

## Inchoate Disaster of Covid-19: A Systematic Review on Risk Factors Triggering Morbidity and Fatality Progression

Research Article

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### Abstract

**Purpose:** The global pervasiveness of COVID-19 has been designated as “Public Health Emergency” and it is crafting major health implications globally. Therefore, the aim of the present study is to propose a conceptual model demonstrating risk factors triggering the morbidity and mortality progression in COVID-19 patients.

**Method/Design:** The present systematic review was carried out in accordance with PRISMA framework. An extensive literature exploration was performed for all published items in numerous databases viz. EBSCO, Google Scholar, ProQuest, Pub-Med and Research Gate. As a result, the inclusion strategy expedited the selection of 28 articles using PICOS procedure.

**Results:** The outcomes of the study suggest that knowledge and awareness regarding risk factors of Covid-19 is momentous for prognostication and prevention. The study delivers an upgraded report in relation to environmental risk factors. Evidence of the rising environmental risks has amplified drastically over the past couple of years and affects the morbidity and comorbidities in grown-ups.

**Conclusion:** The study clearly elucidates that how various risk factors are directly associated with each other, thereby, leading to the intermediary/susceptible outcomes.

**Keywords:** Covid-19; Risk Factors; Environmental Risk; Morbidity; Fatality and Systematic Review.

### Introduction

“Coronavirus disease more commonly known as COVID-19 is an infectious disease caused by a newly discovered coronavirus” [37]. The global pervasiveness of COVID-19 has designated the disease with the stature of “Public Health Emergency” and it is acknowledged as the biggest pandemic in human history that doesn’t consider any monetary level and ethnic background. According to Lipsitch et al. [19], “The epidemic of 2019 novel coronavirus expanded from Wuhan throughout China and is being exported to a growing number of countries, some of which have seen onward transmission”. Preliminary attempts were focused on defining clinical pathways, identifying peracute patients and curing the ailing, but later an imperative need of “public health activities” was encountered to explain the epidemiology of COVID-19 and highlight its risk factors accountable for morbidity and mortality progression.

The pandemic of COVID-19 is crafting major health implications globally. With rising number of severe cases and clinical understandings, a thorough knowledge regarding Covid-19 pandemic has been disseminated. According to Nicola et al. [24] “The upsurge of Covid-19 has been related to the economic scenario of second world war, with detrimental impact on global healthcare systems and ripple effect on all aspects of human life”. Supplementary studies from Italy and China elucidated that old age patients diagnosed with diabetes mellitus and other chronic disease, were at greater risk of morbidity and fatality due to Covid-19 [9, 27, 38]. The available literature on associated risk factors of COVID-19 highlights various risk factors in a scattered manner and their impact on COVID-19 patient’s morbidity/fatality, the present study aims to propose a conceptual model demonstrating how risk factors collectively trigger the morbidity and fatality

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progression in COVID-19 patients.

## Methods And Material

The present systematic review is accomplished in congruence with “Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) framework” (Moher et al.) [22]. According to Oberoi and Kansra [26], “The article suggests a minimum set of guidelines and procedures of writing items to enhance the quality of the systematic review”. An exploration of reliable literature was executed from July 2020 for studies accumulation.

### Search Strategy

An all-embracing literature exploration was performed for all published manuscripts in databases such as EBSCO, Google Scholar, ProQuest, PubMed and Research Gate. Online libraries of the World Health Organization are also searched for more insightful literature. Distinctive search terms were accustomed to different database viz. ‘Corona Virus’, ‘COVID-19’, ‘Risk Factors’, ‘Morbidity’, ‘Mortality’, ‘Death or Fatality’, ‘Comorbidities’, ‘Risk Hazards’ and ‘Environmental Risks’. Moreover, supplementary studies were explored by searching the backward referencing list or references. After employing the search criteria, 533 articles were exhumed from different-different databases. Thereafter, 367 articles were recognised to be identical and eliminated instantaneously (Figure 1).

