



**University of Thessaly**  
**School of Medicine**  
**Department of Biomathematics**  
**Postgraduate Programme (MSc):**  
**Research Methodology in Biomedicine, Biostatistics and Clinical Bioinformatics**

**Master thesis:**

*Attitudes and beliefs of healthcare workers about mandatory COVID-19 vaccination, a systematic review of cross-sectional studies*

**Student:**

Marios Politis

**Master thesis comitee:**

Supervisor: Associate Professor Rachiotis Georgios

Professor Stefanidis Ioannis

Dr. Doxani Chrisoula

# Attitudes of healthcare workers towards mandatory Covid-19 vaccination: A systematic review of cross-sectional studies

Marios Politis

## **Abstract**

**Background:** The main objective of this review is to investigate the views and attitudes of healthcare workers (HCWs) towards mandatory Covid-19 vaccination. Mandatory vaccinations are considered as a controversial public health policy both in public dialogue and among HCWs. Thus, this review aims to give a useful insight into HCWs attitudes towards Covid-19 vaccination mandates amid the ongoing Covid-19 pandemic.

**Methods:** A systematic search of four databases (PubMed, Scopus, Embase, CINAHL) has been conducted between 31 July 2022 and 15 August 2022. Cross-sectional studies that addressed attitudes of adults and professionally active HCWs about mandatory Covid-19 vaccination (any vaccination status with any kind of Covid-19 vaccine) were considered as eligible for this review. All included studies (n=37), were assessed for risk of bias with the NIH - Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies. Narrative synthesis was conducted combining the results of all studies in order to provide a comprehensive overview of HCWs attitudes towards mandatory Covid-19 vaccination.

**Results:** A total number of 37 (50.204 participants) studies has been included in this systematic review. Most HCWs favoured the Covid-19 vaccine mandates for the HCWs (12/20 studies) while the majority of them placed themselves against mandatory vaccination for the general population (7/16 studies). Regarding the Covid-19 vaccine mandates as a working requirement, most HCWs were in agreement with such policies.

**Conclusion:** Attitudes of HCWs towards the various outcomes regarding the Covid-19 vaccine mandates varied a lot. While the majority of HCWs favoured Covid-19 vaccine mandates for HCWs, there was still a considerable number of HCWs who were opposed to them. Our findings confirms that vaccine mandates are a controversial issue. Before governments decide for Covid-19 mandatory vaccinations, other alternatives should be considered first.

**Other:** The protocol of this review is registered on PROSPERO with ID number: CRD42022350275

**Key words:** mandatory vaccination, Covid-19, healthcare workers

## **1. Introduction**

Although World Health Organization (WHO) supports information campaigns and promotion of vaccine accessibility instead of vaccine mandates, many countries chose the opposite way imposing a mandatory COVID-19 vaccination to their HCWs (1). HCWs are frequently a target population when it comes to vaccine mandates, partly because of their obligation of not harming their patients but also due to their important societal role especially in an emerging pandemic (1). On November 2021, England announced a vaccination mandate for all NHS staff that had to be implemented by 1 April 2022, although vaccination rate among NHS trust healthcare staff was 93% and 90% for the first and the second dose, respectively (2). Data from another study suggest that as for 16 January 2022, the percentage of the unvaccinated NHS staff was close to 5.4% or a total number of 80.092 HCWs (3). Regarding the same study, a 5% of the NHS staff will remain unvaccinated despite the mandates, jeopardising their employment and applying additional pressure to an understaffed NHS. In alignment with England, Greece and France imposed COVID-19 vaccinations mandates to their healthcare personnel as well, following Italy, which was the first European country to make COVID-19 vaccination mandatory for the HCWs (4). Interestingly, a 6-15% of Italy's HCWs remained unvaccinated, despite the extreme first COVID-19 pandemic wave that Italy suffered from (5). In accordance to European countries, US decided for COVID-19 vaccinations mandates right after the U.S. Food and Drug Administration fully approved the vaccine (6). Data from the US provided nearly after the release of COVID-19 vaccine, suggested that only a 52% of the frontline HCWs were vaccinated against COVID-19 with at least one dose at that time, with one third of the unvaccinated to insist of not having the vaccine (6).

