

In-Hospital Death Due to COVID-19 Disease in Iranian Patients: A Systematic Review and Meta-Analysis Study

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Research

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Abstract

Context: The prevalence of in-hospital death due to COVID-19 hospital is one of the qualitative indexes, which can be used to assess the quality of care, as well as the mortality patterns in COVID-19 pandemic.

Objectives: Therefore, this systematic and meta-analysis study has been done with the aim of estimating overall prevalence in-hospital death due to COVID-19 disease in Iranian patients

Evidence Acquisition: Articles were identified through international searching databases including PubMed, Scopus, Elsevier, Google Scholar, and Web of Science and Iranian scientific information database (SID), Health.barakatkn, IranDoc, Civilica and MagIran. We reviewed systematically all studies reporting the prevalence of in-hospital death due to COVID-19 disease. In this study meta-analysis method with random effect model has been used to estimate the pooled prevalence.

Results: 118 records were identified by the electronic search, of which 43 studies were identified as relevant papers that were meta-analyzed for the pooled in-hospital death due to COVID-19 prevalence. Overall, prevalence of death were 12.16% (95% CI: 10.72%-13.61%). The highest and lowest death prevalence has been reported in Northern Provinces (Gilan, 27.27% (95% CI: 8.66%-45.88%) and Mazandaran, 21.27% (95% CI: 18.14%-24.40%)) and Turkish-speaking provinces (Azerbaijan, East, 3.29% (95% CI: 2.11%-4.47%) and Zanzan, 3.42% (95% CI: 1.82%-5.02%)) respectively.

Conclusions: Considering the death rate obtained in this study and its comparison with other countries, it can be said that the performance of the Iranian medical system in COVID-19 pandemic is acceptable.

1. Context

In late 2019 began a wave of respiratory diseases in Wuhan(China) On March 11, 2020, according to the World Health Organization, the COVID-19 pandemic was announced[1].

The World Health Organisation estimates that 14% of infected cases are severe and require hospitalization and 4% of infected die[2]. Approximately, 143 million confirmed cases and more than 3 million deaths were reported by the World Health Organization (WHO) as of April 20, 2021[3].

COVID-19 poses a significant global threat due to the lack of a validated cure and the difficulty of its delivery[4]. The rate of death due to COVID-19 in each country depends on the actual number of cases, screening system, the capacity of the health and management [5–7]. COVID-19 patients had a very high ranging in-hospital death rate of admitted patients. The large cohort study in China ((9.6%)[8], 3.98% [9]), USA (8.2% [10], 18.58%[11], 45.11%[12], 22.77% [13]), Brazil (26.82%[14], Spain (21.3% [15], 20.90%[16], 21.41% [17]), France (16.87% [18], 27.72% [19]), Italy (28% [20]) reported various prevalence of in-hospital death due to COVID-19. Abate et al in a meta analysis study showed that the pooled prevalence of in-hospital mortality in patients with coronavirus disease was 15% (95% CI: 13 to 17)[21]. in-hospital death is one of the qualitative indexes, which can be used to assess the resilience of a health system in Crisis

situations. However, the study of in-hospital death due to Covid-19 in Iran is of great importance for two reasons. First, Iran was one of the first countries to face the COVID-19, and on the other hand, due to the existence of many sanctions, this country has not been able to access many equipment and medicines.

2. Objectives

Therefore, this systematic and meta-analysis study has been done with the aim of estimating overall prevalence in-hospital death due to COVID-19 disease in Iranian patients.

3. Evidence Acquisition

3.1. Search Strategy

In this systematic review and meta-analysis study, All studies that reported in-hospital death in admitted patients to hospital due to COVID-19 has been used. The literature in Iran was acquired through Iranian scientific data base including SID, IranDoc, Health.barakatkn, MagIran and Civilica and international searching databases including PubMed, Scopus, Elsevier and Web of Science. Additional search was also done by Google Scholar search engine.

