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Review Article

COMPONENTS OF METABOLIC SYNDROME AS A RISK FACTOR FOR COVID-19 IN INDIA

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ABSTRACT

Several patients with components of metabolic syndrome (MetS) like obesity, hypertension, diabetes mellitus and dyslipidemia is a risk factor for COVID-19 in India. Aims of our review to bring together current data about components of metabolic syndrome & COVID 19 infection. It specially looks the relation between components of MetS (Obesity, Diabetes mellitus, Hypertension and dyslipidemia) and COVID 19. At the time of writing the review is updated till time. Search of literature was done by using google search & PubMed engines for prepare review related to my article. Patients with components of metabolic syndrome like obesity, diabetes, hypertension and dyslipidemia have increased evidence of incidence and severity of COVID-19. COVID-19 has effect on the pathophysiology of all these components of metabolic syndrome. The control of all these components of metabolic syndrome is important not only for patients who are infected with COVID-19, but also for those without the disease. It is commonly known that the existence of comorbidities such as increase in BMI, dyslipidemia, diabetes mellitus and hypertension is associated with additional severe course of COVID-19. So measurement of components of metabolic syndrome parameters is essential to better estimate the risk of COVID-19 and management and control of these components (BMI, blood glucose, blood pressure, lipid profile) of metabolic syndrome parameters will cause less possibility to occur COVID-19.

Keywords: Diabetes mellitus, Hypertension, Obesity, Dyslipidemia, Metabolic syndrome.

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INTRODUCTION

From January 30, 2020, the World Health Organization (WHO) has been confirmed coronavirus disease 2019 (COVID-19) as a community health disaster. Although most of the COVID-19 patients show no or mild symptoms, few patients will develop acute respiratory distress syndrome (ARDS) chronic pneumonia, multi-organ failure, and death [1]. In the Wuhan, Hubei province of china, the 1st case of COVID-19 was occurred on December 8th, 2019 [2].

The WHO published a report on June 1st, 2020, that the quantity of confirmed cases reached 6,057,853 and spread around 216 countries, with highlighting on the American and European continents, with more than 2 million cases each, collectively adding up around 82% of infected global number. Worldwide 371,116 people have been killed due to COVID-19, particularly among individuals with comorbidities and elderly age patients. More than 1,734,040 confirmed cases are in the United States (U.S.), but although huge number of infected people in countries such as Italy (33,415 death), the United Kingdom (38,489 deaths), and Spain (29,045 deaths) which existing the highest mortality rate, exceeding 10% [3].

The data suggests that old aged people with COVID-19 with components of metabolic syndrome (MetS) such as diabetes, hypertension, obesity, and dyslipidemia are particularly at high risk of COVID-19 when compared to common populations and contain higher mortality rate. Hence, it is compulsory to relook these subgroups in COVID-19 patients with related comorbidities [4].

Worldwide, one of the most common underlying comorbidities is obesity [5]. Obesity is noncommunicable disease that has such a contiguity with a communicable disease like COVID-19. Obese people have an increased risk of serious illness hospitalization, and mortality due to chronic inflammation, infection due to altered immune response along with cardiometabolic comorbidities, and COVID-19 pandemic have a major impact on people with obesity [6].

It is a possible confounder of the relationship among diabetes, hypertension, and outcomes in COVID-19 infection and must consequently be assessed [5].

The current facts are rising on the association of obesity with severe COVID-19 infection. In the study from France, the proportion of patients who need mechanical ventilation increased with the rise in body mass index (BMI) >35 kg/m^2 [5]. BMI of more than 30 kg/m^2 was recognized as a risk factor for admission in hospital younger than 60-year patients, and previously, an age group was considered an increased risk [7]. Mortality rate analysis due to COVID-19 infection across countries could also examine BMI as one of the important predictors [5].

As shown in many epidemiological studies, hypertension prevalence is high in patients with COVID-19 disease and it appears to be associated with a rise in risk of mortality [8]. The prevalence of hypertension in the general Chinese population ranges from 18% to 25%. The rate of hypertension is higher in Western countries when compared to China, ranging from 20% to 35% depending on region, ethnicity, and age. Hypertension is the major risk issue related with adverse outcomes during hospitalization for COVID-19. In European countries, the spread of COVID-19 has shown a rise in occurrence among older people, who are frequently affected by hypertension [8].

