http:// ijp.mums.ac.ir
Original Article (Pages: 17590-17598)

COVID-19 Risk Factors in Frontline Healthcare Workers in Mashhad University Hospitals

Leila Golnari [1], Mohammad Hassan Aelami [2], Amin Saeidi nia [3], Maliheh Dadgarmoghaddam [4], * Nafiseh Pourbadakhshan [5]

[1] Resident of Pediatrics, Department of pediatrics, Mashhad University of Medical Sciences, Mashhad, Iran.

[2] Clinical Research Development Unit of Akbar Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

[3] Resident of Pediatrics, Department of pediatrics, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

[4] Community Medicine Department, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

[5] Clinical Research Development Unit of Akbar Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

Abstract

Background: During the pandemic of COVID-19, Healthcare Workers (HCWs) have been at the forefront of infection; they could also carry the disease to the others.

Methods: In this cross-sectional study, HCWs in five hospitals of Mashhad University of Medical Sciences were included from 20 March to 21 July, 2020. HCWs were divided into two categories of frontline and second-line. The checklist was researcher-made and was on the basis of WHO risk factors regarding COVID-19, MERS and SARS. The participants were analyzed. The participants were asked, via phone call, to answer questions in 3 sections of demographics, probable risk factors, and clinical manifestations. The need for Personal Protective Equipment (PPE) and its availability were also evaluated.

Results: From among 534 HCWs included in this study, 197(57.6%) were females; most of them were nurses, and the mean ± SD age was 36.02 ± 8.5 years. Eighteen HCWs were hospitalized due to the severity of disease, most of whom were front-line HCWs. Malaise (78.7%), fever (68.1%) and gastrointestinal symptoms (63.7%) were the most common manifestations in the participants. Smoking (OR=0.078, P=0.001) and underlying diseases (OR=2.19, P=0.025) were known as the factors predicting HCWs hospitalization. Being smoker and participating in intubation procedure were independent predictors of hospitalization in HCWs.

Conclusion: Frontline HCWs had a significantly higher risk of COVID-19 infection, as compared to the second-line group. Although adequate supplies of PPE are necessary, they do not completely mitigate high-risk exposures.

Key Words: COVID-19, Healthcare Workers (HCWs), Risk Factor.

* Please cite this article as: Golnari L, Aelami MH, Saeidi nia A, Dadgarmoghaddam M, Pourbadakhshan N. COVID-19 Risk Factors in Frontline Healthcare Workers in Mashhad University Hospitals. Int J Pediatr 2023; 11 (04):17590-17598. DOI: **10.22038/ijp.2023.71260.5227**

Corresponding Author:

Nafiseh Pourbadakhshan, Clinical Research Development Unit of Akbar Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran. Email: Pourbadakhshann@mums.ac.ir

Received date: Mar.15,2023; Accepted date: Apr.24,2023

1- INTRODUCTION

Coronaviruses are among the most important human and animal pathogens. A novel coronavirus was identified that caused widespread pneumonia in Wuhan, a city in the Hubei Province of China at the end of 2019. The virus spread rapidly, causing an epidemic in China, and then outspread to other countries worldwide (1).

The primary route of transmission of severe acute respiratory syndrome coronavirus 2(SARS-CoV-2) is direct person-to-person transmission. It seems that respiratory droplets containing the virus through coughing, sneezing or talking can transmit the disease to others (2). Also viruses present on surfaces that are highly contaminated (such as those in health centers). They may be a route of transmission if a person touches them and then touches mucosal membranes such as the mouth, eyes and nose (1). Whether SARS-CoV-2 can be transferred via airborne under natural conditions is a challenging issue (3, 4). However, in the aerosol production procedures, airborne precautions are universally recommended in the health care settings (5). This virus has been also found in non-respiratory samples, including stool, blood, ocular secretions and semen; but the role of transmission through these sites is unclear (6-11). Oral fecal transmission cannot be definitively suggested as a route of transmission (12).

During the pandemic of COVID-19, healthcare workers (HCWs) have been at the forefront and at high risk of infection; they could also carry the disease to the community and spread the virus to their family members or anyone in touch (13). Hence, infection is common among medical and nursing staff. Therefore, guidelines of using personal protective equipment are highly recommended for protecting HCWs (14-16). Prevention of COVID-19 infection in HCWs is very important because of their role in the clinical management of patients and ensuring infection control.