The last search took place on 11 April 2021. To search and include related studies as many as possible, we used the following terms: “Deceased”, “Mortality”, “Death”, “COVID 19”, “Cross sectional”, “Cohort”, “Observational”, “Iran” (or the names of its provinces), as keywords for titles and/or abstracts in MeSH word search database with such combination. (“Cohort”[Title/Abstract] OR “Observational”[Title/Abstract] OR “Cross Sectional”[Title/Abstract])) AND (“Mortality”[Title/Abstract] OR “Death”[Title/Abstract] OR “Deceased”[Title/Abstract]) AND (“COVID 19”[Title/Abstract] AND (“Iran”[Title/Abstract] OR “Name of provinces, like Tehran, Isfahan, ...”[Title/Abstract])).

3.2. Selection of Studies and Data Extraction

Published studies were regarded as qualified for the analysis if they met the following criteria: (1) Observational, cross-sectional or cohort studies with the full text of the paper available in the Persian or English languages, (2) studies with a sample size of more than 30, and (3) studies reporting the prevalence of in-hospital death in admitted patients to hospital due to COVID-19, (4) studies with mean Age ranges from 16 to 100, (5) studies with approved diagnosis of COVID-19 by means positive RT-PCR of throat-swab specimens or the chest CT scans according to the WHO interim guidance including ground glass opacity in addition to ill-defined margins, smooth or irregular interlobular septal thickening, air bronchogram, crazy-paving pattern, and thickening the adjacent pleura [22–24] conversely, the following studies were excluded: (1) non-English or non-Persian full-text reports, (2) studies not providing enough data to estimate the death prevalence, (3) studies designed as letters to the editor, expert opinions, editorials, commentaries, case-reports, case-series, and reviews, and (4) Studies reporting overlapping data.

3.3. Data Extraction

All articles categorized as potentially relevant were reviewed separately by both of the authors (Seyed Hassan Saadat and Alireza Najimi-Varzaneh), In case of inconsistency in the results of the two authors, the other two authors ((Mostafa Ghanei and Mohammad Gholami Fesharaki) review the articles and finally the results of the articles summarized the following data using Excel datasheets: First author's name, duration of study, number of COVID-19 hospitalation patients, study sample size, name of the province, mean age and gender of responders. The analysis was conducted according to the preferred reporting items for systematic reviews and meta-analysis (PRISMA)[25]. In this study, The "Newcastle Ottawa Scale (NOS)" was used to evaluate the accuracy of the data in this analysis.

3.3. Statistical Analysis

The prevalence of in-hospitalized death among COVID-19 patient from each province of Iran was computed by metan command. Statistical tests of heterogeneity among the studies were carried out using the Q test ($P < 0.10$ indicates statistically significant heterogeneity) and I-squared statistics. We also used a funnel plot to investigate publication bias. In this study, "metafor" package in R software version 3.6. In this study, the publication bias was assessed graphically and statistically by funnel plot, and based on visual inspection of the funnel plot, Begg's Test, and Egger's test.

4. Results

4.1. Search Results and Study Selection

The study selection process is presented in Figure 1. A total of 118 studies were potentially associated with study subject. After reviewing the abstracts and titles, 79 studies were eliminated based on the stated inclusion and exclusion criteria. After the full text screening and quality assessment, a total of 43 records were deemed as eligible studies published until 11 April 2021.

4.2. Evaluating Heterogeneity Index and Publication Bias

In this study, for evaluating heterogeneity and publication bias the I-squared statistics and Begg and Egger tests has been used respectively. If the I-squared were upper 40% it showed heterogeneity and the random effect model must be used. In this study I-squared calculated 97.3%. Therefore in this study random model has been used. In addition, the upper 5% of Begg's ($T=0.10$, $P\text{-value}=0.920$) and Egger's Test ($T=1.90$, $P\text{-value}=0.051$) $P\text{-value}$ showed any publication bias in this study

4.3. Prevalence of in-hospital death due to COVID-19 in Iran country

Data, including the prevalence of in-hospital death due to COVID-19 as well as other features like reference, province, first author's name, study sample size, mean age and male percent were presented in Table1. Also, the pooled prevalence of in-hospital death due to COVID-19 according to the provinces of Iran were presented in Table 2 . in this study from 43 study, totally 67928 patients evaluated that from them 6781 death has been reported.