Due to more prevalence of diabetes, it is essential to know the special aspects of COVID-19 infection in people with diabetes. Several data suggest that COVID-19 is common in diabetic patients [9].

Pooled data from 10th Chinese studies (n=2209) characteristics of comorbidities in COVID-19 patients, Singh *et al.* found that the prevalence of diabetes and hypertension is 11% and 21% in COVID-19 patients, respectively [4]. Correspondingly, meta-analysis of 8 trials that incorporated 46,248 COVID-19 patients, Yang *et al.* found a prevalence of 8% and 17% for diabetes and hypertension, respectively, in COVID-19 patients [10].

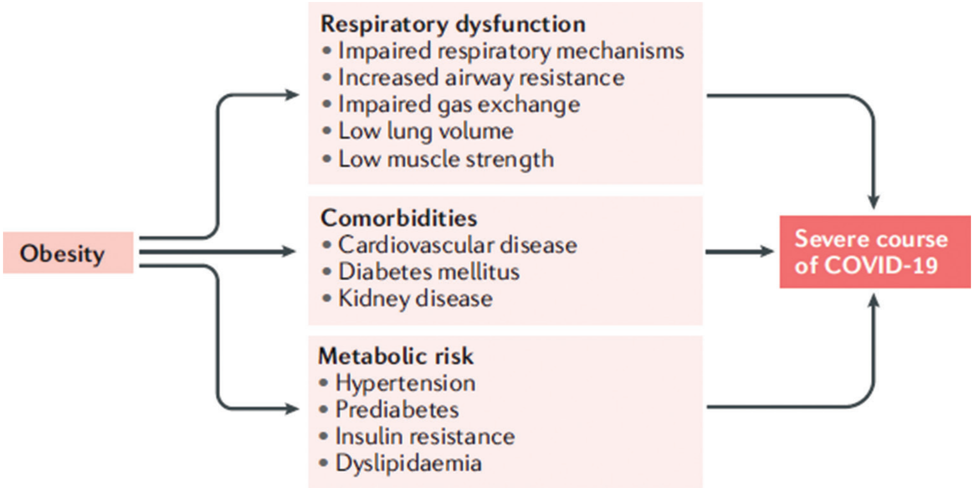

Fig. 1: Obesity-related comorbidities and mechanisms of a severe course of COVID-19

