American Journal of Health Promotion
2023, Vol. 0(0) 1–33

DOI: 10.1177/08901171231200778
journals.sagepub.com/home/ahp
Sage

A Scoping Review on Gender/Sex Differences in COVID-19 Vaccine Intentions and Uptake in the United States

Katelyn M. Sileo, PhD, MPH[1], Inara M. Hirani[1], Rebecca L. Luttinen, BA[2], Matt Hayward, MLIS[3], and Paul J. Fleming, PhD[4]

Abstract

Objective: To explore the empirical literature on gender/sex differences in vaccine acceptance among U.S.-based adults and adolescents in approximately the first 2 years of the pandemic.

Data source: Embase, Medline, PsycINFO, EBSCO, CINAHL, Web of Science

Study inclusion and exclusion criteria: Peer-reviewed studies conducted in the U.S. with those aged 12 and older, published in English before January 12, 2022, examining the relationship between gender/sex on COVID-19 vaccine intentions and/or uptake.

Data extraction: Three authors screened studies and extracted data.

Data Synthesis: Univariate and multivariate results are summarized.

Results: A total of 53 studies met inclusion criteria (48 intentions, 7 uptake), using mostly cross-sectional designs (92.5%) and non-random sampling (83.0%). The majority of studies supported men's greater intentions to vaccinate compared to women, and men's greater vaccine uptake in univariate analyses, but most multivariate analyses supported no gender differences in uptake. Few studies examined gender beyond binary categories (women/men), highlighting a gap in the studies inclusive of transgender or gender-diverse populations in analyses.

Conclusion: Women may have been more hesitant to get the vaccine than men early in the pandemic, but these differences may not translate to actual behavior. Future research should include non-binary/transgender populations, explore the gender-specific reasons for hesitancy and differences by sub-populations, utilize more rigorous designs, and test gender-sensitive public health campaigns to mitigate vaccine concerns.

Keywords
COVID-19, vaccination, gender, United States

Introduction

The COVID-19 pandemic has caused nearly 7 million deaths globally as of May 2023,[1] including over 1 million in the United States (U.S.),[2] and has had enormous social and economic consequences.[3] Among the stark health disparities that have resulted from the pandemic, disparities are apparent by gender. There have been more COVID-19 hospitalizations and deaths in the U.S. among men compared to women which have been attributed to differences in engagement in COVID-19 prevention related to gender rather than biological differences related to sex.[4,5] In addition, some evidence shows that transgender and non-binary people are at elevated risk for negative COVID-19 outcomes, but public health data often fails to report data beyond the binary model of gender/sex.[6,7]

[1]The Department of Public Health, College of Health, Community, and Policy, The University of Texas at San Antonio, San Antonio, TX, USA
[2]The Department of Demography, College of Health, Community, and Policy, The University of Texas at San Antonio, San Antonio, TX, USA
[3]The John Peace Library, The University of Texas at San Antonio, San Antonio, TX, USA
[4]The Department of Health Behavior and Health Education, The School of Public Health at the University of Michigan, Ann Arbor, MI, USA

Corresponding Author:
Katelyn M. Sileo, The Department of Public Health, College of Health, Community, and Policy, University of Texas at San Antonio, One UTSA Circle, San Antonio, TX 78249, USA.
Email: katelyn.sileo@utsa.edu

Studies have shown women use health services more than men,[8-10] and emerging research suggests that they may also engage in COVID-19 prevention strategies (e.g., mask-wearing, social distancing, handwashing) more than men.[11] However, acceptance of the COVID-19 vaccine may stray from these typical gender patterns. Prior to the emergence of COVID-19, greater vaccine hesitancy had been documented among women compared to men.[12,13] Specific to COVID-19, a recent global meta-analysis reported lower vaccine intentions among women compared to men, but this varied by country.[14] The review did not examine non-binary gender populations,[14] but research shows COVID-19 may exacerbate structural inequalities for transgender and gender-diverse communities.[7] Other reviews on gender and COVID-19 vaccination are also global in scope, or broadly examine determinants of COVID-19 vaccination, but are not explicitly focused on gender/sex differences.[15-19] Thus, a review focused on gender/sex differences in vaccination in the U.S. population would fill a gap in the literature.

We conducted a scoping review which sought out studies that examined gender/sex differences in COVID-19 vaccine acceptance (intentions/uptake) among adults and adolescents in the U.S. published in approximately the first 2 years of the pandemic, with the goal of summarizing the existing evidence and identifying gaps for future research. Given that COVID-19 acceptance changes over time, the focus on the early stages of the pandemic allows us to explore acceptance in a timeframe crucial to pandemic control before and soon after vaccine availability. Scoping reviews include the "mapping" of evidence originating from a broad range of methodologies to convey the breadth, depth, and gaps of a field through a team-based iterative review and analytic reinterpretation of the literature.[20] Scoping reviews are appropriate for emerging research areas, as they can demonstrate the scope of the literature on a given topic, provide insight on the quantity of published papers about a topic, and produce specific questions for the purposes of further research and investigation.[21] In addition to synthesizing the literature on gender/sex differences in vaccine acceptance, we were interested in exploring how studies conceptualized gender (i.e., biological sex vs gender identity) and whether the current literature could shed light on vaccination intentions/uptake across the gender spectrum. We were also interested in exploring whether gender differences in vaccination varied by other subpopulations (such as by race/ethnicity, adolescents vs adults, etc.). This review was part of a larger search that also sought studies on gender/sex differences in other COVID-19 prevention behaviors (i.e., mask-wearing, social distancing, adherence to CDC guidelines). Due to space limitations, these outcomes will be reported separately in a companion review.

Methods

Database and Search Strategy

The search was carried out by a librarian specializing in public health (MH) on January 12th, 2022, and included 6 databases: Embase, Medline, PsycINFO, EBSCO, CINAHL, and Web of Science. The search strategy included terms related to COVID-19, gender/sex differences, and the COVID-19 prevention outcomes of interest (see Table S1 for the search terms). We adhered to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) where appropriate (checklist provided in Table S2).[22]

Study Selection

Studies were eligible for inclusion in this review if they examined gender or sex differences in vaccine intentions (self-reported plans/willingness/reluctance to be vaccinated) and/or vaccine behavior (self-reported or clinic record extraction on receipt of the COVID-19 vaccine). The search was inclusive of biological sex and self-identified gender identities on a spectrum (inclusive of non-binary identities). However, since the main research question of interest is gender/sex differences in the stated outcomes, studies could only be included if they made comparisons between groups (thus, a study on only men, only women, or only a non-binary population were excluded). The examination could have been quantitative or qualitative. Studies were published before January 12, 2022, but after the start of COVID-19 pandemic (search start date: January 1, 2020), were peer-reviewed, published in English, and were conducted within the U.S. with adult (18 years or older) and/or adolescent populations (12 years or older, chosen based on the cut-off age for COVID-19 vaccine availability at the time in the U.S.).

Studies identified during searches were merged using Endnote (version X7), and duplicate records were removed. The references were then imported from Endnote into COVIDENCE, a systematic review data management tool.[23] Three authors (KMS, IMH, RLL) and a research assistant reviewed titles and abstracts to determine eligibility based on the inclusion criteria, working in pairs. If there was disagreement within pairs, the article was discussed with a third reviewer; if consensus could not be reached, the article was included in the full-text review. These same teams then reviewed full-text articles in pairs against the review's inclusion criteria. Any study in question or with inconsistent classification between authors was discussed between the team and consensus was reached.

Data Extraction

A data extraction tool was created and piloted to extract key information related to study design, sampling strategy, target population and setting, outcome measurement, gender/sex definition, main study findings related to gender/sex's association with the review outcomes including univariate (unadjusted) and multivariate (adjusted) results, as applicable, and limitations as stated by study authors. Given the review's secondary interests in exploring gender differences in vaccine outcomes by relevant subgroups, the results of moderation analyses were extracted when available (e.g., gender by race, age, or other interactions). Two reviewers (IMH, RLL) reviewed studies, with reviewer 1 conducting the initial extraction, reviewer 2 reviewing extraction and suggesting changes and together coming to consensus. Reviewer 3 (KMS) completed a final review, focusing on the extraction of outcome measurement and results, and acted as a tiebreaker to resolve any discrepancies, as needed. We contacted study authors in cases where clarification was needed on extracted data. In cases where the author's information altered the extracted results, it is noted in the results tables.

Data Analysis Approach

We did not pool the study findings through meta-analysis, given the wide breadth of this scoping review, and disparate measurement of the outcomes of interest. We summarize each study and report findings for studies individually in the format that they were reported in the original paper by study authors. We extracted and present the association of gender/sex and the outcomes of interest obtained from both univariate and multivariate results, when available (with a summarized overview of other variables in the multivariate model). If papers only reported descriptive results (without tests of statistical significance conducted) but made a statement on differences, these results are reported as stated by the study authors.

Results

A total of 3191 unique citations were identified through the database search after the exclusion of duplicates. Of the 195 reports that underwent full-text screening, 142 were excluded for reasons outlined in Figure 1. See Table S3 for a list of ineligible studies reviewed as full-text with reasons for exclusion. In total, 53 studies met criteria for inclusion in this review, and contributed data for the following outcomes: vaccine intentions (k = 48, 52 total outcomes assessed) and vaccine uptake (k = 7, 8 total outcomes assessed).

Characteristics of Included Studies

Table 1 summarizes the included studies' designs and samples. Most studies (92.5%) used cross-sectional study designs (k = 49),[24-72] with a few exceptions (retrospective chart review: 3.8%, k = 2[73,74]; case control design: 1.9%, k = 1[75]; longitudinal, prospective cohort design: 1.9%, k = 1).[76] Most used non-random sampling strategies (e.g., convenience sampling, non-random quota sampling) (83.0%, k = 44).[24,27-44,48,50-62,64-66,68,69,71-76] Only 17.0% of studies used random probability sampling (k = 9),[25,26,45-47,49,63,67,70] while 3.8% of studies used a mix of random and non-random methods (k = 2).[32,57] For study location, just over half of studies were broadly U.S.-based (54.7%, k = 29),[24,25,27,28,40,41,43-47,49,51-53,55,57-60,62,63,65,67,70,72-74,76] while 45.3% (k = 24) were state, region, and city-specific studies.[26,29-39,42,48,50,54,56,61,64,66,68,69,71,75] For study population, 39.6% (k = 21) of samples were broadly defined as the U.S. population,[25,27,28,34,40,43-47,49,51,52,57,60,62,63,65,67,70,76] 22.6% (k = 12) of which reported using methods (sampling/weighting) to achieve national representation,[25,27,28,43,45,46,49,51,62,63,67,70] and 17.0% of studies were with state-specific samples (e.g., California residents) (k = 9).[30-32,36,42,54,66,68,75] Other subpopulations included were health care workers or employees of health systems (17.0%, k = 9),[29,33,35,37-39,53,56,64] patient populations (recruited in clinics) (7.5%, k = 4),[48,50,61,69] ethnicity-specific groups (5.7%, k = 3),[24,58,72] deployed soldiers and/or veterans (5.7%, k = 3),[41,73,74] college students (3.8%, k = 2),[26,59] adolescents (1.9%, k = 1),[71] and older adults (1.9%, k = 1).[55] Most (k = 48[24-34,36-44,46-52,54-59,61-63,65-76] focused on only 2 (i.e., male/female) gender categories; five studies allowed for more than 2 categories in their analysis.[35,45,53,60,64]

Reported Results of Gender/Sex Differences in Vaccine Outcomes

Table 2 reports the detailed results reported from each study, organized by the 2 vaccine outcomes: intentions and uptake. A description of outcome measurement is included for each study; some studies had multiple outcomes analyzed per category. We report the results of both univariate and multivariate analyses (when possible), and the type of analysis used (e.g., logistic regression), as reported by study authors. All studies meeting the inclusion criteria used quantitative methods (no qualitative studies were identified meeting inclusion criteria). While we attempted to extract each study's definition of gender/sex, definitions were infrequently included and the terms were often used interchangeably; thus, the terms used in the table vary but follow the reporting of each paper (e.g., males/females, women/men). There are some cases in which studies analyze more than 2 binary gender categories (e.g., transgender, nonbinary groups). These data were extracted and are reported in Table 2 and described in text. However, since they