The pooled overall in-hospital death due to COVID-19 in Iran using random effect model was 12.16% (95% CI: 10.72%-13.61%). The highest and lowest death prevalence has been reported in Northern Provinces (Gilan, 27.27% (95% CI: 8.66%-45.88%) and Mazandaran, 21.27% (95% CI: 18.14%-24.40%)) and Turkish-speaking provinces (Azerbaijan, East, 3.29% (95% CI: 2.11%-4.47%) and Zanzan, 3.42% (95% CI: 1.82%-5.02%)) respectively.

5. Discussion

Our meta-analysis study of 43 published articles involving 67928 patients is provide a comprehensive analysis of in-hospital death due to COVID-19 disease. The pooled overall, prevalence of in-hospital death in Iran country is 12.16% (95% CI: 10.72%-13.61%). This estimation is upper than large cohort study that reported in-hospital death due to COVID-19 in China[8, 9] and lower than study reported in in-hospital mortality in USA[11–13], Brazil[14], Spain[15–17], France[18, 19] and Italy [20].

This prevalence is also lower than pooled meta prevalence of in-hospital mortality in patients with COVID-19 in the world[21].

More result also showed that two Northern Provinces Gilan (27.27% (95% CI: 8.66%-45.88%) and Mazandaran (21.27% (95% CI: 18.14%-24.40%)) reported the highest in-hospital death prevalence due to COVID-19 in Iran country.

This result can be justified by the fact that these provinces are two destination of tourists travelers in Iran and the main reason for this high prevalence is travel. Previous studies has been identified that travel is a major risk factor for spread COVID-19[26–28]. Increaseing prevalence of disease leads to increasing severity and increasing severity tend to higher prevalence in-hospital death due to COVID-19 disease.

The higher the prevalence of the disease, the greater the severity of the disease and, accordingly, the greater the death of patients. There are several limitations to be noted in the present study. Firstly, some provinces of Iran did not report any published article on in-hospital death due to COVID-19, so the generalizability of the above results to the whole of Iran is biased. Secondly, most of article that has been published in-hospital death due to COVID-19 are from Tehran city so in fact the pooled prevalence of Iran is close to the prevalence of Tehran, Furthermore, non existent data or low number of studies from certain provinces have not allowed us to report geographical distribution of Iran. Finally, due to the lack of meta-analysis studies in other countries, it is suggested that the present study be performed for other countries and the results be compared with the present study.

6. Conclusion

Considering the death rate obtained in this study and its comparison with other countries, it can be said that the performance of the Iranian medical system in COVID-19 pandemic is acceptable.

Declarations

Ethical Approval

This article is based on the management plans approved by the Ethics Committee of Tarbiat Modares University of Tehran with a code of ethics IR.MODARES.REC.1399.240 dated 2021 October 10.

Conflict of interest

The authors say they don't have any conflict of interest.

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Tables

Table 1: Characteristics of the included published in-hospital death due to COVID-19 articles in Iran country

Province	First Author	Time	Ref	Sample size	No. Death	Mean Age	Male Percent
Khuzestan	Moftakhar	Mar 1 to Sep 29, 2020	[29]	16391	691	38	55%
Alborz	Rastad	Jan 30 to Apr 5, 2020	[30]	520	81	62	57%
	Rastad	Feb 20 to Mar 25, 2020	[31]	2957	301	55	54%
	Rastad	Feb 20 to Apr 27, 2020	[32]	455	79	64	42%
Mazandaran	Javanian	Mar 1 to Apr 1, 2020	[33]	557	121	60	75%
	Javanian	Feb 25 to Mar 12, 2020	[34]	100	19	60	51%
Chahar Mahaal & Bakhtiari	Mohammadi	Not mentioned	[35]	101	9	55	62%
Hamedan	Mohammadi	Not mentioned	[35]	100	9	51	52%
Hormozgan	Takhti	Feb 1 to Jun 29, 2020	[36]	3480	239	43	53%
Isfahan	Sami	Feb 1 to Augr 30, 2020	[37]	490	34	57	61%
	Janani	Feb 3 to June 13, 2020	[38]	872	42	46	55%
	Mohammadi	Not mentioned	[35]	127	13	49	55%
Kermanshah	Sayad	Mar 7 to May 12, 2020	[39]	537	39	65	59%
	Mohammadi	Not mentioned	[35]	118	12	44	41%
Kurdistan	Mohammadi	Not mentioned	[35]	179	17	54	41%
Khorasan, Razavi	Moradi	Mar 1 to Jun 31, 2020	[40]	219	31	57	62%
	Sobhani	Feb 1 to May 30, 2020	[41]	397	61	61	56%
Qom	Nasiri	Mar 1 to Jun 31, 2020	[42]	329	64	65	51%
	Rashidi	Feb 20 to Apr	[43]	151	5	56	54%