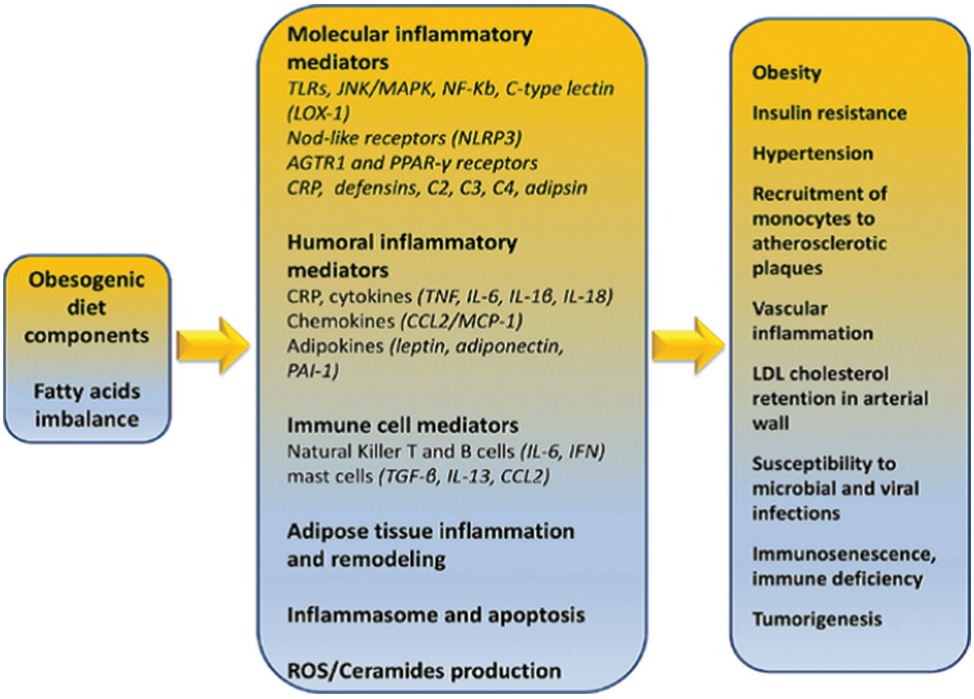

Fig. 2: Obesity-related immune/metabolic mediators and effects

Epidemiology functioning group of Chinese Center for Prevention and disease control that examined 20,982 COVID-19 patients have manifested that hypertension and diabetes were associated in almost 5% and 13% of patients, respectively [11]. Onder *et al*. originate diabetes in almost around 36% of 355 admitted patients with COVID-19 [12]. Comparably in a small survey of 24 patients from the USA, Bhatraju *et al*. found that diabetes is associated with 58.0% patients with COVID-19 [13]. A study from the COVID-19 inspection group in Italy (n=481) has found that 34% patients with COVID-19 have diabetes, Centers for Disease Control and Prevention, the COVID-19 response team in the USA found a prevalence of 11% from data of 7162 COVID-19 patients [9].

METHODS

The data have been thoroughly searched through the PubMed medical database up to August 2024 with MetS and components of MetS key terms that include COVID-19, coronavirus, cardiovascular disease, hypertension, and diabetes. All the existing literature published in English language on COVID 19 have retrieved which has reported the outcomes in different co-morbidities.

RESULTS

Diabetes and COVID-19

Studies have investigated cellular and molecular mechanisms that might be responsible for increased risk in persons with diabetes mellitus for COVID-19. Angiotensin-converting enzyme 2 (ACE2) is one of the crucial ones has appeared. Primarily, ACE2 has found from lymphoma cDNA libraries and human heart failure and later on shown to serve up as the receptor for the severe acute respiratory syndrome coronavirus (SARS-CoV). ACE2 also has been shown that the cellular entry point for the virus SARS-CoV-2 [14] and for ACE2 SARS-CoV-2 has higher affinity than SARS-CoV [15]. The expression and distribution of the ACE2 in the human body can point out the possible routes of the infection and the organs most targeted by SARS-CoV-2. In organs and tissue, ACE2 is expressed differently. Increase ACE2 expression was found in the absorptive enterocytes from the ileum and colon, alveolar cells of the lung, epithelial cells of the oral mucosa, myocardial cells, esophagus epithelial cells, kidney proximal tubule cells, cholangiocytes, and bladder urothelial cells [16]. The increase ACE2 expression in the kidney and lungs corresponds with the most common acute conditions:

Table1: Hypertension,diabetesandotherco-morbiditiesinCOVID-19,world-widedata.

Firstauthor	n	Smokers, %	HTN,%	Diabetes,%	CVD,%	COPD,%	CKD,%	CLD, %	Ref.
COVID-19inChina									
Liuetal.	61	6.6	19.7	8.2	1.6	8.2	NR	NR	3
Guanetal.	1099	12.6	15.0	7.4	3.8	1.1	0.7	NR	4
Huangetal.	41	7.3	14.6	19.5	15.0	2.4	NR	2.4	5
Chenetal.	99	NR	NR	12.1	40.0	1.0	NR	NR	6
Wangetal.	138	NR	31.2	10.1	19.6	2.9	2.9	2.9	7
Zhouetal.	191	6.0	30	19	8.0#	3.0	1.0	NR	8
Zhangetal.	140	NR	30	12.1	8.6	1.4	1.4	NR	9
Yangetal.	52	4.0	NR	17.0	23.0	8.0	NR	NR	10
Wuetal.	201	NR	19.4	10.9	4.0	2.5	1.0	3.5	11
Guoetal.	187	9.6	32.6	15.0	11.2#	2.1	3.2	NR	14
Overall,China, N¼2209		10.7%	20.7%	10.5%	7.4%	2.0%	1.2%	3.2%	
COVID-19 inItaly									
Onderetal.	355	NR	NR	35.5	42.5	NR	NR	NR	12
COVID-19 inSingapore									
Youngetal.	18	NR	NR	NR	NR	NR	NR	NR	13

Table 2: Characteristics of studies with newly diagnosed arterial hypertension.