Vaccine hesitancy among HCWs was a public health concern of great importance even before the Covid-19 pandemic (7). Similar to pre-Covid-19 pandemic era, the reasons of vaccine hesitancy in HCWs against the Covid-19 vaccine include mistrust towards authorities, anticipation for reliable data, doubts about safety and efficacy and concerns about the rapid rollout of the vaccine (7). A great study which included 76.741 HCWs, revealed an average of 22.51% (from 4.3 to 72%) worldwide prevalence of hesitancy against the Covid-19 vaccine. According to the same study, males, doctoral degree holders and participants of older age were more prone to receiving a Covid-19 vaccine than other participants, revealing disparities throughout the HCWs population regarding the Covid-19 vaccine mandates (8).

As mentioned by Bardosh K. et al., from a behavioural scope, vaccine mandates could induce political polarization and even further vaccine mistrust (9). Moreover, discrepancies in global health policies, exclusion from work and social life and depletion of health care system capacities may also emerge due to vaccine mandates (9). In this context, governments and policy makers should

firstly examine thoroughly the reasons of HCWs' hesitancy and pursue for alternatives before imposing a Covid-19 vaccine mandate (10).

Acknowledging the importance and the sensitivity of the Covid-19 vaccine mandates in HCWs, our aim through this systematic review is to give a deep insight into the attitudes of HCWs towards Covid-19 mandatory vaccination.

## **2. Methods**

### **2.1 Search strategy and eligibility criteria**

A systematic literature search was conducted between 31 July 2022 and 15 August 2022 including articles from 4 databases: PubMed, Embase, Scopus, CINAHL. For our search only research articles written in English and published from 1 January 2019 to 30 July 2022 were included. The same search strategy was used for all data bases which is as follows: (healthcare workers OR healthcare personnel OR doctors OR nurses OR students) AND (Covid-19 OR SARS-CoV-2) AND (mandatory OR obligatory OR required) AND (vaccination OR inoculation). EndNote Web was used to import references from all databases and remove duplicates. After duplicates removal, abstracts from the remaining articles were screened.

#### **Inclusion criteria:**

1. Population: For this review, HCWs were defined as adults (>18 years old), from all health related professions (physicians, nurses, midwives, pharmacists, healthcare students, healthcare administration staff etc.) who were professionally active. Both vaccinated and unvaccinated HCWs against Covid-19 were included.
2. Study design: Cross-Sectional and cross-sectional time-series studies were only included. Face to face, online, structured and semi-structured surveys were eligible for this systematic review.
3. Outcomes: Articles which investigated the views and attitudes of HCWs towards mandatory Covid-19 vaccines of any type were included in this systematic review.

#### **Exclusion criteria:**

1. Population: Non HCWs populations were not eligible for this systematic review. Moreover, studies about retired HCWs were not met the eligibility criteria.
2. Study design: Studies of qualitative design were excluded.
3. Outcomes: Studies that did not analyse data about views and attitudes of HCWs were not included.

## 2.2 Study risk of bias assessment

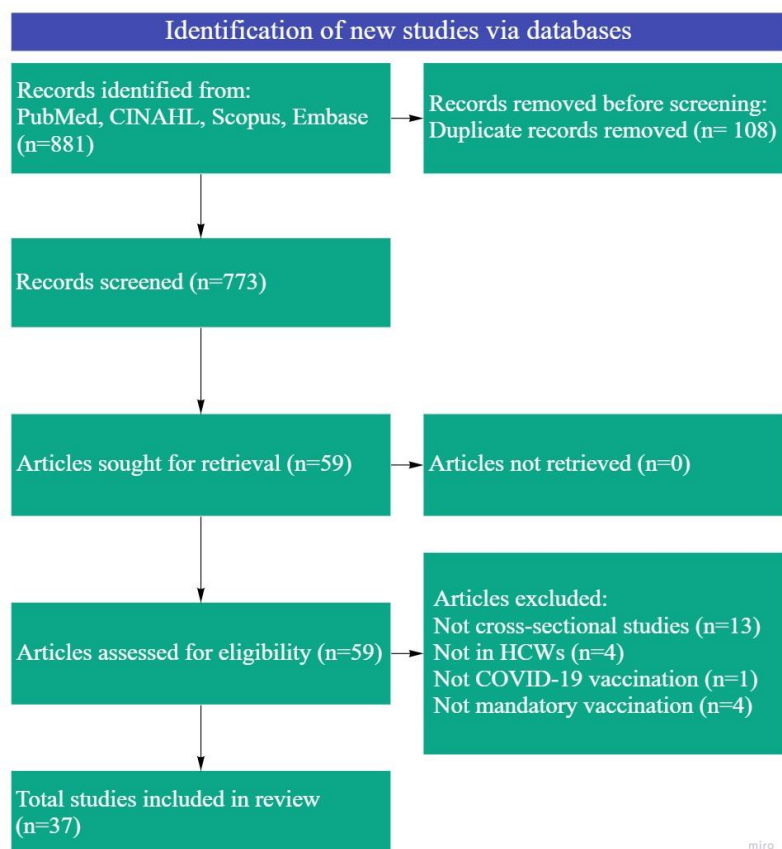
All included studies were evaluated for risk of bias with the NIH - Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (<https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools>). According to the NIH - Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies, studies were rated in a three-rate scale: poor, fair, good.