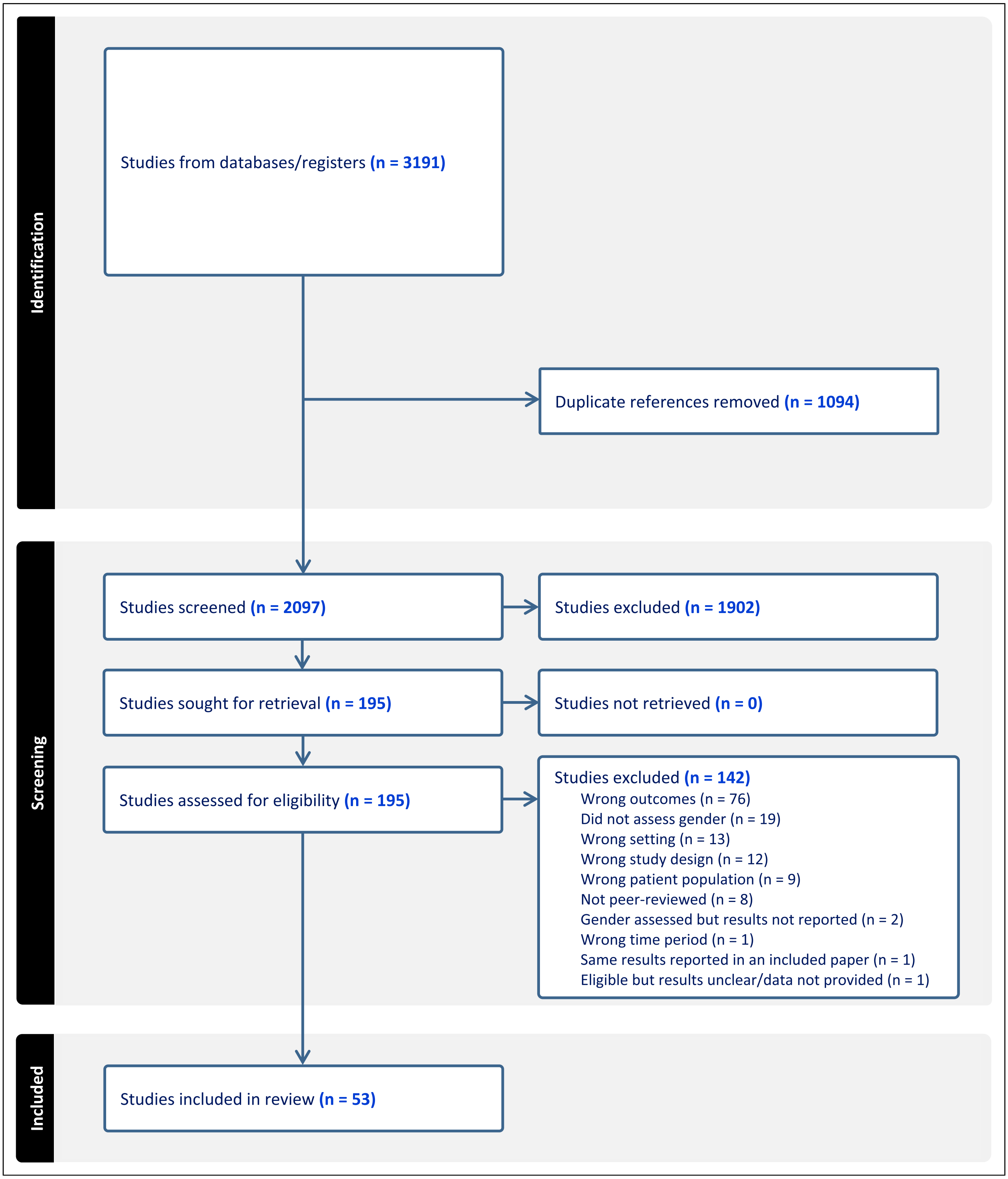

Figure 1. PRISMA flowchart for study inclusion/exclusion.

Table 1. Summary of study characteristics.

Author, year	Location (City, State)	Data Collection Years	Study Design	Sampling Strategy	Population Group	Total N	Age	% Female
Abouhala, 2021	U.S.	May - September 2020	Cross-sectional survey [online]	Convenience sampling [Social media advertisements, informal networks, and word of mouth]	Arab American adults (age 18+)	638	18-25: 226 (35.4%) 26-34: 193 (30.3%) 35-54: 162 (25.4%) 55+: 57 (8.9%)	52.0%
Allen, 2021	U.S.	May - June 2020	Cross-sectional survey [online]	Random probability sample [Random selection from a probability-based panel representative of the U.S. population]	Nationally representative U.S. sample of adults (age 18+)	1219	M = 48.1 SD = 0.6	52.1%
Andrejko, 2021	California	February - April 2021	Case Control [test-negative case control study design extracted from California Department of Public Health electronic records system]	Matched Case Control Sampling [Prospectively selected COVID-19 cases matched with control from a sample of controls randomly selected to match the participant by age, sex, region, and week of COVID-19 test]	California residents who had PCR test results	1023	18-29: 395 (38.6%) 39-49: 363 (35.5%) 50-64: 192 (18.8%) ≥65: 73 (7.1%)	49.3%
Brunson, 2021	Central Texas	November-December 2020	Cross-sectional survey [online]	Random probability sample [Stratified, cross-sectional sampling was conducted by emailing randomly selected students who fit criteria]	College students (age 18-23)	614	M = 20.3 SD = NR	48.8%
Callaghan, 2021	U.S.	May - June 2021	Cross-sectional survey [online]	Quota Sampling [Quota sampling followed by post-stratification weights were used to achieve a nationally representative sample]	Nationally representative U.S. sample of adults (age 18+)	5009	M = 44.5 SD = NR	50.5%
Chen, 2022	U.S.	March 2020	Cross-sectional survey [online]	Quota Sampling [Quota sampling matching sample to census demographics to achieve a nationally representative sample]	Nationally representative U.S. sample of adults (age 18+)	1000	M = 44.9 SD = NR	51.3%
Ciardi, 2021	New York City, New York	December 2020 - January 2021	Cross-sectional survey [online]	Convenience sampling [Employees of a public hospital were provided with an anonymous link to the survey]	Health care workers and staff from a NYC public hospital in the South Bronx (including administrative staff and those with and without patient contact)	428	18-25: 4 (0.93%) 26-35: 125 (29.21%) 36-45: 106 (24.77%) 46-55: 88 (20.56%) 55-65: 86 (20.09%) >65: 19 (4.44%)	65.1%

(continued)

Table 1. (continued)

Author, year	Location (City, State)	Data Collection Years	Study Design	Sampling Strategy	Population Group	Total N	Age	% Female
Coughenour, 2021	Nevada	December 2020	Cross-sectional survey [landline & cell phone]	Non-probability sampling [Nevada residents were called via landline telephone and cell phone across the state of Nevada]	Nevada residents (age 18+)	991	18 to 24: 63 (6.4%) 25 to 44: 180 (18.3%) 45 to 64: 300 (30.5%) 65 and over: 441 (44.8%)	54.9%
Crozier, 2021	Alabama	October - December 2020	Cross-sectional survey [telephone & online]	Convenience sampling [Community health workers involved in COVID-19 messaging recruited from communities]	Rural, minority, and underserved individuals living in Alabama	3721	<18: 115 (3.1%) 18-24: 535 (14.4%) 25-39: 937 (25.2%) 40-59: 1294 (34.8%) >/ = 60: 840 (22.6%)	56.5%
Cunningham-Erves, 2021	Southeastern U.S., 12 states	October - December 2020	Cross-sectional survey [online]	Purposive sampling & Random probability sampling [Recruited from Community Health Centers and from stratified random sampling of general population sources]	English speaking, Black and White adults aged 40-79 years, and living in the southeastern U.S.	4486	<65: n = 1851 (M = 59.9, SD = 3.0) ≥65: n = 2635 (M = 71.9, SD = 5.4)	66.0%
Do, 2021	Eastern Kentucky & West Virginia (Appalachia)	December 2020	Cross-sectional survey [online & in-person]	Convenience sampling [Health care workers were recruited via email and in-person]	Health care workers (including those working in the hospital, emergency room, ambulatory services) working in one of 13 facilities under one health system in rural Appalachia	1076	Vaccine accepters: M = 44.5 (SD = 12.4) Vaccine Rejectors: M = 38.5 (SD = 11.5)	80.2%
Dorman, 2021	Orange County, California	October - November 2020	Cross-sectional survey [online, phone, & in-person]	Convenience Sampling [A county community vaccine taskforce contacted constituents by email. To increase representation of low-income and minority respondents, a coalition of community clinics conducted face-to-face or telephone interviews with clinic clients.]	Residents of Orange County, California (age 18+)	26,324	18-34: 5350 (20.5%) 35-54: 13,402 (51.3%) 55-74: 6593 (25.3%) 75 and older: 760 (2.9%)	72.8%

(continued)

Table 1. (continued)

Author, year	Location (City, State)	Data Collection Years	Study Design	Sampling Strategy	Population Group	Total N	Age	% Female
Dowdle, 2021	Health sciences university in the U.S. (unspecified)	December 2020	Cross-sectional survey [online]	Convenience sample [Email recruitment via an online anonymous survey at a multi-campus health sciences university]	Health Sciences University employees	2258	18-29: 300 (13.29%) 30-39: 591 (26.19%) 40-49: 507 (22.46%) 50-59: 478 (21.18%) 60-69: 330 (14.62%) 70+: 51 (2.26%)	69.6% female, 28.9% male, 1.6% prefer not to disclose*
Fadel, 2021	South Carolina, U.S.	October-November [year NR]	Cross-sectional survey [online]	Convenience sampling [Solicited a stratified sample that drew from each county in South Carolina. Data was sourced through traditional marketing panel via online methods where qualified participants were invited to take the survey]	South Carolina residents (age 18+)	1614	18-30: 476 (29.6%) 31-44: 416 (25.8%) 45-59: 341 (21.2%) 60+: 377 (23.4%)	70.6%
Famuyiro, 2021	Houston, Texas	December 2020	Cross-sectional survey [online]	Convenience sampling [Online survey was individually disseminated among the health workers of 3 community-based, university-affiliated health centers]	Health care workers (both clinical and non-clinical) working at community-based health centers	205	18-24: 9 (4.46%) 25-34: 85 (42.08%) 35-44: 43 (21.28%) 45-54: 39 (19.30%) 55-64: 19 (9.41%) ≥65: 7 (3.47%)	72.7%
Gatto, 2021	Riverside County, California	March - April 2021	Cross-sectional survey [online]	Convenience sampling [Email and flyer recruitment of Riverside University Health Center employees]	Health care workers and health system employees	789	18-29: 106 (13.5%) 30-49: 412 (52.4%) 50-64: 246 (31.3%) 65+: 22 (2.8%)	79.2%
Green-McKenzie, 2022	Philadelphia, Pennsylvania	December 2020 - April 2021	Cross-sectional survey [online & in-person]	Convenience sampling [Participants were sampled via email to hospital employees]	Health care workers and staff (employees at an academic hospital, including physicians, nurses, staff with some patient contact, and staff with no patient contact)	12,610	M = 40.9 SD = 12.4	65.2%

(continued)

Table 1. (continued)

Author, year	Location (City, State)	Data Collection Years	Study Design	Sampling Strategy	Population Group	Total N	Age	% Female
Higginson, 2021	U.S. (Army, Military Reserve & National Guard population)	May 2021	Retrospective chart review	Purposive sampling [Deidentified data on vaccination status were retrospectively extracted from the electronic medical record of the Military Health System]	Members of the Army, Reserve, or National Guard units of the military assigned to deployment area of operations	1809	M = 32.2 SD = 11.0	21.1%
Huynh, 2021	U.S.	NR	Cross-sectional survey [online]	Convenience sampling [Recruitment from online marketing panel]	U.S. adults (age 18+)	351	M = 37.41 SD = 11.51	42.2%
Ioannou, 2021	U.S.	December 2020 - March 2021	Retrospective chart review	Convenience sampling [Veteran Affairs (VA) enrollees COVID-19 vaccination status extracted from the VA's Corporate Data Warehouse, a database of VA enrollees' comprehensive electronic health records system]	Veterans Affairs enrollees	5,766,638	M = 62.4 SD = NR	9.5%
Jasuja, 2021	U.S.	March -August 2021	Cross-sectional survey [online]	Convenience sampling [Sample drawn from the Department of VA Survey of Healthcare Experiences of Patients' (SHEP) Veteran Insights Panel (VIP), a standing, national online group of veterans who regularly use VA health care. Members were invited via email to participate in a web-based survey]	Veterans Affairs enrollees	1178	M = 66.7 SD = 10.1	11.0%
Kantarcioglu, 2021	Georgia & Illinois	June - July 2021	Cross-sectional survey [online]	Convenience sampling [Recruitment from an online survey panel with survey distributed via personal networks of the research team to the members of the Georgia and Illinois community]	Georgia and Illinois residents (inclusive of high school students)	253	M = 22 IQR range = 17-43 years	61.7%
Khubchandani, 2021	U.S.	June 2020	Cross-sectional survey [online]	Convenience sampling [Recruitment from an online survey panel, social media sites, and personal networks]	Nationally representative U.S. sample of adults (age 18+)	1878	18-25: 349 (19.0%) 26-40: 829 (44.0%) 41-60: 525 (28.0%) ≥61: 175 (9.0%)	52.0%
Killgore, 2021	U.S. [Vermont & Wyoming not represented]	December 2020	Cross-sectional survey [online]	Convenience sampling [Recruitment from an online survey panel via email message]	U.S. adults (age 18+)	1017	M = 37.0 SD = 12.2	58.4%