10, 2020

	Hormati	Feb 25 to Mar 20, 2020	[44]	650	100	63	56%
Gilan	Monfared	Feb 20 to Apr 19, 2020	[45]	22	6	52	68%
Markazi	Araban	Feb 9 to Apr 17, 2020	[46]	1142	124	52	58%
Fars	Peymani	Mar 1 to May 30, 2020	[47]	150	19	62	0%
	Shahriarirad	Feb 20 to Mar 5, 2020	[48]	113	9	54	63%
Azerbaijan, East	Rashidi	Feb 20 to Apr 10, 2020	[43]	881	29	56	54%
Tehran	Alamdari	Jan 30 to Apr 5, 2020	[49]	459	63	62	70%
	Baghaei	Feb 19 to Mar 5, 2020	[50]	127	21	54	76%
	Bikdeli	Feb 22 to Mar 25, 2020	[51]	3188	329	55	60%
	Kashefizadeh	Mar 1 to Apr 10, 2020	[52]	53	5	58	45%
	Pirsalehi	Feb 20 to May 20, 2020	[53]	1320	184	52	61%
	Sabri	Feb 21 to Mar 17, 2020	[54]	63	9	54	0%
	Soleimani	Feb 20 to May 29, 2020	[55]	254	68	66	59%
	Zali	Feb 19 to May 12, 2020	[56]	7136	1116	68	63%
	Homayounieh	Feb 10 to Mar 30, 2020	[57]	90	21	60	64%
	Maghbooli	Feb 20 to May 1, 2020	[58]	235	41	59	61%
	Looha	Feb 20 to Jun 8, 2020	[59]	14791	1775	68	53%
	Aghaaliakbari	Mar 1 to Jun 30, 2020	[60]	617	84	58	59%
	Pazoki	Feb 20 to May 14, 2020	[61]	574	104	57	60%

	Khoshnood	Feb 22 to May 30, 2020	[62]	1083	117	51	62%
	Mousavi	Feb 20 to Apr 20, 2020	[63]	225	55	60	58%
	Kalantari	Feb 24 to Mar 24, 2020	[64]	784	80	47	0%
	Akbariqomi	Feb 26 to Mar 24, 2020	[65]	595	65	55	67%
	Nikpouraghdam	Feb 19 to Apr 15, 2020	[66]	2968	239	56	66%
	Allameh	Feb 20 to Mar 19, 2020	[67]	905	124	57	62%
	Papizadeh	Mar 1 to Mar 30, 2020	[68]	186	36	47	53%
	Vahedian-Azimi	Feb 26 to Mar 15, 2020	[69]	167	14	55	80%
	Mohammadi	Not mentioned	[35]	125	13	49	48%
West Azerbaijan	Gharebaghi	Mar 1 to Apr 30, 2020	[70]	215	19	51	58%
Sistan and Baluchestan	Rokni	Feb 29 to May 24, 2020	[71]	233	28	50	64%
Zanjan	Rashidi	Feb 20 to Apr 10, 2020	[43]	497	17	56	54%
	Overall			67928	6781	55.72	55%

Table 2: Pooled prevalence of in-hospital death due to COVID-19 according to the provinces of Iran