## 2.3 Data extraction and synthesis

A narrative synthesis is used for combining evidence of all of the included studies according to Cochrane Consumers and Communication Review Group guidelines (11). The main thematic for which data were extracted were: 1. views and attitudes of HCWs towards Covid-19 vaccination mandates for the general population, 2. views and attitudes of HCWs towards Covid-19 vaccination mandates for the HCWs, 3. views and attitudes of HCWs towards Covid-19 vaccination mandates as a working requirement of HCWs.

Moreover, details of the studies such as names of first authors, year of publication, time period of study implementation, study design, size of sample and country were extracted. Finally, various socio-demographic factors (age of participants, gender and profession etc.) were used in this systematic review. Tabulated data of all available evidence is used for comparison between included studies.

Flow diagram of this systematic review



### **3.Results**

#### **3.1 Views and attitudes of HCWs about Covid-19 vaccine mandates for the general population**

Regarding the outcome attitudes of HCWs towards mandatory Covid-19 vaccination for the general population, 16 studies were collected for evidence synthesis (**table 1, 2**). The total participant's number was 18.127 HCWs, coming from ten different countries. The majority of the participants were opposed to Covid-19 vaccine mandates but not without mentioning the great differences across the studies (from 17.8% to 88%). In only 7 out of 16 studies, HCWs supported Covid-19 mandatory vaccination for the general population with  $\geq 50\%$ .

Three studies from Saudi Arabia were included (**12, 13, 14**), showing a general trend of HCWs preference in Covid-19 vaccine mandates for the general population which was not the case for the single included study from Cyprus (**15**) in which only 34% of HCWs favoured Covid-19 vaccine mandates for the general population. Two studies from Turkey (**16, 17**) resulted in contradictory results, with the larger one (1808 participants) to show an opposition of HCWs towards Covid-19 vaccine mandates while in the second one, most of the participants placed themselves in favour of Covid-19 vaccine mandates.

Clearly against the Covid-19 vaccine mandates, stood the HCWs in two large studies from France (**18**) and the United Kingdom (**19**). Approximately, one third of HCWs were in favour of Covid-19 mandatory vaccinations in two studies from Slovakia and Slovenia (**20, 21**). Both studies from Italy resulted in similar findings (**22, 23**), with about 60% of HCWs to show approval of Covid-19 mandatory vaccinations.

Lastly, four more studies, three from the USA (**24, 25, 26**) and one from Barbados (**27**), were taken into account concerning the attitudes of HCWs towards the mandatory Covid-19 vaccinations for the general population. A great variation in the results of these studies has been observed, with the range acceptance percentage to be between 29% and 66%.

**Table 1. Characteristics of included studies for the outcome: attitudes of HCWs towards mandatory Covid-19 vaccination for the general population**

Author (year)	Study design	Participants	Country	Agreement with mandates	Quality
Aldosary (2021)	Cross-Sectional	n=334	Saudi Arabia	79.00%	Good
Giannakou (2022)	Cross-Sectional, online	n=504	Cyprus	34.00%	Fair
Gönüllü (2021)	Cross-Sectional, online	n=506	Turkey	60.00%	Good
Janssen (2021)	Cross-Sectional, online	n=4349	France	18.00%	Good
Kelekar (2021)	Cross-Sectional, online	n=415	USA	51.00%	Fair
Krishnamurthy (2021)	Cross-Sectional, online	n=343	Barbados	29.00%	Poor
Lucia (2021)	Cross-Sectional, online	n=168	USA	66.00%	Poor
Mascarenhas (2021)	Cross-Sectional, online	n=248	USA	40.00%	Fair
Öncel (2022)	Cross-Sectional, online	n=1808	Turkey	42.00%	Poor
Papini (2022)	Cross-Sectional, online	n=2137	Italy	61.00%	Good