Consequently, recognizing risk factors of infection in frontline HCWs to COVID-19 is very important to prevent further infection spread. This study was, therefore, designed to identify COVID-19 risk factors in HCWs to adopt appropriate preventive measures. Among these actions, we can mention training of personnel, elimination of risk factors if possible, and applying corrective measures in the field of HCW's lifestyles.

2- MATERIALS AND METHODS

2-1. Design and participants

In this cross-sectional study, 534 HCWs in five centers of Akbar, Imam Reza, Ghaem, Shariati and Dr. Sheikh, affiliated to Mashhad University of Medical Sciences, were included from 20 March to 21 July, 2020.

First, a list of HCWs with COVID-19 infection was received from the administrative affairs of the mentioned hospitals by permission of the university. HCWs were divided into two categories of frontline and second-line. Frontline HCWs were defined as participants who reported direct contact with COVID-19 patients. And risk factors were asked from HCWs by telephone.

2-2. Data collection

Data including baseline demographic information, comorbidities, daily information about potential symptoms, COVID-19 test and risk factors were recorded. COVID-19 infection was confirmed according to the guideline for diagnosis and treatment of new coronavirus, issued by the National Health Commission of Iran.

Data were collected based on WHO reports of risk factors associated with COVID-19 pandemic. In summary, the participants were asked to answer

questions in 3 sections including demographics, probable risk factors, and clinical manifestations. The need for Personal Protective Equipment (PPE) and its availability were also evaluated.

2-3. Ethical considerations

This research was approved by the Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.REC.1399.172990228). All participants gave a written informed consent.

2-4. Data Analysis

Data entered into SPSS software version 19 (SPSS Inc. Chicago, Il, The USA). Descriptive data were reported using mean, standard deviation, frequency and percentage. Independent t-test was used to evaluate quantitative variables and Fisher exact test or Chi Square to assess the association between variables. P-value below 0.05 was considered to be statistically significant. Regression analysis was used to analyze the risk factors.

3- RESULTS

Out of 534 HCWs included in this study, 197(57.6%) were female; most of them were nurses, and the mean ± SD age was 36.02 ± 8.5 years. Demographic information of the participants is presented in **Table 1**.

Table-1: Demographic characteristics of the study participants

variable		Frequency (%)
sex	male	145 (42.4%)
	female	197 (57.6%)
Age, year	< 30	101 (29.5%)
	30-40	164 (48%)
	40-50	60 (17.5%)
	50-60	15 (4.4%)
	> 60	2 (0.6%)
smoking		19 (5.6%)
Family history of COVID-19		75 (21.9%)
History of influenza vaccination		74 (21.6%)
HCW	front line	196 (57.3%)
	second line	146 (42.7%)

Most participants wore surgical masks (65.6%), 79 (1.27%) of them used N95 masks, and others wore both of them concurrently.

Reuse of N95 masks was significantly more frequent in the frontline HCW compared to second-line ones (P=0.035). Although reuse of surgical masks was significantly higher in the second line HCWs (P=0.013). **Table 2** demonstrates individual and clinical risk factors in front and second-line HCWs.

Access to personal protective equipment was 47.6% and 69.3% in the frontline and second-line groups, respectively, which was significantly higher in the second-line group)P=0-001).

Eighteen HCWs were hospitalized due to the severity of disease, most of whom were front-line HCWs. In addition, malaise (78.7%), fever (68.1%) and gastrointestinal symptoms (63.7%) were the most common manifestations in the participants. Signs and symptoms observed in the study participants are presented in **Fig. 1**.