Province	Number of study	Death %	95% Confidence Interval	
			Lower	Upper
Alborz	3	14.17	9.25	19.09
Azerbaijan, East	1	3.29	2.11	4.47
Azerbaijan, West	1	8.83	5.04	12.63
Chahar Mahaal and Bakhtiari	1	8.91	3.35	14.47
Fars	2	10.22	5.62	14.83
Gilan	1	27.27	8.66	45.88
Hamedan	1	9.00	3.39	14.61
Hormozgan	1	6.87	6.03	7.71
Isfahan	3	6.44	4.03	8.86
Kermanshah	2	7.67	5.63	9.70
Khorasan, Razavi	2	14.92	12.10	17.73
Khuzestan	1	4.21	3.91	4.52
Kurdistan	1	9.50	5.20	13.79
Markazi	1	10.86	9.05	12.66
Mazandaran	2	21.27	18.14	24.40
Qom	3	12.63	3.12	22.14
Sistan and Baluchestan	1	12.02	7.84	16.19
Tehran	22	13.82	12.37	15.28
Zanjan	1	3.42	1.82	5.02
Overall	43	12.16	10.72	13.61

No study has not reported in province including Ardabil, Bushehr, Golestan, Kerman, Khorasan, South and North, Kohgiluyeh and Boyer-Ahmad, Lorestan, Qazvin, Semnan and Yazd