Qattan (2021)	Cross-Sectional, online	n=673	Saudi Arabia	40.00%	Fair
Ricco (2021)	Cross-Sectional, online	n=166	Italy	60.00%	Poor
Temsah (2022)	Cross-Sectional, online	n=1285	Saudi Arabia	82.20%	Fair
Ulbrichtova (2021)	Cross-Sectional, online	n=1124	Slovakia	35.00%	Good
Velikonja (2022)	Cross-Sectional, online	n=832	Slovenia	30.00%	Good
Woolf (2022)	Cross-Sectional, online	n=3235	United Kingdom	12.00%	Good

**Table 2. Socio-demographic characteristics of included studies for the outcome: attitudes of HCWs towards mandatory Covid-19 vaccination for the general population**

Author (year)	Country	Participants	Gender (female)	Age (years)	Profession
Aldosary (2021)	Saudi Arabia	n=334	-	-	HCWs
Giannakou (2022)	Cyprus	n=504	320 (63%)	Mean age: 36.7±9.6 (SD)	Physicians: 62 (13.3%) Nursing staff: 223 (48%) Pharmacists: 76 (16.3%) Non-medical professionals: 62 (13.3%) Physiotherapists: 31 (6.7%)
Gönüllü (2021)	Turkey	n=506	297 (58%)	26–35: 169 (33%) 36–44: 168 (33%) 45–60: 153 (30%) >60: 16 (4%)	Paediatrician: 506 (100%)
Janssen (2021)	France	n=4349	2806 (64%)	<25:202 (5.6%) 25-40: 1675 (46.2%) 41-50: 908 (25.1%) >50: 838 (23.1%) Missing: 29 (16.7%)	Frontline caregiver: 1940 (53.6%) Other caregiver: 1018 (28.1%) Administrative and non-caregiver staff: 624 (17.3%) Unclassified: 35 (1.0%) Missing: 730 (16.8%)
Kelekar (2021)	USA	n=415	-	-	Medical students: 163 (39%) Dental students: 245 (59%)
Krishnamurthy (2021)	Barbados	n=343	260 (76%)	18–34: 144 (42%) >35: 199 (58%)	Medical Doctor: 119 (34.7%) Nurse: 144 (42%) Allied health/Admin: 80 (23.3%)
Lucia (2021)	USA	n=168	96 (57%)	-	Medical students: 168 (100%)
Mascarenhas (2021)	USA	n=248	144 (58%)	Mean age: 26.3±3.8 (SD)	Dental students: 248 (100%)
Öncel (2022)	Turkey	n=1808	1,227 (68.1%)	18-35: 780 (43.3%) 36-50: 664 (36.9%) >50: 357 (19.8%)	Physicians 927 (51.5%), Nurses and midwives 479 (24.6%) Medical technicians 80 (4.4%) Aides or helpers,93 (5.2%) Others 222 (12.3%)
Papini (2022)	Italy	n=2137	1528 (71.7%)	<31: 190 (8.92%) 31–40: 440 (20.65%) 41–50: 571 (26.79%) 51–60: 700 (32.85%) >60: 230 (10.79%)	Medical Doctors: 634 (29.91%) Nurses: 894 (42.17%) Auxiliary nurses: 100 (4.72%) Technicians: 189 (8.92%) Pharmacists: 24 (1.13%) Territorial medicine: 74 (3.50%) Administration: 111 (5.26%) Other: 64 (3.03%)
Qattan (2021)	Saudi Arabia	n=673	268 (39.82%)	18–29: 147 (21.84%) 30–39: 305 (45.32%) 40–49: 141 (20.95%) 50–59: 56 (8.32%) ≥60: 24 (3.57%)	Frontline healthcare worker: • Yes: 327 (48.59%) • No: 346 (51.41%)
Ricco (2021)	Italy	n=166	99 (59.6%)	Mean age: 49.1 ± 10.7 (SD) <50: 106 (63.9%) >50: 60 (36.1%)	Occupational Physicians: 166 (100%)
Temsah (2022)	Saudi Arabia	n=1285	822 (64%)	25–34: 434 (33.8%) 35–44: 477 (37.1%) 45–54: 273 (21.2%) ≥ 55: 101 (7.9%)	Medical Doctors: 596 (46.4%) Nurse: 640 (49.8%) Allied Health Practitioner 49 (3.8%)
Ulbrichtova (2021)	Slovakia	n=1124	-	-	Physicians: 582 (52%) Non-physician HCWs: 542 (48%)