(continued)

Table 1. (continued)

Author, year	Location (City, State)	Data Collection Years	Study Design	Sampling Strategy	Population Group	Total N	Age	% Female
King, 2021	U.S.	January - May 2021	Repeated Cross-sectional survey [online]	Stratified random sampling [Survey was offered monthly to a random sample, stratified by geographic region to an online panel via Facebook. Post-stratification weights were applied to match the US general population by age, gender, and state]	Nationally representative U.S. sample of adults (age 18+)	525,644	18-24: 15,382 (2.9%) 25-34: 52,015 (9.9%) 35-44: 72,541 (13.8%) 45-54: 81,005 (15.4%) 55-64: 102,934 (19.6%) 65-74: 95,607 (18.2%) ≥75: 41,799 (8.0%) Missing: 64,361 (12.2%)	53.2% female, 83% male, 0% transgender man, <1% transgender woman, <1% nonbinary, <1% other, and 5% missing*
Latkin, 2021a	U.S.	May 2020	Cross-sectional survey [online & telephone]	Random probability sampling [Data were collected from a probability-based panel designed to be representative of the US adult population. Randomly selected US households were contacted by mail, email, telephone, and field interviewers]	Nationally representative U.S. sample of adults (age 18+)	1043	18-29: 71 (6.8%) 30-39: 147 (14.1%) 40-59: 373 (35.8%) 60-64: 118 (11.3%) 65 or older: 334 (32.0%)	70.1%
Latkin, 2021b	U.S.	July 2020	Longitudinal, prospective cohort design [online]	Convenience sampling [Recruitment from an online survey panel]	U.S. adults (age 18+)	592	Mean = 39.9 SD = 11.4	56.1%
Lazarus, 2021	U.S. [multi-country study]	June 2020	Cross-sectional survey [online]	Random sampling [Random sampling across 18 countries including the U.S. No other details provided]	U.S. adults (age 18+)	760	Age <50: 574 (75.5%) Age ≥50: 199 (26.2%)	55.7%
Litaker, 2021	Central Texas	November - December 2020	Cross-sectional survey [online]	Convenience sampling [Policy holders for a health insurance plan were invited to participate via email or post]	Central Texas adults, who were the primary policy holder for a health insurance plan	1648	M = 46.8 SD = 12.3	54.1%

(continued)

Table 1. (continued)

Author, year	Location (City, State)	Data Collection Years	Study Design	Sampling Strategy	Population Group	Total N	Age	% Female
Liu, 2021	U.S.	January -March 2021	Repeated cross-sectional [online survey conducted weekly, 6 weeks of data used for this analysis]	Random probability sampling [Data were obtained from the public microdata of the Household Pulse Survey conducted by the U.S. Census Bureau, based on national household probability samples. Independent samples of households were selected, and each sampled household was interviewed once].	Nationally representative U.S. sample of adults (age 18+)	443,680	M = 53.9 SD = 15.9	60.0%
McElish, 2022	Arkansas	October 2020 - January 2022	Cross-sectional survey [online]	Convenience sampling [Participants were recruited from 6 primary care clinics via a recruitment email].	Arkansas patients of primary care clinics in urban and rural areas	754	M = 47.4 SD = 16.3	70.4%
Meier, 2021	U.S.	October 2020	Cross-sectional survey [online]	Convenience sampling [Recruitment from an online survey panel, to match a sample representative of the U.S. population]	Nationally representative U.S. sample (age 18+)	1054	M = 45.4 SD = 16.2	51.2%
Milligan, 2021	U.S.	April 2020 - May 2021	Cross-sectional survey [online]	Convenience sampling [Recruitment from an online survey panel]	U.S. adults (age 18+)	249	M = 35.5 SD = 11.8	40.16%
Momplaisir, 2021	U.S.	November - December 2020	Cross-sectional survey [online]	Convenience sampling [Employees of an adult and children's hospital were recruited via email]	Health care workers and staff working at a hospital (including those with and without patient contact)	10,866	<40: 5923 (54.7%) 40-64: 4486 (41.4%) 65 or older: 424 (3.9%)	77% female, 22.4% male, .7% other*
Mondal, 2021	U.S.	May 2020 - January 2021	Cross-sectional survey [online]	Random probability & convenience sampling [Recruitment from an online survey panel with participants contacted randomly. Non-random approaches were also used (Studyfinder, social media platforms, bulk email invitations to Penn State Health patients)]	U.S. adults (age 18+)	2378	18-24: 175 (5.9%) 25-44: 950 (32.0%) 45-60: 783 (26.4%) 61-70: 645 (21.7%) 70+: 409 (13.8%)	75.1%
Neely, 2022	Florida	June 2021	Cross-sectional survey [online]	Quota sampling [Online survey panel participants were selected using a stratified, quota sampling approach to ensure representativeness]	Florida residents (age 18+)	600	18-24: 7.8% 25-44: 30.2% 45-64: 33.8% 65+: 28.2%	52.0%

(continued)

Table 1. (continued)

Author, year	Location (City, State)	Data Collection Years	Study Design	Sampling Strategy	Population Group	Total N	Age	% Female
Nikolovski, 2021	U.S.	November 2020	Cross-sectional survey [online]	Convenience sampling [Participants were enrolled in the Heartline™ clinical study, and were invited to participate in the survey via the Heartline™ mobile application]	Older adults (age 65+, possessing an iPhone 6 or later, Medicare beneficiary, English-speaking)	7402	M = 70.8 SD = 4.7	46.2%
Parente, 2021	Kansas	August 2020	Cross-sectional survey [online]	Convenience sampling [Email recruitment of employees, faculty, and students at the University of Kansas Medical Center (including ambulatory clinics, a hospital, and the Schools of Medicine, Nursing and Health Professions)]	Health care workers, faculty, students, and other employees of a university health system (age 18+)	3347	18-24: 13.1% 25-34: 29.1% 35-44: 21.1% 45-54: 16.9%; 55-64: 15.5% 65+: 4.2%	78%
Park, 2021	U.S.	October - December 2020	Cross-sectional survey [online, phone, & limited in-person]	Convenience sampling [Recruitment through organizations serving Asian-American or Pacific Islanders, personal networks, social media, email/ listservs, flyers, and ethnic media]	Asian-American or Pacific Islanders (age 18+)	1646	M = 40.6 SD = 15.8	62.5%
Patil, 2021	U.S.	July 2020	Cross-sectional survey [online]	Quota Sampling [Sequential sampling of an online research panel, with prospective respondents alerted of their eligibility and invited to participate electronically. Sampling quotas were used to mirror racial/ethnic and gender diversity in the U.S. national collegiate population]	Representative sample of U.S. college students	256	M = 23.9 SD = 4.3	42.0%
Reiter, 2020	U.S.	May 2020	Cross-sectional survey [online]	Convenience sampling [Recruitment via a national opt-in survey panel. Panel members who were potentially eligible received an email invitation to participate]	U.S. adults (age 18+)	2006	18-29: 313 (16.0%) 30-49: 657 (33.0%) 50-64: 532 (27.0%) 65+: 504 (25.0%)	56.0% female, 43.0% male, 1.0% other*
Rodriguez, 2021	14 U.S. cities**	December 2020 - March 2021	Cross-sectional survey [in-person & telephone].	Convenience sampling [Participants were recruited in-person at 11 sites, via calling into emergency department patient rooms at 3 sites, via calling patients immediately after emergency department discharge at 1 site]	Health care patients in emergency departments (age 18+)	2301	M = 48.0 IQR = 34.0-61.0	49.0%

(continued)

Table 1. (continued)

Author, year	Location (City, State)	Data Collection Years	Study Design	Sampling Strategy	Population Group	Total N	Age	% Female
Ruiz, 2021	U.S.	June 2020	Cross-sectional survey [online]	Nonprobability quota sampling [Recruitment via an online survey panel using a nationwide nonprobability quota sampling design to create a sample representative of the nation]	Nationally representative U.S. sample of adults (age 18+)	804	18-24: 118 (14.7%) 25-34: 146 (18.2%) 35-44: 150 (18.7%) 45-54: 114 (14.2%) 65 or older: 141 (17.5%)	53.6%
Salmon, 2021	U.S.	November-December 2020	Cross-sectional survey [online]	Random probability sampling [Recruitment via a probability-based web panel, sampled from all US households. Those without internet were given tablets and internet access. Latinx individuals were recruited through random digit dialing of area codes with concentrated Latinx populations. Enrollment quotas ensured approximated representation of the U.S. population]	Nationally representative U.S. sample of adults (age 18+)	2525	18-29: 385 (15.2%) 30-44: 602 (23.8%) 45-59: 673 (26.7%) ≥60: 865 (34.3%)	51.8%
Shaw, 2021	New York state (17 counties)	February -March 2021	Cross-sectional survey [online]	Convenience Sampling [Recruitment via email invitation to employees of an academic medical center in Central New York]	Health care workers and employees at a single hospital/ academic center (clinical and nonclinical staff)	4537	M = 45.5 SD = 13.3	23.9% male, 73.4% female, .19% non-binary, 2.5% not disclosed*
Shih, 2021	U.S.	March 2020	Cross-sectional survey [online]	Convenience Sampling [Recruitment via an online survey panel, with participants recruited through social media and other advertisements. Age-gender nested quota system was built into the model to approximate the distribution in the U.S. population]	U.S. adults (age 18+)	713	18-23: 70 (9.9%) 24-39: 176 (24.8%) 40-55: 222 (31.3%) 56+: 242 (34.1%)	54.3%
Thompson, 2021	Michigan	June -December 2021	Cross-sectional survey [online & telephone]	Purposive sampling [Email recruitment to the networks of hospitals affiliated with the researchers and 9 community-based organizations in Michigan e.g., social service agencies, faith-based organizations, and federally qualified health centers]	Michigan residents (age 18+)	1835	M = 49.4 SD = 17.9	79.0%

(continued)

Table 1. (continued)

Author, year	Location (City, State)	Data Collection Years	Study Design	Sampling Strategy	Population Group	Total N	Age	% Female
Tram, 2021	U.S.	January - March 2021	Repeated cross-sectional survey [online survey conducted weekly, 6 weeks of data used for this analysis]]	Random probability sampling [Households were contacted by email and/or text message, with the sample drawn from the Census Bureau Master Address File and the Census Bureau Contract Frame. Survey was weighted to approximate a nationally representative sample]	Nationally representative U.S. sample	459,235	18-24: 2.87% 25-39: 18.84% 40-54: 26.99% 54-64: 20.43% ≥65: 30.86%	59.8%
Travis, 2021	South Carolina	October - November 2021	Cross-sectional survey [online]	Non-random stratified sampling [A stratified sample that drew from each county in South Carolina was obtained through an online survey panel, with participants recruited online and through e-mail solicitation]	South Carolina residents	1695	M = 43.0 SD = 17.5	74.1%
Unroe, 2021	Indiana	November 2020	Cross-sectional survey [online]	Convenience sampling [Recruitment via text message to nursing home staff, using personal cell phone numbers collected during a state sponsored all-staff COVID-19 testing effort. The survey link was also sent to assisted living facility administrators who were asked to send to their staff.]	Long-term care & nursing home staff	8243	16-24: 1044 (12.7%) 25-40: 3053 (37%) 41-60: 3204 (38.9%) >60: 938 (11.4%)	Unweighted 86.8%
Upenieks, 2021	U.S.	January-March 2021	Cross-sectional survey [mail & online]	Random probability sampling [Online survey panel participants were randomly selected individuals to participate using an address-based sample frame. The data were weighted to approximate representation of the U.S. population]	Nationally representative U.S. sample	877	M = 54.88 Range = 18-98	54.2%
Willis, 2021	Northwest Arkansas	May 2021	Cross-sectional survey [in-person and online]	Convenience sampling [All students enrolled in a health education program were recruited from 4 junior high schools]	Adolescents (9^{th} grade students)	345	M = 14.51 SD = NR	43.0%

(continued)

Table 1. (continued)

Author, year	Location (City, State)	Data Collection Years	Study Design	Sampling Strategy	Population Group	Total N	Age	% Female
Zhang, 2021	U.S.	December 2020 - January 2021	Cross-sectional survey [online & text messaging]	Convenience/snowball sampling [Leaders in the Afghan, Bhutanese, Somali, South Sudanese, and Burmese refugee communities identified through the study team's professional network were messaged and asked to share the survey link with peers and community members meeting inclusion criteria]	Afghan, Bhutanese, Somali, South Sudanese and Burmese refugees residing in the U.S. (age 18+)	435	≤30: 130 (29.9%) 31-40 164 (37.7%) ≥41: 141 (32.4%)	46.0%

Abbreviations: M = Mean, SD = Standard Deviation; IQR = Interquartile range; Notes: *More than the percent female is reported for studies that included more than binary (male/female) gender categories in their analyses (reported in Table 2) **San Francisco, CA; Oakland, CA; Fresno, CA; Sylmar, CA; Seattle, WA; Iowa City, IA; Detroit, MI; Ann Arbor, MI; New Orleans, LA; Philadelphia, PA; Durham, NC; Baltimore, MD; Camden, NJ; Boston, MA; The reporting of age varied; it is reported as reported in the paper. Age and percent female were sometimes calculated by the review authors from other data provided.

are few, the symbols used in Table 2 to summarize the associations between gender/sex and the outcomes only summarize differences captured between men and women. The symbol indicates either greater vaccination intentions/uptake in men compared to women, women compared to men, or no difference.