Table-2: Comparison of personal and clinical risk factors in front and second line HCWs

Risk factors		Health care workers		P value*
		front line N=196	second line N=146	
Mean of age		36.16 ± 9.1	35.81±7.71	0.704
Sex (male)		61 (31.1%)	84(57.5%)	0.001
Duration of symptoms		4.38 ± 3.03	3.86±2.45	0.131
Hospitalization		11 (5.6%)	7 (4.8%)	0.469
Family history of COVID-19		45 (23%)	30 (20.5%)	0.345
smoking		5 (2.6%)	14 (0.6%)	0.005
History of influenza vaccination		39 (19.9%)	35 (24%)	0.220
Reuse of N95 masks		65 (55.6%)	33 (39.7%)	0.035
Reuse of surgical mask		101 (68.7%)	107 (81.1%)	0.013
Participate in intubation process		122 (70.5%)	51 (39.8%)	0.001
COVID-19 Infection in colleagues		102 (64.6%)	109 (83.2%)	0.001
Underlying disease		56 (31.8%)	32 (24.2%)	0.092
Wear protective clothing		74 (42%)	58 (42.3%)	0.525
Wear protective shield		65 (36.9%)	51 (36.2%)	0.491
Prophylaxis with hydroxychloroquine 200 mg/ One every 12 hours		22 (13.3%)	4 (3%)	0.001
Doing invasive procedures		119 (70%)	31 (24.8%)	0.001
Cardiopulmonary resuscitation		101 (59.1%)	39 (31.5%)	0.001
Eating during work shifts at the place of activity and reuse of the same mask as before		97 (49.51%)	52 (36.5%)	0.007
Work shift time	Morning	26 (15.1%)	7 (5.1%)	0.001
	Evening	13 (7.6%)	19 (13.9%)	
	Night	12 (7%)	4 (2.9%)	
	All times	89 (51.7%)	82 (59.9%)	
	Morning+ evening	17 (9.9%	-	
	Morning+ Night	1 (0.6%)	21 (15.3%)	
	Evening+ Night	14 (8.1%)	4 (2.9%)	

* Independent T-Test

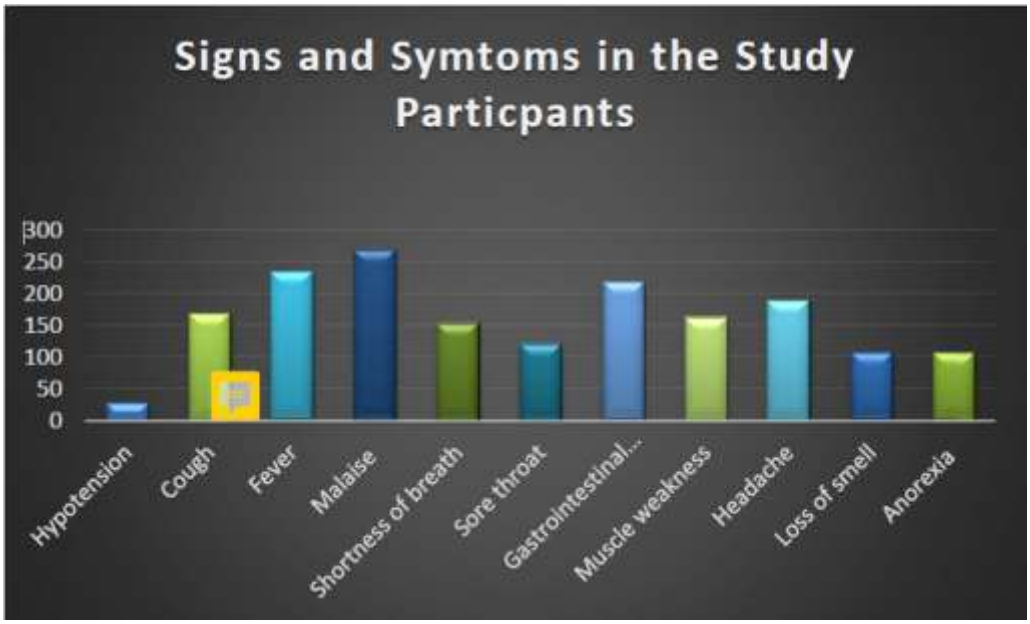

Fig. 1: Signs and symptoms of COVID-19 in HCWs

There were associations between hospitalization with age (P=0.012), consumption of food during work shifts (r=0.128, P=0.018), having an underlying disease (r=0.155, P=0.007), activity during intubation of patients (r=0.118, P=0.041) and smoking (r=0.171, P=0.001). Moreover, in our study, smoking (OR=0.078, P=0.001) and underlying disease (OR=2.19, P=0.025) were recognized as the factors predicting HCWs hospitalization. Furthermore, multivariate regression analysis showed that smoking (OR=0.83, P=0.002) and activity during patient intubation (OR=5.2, P=0.001) were independently predictors of hospitalization.