Velikonja (2022)	Slovenia	n=832	-	-	-
Woolf (2022)	United Kingdom	n=3235	2405 (74%)	16-<40: 1020 (31.5%) 40-<55: 1239 (38.3%) >55: 963 (29.8%)	Medical staff: 778 (24.1%) Nursing staff: 698 (21.6%) Allied health professional: 917 (28.4%) Pharmacy: 62 (1.9%) Healthcare scientist: 146 (4.5%) Ambulance staff: 94 (2.9%) Dental staff: 93 (2.9%) Optical staff: 82 (2.5%) Admin/estates/other staff: 184 (5.7%) Missing: 103 (3.2%)

### 3.2 Views and attitudes of HCWs about Covid-19 vaccine mandates for the HCWs

A total number of 24 studies (**table 3, 4**) with 28.209 participants were included for narrative synthesis of evidence for the outcome: attitudes of HCWs towards mandatory Covid-19 vaccination for the HCWs. Despite the great heterogeneity of the evidence, a general trend of Covid-19 vaccine mandate support is observed among the HCWs. In twelve out of 20 studies where binary data were available, HCWs placed themselves in favour of mandatory Covid-19 vaccinations for the HCWs.

As regards Europe, two studies from Italy were taken into consideration, with the first study (**28**) resulting in a marginally low (43%) support towards Covid-19 vaccine mandates, while the second one (**29**) showing a great influence (64.3%) of Covid-19 vaccination mandates in the participant's decision either for or against Covid-19 vaccination. All three studies from Greece (**30, 31, 32**), have constantly shown a supportive attitude of HCWs for Covid-19 vaccine mandates for HCWs (83.9%, 57.1%, 66%), as opposed to the two studies from France in which the majority of the included HCWs were opposed to Covid-19 vaccine mandates (74%, 64.5%). Moreover, an almost equal percentage of opposition and support has been observed in two studies of Slovakia and Cyprus (18, 23). Two more studies, one from the United Kingdom (**19**) and one from Poland (**33**), have shown contradictory results regarding the support for Covid-19 vaccine mandates (6%, 70%).

A series of 6 studies from the USA (**24, 25, 26, 34, 35, 36**) has been included, resulting in a strong supportive attitude (from 52% to 83%) of the participants towards Covid-19 vaccine mandates for HCWs. Data from 2 Australian studies (**37, 38**), suggested a divided attitude regarding the approval of Covid-19 mandatory vaccination for HCWs (50%, 43%). As for the evidence derived from 5 Asian studies, a great divergence has been observed regarding the views and attitudes of the participating HCWs towards Covid-19 vaccine mandates. In more detail, the majority of the participants in two studies, one from India and one from Mongolia, (**39, 40**) were in favour of Covid-19 vaccine mandates, while in another Indian (**41**) study a 60% bucked against them. Lastly, two studies one from Saudi Arabia (**42**) and one from Pakistan (**43**), reported opposite results considering the role of Covid-19 vaccine mandates in the Covid-19 vaccine acceptance.



**Table 3. Characteristics of included studies for the outcome: attitudes of HCWs towards mandatory Covid-19 vaccination for the HCWs**