Vaccine Intentions. The measurement of vaccine intentions varied considerably across studies, but most often used a single item constructed by study authors asking about the likelihood that respondents would get a vaccine (sometimes hypothetically, in cases when it was not yet available) or their plans to get the vaccine. Response options used included a range of options, including binary (e.g., yes/no), categorical (e.g., I plan to, I do not plan to, I am not sure), and continuous outcomes (e.g., Likert scale on likelihood of vaccination in the future).

The vast majority of studies examined gender/sex in binary categories[24-34,36-38,40-44,46-52,55-59,61-63,65-69,71,72,75,76] with only five studies reporting analyses inclusive of other gender identities for vaccine intentions.[35,45,53,60,64] We summarize the findings first for gender binary comparisons. In univariate analyses, 73.7%, or 28 of the 38 analyses (k = 27), found greater vaccine intentions among men compared to women,[24-26,29,31,33-38,44,46,48,50,55-58,60-64,68,69,72] and 7.9%, or 3 of the 38 analyses (k = 3), found greater vaccine intentions among women compared to men.[42,45,47] Finally, 18.4% or 7 of the 38 analyses (k = 7), found no differences between men and women in COVID-19 vaccine intention.[30,41,43,47,71,75,76]

A total of 37 studies examined differences between men and women's vaccine intentions using multivariate analyses across 40 outcomes (i.e., controlling for other variables). In summary, 72.5%, or 29 of 40 analyses (k = 27), found greater vaccine intentions among men compared to women,[24,26,27,30-33,35,36,38,42,43,45,48-51,53,56,58,60,62,66-68,72,75] and only one study (1 outcome) or 2.5% of the 40 analyses found greater vaccine intentions among women compared to men.[76] Finally, 25.0%, or 10 of the 40 analyses (k = 9), found no differences between men and women in COVID-19 vaccine intentions.[28,37,40,44,47,52,57,59,65] A visual overview is provided that showcases these findings in brief (symbols only) in Table S4.

The results of the five studies that examined gender beyond binary categories for vaccine intentions are mixed and difficult to compare due to varying classifications and reference groups (detailed statistics in Table 2 and highlighted separately in Table S5).[35,45,53,60,64] In summary, 2 studies with general U.S. samples reported no differences in COVID-19 vaccine intentions in non-binary or "other" gender categories compared to males (univariate and multivariate analyses),[45,60] although one of these studies reported lower intentions in those not responding to the gender question compared to males.[45] All other studies were with health workers and/or health system employees. Dowdle et al.[35] reported greater intentions in gender non-conforming groups compared females (univariate and multivariate analyses). Momplaisir et al.[53] reported lower intentions in those in the "other" sex category compared to males (multivariate analysis). Shaw et al.[64] reported overall lower vaccine intentions in non-binary/gender not-disclosed employees compared to males and females, with a wider difference compared to males (univariate analysis).

Vaccine Uptake. Out of the 7 total studies measuring vaccine uptake, the outcome was most often measured through self-report (71.4%, k = 5)[42,54,64,70,73]; usually self-reported outcomes were obtained through constructed questions asking whether one had been vaccinated against COVID-19 (yes/no).[39,74] The remaining 2 studies used electronic clinic records to

Table 2. Summary of study results on sex/gender differences in COVID-19 vaccination intentions and uptake in the first year of the pandemic, U.S. populations (age 12 and above).

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
COVID-19 vaccine intentions					
Abouhala, 2021	Arab American adults, U.S.	Respondents were asked if they would receive the COVID-19 vaccine when it becomes available (strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, strongly disagree) [categorical variable]. For multivariate analysis, the item was recoded into likely (agree), unlikely (disagree), and unsure (neither agree/disagree) [categorical outcome].	○u ○m	Males (48%) were more likely than females (45.6%) to report being likely to receive the COVID-19 vaccine (P < .01) [Chi-square test].	Women had higher odds of reporting they are unlikely to be vaccinated vs likely to be vaccinated compared to men (AOR = 4.45, 95% CI = 1.91 - 10.36, men ref) and had higher odds of reporting they are unsure about receiving the vaccine vs likely to be vaccinated compared to men (AOR = 1.67, 95% CI = 1.21 - 2.48, men ref) [Multivariate multinomial logistic regression model adjusted for other demographics].
Allen, 2021	Nationally representative U.S. sample of adults	Respondents were asked if they would receive a COVID-19 vaccine if it became available (yes, no, or don't know) [categorical outcome].	○u	Women were less likely compared to men to intend to vaccinate (Men: 62.4%, Women: 54.3%) and were more likely to be unsure about their vaccination intentions compared to men (Men: 21.3%, Women: 26.8%) (P = .04) [Chi-square test, statistic NR].	NR
Andrejko, 2021	California residents	Unvaccinated respondents were asked if they would be willing to receive a COVID-19 vaccine when they became eligible (Not willing/unsure vs willing) [categorical outcome].	⊗u ○m	No statistically significant gender differences were identified in willingness to receive the COVID-19 vaccine (OR = 1.35, 95% CI = .97 - 1.87, male ref) [Logistic regression].	Females had greater odds of being unwilling to receive the COVID-19 vaccine compared to males (AOR = 1.47, 95% CI = 1.04 - 2.08, male ref) [Multivariate logistic regression models adjusted for other sociodemographic variables].
Brunson, 2021	College students (age 18-23), Central Texas	Respondents were asked if a COVID-19 vaccine was approved and released to the public, would they: take it as soon as possible, take it eventually, take it only if required, or not take [categorical outcome].	○m	NR	Female students had greater odds of not intending to take the vaccine compared than males (male ref). • Eventually: AOR = 2.97, P < .01 • If required: AOR = 3.77, P < .001 • Never: AOR = 1.80, P < .01 [Multivariate multinominal regression model adjusted for health major/minor, political affiliation, & health/COVID-19 related variables].
		A binary outcome was created by combining categories into (0) willing (take as soon as possible or take eventually) and (1) not willing (take only if required or not take) [binary outcome].	○u ○m	Female students were less likely to report being willing to accept the vaccine compared to male students (χ^2 = 14.34, P = .002, male ref) [Chi-square test].	Female students had greater odds of being unwilling to accept the COVID-19 vaccine compared to male students (AOR = 2.41, P < .001) [Multivariate logistic regression model adjusted health major/minor, political affiliation, flu shot, preventive behavior, perception of risk, & hesitancy scores].

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Callaghan, 2021	Nationally representative U.S. sample of adults	Respondents were asked if a COVID-19 vaccine was developed, would they pursue getting the vaccine? (yes/no) [binary outcome].	$\bigcirc^{m}$	NR	Women had greater odds of reporting being likely to refuse the vaccine compared to men (AOR = 1.71, 95% CI = 1.42 - 2.07, male ref) [Multivariate logistic regression model adjusted for other sociodemographic variables, and variables related to COVID-19 fears, risk, etc.].
Chen, 2022	Nationally representative U.S. sample of adults	Respondents were asked whether they will get a vaccine if one becomes available (Extremely likely, very likely, somewhat likely, not very likely, not likely at all) [continuous outcome].	$\otimes^{m}$	NR	No statistically significant gender differences were identified in likelihood of vaccination (*b* = -.03 SE = .02, *P* > .05 (male ref) [Multivariate ordinary least squares regression model adjusted for other sociodemographic variables, political affiliation, benevolent sexism, political knowledge, hostile sexism, & authoritarianism].
Ciardi, 2021	Health workers, New York, New York	Respondents were asked if they plan to vaccinate (yes/no) in the next 30 days [binary outcome].	$\bigcirc^{u}$	Men were more willing to get vaccinated compared to women (75% of male respondents were planning on being vaccinated within 30 days, vs 60% of female respondents) (χ^2 = 8.99, *P* = .002) [Chi-square test].	NR
		Respondents were asked if they plan to vaccinate (yes/no) in the next 60 days [binary outcome].	$\bigcirc^{u}$	Male respondents remained more likely to plan on being vaccinated in the next 60 days than female respondents (*P* < .001) [Chi-square test, statistic NR].	NR
Coughenour, 2021	Adult residents, Nevada	Respondents were asked, if in 6 months a COVID-19 vaccine became available, would they get it with a 4-point Likert scale (very likely, likely, unlikely, very unlikely) [categorical outcome], which were recategorized for multivariate analysis into more unlikely vs more likely [binary outcome].	$\otimes^{u}$ $\bigcirc^{m}$	No statistically significant gender differences were identified in intentions to be vaccinated: • Very likely: Female (47.65%), Male (51.29%) • Likely: Female (21.03%), Male (19.49%) • Unlikely: Female (12.75%), Male (11.95%) • Very unlikely: Female (18.57%), Male (17.28%) *P* = .73 [Chi-square test, statistic NR].	Males had less odds of being "more unlikely" (or vaccine hesitant) compared to females (OR = .63, 95% CI = .46 - .87, *P* = .005, female ref) [Multivariate logistic regression adjusted for other sociodemographic variables, health status, political views, & other COVID-related attitudes].
Crozier, 2021	Rural, underserved, and minority individuals, Alabama	Respondents were asked if they would receive the COVID-19 vaccination if they were given the opportunity (yes, no, unsure) [categorical outcome].	$\bigcirc^{u}$ $\bigcirc^{m}$	Males were more willing to receive the vaccine compared to females (43.3% vs 37%, *P* = .0004) [Chi square test, statistic NR].	Females has higher odds of being unsure and not intending to receive the vaccine than males. • Unsure: AOR = 1.37, 95% CI = 1.17 - 1.60, (*P* < .0001) (male ref) • No: AOR = 1.22, 95% CI = 1.02 - 1.46, *P* = .0276 (male ref) [Multivariate multinominal logistic regression adjusted for other sociodemographic variables].

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Cunningham-Erves, 2021	Black and White adults aged 40-79 years, living in the southeastern U.S.	Respondents were asked if they would receive a COVID-19 vaccine if it became available to them (very unlikely, somewhat unlikely, neither unlikely nor likely, somewhat likely, very likely), which was categorized into "low intent" for analysis (somewhat or very unlikely).	m	NR	Males had lower odds of having low intent to vaccinate compared to females (AOR = .69, 95% CI = .60 - .79, *P* < .0001, female ref) [Proportional odds models adjusted for other socio-demographics and a large number of health behavior, history, & belief variables].
Do, 2021	Health care workers in rural Appalachia, Eastern Kentucky & West Virginia	Respondents were asked if they were willing to take the COVID-19 vaccine (yes/no) [binary outcome].	u m	Males were more willing to take the COVID-19 vaccine compared to females (Male: proportion [P] = 67.6%, 95% CI = 60.9 - 73.8; Female: P = 48.6%, 95% CI = 45.2 - 51.9), χ^2 (df): 24.9 (1), *P* < .001) [Chi-square test].	Females had lower odds of being willing to accept the vaccine than males (AOR = .50, 95% CI, 95% CI = .35 - .73, *P* < .001, male ref) [Multivariate mixed effect logistic regression model adjusted for other sociodemographic variables, diabetes, had positive COVID-19 test, & takes flu vaccine yearly].
Dorman, 2021	Residents, Orange County, CA	Respondents were asked the degree to which they agreed that if a vaccine became available, if they plan to take it. Response options included a 7-item Likert scale [continuous outcome].	u	Males were more willing to get vaccinated compared to females (t [12,963] = −20.73, *P* < .001, female ref) [t test].	NR
Dowdle, 2021	Health Science University employees, U.S.	Respondents were asked if they intended to get the COVID-19 vaccine (definitely or probably will get the vaccine vs not sure, probably will not, and definitely will not) [binary outcome].	u m	Males had higher intentions to probably/definitely receive the vaccine compared to females (76.65% vs 60.14%, *P* < .05). Those that preferred to not disclose their gender were less likely to report intentions to probably/definitely receive the vaccine compared to females (34.29% vs 60.14%, *P* < .05) [Wald test].	Males had higher odds of intending to probably/definitely receive the vaccine compared to females (AOR = 2.11, 95% CI = 1.64 - 2.71, *P* < .001, female ref). Those that preferred to not disclose their gender had lower odds of intending to probably/definitely receive the vaccine compared to females (AOR = .31, 95% CI = .14 - .70, *P* = .005, female ref) [Multivariate logistic regression model adjusted for other sociodemographic variables].
Fadel, 2021	South Carolina residents (age 18+)	Respondents were asked if they plan on getting the vaccine after the FDA approves it/it becomes available (yes/no) [binary outcome].	u m	Being female was negatively correlated with vaccine intentions [Correlation: -.16, *P* < .05].	Females had lower odds than males of intending to vaccinate (*b* = -.75, SE = .14, AOR = .47, *P* < .05, male ref) [Multivariate logistic regression model adjusted for other sociodemographic items, COVID-19 knowledge, trust in science, & contact with COVID-19 cases].