### Inclusion Strategy

Of the remaining 166 items, a limited number of studies managed to achieve eligibility criteria grounded upon the “Patient Intervention Comparison Outcome Study” (PICOS) procedure [26]. Further, the remaining 166 articles were evaluated to determine their relevance based on title, abstract and keywords. Only those articles are included which managed to clear the inclusion criteria (a) available in English language; (b) Indexed under Academia, Google Scholar, PubMed, Research Gate, ProQuest and EBSCO; (c) acmes unprecedented research inferences; (d) covering at least one or more risk factor of COVID-19. As a result, the inclusion strategy expedited the selection of 28 articles.

### Exclusion Strategy

A large number of publications were excluded on the following rationales if they (a) doesn't highlight even a single category of the associated risk factors of COVID-19 (behavioural, biological, physical and environmental); (b) published a letter to the editor; (c) were published as research commentaries; (d) non-peer reviewed studies; and (e) were not available in the English language.

### Data Extraction and Quality Assessment

Data extraction and the quality estimation of the available literature was done individually by the authors. In the process of extraction, only those studies were included which highlighted the major risk factors of Covid-19. Microsoft excel spreadsheets are used to document all the essential information. Two distinctive Microsoft excel sheets were developed to summarise the available information. First excel spreadsheet highlights, a predefined profile of the included studies viz. source, year, study type, country, dimensions of risk factors and findings. The second spreadsheet majorly emphasizes the criteria put into practice for quality assessment of included studies. Minors (Methodological index for non-randomized studies) rating scale was adapted for the quality evaluation of the studies. Thus, the quality statements developed were based on the criteria proposed by prior literature [42].

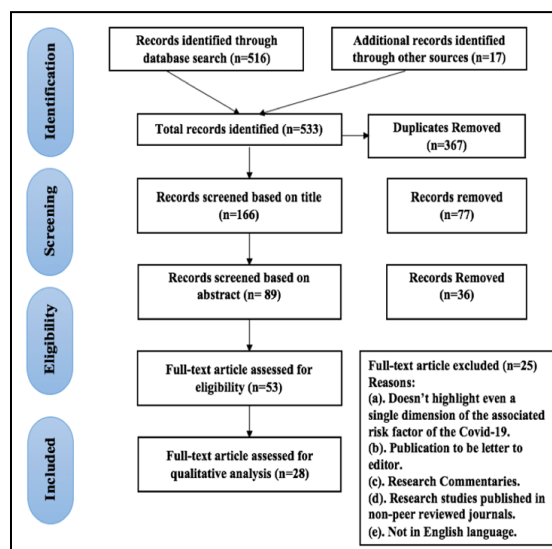
A numerical value of ‘1’ yes, ‘0.5’ partially available and ‘0’ no was allocated to individual quality measure. The included study was considered to be genuinely flawed if it scores less than 5 ‘Yes’. Hence, all included studies certified the quality evaluation index and hold a low risk of bias selection.

## Results

### Study Characteristics

The characteristics of the twenty-eight included studies were presented in (Table 1). While directing review articles, its indispensable to primarily define the profile of the included studies viz. source, study period (year), study type, location and study

Figure 1. PRISMA Framework for Inclusion Criterion.



outlook. All included studies were published from January 2020 to July 2020. Of the included 28 studies, 10 studies (35%) were clinical research, 6 studies (22%) were theoretical, 4 studies (14%) were empirical and 3 studies (11%) was categorised under systematic review and review based study type. Lastly, only 2 studies (7%) were catalogued under meta-analysis study type. The majority of associated risk factors of Covid-19 was determined from studies published in different countries viz. China (n= 11studies), U.S.A (n= 2 studies), and one-one study from India, Italy, Romania and the United Kingdom. An enormous percentage of 11 studies (39%) were stated under the not available (N.A.) category. Lastly, the findings of the total 28 studies emphasise that biological risk factors were high pointed in the majority of the included studies (n = 20 studies), followed by physical risk factors (n=15 studies), behavioural risk factors (n= 8 studies) and environmental risk factors in 4 studies.