Author (year)	Study design	Participants	Country	Main findings and percentage of agreement with mandates	Quality
Arif (2022)	Cross-Sectional	n=529	Saudi Arabia	vaccine mandates decrease the OR of vaccine acceptance of HCWs by 0.27 in a logistic regression model	Poor
Constantino (2022)	Cross-Sectional, two waves	n=1450,	Italy	522/1450 of participants were unwilling to get the vaccine during the first survey. In the second survey, a 64.3% of those who changed their opinion regarding Covid-19 vaccination, they did it due to vaccines mandates	Good
Craxi (2021)	Cross-Sectional online	n=465	Italy	43.00%	Fair
Giannakou (2022)	Cross-Sectional, online	n=504	Cyprus	49.00%	Fair
Grabert (2022)	Cross-Sectional, online	n=1047	USA	83.00%	Fair
Jain (2021)	Cross-Sectional	n=1068	India	75.00%	Fair
Janssen (2021)	Cross-Sectional, online	n=4349	France	26.00%	Good
Kaufman (2021)	Cross-Sectional	n=3074	Australia	50.00%	Fair
Kavanagh (2022)	Cross-Sectional, online	n=252	Australia	43.00%	Fair
Kalucka (2022)	Cross-Sectional	n=1080	Poland	70.00%	Good
Kelekar (2021)	Cross-Sectional, online	n=415	USA	65.00%	Fair
Lucia (2021)	Cross-Sectional, online	n=168	USA	83.00%	Poor
Maltezou (2021)	Cross-Sectional	n=1591	Greece	83.90%	Fair
Maltezou (2022)	Cross-Sectional	n=134	Greece	57.10%	Poor
Maltezou (2022)	Cross-Sectional	n=1284	Greece	66.00%	Fair
Mascarenhas (2021)	Cross-Sectional, online	n=248	USA	52.00%	Fair
Masood (2022)	Cross-Sectional	n=331	Pakistan	59% of the participants answered that official requirements is the reason of getting vaccinated	Fair
Mayan (2021)	Cross-Sectional	n=1899	USA	58.00%	Good
Navarre (2021)	Cross-Sectional, online	n=1964	France	35.30%	Good
Poyiadji (2022)	Cross-Sectional, time-series	n=1506	USA	The majority of HCWs showed compliance to vaccine mandates. Very little of disruption in operation capacity of healthcare settings has been shown	Fair
Singh (2021)	Cross-Sectional	n=254	India	40.00%	Fair
Turbat (2022)	Cross-Sectional, online	n=238	Mongolia	93.00%.	Fair
Ulbrichtova (2021)	Cross-Sectional, online	n=1124	Slovakia	52.00%	Good
Wolf (2022)	Cross-Sectional, online	n=3235	United Kingdom	6.00%	Good

**Table 4. Socio-demographic characteristics of included studies for the outcome: attitudes of HCWs towards mandatory Covid-19 vaccinations for the HCWs**

Author (year)	Country	Participants	Gender (female)	Age (years)	Profession
Arif (2022)	Saudi Arabia	n=529	362 (68%)	-	Physician: 88 (16.64%) Nurse: 223 (42.16%) Administrator: 41 (7.75%) Allied health professional: 23 (4.35%) EMS: 1 (0.19%) Pharmacist: 16 (3.02%) Technician 28 (5.29%) Other: 109 (20.60%)
Constantino (2022)	Italy	n=1450	939 (64.7)	Mean age: 46.3±15.7 (SD)	Pharmacists: 1450 (100%)
Craxi (2021)	Italy	n=465	225 (48%)	Mean age: 51±9 (SD)	Physician: 212 (45.6%) Nurse: 120 (25.8%) Healthcare technician: 41 (8.8%)

