID-19 patients were identified. Thus, no recommendation can be made for e-cigarette users.

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