Study, (Year)	City/ Country	Sample Size	Disease Severity	Median/Mean Follow-Up Periods	Median/ Mean Age, % of Male in Case Group	% of Patients with Newly Diagnosed HTN	Obtain Data
Xiong et al. [38] (2020)	Wuhan, China	722	Mostly Severe	Median 97 days (95–102)	Median 52 (41–62) 45.5%	1.3	Telephone surveys
Mei et al. [39] (2021)	Wuhan, China	3677	Mild, Wuhan, China 3677 Severe, Critical	Median 144 days (135–157)	Median 59 (47–68) 45.9%	0.16	Case, 0.16 medical and self-reports
Shang et al. [40] (2021)	Wuhan, China	796	Severe	6 months after infection	Median 62 (51–69) 50.8%	0.4	Telephone surveys
Boglione et al. [41] (2021)	Vercelli, Italy	449	Hospitalized	Median visit 1 32.5 days, visit 2 178.5 days	Median 65 (56–75.5) 78%	25.8—First visit 14—Second visit	Visit with examination
Telephone (2022)	Turkey	406	Hospitalized	3 and 6 months	WHO-1: 46.8 ± 13.3 WHO-2 52.8 13.1 WHO-3 54.8 ± 11.8	1	Telephone surveys
Akpek et al. [43] (2021)	Turkey	153	Mild	Mean 31.6 Mean days	Mean 46.5 ± 12.7 34%	11.76	Visit, examination
Delalic et al. [44] (2022)	Croatia, Zagreb	199	No data	Median 1 month	Mean age 57.3 46%	16.08	Visit, examination
Ogungbe et al. [45] (2022)	No data	442	Mild	Median 12.4 months (10–15.2)	Mean 45.4 29%	20	Telephone surveys
Fernandez-Ortega MA [46] (2023)	Mexico	70	Hospitalized	Follow up 5 months and 12 months	No data 65.7%	29.7 (5 months) 12.5 (12 months	Telephone surveys
Vyas et al. [47] (2023)	India	248	Hospitalized	Follow-up length 1 year	Mean 51.16 ± 12.71 68.1%	32.3	Visit, examination
Abumayyaleh et al. [48] (2023)	International	3096	(months) Severe	Follow-up time diabetes 2.6 ± 4.6 non-diabetes 2.8 ± 4.9	DM patients Mean 72.6 ± 12.7 63.5%	0.5% non-DM 63.5% patients	Telephone surveys
Maestre-Muniz et al. [49] (2021)	Spain	543	Hospitalized	12 months	Mean 65.1 (17.5; 18–98), 50.7%	2%	Telephone surveys

acute renal failure (ARF) and acute respiratory distress (ARD). ARD was observed in nearly the entire patients 96.5% followed by ARF 24.3% [17]. In diabetes mellitus patients, the appearance of ACE2 depends on the development of diabetes. ACE2 is upregulated in an early phase of diabetes mellitus [14].

People without pre-existing diabetes ACE2 receptor are expressed in pancreatic islets and contamination with SARS-COV-1 has been found to cause hyperglycemia. A transient damage to beta cells indicating that hyperglycemia was found to persist for 3 years after recovery from SARS [18]. The risk of morbidity and mortality increases due to diabetes and associated complications during acute infection due to suppressed humoral and innate immune functions. The glycated hemoglobin levels more than 9% has been linked to a 60% raised risk of admit in hospital pneumonia-related severity during bacterial infection [19]. In the early period, viral pandemics have witness the relationship of diabetes to raised morbidity and mortality. An independent threat aspect for complications and death through 2002–2003 occurrence of severe acute respiratory (SARS-COV-1) was due to diabetes [20]. In 2012 occurrence of Middle East Respiratory Syndrome Coronavirus (MERS-COV), nearly 50% population was diabetes and the odds ratio (OR) for severe or critical MERS-COV range from 7.2 to 15.7 in diabetic cohort when compared to general population. Diabetic patients had mortality rate in patients with MERS which was 35% [9].