**Quality of the Included Studies**

The merits of the reviewed articles are broadly demonstrated in (Table 2). Research questions and study outcomes were elaborately discussed and explained for all 28 included articles. The results

of the studies were presented in absolute synchronisation, highlighting the purpose and inferences derived from the manuscripts. It was established that 32 percent (n= 9) studies have meticulously outlined the epidemiological explanation of Covid-19. The major limitation witnessed by the large number of studies which restrained the quality of studies was the absence of an extensive elucidation of Covid-19 and dearth of appropriate selection of control group. A large proportion of 13 studies (46 percent) not at all defined Covid-19 and 11 studies (39 percent) partially observed the appropriate selection of control groups.

For the majority of reviewed studies, incorporation of associated risk factors, the relevance of the results to the aim of the article and unbiased assessment of the study conclusion were addressed diligently. However, 79 percent (n= 22) of studies coherently outlined the appropriate statistical analysis employed in the review studies and the rest 4 studies partially described the statistical analysis. Henceforth, depending upon the quality scores, a large number of articles (n= 8) scored 7 ‘Yeses’ on a 10-point Minors rating scale. Fascinatingly, only 2 research articles highlighted a slightly low score of 5 ‘Yeses’ of the total 28 included research papers as exhibited in (Table 2).

**Table 1. Delineation of the included studies.**

Ref. No	Source	Year	Study Type	Country	Type of Risk Factors Observed
1	Albitar et al.,	2020	Empirical	N.A.	BioRFs and PRFs
2	Alqahtani et al.,	2020	Systematic Review	N.A.	BRFs and BioRFs
6	Da et al.,	2020	Empirical	N.A.	BRFs
10	Hamer et al.,	2020	Clinical Research	United Kingdom	BRFs
11	Hou et al.,	2020	Clinical Research	China	BioRFs and PRFs
12	Hu et al.,	2020	Clinical Research	China	BRFs, BioRFs and PRFs
13	Hussain et al.,	2020	Systematic Review	N.A.	BioRFs and PRFs
14	Jin et al.,	2020	Clinical Research	China	BioRFs and PRFs
15	Khunti et al.,	2020	Theoretical	N.A.	BRFs,BioRFs and ERFs
16	Lakshmi Priyadarsini & Suresh	2020	Narrative Review	India	ERFs
17	Leung	2020	Clinical Research	China	PRFs
18	Li et al.,	2020	Clinical Research	China	BioRFs and PRFs
20	Long et al.,	2020	Systematic Review	N.A.	BioRFs
21	Mihai	2020	Empirical	Romania	ERFs
23	Muniyappa&Gubbi	2020	Theoretical	U.S.A	BioRFs and PRFs
27	Onder et al.,	2020	Theoretical	Italy	BioRFs and PRFs
28	Ouchetto&Bourhanbour	2020	Empirical	N.A.	BioRFs and PRFs
29	Pareek et al.,	2020	Theoretical	N.A.	BRFs and BioRFs
30	Prata et al.,	2020	Narrative Review	N.A.	ERFs
31	Sattar et al.,	2020	Theoretical	N.A.	BRFs, BioRFs and PRFs
32	Shi et al.,	2020	Clinical Research	China	BioRFs and PRFs
33	Shi et al.,	2020	Clinical Research	China	BioRFs
34	Sun et al.,	2020	Clinical Research	China	PRFs
36	Wang et al.,	2020	Meta-Analysis	China	BioRFs
39	Yancy	2020	Theoretical	U.S.A	BioRFs and PRFs
40	Zaim et al.,	2020	Narrative Review	N.A.	BioRFs
42	Zheng et al.,	2020	Meta-Analysis	China	BioRFs and PRFs
43	Zhou et al.,	2020	Clinical Research	China	BRFs, BioRFs and PRFs

Source: Based on authors compilation

Note: N.A. (Not Available); n= number of studies.