4- DISCUSSION

The current study revealed that reuse of N95 or surgical masks, intubation process, prophylaxis with hydroxychloroquine 200 mg/one every 12 hours, doing invasive procedures, cardiopulmonary resuscitation, and consumption of food during work shifts were significantly higher in frontline HCWs compared to the second line ones. However, smoking was significantly more frequent in the second-line HCWs group.

Moreover, 10.4% of HCWs were hospitalized, most of whom were front-line ones. The results indicate that hospitalization was associated with age, eating during shifts, intubation process, having an underlying disease, and smoking. In addition, smoking and intubation processes were identified as predictors of hospitalization.

One of the most important findings of our study was that participation in high-risk procedures such as intubation and cardiopulmonary resuscitation was a risk factor for COVID-19 infection in front-line HCWs compared to the second-line ones. Studies are underway to determine various risk factors for COVID-19 infection in HCWs (17-18). For instance, Ran et al. showed that infection with COVID-19 was related with staff ward and work activity, working hours and hand hygiene (19).

Previous research has shown higher susceptibility to respiratory infectious

diseases for high-risk ward workers (20). This was also seen in the SARS epidemic. In a multicenter study in China, the incidence of SARS infection in intensive care unit workers was reported to be 13.5% (21). Obviously, HCWs in high-risk wards are at greater risk for respiratory infections because of their involvement in aerosol production procedures (22). In another study, it was found that among 2135190 participants in the United Kingdom and the United States, front-line HCWs had a 12-fold increase in catching COVID-19 infection (23).

We indicated that smoking was a predictor of hospitalization of HCWs with COVID-19 infection and this was consistent with the results of some previous studies. A systematic review and meta-analysis suggested smoking had a possible adverse effect on the severity of disease and mortality in hospitalized patients with COVID-19, especially young people without diabetes mellitus (24). Despite the fact, another systematic review that proposed the role of smoking as a risk factor for COVID-19 was highly criticized due to the lack of reliable data (25).

Many diseases such as hypertension, cardiovascular diseases, diabetes mellitus, Chronic Obstructive Pulmonary Disease (COPD), cancer, and chronic kidney disease are tobacco-related diseases, and these are the most common underlying diseases among hospitalized COVID-19 patients. Therefore, smoking is likely to have a negative impact on the consequences of COVID-19.

The most common symptom of patients in our finding was malaise, while some studies reported coughing as the most frequent one (26). Nonetheless, in line with other studies, fever was one of the most common clinical manifestations in our patients (27). In a systematic review in China, COVID-19 gastrointestinal manifestations accounted for 18% of patients' clinical symptoms, while in our study 63.7% of patients had gastrointestinal manifestations (28).

In our study, most HCWs were working at different times and for long hours. Working more than 10 hours a day can increase the risk of respiratory infections (29, 30). A study in China found that an increased risk of COVID-19 infection was associated with increased working hours (19). Therefore, limiting working hours (less than 10 hours per day), depending on the special role of HCWs is essential.

The present investigation showed that more than half of the participants re-use health masks, which was more frequent in frontline HCWs compared to the second-line ones. Nguyan et al. demonstrated that reuse of personal protective equipment or inadequate equipment is common in first-line HCWs. This indicates that insufficient supplies of equipment for the staff or poor quality of equipment can increase the risk of developing COVID-19 by 31% to 46% (23).

It seems, therefore, necessary to support HCWs by providing sufficient high-quality personal protective equipment. Repeated use of equipment can be associated with contamination and decomposition of their materials due to friction.

5- CONCLUSION

Frontline HCWs had a significantly higher risk of COVID-19 infection, as compared to the second-line group. Being smoker and participating in intubation procedure were independent predictors of hospitalization of HCWs. Although adequate supplies of PPE are necessary, they do not completely mitigate high-risk exposures.

6- CONFLICTS OF INTEREST

None.

7- REFERENCES

1. McIntosh K, Hirsch MS, Bloom AJ. Coronavirus disease 2019 (COVID-19):

Epidemiology, virology, and prevention. Lancet. Infect. Dis. 2020 Jul; 1:2019-20.