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Famuyiro, 2021	Health workers (both clinical and non-clinical), Houston, Texas	Vaccine uptake readiness was assessed with these statements: "I would like to receive the vaccine once available," "I would like to receive the vaccine but prefer to wait until later," or "I do not plan on receiving the vaccine," which were coded for analysis as yes (once available/later) vs no [binary outcome].	○^{u} ⊗^{m}	Females had lower odds of being willing to accept the vaccine compared to males (OR = .22, *P* = .01, male ref) [Logistic regression].	No statistically significant gender effects were identified [statistics NR but authors state that sex did not remain significant in multivariate logistic regression adjusted for other sociodemographic items and perceived risk].
Gatto, 2021	Health workers and health system employees, California	Respondents were asked if a vaccine became available, would they get vaccinated (yes, no, unsure) and if they chose not to become vaccinated now, will they consider vaccination in the future (yes, no, unsure). Responses were recoded into 3 categories: vaccine acceptors (been vaccinated or planning to), vaccine hesitant (not currently vaccinated and uncertain to get vaccinated in the future), and vaccine refusers (not currently vaccinated and do not plan in the future to get vaccinated) [categorical outcome].	○^{u} ○^{m}	Males were less likely to be vaccine hesitant (OR = .17, 95% CI = .05 - .53) and to refuse the vaccine (OR = .20, 95% CI = .05 - .82) compared to females (female ref) [Multinomial logistic regression].	Males had lower odds of being vaccine hesitant (OR = .20, 95% CI: .05 - .82) and to refuse the vaccine (OR = .17, 95% CI: .01 - 1.29) compared to females (female ref) [Multivariate multinomial logistic regression adjusted for other sociodemographic, health, & COVID-19 related variables].
Huynh, 2021	U.S. adults	Respondents were asked if a COVID-19 vaccine was available, would they get it; response options on a 7-point Likert scale (1: not at all, 7: extremely likely) [continuous outcome].	⊗^{m}	NR	No statistically significant sex differences were identified in vaccine intentions (β = .05, *P* > .05) [Multivariate hierarchical regression model adjusted for other sociodemographic and intellectual humility variables].
Jasuja, 2021	Veterans Affairs enrollees	Respondents were asked if they intended to get a COVID-19 vaccine, with 4 response options: definitely will not, not sure, probably will, definitely will [categorical outcome].	⊗^{u}	No statistically significant gender differences were identified in vaccine intention group (χ^2 = 3.99; *P* = .14) [Chi square test].	NR
Kantarcioglu, 2021	Georgia and Illinois residents (inclusive of high school students)	Respondents were asked if they were willing/recommend vaccinating against COVID-19 (yes/no) [binary outcome].	●^{u} ○^{m}	Males were less likely to report being willing/recommend to vaccinate against COVID-19 compared to females [OR = .12, 95% CI = .02 -.89, *P* = .01] [from correspondence with the study author: OR from chi-square tests].	Females had lower odds of reporting being willing/ recommend to vaccinate compared to males [OR = .12, 95% CI = .02-.97, p= .04) [Multivariate logistic regression model adjusted for COVID-19 related variables].

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Khubchandani, 2021	Nationally representative U.S. sample of adults	Respondents were asked if a COVID-19 vaccine was available to prevent infection, how likely would they get the vaccine/shot with the following response options: very likely, somewhat likely, not likely, definitely no. Responses were recategorized into very likely/somewhat likely vs not likely/definitely not likely (or vaccine hesitant) for analysis [binary outcome].	⊗u ○m	No statistically significant gender differences in vaccine intentions were identified (Not likely to get the vaccine/definitely not: Male: 22% vs Female: 22%, *P* = .81) [Chi-square test, statistic NR].	Females had greater odds of being vaccine hesitant compared to males (AOR = 1.44, 95% CI = 1.12 -1.84, *P* = .004, male ref) [Multivariate logistic regression model adjusted for other socio-demographic variables and concern about and perceived risk of infection].
Killgore, 2021	U.S. adults	Respondents were asked if they will get the COVID-19 vaccine when it is offered to them with responses on a 7-point Likert scale ranging from totally disagree to totally agree [continuous outcome].	○u ⊗m	Females were less likely to intend to get the COVID-19 vaccine compared to males (-.11, *P* < .05) [Correlation test].	No statistically significant sex differences were identified in vaccine intentions (β = -.15, t [-5.58], *P* = 3.06, partial r = -.17) [Multivariate stepwise multiple linear regression model, adjusted for other socio-demographic variables fear of COVID-19 and COVID-19 diagnosis].
King, 2021	Nationally representative U.S. sample of adults	Respondents were asked if they would get a COVID-19 vaccine if it became available. Responses of probably or definitely would not choose to get vaccinated were categorized as vaccine hesitant vs probably or definitely would choose to get vaccinated or were already vaccinated [categorical outcome].	●u ○m	Females were less likely to be vaccine hesitant compared to males (Relative Risk = .79, 95% CI = .78 - .81). There was no statistically significant difference between non-binary individuals and males (Relative Risk = 1.10, 95% CI = .97 - 1.22). Those providing no response to the gender question were more likely to be vaccine hesitant compared to males (Relative Risk = 1.58, 95% CI = 1.54 - 1.61) [Poisson regression model, male ref for all comparisons].	Females were more likely to be vaccine hesitant compared to males (Relative Risk = 1.12, 95% CI = 1.10 - 1.14). There was no statistically significant difference between non-binary individual and males (Relative Risk = .99, 95% CI = .88 - 1.10). Those providing no response to the gender question were more likely to be vaccine hesitant compared to males (Relative Risk = 1.39, 95% CI = 1.34 - 1.44) [Poisson regression model adjusted for other sociodemographic variables, male ref for all comparisons].
Latkin, 2021a	Nationally representative U.S. sample of adults	Respondents were asked if they planned on receiving the COVID-19 vaccine if it becomes available (yes, no, not sure) [categorical outcome].	○u	Males were less likely to not intend to vaccinate (compared to intending to vaccinate) (OR = .64, .44-.94, *P* = .02, female ref) and were less likely to be unsure about vaccinating (compared to intending to vaccinate) (OR = .43, .31-.59, *P* < .001, female ref) [Logistic regression].***	Not extracted***

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Latkin, 2021b	U.S. adults	Respondents were asked about their likelihood to receive the COVID-19 vaccine (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). Responses were recoded for analysis into positive intentions (agree), negative intentions (disagree), and ambivalent (neither agree nor disagree) [categorical outcome].	⊗^{u} ●^{m}	No statistically significant gender differences were identified in negative vaccine intentions compared to positive intentions (ref) (OR = .75, 95% CI = .50 -1.11, male ref) or in ambivalent intentions compared to positive intentions (ref) (OR = 1.21, 95% CI = .77 - 1.88, male ref) [Multinomial logistic regression models].	Females had lower odds of reporting negative intention to receive the vaccine compared to positive intention (AOR = .51, 95% CI = .29 - .87, male ref). No statistically significant gender differences were found when comparing ambivalent intentions to positive intentions (AOR = .96, 95% CI = .59 - 1.57, male ref) [Multinomial logistic regression models adjusted for other sociodemographic items and a range of COVID-19 variables].
Lazarus, 2021	U.S. adults	Respondents were asked if they will take a COVID-19 vaccine that is proven to be safe and effective (yes/no) [binary outcome].	⊗^{u} ⊗^{m}	No statistically significant gender differences were identified in vaccine acceptance (Females: 76.4%; Males: 74.8%, *P* > .05) [Logistic regression model].	No statistically significant gender differences were identified in vaccine acceptance (AOR = .99, 95% CI = .70 - 1.39, female ref) [Multivariate logistic regression model adjusted for other sociodemographic variables].
		Respondents were asked if they would follow their employer's recommendations to get a COVID-19 vaccine if the government approved it as effective and safe, with response options on a 5-point Likert scale (completely agree to completely disagree) which were recategorized for analysis into willingness to accept the vaccine (yes/no) [binary outcome].	●^{u} ⊗^{m}	Females were more likely to report that they would accept the vaccine if recommended by their employer compared to males (Females: 55.8%; Males: 46.3%, *P* < .05) [Logistic regression model].	No statistically significant gender differences were identified in likelihood of accepting the vaccine if recommended by employer (AOR = .74, 95% CI = .55-1.00, female ref) [multivariate logistic regression model adjusted for other sociodemographic variables].
Litaker, 2021	Adults, Central Texas	Respondents were asked if they would plan to get the COVID-19 vaccine when it becomes available (yes, no, not sure), recoded for analysis as yes vs no/not sure/prefer not to say [binary outcome].	○^{u} ○^{m}	Females were less were less likely to intend to receive the vaccine compared to males (OR = .56, 95% CI = .46-.69, *P* < .001, male ref) [Logistic regression model].	Females had lower odds of intending to receive the vaccine compared to males (AOR = .65, 95% CI = .52 - .82, *P* < .001, male ref) [Multivariate logistic regression model adjusted for other sociodemographic variables].
Liu, 2021	Nationally representative U.S. sample	Respondents who had not received the COVID-19 vaccine were asked, once a COVID-19 vaccine becomes available, will they get it (Response options: Definitely; Probably; Probably not; Definitely not). Item was recorded as vaccine hesitancy if a respondent indicated that they would "probably not" or "definitely not" receive a COVID-19 vaccine when available [binary outcome].	○^{m}	NR	Males had lower odds of being vaccine hesitant compared to females in the initial data collection period (AOR = .13, SE = .01, *P* < .001), but vaccine hesitancy declined faster overtime in women compared to men, with gender differences no longer statistically significant by the final time period (Gender interaction reported with week iteration of survey: Week X Male Overall: .03 (SE = .01), *P* < .001) [Multilevel logistic regression model adjusted for other sociodemographic variables and gender week/data collection period].