					Administrative/others: 92 (19.8)
Giannakou (2022)	Cyprus	n=504	320 (63%)	Mean age: 36.7±9.6 (SD)	Physicians: 62 (13.3%) Nursing staff: 223 (48%) Pharmacists: 76 (16.3%) Non-medical professionals: 62 (13.3%) Physiotherapists: 31 (6.7%)
Grabert (2022)	USA	n=1047	515 (49%)	-	Physicians: 747 (71%) Other: 300 (29%)
Jain (2021)	India	n=1068	519 (48%)	-	Medical students: 1068 (100%)
Janssen (2021)	France	n=4349	2806 (64%)	<25:202 (5.6%) 25-40: 1675 (46.2%) 41-50: 908 (25.1%) >50: 838 (23.1%) Missing: 29 (16.7%)	Frontline caregiver: 1940 (53.6%) Other caregiver: 1018 (28.1%) Administrative and non-caregiver staff: 624 (17.3%) Unclassified: 35 (1.0%) Missing: 730 (16.8%)
Kaufman (2021)	Australia	n=3074	2532 (82%)	18-49: 1643 (55.4%) >50: 1321 (44.6%)	Medical Doctor: 171 (5.6%) Nurse: 2071 (67.4%) Pharmacist: 53 (1.7%) Allied Health Professional: 232 (7.5%) Personal support staff 66 (2.1%) Ambulance staff 124 (4.0%) Other 357 (11.6%)
Kavanagh (2022)	Australia	n=252	178 (70%)	18-29: 26 (11.7%) 30-49: 73 (32.9%) 50-64: 109 (49.1%) >65: 14 (6.3%)	Disability support workers: 252 (100%)
Kalucka (2022)	Poland	n=1080	830 (77%)	Mean age: 26.8±9.7 (SD) 19-26: 815 (75.5%) >27: 260 (24.1%) Missing: 5 (0.5%)	Medical Doctors: 135 (12.5%) Nurses and midwives: 128 (11.8%) Medical students: 423 (39.2%) Students of nursing and midwifery 394 (36.5%)
Kelekar (2021)	USA	n=415	-	-	Medical students: 163 (39%) Dental students: 245 (59%)
Lucia (2021)	USA	n=168	96 (57%)	-	Medical students: 168 (100%)
Maltezou (2021)	Greece	n=1591	1004 (63%)	< 30: 282 (17.7%) 31-40: 363 (22.8%) 41-50: 450 (28.3%) > 50: 496 (31.2%)	Physicians: 480 (31.6%) Nursing personnel: 607 (39.9%) Paramedical personnel: 171 (11.2%) Supportive personnel: 72 (4.7%) Administrative personnel: 191 (12.6%)
Maltezou (2022)	Greece	n=134	92 (68%)		Dental students 134 (100%)
Maltezou (2022)	Greece	n=1284	816 (63%)	≤30: 214 (16.7%) 31-40: 317 (24.7%) 41-50: 384 (29.9%) >50: 367 (28.6%)	Physicians: 402 (31.3%) Nursing personnel: 470 (36.6%) Paramedical personnel: 142 (11.1%) Administrative personnel: 170 (13.2%) Supportive personnel: 94 (7.3%) Unknown: 6 (0.5%)
Mascarenhas (2021)	USA	n=248	-	-	Dental students: (100%)
Masood (2022)	Pakistan	n=331	175 (53%)	<30: 183 (55%) 30-40: 93 (28%) 41-50: 26 (8%) 50-60: 22 (7%) >60: 7 (2%)	Physicians: 94 (28%) Nurse/ Nursing Assistant: 95 (29%) Technologist/ Technician: 118 (36%) Medical Social Officer: 24 (7%)
Mayan (2021)	USA	n=1899	1221 (64%)	<25 : 649 (34.18%) 25-29: 1091 (57.45%) >30: 159 (8.37%)	Medical students: 1899 (100%)
Navarre (2021)	France	n=1964	1532 (78%)	18-29: 306 (16%) 30-49: 1.118 (57%) >50: 540 (27%)	Physicians: 423 (21.5%) Paramedical staff: 876 (44.6%) Administrative workers: 432 (22.0%) Technical staff: 213 (10.8%) Other: 20 (1.0%)
Poyiadji (2022)	USA	n=1506	-	-	Radiology department employees: 1506 (100%)
Singh (2021)	India	n=254	72 (28%)	-	Medical Doctors: 172 (67.7%) Paramedical workers: 82 (32.3%)
Turbat (2022)	Mongolia	n=238	195 (81%)	18-25: 18 (7.6%) 26-35: 148 (62.2%) 36-45: 48 (20.2%) 46-55: 20 (8.4%) > 55: 4 (1.7%)	Physician: 162 (68.1%) Other: 76 (31.9%)

Ulbrichtova (2021)	Slovakia	n=1124	-	-	Physicians: 582 (52%) Non-physician HCWs: 542 (48%)
Woolf (2022)	United Kingdom	n=3235	2405 (74%)	16-<40: 1020 (31.5%) 40-<55: 1239 (38.3%) >55: 963 (29.8%)	Medical staff: 778 (24.1%) Nursing staff: 698 (21.6%) Allied health professional: 917 (28.4%) Pharmacy: 62 (1.9%) Healthcare scientist: 146 (4.5%) Ambulance staff: 94 (2.9%) Dental staff: 93 (2.9%) Optical staff: 82 (2.5%) Admin/estates/other staff: 184 (5.7%) Missing: 103 (3.2%)

### 3.3 Views and attitudes of HCWs about Covid-19 vaccine mandates as a working requirement

Only five studies addressed the attitudes of HCWs towards mandatory Covid-19 vaccination as a working requirement. In the largest included study, with 12,875 HCWs from USA (44), a 90.5% of those who faced vaccine mandates as a working requirement got the vaccine in compare with a 73.3% without vaccinations requirements. In the second US study (45), only 9.7% of the hesitant HCWs would change their decision regarding Covid-19 vaccination if vaccine mandates were implemented.