2. Peng X, Xu X, Li Y, Cheng L, Zhou X, Ren B. Transmission routes of 2019-nCoV and controls in dental practice. International journal of oral science. 2020 Mar 3; 12(1):1-6.

3. Guo ZD, Wang ZY, Zhang SF, Li X, Li L, Li C, Cui Y, Fu RB, Dong YZ, Chi XY, Zhang MY. Aerosol and surface distribution of severe acute respiratory syndrome coronavirus 2 in hospital wards, Wuhan, China, 2020. Emerging infectious diseases. 2020 Jul; 26(7):1586.

4. Bahl P, Doolan C, De Silva C, Chughtai AA, Bourouiba L, MacIntyre CR. Airborne or droplet precautions for health workers treating coronavirus disease 2019?. The Journal of infectious diseases. 2020 Apr 16.

5. Palmore TN, Smith BA. COVID-19: Infection prevention for persons with SARS-CoV-2 infection.

6. Chen W, Lan Y, Yuan X, Deng X, Li Y, Cai X, Li L, He R, Tan Y, Deng X, Gao M. Detectable 2019-nCoV viral RNA in blood is a strong indicator for the further clinical severity. Emerging microbes & infections. 2020 Jan 1; 9(1):469-73.

7. Wang W, Xu Y, Gao R, Lu R, Han K, Wu G, Tan W. Detection of SARS-CoV-2 in different types of clinical specimens. Jama. 2020 May 12; 323(18):1843-4.

8. Colavita F, Lapa D, Carletti F, Lalle E, Bordi L, Marsella P, Nicastri E, Bevilacqua N, Giancola ML, Corpolongo A, Ippolito G. SARS-CoV-2 isolation from ocular secretions of a patient with COVID-19 in Italy with prolonged viral RNA detection. Annals of internal medicine. 2020 Aug 4; 173(3):242-3.

9. Cheung KS, Hung IF, Chan PP, Lung KC, Tso E, Liu R, Ng YY, Chu MY, Chung TW, Tam AR, Yip CC. Gastrointestinal manifestations of SARS-CoV-2 infection and virus load in fecal samples from a Hong Kong cohort: systematic review and meta-analysis. Gastroenterology. 2020 Jul 1; 159(1):81-95.

10. Zheng S, Fan J, Yu F, Feng B, Lou B, Zou Q, Xie G, Lin S, Wang R, Yang X, Chen W. Viral load dynamics and disease severity in patients infected with SARS-CoV-2 in Zhejiang province, China, January-March 2020: retrospective cohort study. bmj. 2020 Apr 21; 369.

11. Li D, Jin M, Bao P, Zhao W, Zhang S. Clinical characteristics and results of semen tests among men with coronavirus disease 2019. JAMA network open. 2020 May 1; 3(5):e208292-.

12. Begashaw GB, Yohannes Y. Risk of Transmission and Knowledge Gap for Novel Coronavirus Disease 2019 (Covid-19) in Addis Ababa: Risk Estimation and Control Strategies.

13. World Health Organization. Health workers exposure risk assessment and management in the context of COVID-19 virus: interim guidance, 4 March 2020. World Health Organization; 2020.

14. Fischer RJ, Morris DH, van Doremalen N, Sarchette S, Matson MJ, Bushmaker T, Yinda CK, Seifert SN, Gamble A, Williamson BN, Judson SD. Assessment of N95 respirator decontamination and re-use for SARS-CoV-2. MedRxiv. 2020 Apr 24.

15. Schwartz, A., Stiegel, M., Greeson, N., Vogel, A., Thomann, W., Brown, M., Sempowski, G.D., Alderman, T.S., Condreay, J.P., Burch, J. and Wolfe, C., 2020. Decontamination and reuse of N95 respirators with hydrogen peroxide vapor to address worldwide personal protective equipment shortages during the SARS-CoV-2 (COVID-19) pandemic. Applied Biosafety, 25(2), pp.67-70.

16. Livingston E, Desai A, Berkwits M. Sourcing personal protective equipment

during the COVID-19 pandemic. Jama. 2020 May 19; 323(19):1912-4.