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
McElfish, 2021	Patients, Arkansas	Respondents were asked if a vaccine was available, would they get vaccinated (very likely, likely, don't know/not sure, unlikely, or very unlikely). For analysis, responses don't know/not sure, unlikely, and very unlikely were coded as vaccine hesitant [binary outcome].	$\bigcirc^{u}$ $\bigcirc^{m}$	Women reported greater COVID-19 vaccine hesitancy compared to men (Women: 42.41%; Men: 29.86%, $P < .01$ [Chi-square test, statistic NR].	Women had greater odds of reporting COVID-19 vaccine hesitancy compared to men (B = .42, SE = .20, AOR = 1.52, P = .03, male ref) [Multivariate logistic regression model adjusting for other sociodemographic variables, fear of infection, & COVID-19 self-efficacy].
Meier, 2021	Nationally representative U.S. adults	Respondents were asked if they would get a COVID-19 vaccine if it became available with response options on a 7-point Likert scale (not at all likely to very likely) [continuous outcome].	$\bigcirc^{m}$	NR	Females were less likely than males to intend to receive the vaccine (β: -.10, b -.38, 95% CI = -.58, -.19, $P < .001$, male ref) [Multivariate linear regression adjusting for other sociodemographic variables and risk perception].
Milligan, 2021	U.S. adults	Respondents were asked if they would get the COVID-19 vaccine if it became available (yes/no) [binary outcome].	$\otimes^{m}$	NR	No statistically significant gender differences were identified in vaccine intentions (B = -.25, SE = .28, Wald = .84, P = .36, female ref) [Multivariate logistic regression model adjusting for other sociodemographic variables].
Momplaisir, 2021	Health workers and employees of a hospital, U.S.	Respondents were classified as being hesitant if they reported that they did not plan to receive a vaccine, were unsure about receiving a vaccine, or if they planned on delaying receipt of the vaccine for 3 months or more. Those reporting that they were planning to receive the COVID-19 vaccine as soon as it was available to them were classified as not hesitant [binary outcome].	$\bigcirc^{m}$	NR	Women health care workers had greater odds of reporting vaccine hesitancy compared to men (AOR = 2.39, 95% CI = 2.15 - 2.65, men ref). Those in the "other" sex category (transgender or binary, prefer not to say, other) also had greater odds of reporting vaccine hesitancy compared to men (AOR = 2.59, 95% CI = 1.53 - 4.40, $P < .001$, men ref) [Multivariate logistic regression model adjusting for other sociodemographic variables].
Mondal, 2021	U.S. adults	Respondents were asked if they would like to get a COVID-19 if it was available (yes/no) [binary outcome].	$\bigcirc^{u}$ $\otimes^{m}$	Males had greater desire to receive the vaccine compared to females (χ^2 = 10.42; P = .001) [Chi-square test].	No statistically significant gender differences were identified in desire to get the vaccine (Wald χ^2 = 1.03, P = .23) [Multivariate logistic regression model controlling for other sociodemographic variables, health worker status, & health care access].
Nikolovski, 2021	Older adults (age 65+), U.S.	Respondents were asked if they would like to get a COVID-19 vaccine if it was available with response options on a 4-point scale (very willing, somewhat willing, not very willing, not at all willing) [ordinal outcome].	$\bigcirc^{u}$	Women were less likely than men to report wanting to receive the vaccine compared to men (OR = .49, 95% CI = .45 - .54, male ref) [Logistic regression].	NR

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Parente, 2021	Health workers and employees of a university health system, Kansas	Respondents were asked if they would get the COVID-19 vaccine after the first month of FDA approval, 1-3 months, 4-6 months, 7-12 months, more than 12 months, or never. For analysis, responses were categorized into intentions of early acceptance (planning to obtain vaccine at least 3 months after approval) vs not or intending to obtain it later than 3 months [binary outcome].	○u ○m	Males had higher odds of intending to receive the vaccine early compared to females (OR = 2.39, 95% CI = 1.99 - 2.89, *P* < .001, female ref) [Logistic regression model].	Males had higher odds of intending to receive the vaccine early compared to females (AOR = 2.43, 95% CI = 2.00 - 2.95, *P* < .001, female ref) [Multivariable logistic regression model adjusted for other sociodemographic variables, health, prior influenza vaccination, viral concern, & patient interaction].
Park, 2021	Asian-American or Pacific Islander Adults, U.S.	Respondents were asked if they would get a COVID-19 vaccine if it became available to them (definitely yes, probably yes, unsure, probably no, definitely no). For the analysis, responses were categorized into definitely yes, probably yes, and unsure/probably no/ definitely no [binary outcome].	○u ○m	Males had lower odds of reporting being uncertain/not intending to receive the vaccine than definitely planning to get the vaccine (ref) compared to females (OR = .60, 95% CI = .46 - .78, female ref), but no statistically significant gender differences were identified between those reporting they were probably going to get the vaccine vs definitely (ref) (OR = .96, 95% CI = .76 – 1.21, female ref) [Multinominal logistic regression model].	Males had lower odds of reporting being uncertain/not intending than definitely planning to get the vaccine (ref) compared to females (AOR = .72, 95% CI = .52 - .98, female ref), but no statistically significant gender differences were identified between those reporting they were probably going to get the vaccine vs definitely (ref) (AOR = 1.06, 95% CI = 1.80 – 1.40, female ref) [Multivariable logistic regression model adjusted for other sociodemographic variables, COVID-19 severity, & vaccine concerns].
Patil, 2021	College students, U.S.	Respondents were asked how likely they were to take the COVID-19 vaccine. Responses were dichotomized into very likely vs somewhat/not likely [binary outcome].	⊗m	NR	No statistically significant gender differences were identified in intentions to vaccinate (OR = 1.21, 95% CI: .66-2.22, female ref) [Multivariate logistic regression models adjusted for other sociodemographic variables].
Reiter, 2020	U.S. adults	Respondents were asked if a COVID-19 becomes available, and is free or covered by insurance, would they take it (definitely willing, probably willing, not sure, probably not willing, definitely not willing). Responses were recoded into willing to get the vaccine vs not willing [binary outcome].	○u ○m	Females were less likely to report vaccine willingness than males (Relative Risk: .85, 95% CI = .80 - .90, *P* < .001, male ref). No statistically significant differences were identified between those in the "other" category and males (Relative Risk = .75, 95% CI = .49 - 1.16) [Relative risk regression model].	Females were less likely to report vaccine willingness than males (Relative Risk = .91, 95% CI .87 - .96, *P* < .001, male ref). No statistically significant differences were identified between those in the "other" category and males in vaccine willingness (Relative Risk = .78, 95% CI = .53 - 1.17) [Multivariate relative risk regression model adjusted for other sociodemographic variables, health-related characteristics, & COVID-19 attitudes/beliefs].

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Rodriguez, 2021	Adult patients in emergency departments, 14 U.S. cities	Respondents were asked if they would get the COVID-19 vaccine when it becomes available (yes, no, unsure). For analysis, response options were recorded as yes vs no/ unsure [binary outcome].	◯u	Males had greater intentions to accept the vaccine than females (Males: 66%, 95% CI = 64 - 69; Females: 55%, 95% CI = 52 - 58) [Compared 95% CIs around differences in proportions; no tests of statistical difference conducted].	NR
Ruiz, 2021	Nationally representative U.S. sample of adults	Respondents were asked if they intend to get the COVID-19 vaccine when it becomes available (extremely likely, somewhat likely, unsure, somewhat likely, extremely likely). In univariate analysis, response options were dichotomized into likely/very likely to get vaccinated vs all other [binary outcome]. In multivariate analysis, a higher score indicates that respondents want to get vaccinated [continuous outcome].	◯u ◯m	Males were more likely to report being likely/very likely to get vaccinated than females (Female: 53.8%, Male: 71.9%, P = .001) [Chi-square test, χ^2 statistic NR].	Males were more likely to intend to receive the vaccine compared to females (B = .29, SE = .07, Beta = .12, t = 4.17, P = .001, female ref) [Multivariate linear regression model adjusted for other sociodemographic variables, personal risk factors, and other COVID-19 related beliefs & health practices].
Salmon, 2021	Nationally representative U.S. sample of adults	Respondents were asked if they intended to receive the COVID-19 vaccine (definitely get it as soon as possible, probably get it as soon as possible (ASAP), probably get it but not as soon as possible, probably not get it, definitely not get). Respondents were recategorized into 4 groups: intenders (ASAP), intenders (eventually), unlikelys, and wait and learn [categorical outcome].	◯u	Males had greater odds of intending to vaccinate ASAP and eventually compared to females and had lower odds than females to report being unlikely to vaccinate or to plan to wait and learn compared to females (female ref). • **Intenders ASAP (vs. not):** OR = 1.35, 95% CI = 1.11 -1.63 • **Intenders Eventually (vs. not):** OR = 1.28, 95% CI = 1.01 - 1.62 • **Unlikelys (vs. ASAP):** OR = .66, 95% CI = .48-.92 • **Wait and Learn (vs. ASAP):** OR = .76, 95% CI = .62-.93 [logistic regression analyses]	NR
Shaw, 2021	Health workers, New York	Respondents were asked if a vaccine was offered free of charge, would they take it (before COVID-19 emergency use authorization). Responses were dichotomized with agree/ strongly agree considered yes [binary outcome].	◯u	Males (72.5%) were more likely to intend to get vaccinated than females (52.4%). Gender nonbinary/other/not disclosed participants reported lower intention of vaccination than males and females (41.0%) (P < .001) [Chi-square test, statistic NR].	NR

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Shih, 2021	U.S. adults	Respondents were asked whether they would accept a hypothetical COVID-19 vaccine (yes/no) [binary outcome]	⊗[m]	NR	There were no statistically significant gender differences in the odds of vaccine rejection (AOR = 1.36, 95% CI = .90 - 2.06, male ref) [Multivariate logistic regression model adjusted for other sociodemographic variables, political affiliation, COVID & vaccine beliefs].
Thompson, 2021	Adult residents, Michigan	Respondents were asked if they would take a COVID-19 vaccine approved by the FDA (definitely yes, probably yes, neither yes or no, probably no, definitely no). Greater scores indicate higher likelihood of vaccine rejections [continuous outcome].	○[m]	NR	Females were more likely to display intentions of vaccine uptake rejection compared to males [B (SE) Female: B = .57, SE = .08, $P < .001$) [Multivariate path analysis adjusted for other sociodemographic variables].
Tram, 2021	Nationally representative U.S. sample	Respondents were asked if they had received a COVID-19 vaccine, and if not, if they were going to (definitely get a vaccine, probably get a vaccine, probably NOT get a vaccine, and definitely NOT get a vaccine) [used categorically in univariate analysis]. Vaccine hesitancy was defined as probably NOT or definitely NOT get a vaccine and all other responses were considered not hesitant for multivariate analysis [binary outcome].	○[m]	**Already Received a Vaccine** Female: 27.1 (26.8-27.3) Male: 22.0 (21.7-22.3) **Definitely Get a Vaccine** Female: 36.2 (35.9-36.6) Male: 42.8 (42.3-43.2) **Probably Get a Vaccine** Female: 17.5 (17.2-17.7) Male: 17.6 (17.2-17.9) **Probably NOT Get a Vaccine** Female: 11.0 (10.7-11.3) Male: 9.4 (9.1-9.7) **Definitely NOT Get a Vaccine** Female: 8.2 (8.0-8.4) Male: 8.3 (8.0-8.6) Pearson $\chi^2 = 2.73 \times 10^3$ [Chi-square test, because between group comparisons are not clear, results were extracted to provide descriptive statistics, but we do not make conclusions for the univariate results in the symbols].	Females had higher odds of being vaccine hesitant compared to males (AOR = 1.26, 95% CI = 1.21 - 1.30, $P < .001$) [Multivariate logistic regression model adjusted for other sociodemographic variables].
		Intentions to reject the vaccine (response: definitely not) among only those in the sample with hesitancy (response: probably not or definitely not get the vaccine) [binary outcome].	○[m]	NR	Females had lower odds of intending to reject the vaccine than males among those with vaccine hesitancy (Adjusted OR = .87, 95% CI = .81-.93), $P < .001$, male ref) [Multivariate logistic regression model adjusted for other sociodemographic variables].

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Travis, 2021	Adult residents, South Carolina	Respondents were asked if they would take the COVID-19 vaccine if it was approved by the FDA as soon as it is available (yes/no) [binary outcome].	○u ○m	Female gender was negatively associated with vaccine intentions (-.16, $P < .01$) [Correlation test].	Females had lower odds of intending to receive the vaccine compared to males (b = -.89, AOR = .41, Wald = 30.72, $P <$ .05, male ref) [Multivariate logistic regression model adjusted for other sociodemographic variables, variables related to political affiliation/trust in science & COVID-19 history].
Unroe, 2021	Long-term care & nursing home staff, Indiana	Respondents were asked if they would take the COVID-19 vaccine if it was approved by the FDA and available (yes/no) [binary outcome].	○u	Males (66.4%) were more likely to intend to receive the vaccine compared to females (42.1%) ($P < .001$) [Pearson chi square test, statistic NR].	NR
Willis, 2021	Adolescents (9th grade students), Northwest Arkansas	Respondents were asked how hesitant they were to get a COVID-19 vaccine (not at all, hesitant, a little hesitant, somewhat hesitant, very hesitant). Those that responded "not at all hesitant" were coded as zero while all others were considered as some level of hesitancy [binary outcome].	⊗u	No statistically significant gender differences were identified in vaccine hesitancy (Girls: 69%, Boys: 56%, χ^2 = 3.57, P = .06) [Chi-square test].	NR
Zhang, 2021	Afghan, Bhutanese, Somali, South Sudanese and Burmese adult refugees residing in the U.S., U.S.	Respondents were asked, if a COVID-19 vaccine was available, would they get it (yes vs unsure/no) [binary outcome].	○u ○m	Males were more likely to intend to receive the vaccine compared to females (Male: 76.2%, Female: 63.5%, P = .004) [Pearson's chi-square test, statistic NR]	Males had higher odds of intending to receive the vaccine compared to females [AOR = 1.87, 95% CI = 1.12 - 3.12, P = .02, female ref) [Multivariate logistic regression model adjusted for other sociodemographic variables and variables related to COVID-19 infection history].
COVID-19 vaccine uptake					
Green-McKenzie, 2022	Health care workers and staff, Philadelphia, Pennsylvania	Data extraction from electronic medical records of health care workers, categorized into uptake of the first vaccine dose (yes/no) [binary variable]	●u ⊗m	Univariate analyses compared uptake of the first vaccine dose among health care personnel by gender stratified by job category. No differences were found by gender among physicians, nurses, and health workers with some patient contact (technicians, therapists, nursing aides, and phlebotomists). For health workers with no patient contact (finance, coders, information technology, environmental and food services), females (72.6%) were less likely than males (79.1%) to receive the first vaccine dose ($P < .001$) [Chi square test, χ^2 statistic NR].	There were no statistically significant gender differences in uptake of the first vaccine dose (Risk Ratio = 1.00, 95% CI = .98 – 1.02, P = .81, female ref) [Multivariate logistic regression models adjusted for other sociodemographic variables].