COVID-19 and Obesity

There is more chance of infection due to obesity [21]. Important field of research advocates that many type of viruses use fatty tissue as a reservoir, including influenza A virus, adenovirus Ad-36, and HIV [22]. In this regard, the COVID-19 cellular localization and tissue can be associated to fatty tissue [23]. The correlation between obesity with increased mortality rates compared with non-obese persons who have a common viruses (H1N1) has been reported [24]. 30 COVID-19 patients study found that patients having BMI 27.0±2.5 show the disease with increased severe symptoms as compared to patients with BMI 22.0±1.3 [25]. Ultimately BMI analysis is correlated cohort of COVID-19 patients appear that 15.18% non-survivors of the total participants in particular study had BMI>25 at a rate of 88.2%. BMI more than 25 had only 18.9% survivors [26].

The majority of the existing studies discuss the impact of obesity on COVID-19 from a single perspective. The exact mechanism among obesity and the risk of COVID-19 infection is still unclear. Further studies are needed to understand the relationship and develop and customize intervention and prevention strategies suitable for person with obesity.

Hypertension and COVID-19

Increased severity and mortality of patients with COVID-19 has been commonly reported due to hypertension. In comparison of 11 studies, the rate of hypertension in non-severe against severe patients cases in positive COVID-19 with a sample of 2552 patients, among these patients, 748 (29.3%) of them were classified as having to occur severe disease. The prevalence of hypertension in survivors against non-survivor among 34 COVID-19 patients, 35.8% of them was non-survivors [27]. Although there is a constant association of hypertension with COVID-19 patients, these studies is unique all across and serious attention is needed which concern is the increase in mortality. In this direction, two Chinese studies have worked to date. Zhou *et al*. found in 191 COVID-19 patients that diabetes with OR of 2.85 (95% confidence interval [CI], 1.35–6.05; p<0.001) and hypertension with OR of 3.05 (95% CI, 1.57–5.92; p<0.006) for in hospital mortality and in analysis univariate, respectively [28]. Correspondingly, 201 COVID-19 patients were analyzed by Wu *et al*. found that hypertension has a hazard ratio (HR) of 1.70 (95% CI, 0.92–3.14, p=0.09) for death and 1.82 (95% CI, 1.13–2.95; p=0.01) for ARDS. The diabetes had HR of 1.58 (95% CI, 0.80–3.13, p=0.19) for death and HR of 2.34 (95% CI, 1.35–4.05; p=0.002) for ARDS, in a bivariate co-regression analysis [29]. A summary report of COVID-19 by the Chinese Center for Disease Control and Prevention reported a case fatality rate (CFR) of 2.3% (44,672 confirmed cases among 1023 death), although CFR was increased to 7.3% for diabetes and 6.0% for hypertension [2]. However, still, it remains not clear whether increased association of hypertension with COVID-19 and raised risk of mortality is related directly to hypertension or further associated comorbidities or treatment with anti-hypertensive [4]. About the BP control in hypertensive patients, numerous studies reported the BP change throughout the early phase of the COVID-19 pandemic. In Japan, Kobayashi *et al*. found that during office hours, BP significantly increased from 136.5±17.5/78.2±12.0 to 138.6±18.6/79.0±12.2 mmHg, whereas during in home, BP significantly reduced from 128.2±10.3/75.8±8.8 to 126.9±10.2/75.2±9.0 mmHg after the declaration for the state of emergency, rising the ratio of white coat hypertension. Chronic stress is the main causes for increase in BP [30].

CONCLUSION

COVID-19 is not a primary metabolic disease, but metabolic control of lipid levels, glucose, blood pressure, and BMI is very important in these patients. Furthermore, efficient control of these metabolisms may signify as exact and mechanistic approach to ameliorate and prevent the acute effects of this virus by decreasing the local inflammatory response and blocking its into cells entry.

It is commonly known that the existence of comorbidities such as diabetes mellitus and hypertension is associated with additional severe course of COVID-19. Increased in BMI is a major threat factor for these comorbidities and more generally for metabolic health (such as insulin resistance and dyslipidemia) and these metabolic components are linked to increased risk of COVID-19. Hence, measurement of components of MetS parameters is essential to better estimate the risk of COVID-19 and management and control of these components (BMI, glucose, blood pressure, and lipid levels) of MetS parameters will cause less chance to occur COVID-19.

CONFLICT OF INTEREST

There are no conflicts of interest.

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