In a study from Nigeria (46), a 52.3% of HCWs would get vaccinated if it was imposed from the institutional heads. Mandatory Covid-19 vaccinations did not seem to be an adequate factor to change their opinion in relation to vaccination acceptance for the HWCs in a study in Jordan. The last included study, resulted in a 95.8% agreement of HCWs of Mongolia (47) with the Covid-19 vaccine mandates as a working requirement.

**Table 5. Characteristics of included studies for the outcome: attitudes of HCWs towards mandatory Covid-19 vaccination as a working requirement**

Author	Study design	Participants	Country	Attitudes	Quality
Aloweidi	Cross-Sectional, online	n=287	Jordan	Factors affecting the willingness to get vaccinated for COVID-19: 25.4% Mandatory in schools, universities and workplaces	Good
Lee	Cross-Sectional, telephone	n=12875	USA	90.5% of HCWs who faced working requirements had been vaccinated against COVID-19, as compared to 73.3% of HCP without vaccination requirements	Good
Mustapha	Cross-Sectional, online	n=440	Nigeria	52.3 would get the Covid-19 vaccine if mandated by the heads of institution	Fair
Niznik	Cross-Sectional, online	n=185	USA	9.7% of the hesitant HCWs reported that could change attitude either for or against Covid-19 vaccination if it is a workplace	Fair

Turbat	Cross-Sectional, online	n=238	Mongolia	requirement 95.8% agree with the approach of requiring HCWs to get vaccination due to their work	Fair
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#### **4. Discussion**

Given the globally existing Covid-19 vaccine hesitancy among HCWs (8), and the excess of mortality of 18.2 million people (95% UI 17.1–19.6) (49) amid an ongoing Covid-19 pandemic, many countries, as we previously discussed, opted for vaccine mandates for their HWCs (2, 4, 6) in order to achieve an adequate coverage.

Our study suggests, that HCWs were in favour of Covid-19 vaccine mandates for HCWs and opposed to them regarding the general population. In a systematic-review with a meta-analysis conducted in Italy (50), the pooled proportion of HCWs who favoured mandatory vaccinations against influenza were 61% (95% C.I.: 53%- 68%). Our results come in contrast with the previous study, considering that no distinction to attitude orientation (for HCWs, for general population) has been made, giving to their outcome a more generic perspective. Mandatory vaccination interventions have been also implemented for the Tdap vaccine (51). In this systematic review, mandatory interventions have achieved a  $\geq 90\%$  vaccination coverage in HCWs, a result that is in accordance with our findings as most HCWs agreed that Covid-19 mandatory vaccinations have to be implemented as a working requirement. Influenza vaccine mandates for HCWs seemed also to be an effective strategy in another systematic-review of 12 studies (52). Interestingly, in a systematic-review that addressed the attitudes towards Covid-19 vaccination among HCWs for the HCWs (53), the participants favoured vaccinations in two-thirds of the included studies, roughly the same proportion as in our systematic-review, in which we also considered the factor of obligatoriness.

Another interesting finding emerged from an Australian study of 2009 (54) where the vast majority (78%) of HCWs favoured a new mandatory vaccination policy for HCWs while only 3.6% were opposed to it. This made us to consider the rapid rollout of the Covid-19 vaccine and the novelty of the mRNA technology as major factors of vaccine hesitancy among HCWs (55). Despite our study's findings has shown a preference of HCWs vaccine mandates for HCWs as well, this preference did not reach a near 80% as in the Australian study.

Our study has several strengths and limitations. This systematic-review has been conducted in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement. We tried to avoid publication bias implementing our search in four databases, including an adequate number of studies and participants (56).

Of course, our study has several limitations. First of all, as happens with observational studies (56),

a great heterogeneity across the included studies has been observed. Response rates were suboptimal in many studies and the sampling procedure varied a lot among the included studies. These elements contributed to a mostly fair quality of the primary studies.

## **5. Conclusions**

Evidence from observational studies suggest that the majority of HCWs support Covid-19 vaccine mandates for HCWs but are opposed to them regarding general population. The great differences between studies urge for further research in order for disparities between countries and working groups to be identified.

## **6. Other**

### 6.1 Protocol registration

The protocol of this systematic review has been registered on PROSPERO with ID number: CRD42022350275.

### 6.2 Funding

Non reported

### 6.3 Potential conflicts of interest

All authors report no conflicts of interests relevant to this article

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