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Higginson, 2021	Army, Military Reserve, & National Guard pop., U.S.	Vaccine status was assessed by asking respondents if they accepted the vaccine (accepted/did not accept) [binary outcome].	$\otimes^{u}$	No statistically significant gender effects were identified for vaccine acceptance (female: 63.6%, male: 60.8%, P = .31) [Chi-square test].	NR
Ioannou, 2021	Veterans Affairs (VA) enrollees, U.S.	Outcome was received at least one dose of the COVID-19 vaccine (vs. not). Data were extracted from VA pharmacy records on type and date of each vaccine dose [binary outcome].	$\bigcirc^{u}$ $\bullet^{m}$	Males were more likely to receive at least one dose of the vaccine than females (10.63 vs 5.88 per 100 person-months; unadjusted hazard ratio: 1.79 [1.78-1.80], female ref) [Kaplan Meier curves compared cumulative incidence of vaccination].	Males were less likely to receive at least one dose of the vaccine than females (Adjusted Hazard Ratio = .96, 95% CI = .95 – .96, female ref) [Kaplan Meier curves compared cumulative incidence of vaccination adjusted for other sociodemographic variables and co-morbidities].
		Outcome was missed the recommended second COVID-19 vaccine dose (vs. received it). Respondents who failed to receive the second dose within 42 days of the first dose were coded as missing the second. Data were extracted from VA pharmacy records [binary outcome].	$\bigcirc^{u}$ $\bigcirc^{m}$	Males had lower odds of missing the second dose compared to females (Males: 3.54%, Females: 5.74%; OR: .60, 95% CI = .57 - .64, female ref) [Logistic regression].	Males had lower odds of missing the second dose compared to females (AOR: .91, 95% CI = .85 - .98, female ref) [Logistic regression model adjusted for other sociodemographic variables, urban/rural residence, & health-related variables].
Kantarcioglu, 2021	Residents (inclusive of high school students), Georgia and Illinois	Respondents were asked if they have ever received vaccination against COVID-19 (yes/no). If yes, they were asked how many doses (1 vs 2). Responses were categorized into any vaccination vs no vaccination for analysis [binary outcome].	$\bigcirc^{u}$ $\otimes^{m}$	Men were more likely to be vaccinated against COVID-19 (OR = .31, 95% CI = .10-.94, P = .03) [Logistic regression model].	No statistically significant gender differences were identified in being vaccinated against COVID-19 (AOR = .36, 95% CI = .11 – 1.16, P = .09) [Logistic regression model adjusted for other factors affecting vaccine status, e.g., previous infection, severity of infection, & concerns and beliefs about COVID and the vaccine]
Neely, 2022	Florida residents (age 18+)	Outcome for univariate analysis was received one dose of the COVID-19 vaccine (yes/no) [binary outcome]. For multivariate model, vaccination status = yes [binary outcome].	$\otimes^{u}$ $\otimes^{m}$	No statistically significant gender differences were identified in receiving at least one dose of the COVID-19 vaccine (Female: 61.9%, Male: 67.0%, P > .05) [Chi-square test, statistic NR].	No statistically significant gender differences were identified in vaccination status (OR = 1.20, β = .18, SE = .24, female ref) [Multivariate logistic regression models adjusted for socio-demographics, misinformation, & spoken to primary care provider].
Shaw, 2021	Health workers and employees, New York	Respondents were asked if they received the COVID-19 vaccine. Responses were dichotomized into yes, or I plan to vs no [binary outcome].	$\bigcirc^{u}$	Males (93.7%) were more likely than females (89.8%) and gender nonbinary/other/not disclosed participants (68.4%) to report receiving the COVID-19 vaccine (P < .001) [Chi-square test, statistic NR].	NR

(continued)

Table 2. (continued)

Author, year	Population, location	Outcome Definition	Results symbol	Summary of Univariate Results	Summary of Multivariate Results
Upenieks, 2021	Nationally representative, U.S.	Respondents were asked if they have been vaccinated for the coronavirus (yes, no but I am planning to be vaccinated, no and I do not plan to be vaccinated, and no and I am undecided about getting a vaccine). Vaccine acceptance was coded as yes/no but plan to be vs no and do not plan to be/no and undecided [binary outcome].	⊗m	NR	No statistically significant gender differences were identified in vaccine uptake (AOR = .96, 95% CI = .75 - 1.25, male ref) [Multivariate ordinal logistic regression model adjusted for other sociodemographic variables, COVID-19 history, & beliefs in an engaged god].

Notes: Symbols indicate greater intentions COVID-19 vaccine acceptance in ● = Women (vs. men), ◯ = Men (vs. women), or ⊗ = No difference; NR = not reported; OR = Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval; SE = Standard Error; ref = reference group; ****Univariate results sent from study authors and multivariate not extracted due to difficulty in interrupting published results.*

extract vaccine status (28.6%, k = 2). Across both self-report and clinic record outcomes, there was variation in the definition of vaccination based on doses, which in some cases can be attributed to the varying timeframes of the studies (availability of second dose varied). Most studies defined vaccination as uptake of at least one dose (57.1%, k = 4),[39,42,54,74] while others asked whether respondents were vaccinated without specifying doses (42.9%, k = 3),[64,70,73] and only one study examined receipt of the second dose (14.2%, k = 1).[74]

All but one study examined vaccine behavior using only a binary variable for gender/sex, which we summarize first.[39,42,54,70,73,74] A total of 7 studies examined differences between men and women in vaccine uptake using univariate analyses across 7 outcomes. In summary, 57.1%, or 4 of the 7 analyses (k = 3), found greater vaccine uptake among men compared to women,[42,64,74] while one study (1 outcome), or 14.3% of 7 analyses, found greater vaccine uptake among women compared to men.[39] Finally, 28.5%, or 2 of the 7 analyses (k = 2), found no differences between men and women in COVID-19 vaccine uptake.[54,73]

A total of five studies examined differences between men and women in vaccine uptake using multivariate analyses across 6 outcomes. Most analyses (66.7%, 4 outcomes, k = 4) reported no differences between men and women in COVID-19 vaccine uptake.[39,42,54,70] The only exception was Ioannou et al.,[74] a study with Veterans Affairs (VA) enrollees, with mixed multivariate results; the study reported lower odds of receiving at least one dose of the vaccine among males compared to females, but females had higher odds of missing the second dose compared to males.[74] Similar to intentions, a visual overview is provided that showcases these findings in brief (symbols only) in Table S6.

Shaw et al.[64] was the only study to examine vaccine uptake beyond binary gender/sex categories (highlighted in Table S5). In their study of health care workers, they reported lower uptake of the vaccine among non-binary/gender not-disclosed employees compared to males and female employees (univariate analysis).

Subgroup Comparisons

The review authors attempted to draw conclusions based on the results, from within and across studies, about whether gender/sex differences in vaccine acceptance varied by sub-groups (e.g., age, race/ethnicity). Within studies, Green-McKenzie et al.[39] was the only study that examined interactions between gender/sex and other identities of interest, reporting on the effect of gender on vaccine uptake by health worker occupational category. No differences were found by gender among physicians, nurses, and health workers with some patient contact (technicians, therapists, nursing aides, and phlebotomists). However, for health workers with no patient contact (finance, coders, information technology, environmental and food services), females (72.6%) were less likely than males (79.1%) to receive the first vaccine dose ($P < .001$).

Across studies, 9 (17.0% of total studies) included samples of health workers and/or employees of health systems.[29,33,35,37-39,53,56,64] The findings of these studies support greater intentions to vaccinate among men compared to women; which was the reported result for all (100%) of the 7 univariate and five multivariate analyses conducted in these studies. Only 2 studies with health workers/employees examined behavior, one supporting women's greater vaccine uptake,[39] and the other supporting men's greater uptake using univariate analyses.[64] No other homogeneous subpopulations (e.g. race/ethnicity) were represented in a sufficient number of studies to summarize and make conclusions about their findings separately.

Discussion

This scoping review provides an overview of the empirical literature that examined the relationship between gender/sex and COVID-19 vaccine intentions and uptake in approximately the first 2 years of the pandemic in U.S.-based samples of adults and adolescents. The search yielded 54 studies that examined this question – a reflection of the scientific community's rapid response to conduct research to understand the COVID-19 pandemic. There were more studies that examined intentions than behavior, due to the timeframe of the scoping review and vaccine availability. Overall, approximately 3 quarters of all studies' results (univariate and multivariate) support higher intentions to be vaccinated among men compared to women in the first years of the pandemic. Over half of analyses on vaccine uptake assessed through univariate analysis also favored greater uptake among men, but 2 thirds of multivariate analyses supported no gender/sex differences in vaccine uptake. Thus, while there was variation in both outcomes, the overall findings of the review support women's lower vaccine acceptance in the first years of the pandemic in the U.S., but the findings are stronger for intentions than for behavior. Notably, few studies included transgender or non-binary populations and those that did had varying categories limiting our ability to make meaningful conclusions in this review.

Our results for differences between men and women could mean that hesitancy may not always translate into differences in men and women's behavior, especially when other sociodemographic and related variables are considered. However, given the low number of studies examining uptake, more research is needed to strengthen these conclusions. Our findings align with the results of other reviews that have been published with similar aims. Systematic and scoping reviews on determinants of vaccine acceptance/hesitancy report being male as a prominent correlate of higher vaccine acceptance/willingness and lower hesitancy.[14-17,19] Most reviews were conducted globally, and report that this finding is consistent across cultures (in the U.S. and other countries),[15-18] although the only meta-analysis among them found variation by country.[14] Notably, within our review, one study with a repeated cross-sectional design and a nationally representative U.S. sample reported that women were more hesitant towards the COVID-19 vaccine than men, but vaccine hesitancy declined faster overtime in women compared to men, with gender differences no longer statistically significant by the final time period.[49] While we cannot say that this trend is occurring across studies in our review, it provides one possible explanation (i.e., that women's hesitancy was high initially but reduced overtime) for this review's support for women's greater hesitancy but less support for a gender difference in actual vaccine behavior.

Our review's findings can be considered against research that examines gender-specific reasons for vaccine hesitancy. Irrespective of gender, studies report the following among the main reasons for COVID-19 vaccine hesitancy: being against vaccines in general, concerns about safety and side effects, low risk perception specific to COVID-19 infection, public health/government mistrust, efficacy doubts, beliefs about current immunity.[18] In research that examines hesitancy by gender, women's hesitancy has been more associated with circumspection (weighing of benefits and costs of taking a particular vaccine based on evolving information), and men's with complacency (perceiving the risks of vaccine preventable diseases as low).[49] In addition, some of the most common side effect concerns among both women and men specific to COVID-19 relate to reproductive health and fertility[77,78]; with pregnant and breastfeeding women excluded from the early clinical trials, this may have been especially concerning for women of reproductive age.[79,80] In addition, research with transgender individuals as part of the broader lesbian, gay, bisexual, transgender, queer, intersex, and asexual (LGBTQIA) community highlights unique barriers to COVID-19 vaccine uptake, such as medical trauma, misgendering, and fear of violence, underscoring the need for more research with this population.[81]

In contrast to this review's findings, the results of our companion review that examined gender/sex differences in social distancing, mask-wearing, and adherence to CDC guidelines more broadly found women's greater engagement in these prevention behaviors compared to men, or no gender differences, but rarely supported men's greater prevention behaviors compared to women (to be reported in a separate manuscript). These findings align with other literature grounded in gender theory positing that the socialization of men and women results in women's greater health care engagement than men, shaped by gender norms that deem self-care and health-seeking as feminine behaviors.[82,83] On the surface, this review's findings might appear to contradict the gender norm and health behavior literature. However, women's greater early hesitancy could be a reflection of women's greater conscientiousness around health, making them more likely to weigh the risks and benefits of vaccination, but ultimately still adopt the behavior if deemed beneficial to health and due to their socialization to be agreeable and compliant.[49,84]

Further, gender theory posits that women and men are less likely to engage in behaviors that are considered a threat to their fulfillment of socially ascribed gender roles and norms.[82,83] As such, engagement in preventative behaviors is theorized to be lower in men because they are counter to masculine norms, such as the idea that men should be tough and self-reliant.[82,83] Vaccine intentions may be an exception to the typical gendered pattern of health-seeking behavior because fears around fertility and pregnancy outcomes are most threatening to the role of mother. Further, given norms of masculinity around risk-taking,[85-87] men may have been more willing to take on the risks of a new experimental vaccine than women. Research is needed to explore how gender norms intersect with vaccine hesitancy. Cassino et al.[88] found that men and women who report adherence to the most traditional gender identities had significantly lower intentions to vaccinate against COVID-19 compared to their less rigid counterparts. Other studies that examine COVID-19 outcomes through the lens of adherence to traditional masculine/feminine norms similarly report strict adherence to associate with less prevention behavior.[89-91] Future research should explore adherence to social structures of gender further, rather than just identification with binary categories of male/female or man/woman, in relation to vaccine hesitancy.