17. Zheng L, Wang X, Zhou C, Liu Q, Li S, Sun Q, Wang M, Zhou Q, Wang W. Analysis of the infection status of healthcare workers in Wuhan during the COVID-19 outbreak: a cross-sectional study. Clinical Infectious Diseases. 2020 Oct 15; 71(16):2109-13.

18. Clemency BM, Varughese R, Scheafer DK, Ludwig B, Welch JV, McCormack RF, Ma C, Nan N, Giambra T, Raab T. Symptom criteria for COVID-19 testing of healthcare workers. Academic Emergency Medicine. 2020 Jun; 27(6):469-74.

19. Ran L, Chen X, Wang Y, Wu W, Zhang L, Tan X. Risk factors of healthcare workers with coronavirus disease 2019: a retrospective cohort study in a designated hospital of Wuhan in China. Clinical Infectious Diseases. 2020 Mar 17.

20. Macintyre CR, Seale H, Yang P, Zhang Y, Shi W, Almatroudi A, Moa A, Wang X, Li X, Pang X, Wang Q. Quantifying the risk of respiratory infection in healthcare workers performing high-risk procedures. Epidemiology & Infection. 2014 Sep; 142(9):1802-8.

21. Zou Q, Yin W, Du L. Study on severe acute respiratory syndrome nosocomial infection of doctors and nurses in intensive care units. Journal of Tropical Medicine. 2003; 3(4):416-9.

22. Jaeger JL, Patel M, Dharan N, Hancock K, Meites E, Mattson C, Gladden M, Sugerman D, Doshi S, Blau D, Harriman K. Transmission of 2009 pandemic influenza A (H1N1) virus among healthcare personnel—Southern California, 2009. Infection Control & Hospital Epidemiology. 2011 Dec; 32(12):1149-57.

23. Nguyen LH, Drew DA, Graham MS, Joshi AD, Guo CG, Ma W, Mehta RS, Warner ET, Sikavi DR, Lo CH, Kwon S. Risk of COVID-19 among front-line health-care workers and the general community: a prospective cohort study. The Lancet Public Health. 2020 Sep 1; 5(9):e475-83.

24. Karanasos A, Aznaouridis K, Latsios G, Synetos A, Plitaria S, Tousoulis D, Toutouzas K. Impact of smoking status on disease severity and mortality of hospitalized patients with COVID-19 infection: a systematic review and meta-analysis. Nicotine & tobacco research. 2020 Aug 24.

25. Cattaruzza MS, Zagà V, Gallus S, D'Argenio P, Gorini G. Tobacco smoking and COVID-19 pandemic: old and new issues. A summary of the evidence from the scientific literature. Acta Bio Medica: Atenei Parmensis. 2020; 91(2):106.

26. McMichael TM, Currie DW, Clark S, Pogosjans S, Kay M, Schwartz NG, Lewis J, Baer A, Kawakami V, Lukoff MD, Ferro J. Epidemiology of Covid-19 in a long-term care facility in King County, Washington. New England Journal of Medicine. 2020 May 21; 382(21):2005-11

27. Liu XQ, Xue S, Xu JB, Ge H, Mao Q, Xu XH, Jiang HD. Clinical characteristics and related risk factors of disease severity in 101 COVID-19 patients hospitalized in Wuhan, China. Acta Pharmacologica Sinica. 2022 Jan; 43(1):64-75.

28. Cheung KS, Hung IF, Chan PP, Lung KC, Tso E, Liu R, Ng YY, Chu MY, Chung TW, Tam AR, Yip CC. Gastrointestinal manifestations of SARS-CoV-2 infection and virus load in fecal samples from a Hong Kong cohort: systematic review and meta-analysis. Gastroenterology. 2020 Jul 1; 159(1):81-95.

29. Weaver MD, Landrigan CP, Sullivan JP, O'Brien CS, Qadri S, Viyaran N, Wang W, Vetter C, Czeisler CA, Barger LK. The association between resident physician work-hour regulations and physician safety

and health. The American journal of medicine. 2020 Jul 1; 133(7):e343-54.

30. Li D, Wu S. Analysis on the health status and influencing factors of medical workers in a city of Fujian province. InThe Medical Forum 2016 (Vol. 20, No. 14, pp. 1893-5).