BioRFs = Biological Risk Factors; BRFs = Behavioural Risk Factors; ERFs = Environmental Risk Factors and PRFs = Physical Risk Factors

Table 2. Quality Index of the Included Studies.

References	1	2	6	10	11	12	13	14	15	16	17	18	20	21	23	27	28	29	30	31	32	33	34	36	39	40	42	43
1. A thorough definition of Covid-19 was given?	0	1	0.5	0	1	1	0.5	0	0	0.5	1	0	1	0	1	0	0.5	0	0	0	1	0	1	0.5	0	0.5	1	0
2. Aim and objectives lucidly defined?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1
3. Incorporation of associated risk factor?	1	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	1
4. Study location was clearly stated?	0	0	0	1	1	1	0	1	0	1	1	1	0	1	1	1	0	0	0	0	1	1	1	1	1	0	1	1
5. Results were relevant to the aim of the article?	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1
6. Unbiased assessment of the study conclusion?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Follow-up period appropriate to the aim of the study?	1	0.5	0.5	0.5	1	0.5	1	0.5	0.5	1	1	1	0.5	1	0.5	0	1	1	1	0.5	1	1	1	1	1	0	1	1
8. Appropriate selection of control group?	0.5	0.5	0	1	0.5	1	0.5	0.5	0	0	0	1	0	0.5	0.5	0	0	0	0	0	1	0.5	0.5	0	0	0	0.5	0.5
9. Appropriate statistical analysis?	1	1	1	1	1	1	1	1	0	0	0.5	1	1	1	1	0.5	1	1	1	0.5	1	1	1	1	0.5	1	1	1
10. Study Outcomes were elaborately discussed?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<b>Total Score of the Studies Reviewed</b>																												
Yes (1)	7	6	6	8	9	9	7	7	5	7	8	9	7	7	8	6	7	7	6	5	9	8	9	8	6	6	9	8
No (0)	2	1	2	1	0	0	1	1	4	2	1	1	2	1	0	3	2	3	3	0	1	0	1	2	3	0	1	1
Partially Available (0.5)	1	3	2	1	1	1	2	2	1	1	1	0	1	2	2	1	1	0	1	2	1	1	1	1	2	1	1	1

Source: Based on authors compilation

### Mechanism Linking Risk Factors And Susceptible Outcome

Knowledge regarding risk factors of Covid-19 is momentous for prognostication and prevention. Therefore, to advance an integrated conceptual model, a meticulous examination of the previous literature on Covid-19 was solicitude. Literature on risk factors of Covid-19 is integrated with a wide range of biological; behavioral, environmental and physical risk factors.

#### Environmental Risk Factors (ERFs)

Evidence of the rising environmental jeopardies has augmented drastically over the past couple and affects the morbidity and comorbidities in grown-ups. According to Fabian [8], “public overcrowdedness or urban sprawl is very detrimental and increases the risk of contagious viruses by more than 20 times”. In a similar study by Bramley et al. [5], a dense locality increases the disorders and encourages unhealthy behaviour. Since, the world is fighting to contain the outspread of COVID-19, the bigger concern for government and hospitals is the mounting medical waste. According to Mihai [21], “Medical and municipal waste management systems are critical services in combating the virus spread in the community”. In a similar study by Prata et al. [30], “Mismanagement of personal protective equipment (PPE) during the COVID-19 pandemic, is resulting in widespread environmental contamination. This poses a risk to public health as waste is a vector for SARS-CoV-2 virus”. Therefore, inappropriate waste treatment practices

and medical waste flow may escalate the risk of contamination. Only a few articles have evaluated the effects of health accessibility as a risk factor for morbidity. Proximity to better health services is a boon for individual/household. According to Boone-Heinone et al. [4], “Health conscious individuals, choose to live in areas with better access to health services and healthy food resources”. Therefore, individuals living in areas with a lack of approachability to health services are more susceptible to morbidities and illness. Though there is a paucity of literature highlighting the effects of area conditions on rising susceptibility to other major risk factors. According to Zhao et al. [41], Residential proximity to streets or highways is associated with upsurge risk factors viz. obesity, increasing age, lack of exercise, etc. In a similar study by Dendup et al. [7], area conditions and other environmental risk factors are associated with behavioral and physical risk factors viz. physical inactivity, unhealthy diet, stress, etc. thereby, leading to the intermediary outcome of diabetes, hypertension and obesity. Finally, Priyadarsini & Suresh [16], “identified environmental risk factors, based on their interdependence categorized the triggering factors, air temperature, humidity, airflow and ventilation, responsible for the increased mortality rate of COVID 19”.