Figures

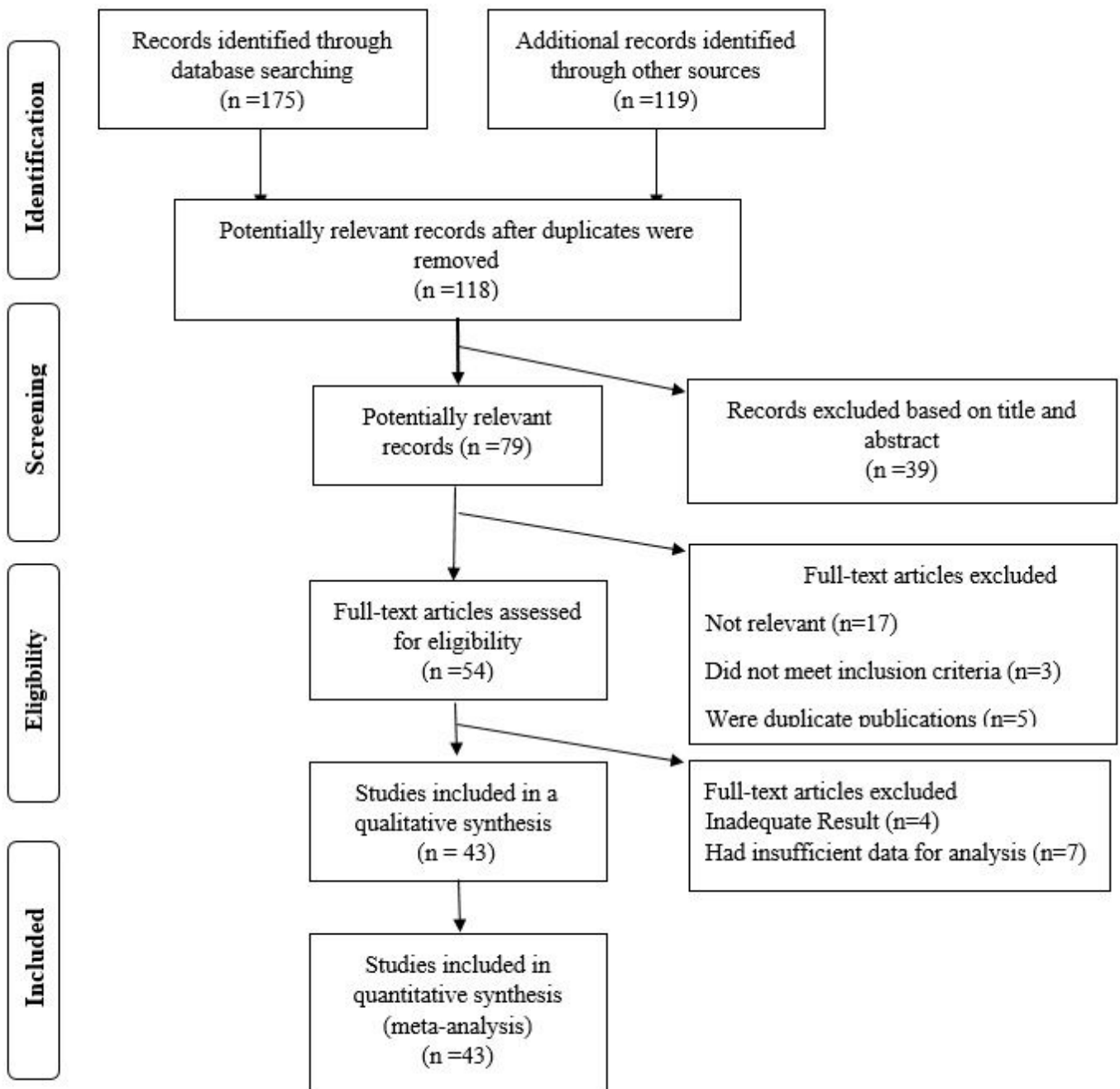


Figure 1

Screening of Articles Based on PRISMA Statement

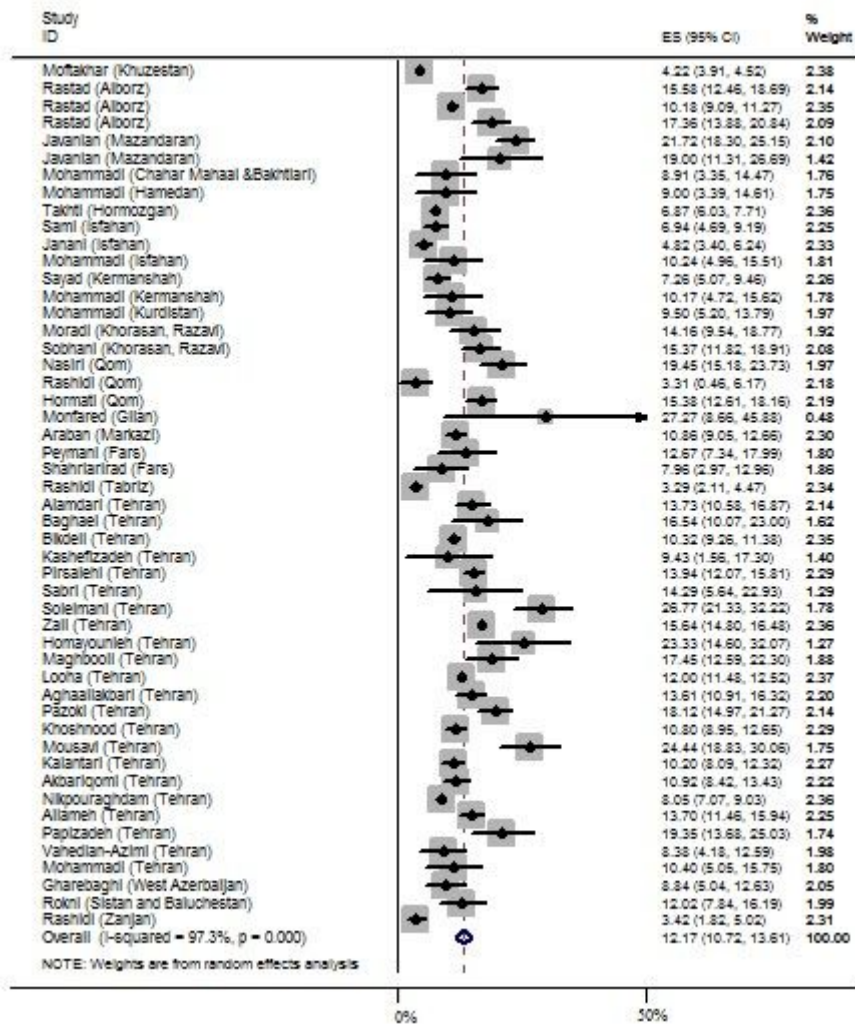


Figure 2

The Forest plot in-hospital death due to COVID-19 disease in Iranian patients