Preposition 1: - Environmental Risk Factors (ERFs) are directly related to behavioral and physical risk factors which in turn leads to morbidity and fatality amongst Covid-19 patients.

#### Behavioural Risk Factors (BRFs)

Several lifestyle habits and behaviours which exert strong consequences on wellbeing are identified as behavioural risk factors



(BRFs). Behavioral risk factors viz. tobacco use, low servings of fruits & vegetables and alcohol abuse are the known contributors to biological risk factors [3]. According to Hamer et al. [10], “An unhealthy lifestyle synonymous with an elevated risk of COVID-19 hospital admission. The findings of the study highlight lifestyle factor, smoking and obesity but not heavy alcohol consumption were all related to COVID-19”. In a similar study by Da et al. [6], “Patients with alcohol use disorder (AUD) are at a risk for developing severe COVID-19 infection. Alcohol disrupts both the innate and adaptive immune systems and likely predisposes such patients to COVID-19. Also concurrent smokers with chronic respiratory disease that further predisposes them to COVID-19-related morbidity and mortality”. Lastly, a couple of analogous studies concluded lifestyle risk factors viz. low serving of fruit/vegetables, smoking and alcohol use disorder are independent risk factors for the unfavourable outcome of Covid-19 [2, 12, 31].

**Preposition 2:** - Behavioural Risk Factors (BRFs) are directly related to biological risk factors which in turn leads to unfavourable/susceptible outcomes of Covid-19.

**Physical Risk Factors (PRFs)**

Numerous studies have discussed physical risk factors viz. overweight/obesity, no exercise regime and age as momentous risk factors amongst Covid-19 patients [27, 13, 14, 13, 28, 34, 39]. According to Sun et al. [32], “study identified older/advanced age to be the major risk factor for death amongst the hospitalized Covid-19 patients”. In a similar study by Leung [17], concluded older/advanced age to be an independent risk factor and associated with mortality amongst the Covid-19 patients. According to Jin et al. [14], “older patients (≥65 years old), were more likely to have a Severe type of COVID-19. The study also found that the percentage of older age (≥65 years) was much higher in the deceased patients than in the patients who survived”. Therefore, a copious amount of literature is available highlighting older age triggers the severity of morbidity and mortality amongst Covid-19 patients. Also, a couple of studies by Sattar et al. [31] and Yancy [39], “accentuated older age, hypertension, diabetes mellitus and obesity as imperative risk factors associated with worse outcomes in Covid-19 patients”.

**Preposition 3:** - Physical Risk Factors (PRFs) are directly related to biological risk factors which in turn leads to unfavourable/susceptible outcomes of Covid-19.

**Biological Risk Factors (BioRFs)**

According to Thakur et al. [35], “a blend of both dry and wet chemistry techniques are utilized to measure the biological pro-

file of patients and associated risk factors”. Biological risk factors viz. diabetes, hypertension, coronary heart disease (CHD) and chronic obstructive pulmonary disease (COPD) are identified to be major biological risk factors (BioRFs) for Covid-19 [14, 15, 18, 20, 32]. Hu et al. [16], identified 27 risk factors to be significantly associated with clinical outcomes, but only 8 were established to be independent risk factors and the results register diabetes, hypertension, obstructive lung disease to be the leading risk factor for morbidity and severity amongst Covid-19 patients. In a similar study by Wang et al. [36], investigated that the incidence of chronic comorbidities increases the risk of Covid-19 patients and the cognizance of these BioRFs is an asset for the clinician and medical supervision. According to Muniyappa & Gubbi [23], “It is well recognized that the presence of diabetes mellitus, hypertension, and severe increase morbidity and mortality in patients with COVID-19”. Lastly, Albitar et al. [1] and Zhou et al. [43], concluded that “hypertension, diabetes mellitus patients, and comorbidities were the independent risk factors of fatality among COVID-19 patients” and additional alertness is a prerequisite for these risk factors.

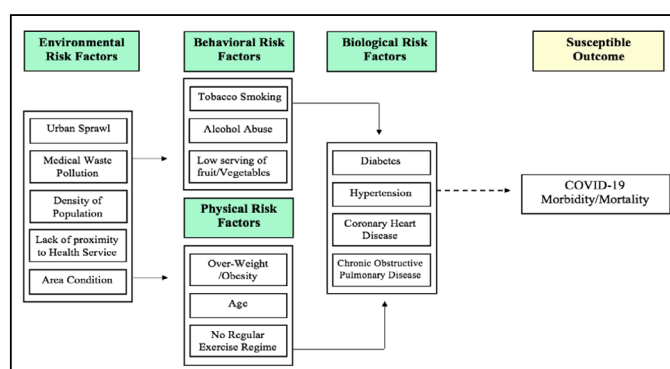
**Preposition 4:**- Biological risk factors (BioRFs) are directly associated with the susceptible outcome of Covid-19 and triggering the severity of morbidity and fatality.

**Discussion**

Accelerating cases and far-reaching spread of the Covid-19 is a major worry globally. Till date, the cause and pathogenesis of the Covid-19 remains to be ambiguous and no precise therapeutic has been commended for Covid-19 affliction. Thus, immediate recognition of associated risk factors and critical patients is utmost important for strengthening the therapeutic consequences of Covid-19 and plummeting the mortality rate. The principal objective of this study is to identify and seize the proof from available literature on the associated risk factors of Covid-19 which are accessible and published in 2020. Of the total 533 reports, 28 studies were acknowledged to meet the inclusion criteria. Hence, the outcomes of the study suggest that knowledge and awareness regarding risk factors of Covid-19 is momentous for prognostication and prevention.

Previous literature has explained the presence of usual and standard risk factors viz. behavioural, physical and biological risk factors are associated with Covid-19 patients. To the best of our acquaintance, the present study is the first of its kind to consolidate and propose a conceptual model to demonstrate how environ-

**Figure 2. Schematic illustration of conceptual model.**



mental, behavioural, physical and biological risk factors collectively trigger the morbidity and mortality progression of COVID-19 patients. The study delivers an upgraded report in relation to environmental risk factors. Evidence of the rising environmental risks has amplified drastically over the past couple of years and affects the morbidity and comorbidities in grown-ups. The findings of the present study are coherent with Dendup et al. [7], environmental risk factors are directly associated with behavioral and physical risk factors viz. physical inactivity, unhealthy diet, stress, etc. thereby, leading to the intermediary/susceptible outcomes.

Taking into the consideration the quality of statistical analysis employed by studies, a substantial amount of 79 percent (n= 22) of studies coherently outlined the standard of tools and statistical analysis techniques. Similarly, incorporation of associated risk factors of Covid-19 was also determined by copious amount of assessed articles. The dearth of a thorough definition of Covid-19 and selection of control group generate enigma regarding the quality/standard of the study.

## Research Limitations

The study is approached to the theoretical model and systematically investigation of the prior literature to identify the various types of risk factors collectively triggering the morbidity/mortality of Covid-19 patients. The present study possesses sporadic limitations or restraints. Firstly, the exclusion/elimination of the published articles available as letters to the editors, research commentaries and studies published under non-peer-reviewed journals. With the exclusion of such literature, an essence of biasness might have been commenced in the review process. A deceptive restraint of the present study is the non-existence of the contributions based on empirical data. The future research should empirically validate the conceptual model or perform a meta-analysis using random effect size model.

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