This review highlighted numerous gaps in the literature, which can inform future research, but are also important to consider as limitations to the extrapolation this review's findings more broadly. First, most studies were cross-sectional designs. Thus, they capture a single point in time in the first 2 years of the pandemic. Since vaccine intentions and uptake are not static, but changing overtime, longitudinal studies on this topic would shed light on how hesitancy/uptake evolved over time by gender, especially as more data on vaccine efficacy, safety, etc. became available. In addition, most studies used non-random sampling, which reduces the likelihood of representative samples and introduces the risk of selection bias. Forty percent of studies were broadly with the U.S. population, but only a quarter of them used sampling or analytic methods to achieve population representation. In addition, the generalizability of the review's finding specific to vaccine uptake is limited by the relatively small number of studies identified with that outcome, and most of those studies were limited in their reliance of self-reported measurements of vaccination (rather than clinic record extraction), which could introduce social desirability bias. In addition, few studies examined gender identity outside of binary definitions of woman/man or male/female. In those that did, differences were found, but the results were mixed and the studies too few to make meaningful conclusions. Future research and public health data need to include better defined measures of gender/sex that are inclusive of non-binary populations.

This review is also limited in its ability to make comparisons by subpopulations. Only one study did any sub-analysis to examine if gender/sex's association with COVID-19 vaccine intentions/uptake differed by subpopulation. Given the large portion of studies whose samples were broadly geography-based (e.g., U.S. adults, residents of specific states), the review was limited in being able to make conclusions about differences by subpopulations across studies. If gender/sex differences were examined by factors such as race/ethnicity, age, or political affiliation, the findings might explain the variation identified across study results. The one group that was represented enough to make comparisons across studies were health care providers/employees of health systems, which largely supported greater vaccine hesitancy among women compared to men. Future research should be conducted that examines how gender affects COVID-19 vaccination across intersecting identities. Research on this topic could also benefit from the inclusion of qualitative methodologies, which were absent in the studies meeting our inclusion criteria, but that may have been a result of our inclusion criteria/research question requiring comparisons between groups.

Conclusions

Heirdari et al.[92] posit that the success of COVID-19 vaccine programs will require a gender transformative approach to address vaccine hesitancy and increase vaccine acceptance and access, arguing that these factors are gendered and shaped by gender norms. This scoping review supports their argument by highlighting the important role gender/sex plays in health seeking behavior specific to COVID-19 vaccination. Overall, the studies included in this review provided evidence to support more hesitancy among women, and some support for gender differences in vaccine uptake among U.S. samples in the first 2 years of the pandemic, but there was variation in both outcomes. Transgender and gender diverse populations were largely missing in the analyses included in this review, highlighting the need for more research with these populations and better-defined measures of gender/sex that are inclusive of non-binary populations. This review also highlights the need for more research in this area, especially research employing rigorous research designs and exploring context and population-specific differences in, and drivers of, hesitancy and uptake. The findings of this review highlight the need for the development of tailored, gender sensitive vaccine campaigns; additional research is needed to inform the content of such programs, so that they can address the core drivers of hesitancy across the gender spectrum.

So What?

What is already known on this topic?

In the United States, there are significant gender disparities in COVID-19 outcomes. Prior research suggests women may be more hesitant to vaccinate than men, and gender diverse populations face unique barriers to COVID-19 vaccination.

What does this article add?

This is the first study to synthesize the literature on gender differences in COVID-19 vaccine acceptance in the United States. Women may have been more hesitant to get the vaccine than men early in the pandemic, but findings were mixed on whether these differences may translate to actual behavior. The review highlights a gap in research inclusive of gender diverse individuals and a need for more rigorous designs.

What are the implications for health promotion practice or research?

Future research should include gender diverse populations, explore gender differences by sub-populations, utilize more rigorous designs, and test gender-sensitive public health campaigns to mitigate vaccine concerns.

Ethical Statement

Ethical approval

This review does not constitute human subjects research.

Acknowledgments

The authors acknowledge and thank Suyapa Muñoz for assistance in the screening of studies.

Author Contributions

KMS conceptualized the aims of the review with input from PJF. KMS developed the review protocol, with input from all review authors. KMS and MH developed the search terms and MH ran the search. KMS, IMH, and RLL screened all studies by abstract, full text, and extracted the data. KMS, IMH, and RLL synthesized the results. KMS and IMH led the writing of the manuscript. All review authors contributed to the writing, review, and editing of the manuscript and consent to be authors.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Katelyn M. Sileo was supported by a Mentored Research Scientist Career Development Award from the National Institute of Mental Health of the National Institutes of Health [K01MH121663]. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

ORCID iD

Katelyn M. Sileo https://orcid.org/0000-0003-3714-2945

Supplemental Material

Supplemental material for this article is available online.

References

1. WHO COVID-19 Dashboard. *World Health Organization*. https://covid19.who.int/info. Accessed May 02, 2023.
2. Centers for Disease Control and Prevention (CDC). COVID Data Tracker. *US Department of Health and Human Services*. https://covid.cdc.gov/covid-data-tracker/#cases-deaths-testing-trends. Accessed May 02, 2023.
3. Kirson N, Swallow E, Lu J, et al. The societal economic value of COVID-19 vaccines in the United States. *J Med Econ*. 2022;25(1):119-128. doi:10.1080/13696998.2022.2026118.
4. Ko JY, Danielson ML, Town M, et al. Risk factors for coronavirus disease 2019 (COVID-19)-associated hospitalization: COVID-19-associated hospitalization surveillance network and behavioral risk factor surveillance system. *Clin Infect Dis*. 2021;72(11):e695-e703. doi:10.1093/cid/ciaa1419.
5. Danielsen AC, Lee KMN, Boulicault M, et al. Sex disparities in COVID-19 outcomes in the United States: quantifying and contextualizing variation. *Soc Sci Med*. 2022;294:114716-114716. doi:10.1016/j.socscimed.2022.114716.
6. Perret M, Jillson K, Danielsen AC, et al. COVID-19 Data on Trans and Gender-Expansive people, stat! *Health Affairs Blog*. 2021. doi:10.1377/hblog20210510.756668.
7. Goldie PD, Chatterjee I. Examining the elevated risk of COVID-19 in transgender communities with an intersectional lens. *SN Soc Sci*. 2021;1(10):249. doi:10.1007/s43545-021-00255-x.
8. Bertakis KD, Azari R, Helms LJ, Callahan EJ, Robbins JA. Gender differences in the utilization of health care services. *J Fam Pract*. 2000;49(2):147-152.
9. Nardell MF, Adeoti O, Peters C, et al. Men missing from the HIV care continuum in Sub-Saharan Africa: a meta-analysis and meta-synthesis. *J Int AIDS Soc*. 2022;25(3):e25889-n/a. doi:10.1002/jia2.25889.
10. Eisenberg D, Downs MF, Golberstein E, Zivin K. Stigma and help seeking for mental health among college students. *Med Care Res Rev*. 2009;66(5):522-541. doi:10.1177/1077558709335173.
11. Naeim A, Baxter-King R, Wenger N, Stanton AL, Sepucha K, Vavreck L. Effects of age, gender, health status, and political party on COVID-19-related concerns and prevention behaviors: results of a large, longitudinal cross-sectional survey. *JMIR Public Health Surveill*. 2021;7(4):e24277. doi:10.2196/24277.
12. Srivastav A, Lu P-J, Amaya A, et al. Prevalence of influenza-specific vaccination hesitancy among adults in the United States, 2018. *Vaccine*. 2023;41(15):2572-2581. doi:10.1016/j.vaccine.2023.03.008.
13. Ramanadhan S, Galarce E, Xuan Z, Alexander-Molloy J, Viswanath K. Addressing the vaccine hesitancy continuum: an audience segmentation analysis of American adults who did not receive the 2009 H1N1 vaccine. *Vaccines (Basel)*. 2015;3(3):556-578. doi:10.3390/vaccines3030556.
14. Zintel S, Flock C, Arbogast AL, Forster A, von Wagner C, Sieverding M. Gender differences in the intention to get vaccinated against COVID-19: a systematic review and meta-analysis. *Z Gesundh Wiss*. 2022;7:1-25. doi:10.1007/s10389-021-01677-w.
15. Joshi A, Kaur M, Kaur R, Grover A, Nash D, El-Mohandes A. Predictors of COVID-19 vaccine acceptance, intention, and hesitancy: a scoping review. *Front Public Health*. 2021;9:698111. doi:10.3389/fpubh.2021.698111.
16. Al-Jayyousi GF, Sherbash MAM, Ali LAM, et al. Factors influencing public attitudes towards COVID-19 vaccination: a scoping review informed by the socio-ecological model. *Vaccines (Basel)*. 2021;9(6):548. doi:10.3390/vaccines9060548.
17. AlShurman BA, Khan AF, Mac C, Majeed M, Butt ZA. What demographic, social, and contextual factors influence the intention to use COVID-19 vaccines: a scoping review. *Int J Environ Res Public Health*. 2021;18(17):9342. doi:10.3390/ijerph18179342.
18. Troiano G, Nardi A. Vaccine hesitancy in the era of COVID-19. *Public Health*. 2021;194:245-251. doi:10.1016/j.puhe.2021.02.025.
19. Yasmin F, Najeeb H, Moeed A, et al. COVID-19 vaccine hesitancy in the United States: a systematic review. *Front Public*

Health. 2021;9:770985-770985. doi:10.3389/fpubh.2021.770985.
20. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci*. 2010;5(1):69-69. doi:10.1186/1748-5908-5-69.
21. Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, Aromataris E. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Med Res Methodol*. 2018;18(1):143-143. doi:10.1186/s12874-018-0611-x.
22. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med*. 2018;169(7):467-473. doi:10.7326/m18-0850.
23. Covidence Systematic Review Software. *Veritas Health Innovation*. www.covidence.org
24. Abouhala S, Hamidaddin A, Taye M, et al. A national survey assessing COVID-19 vaccine hesitancy among Arab Americans. *J Racial Ethn Health Disparities*. 2022;9(6):2188-2196. doi:10.1007/s40615-021-01158-6.
25. Allen JD, Feng W, Corlin L, et al. Why are some people reluctant to be vaccinated for COVID-19? A cross-sectional survey among U.S. Adults in May-June 2020. *Prev Med Rep*. 2021;24:101494. doi:10.1016/j.pmedr.2021.101494.
26. Brunson EK, Rohde RE, Fulton LV. College students' willingness to accept COVID-19 vaccines. *J Am Coll Health*. 2021;9:1996375. doi:10.1080/07448481.2021.1996375.
27. Callaghan T, Moghtaderi A, Lueck JA, et al. Correlates and disparities of intention to vaccinate against COVID-19. *Soc Sci Med*. 2021;272:113638. doi:10.1016/j.socscimed.2020.113638.
28. Chen P, Farhart C. Gender, benevolent sexism, and public health compliance. *Politics & Gender*. 2020;16(4):1036-1043. doi:10.1017/s1743923x20000495.
29. Ciardi F, Menon V, Jensen JL, et al. Knowledge, attitudes and perceptions of COVID-19 vaccination among healthcare workers of an inner-city hospital in New York. *Vaccines (Basel)*. 2021;9(5):516. doi:10.3390/vaccines9050516.
30. Coughenour C, Gakh M, Sharma M, Labus B, Chien LC. Assessing determinants of COVID-19 vaccine hesitancy in Nevada. *Health Secur*. 2021;19(6):592-604. doi:10.1089/hs.2021.0079.
31. Crozier J, Christensen N, Li P, Stanley G, Clark DS, Selleck C. Rural, underserved, and minority populations' perceptions of COVID-19 information, testing, and vaccination: report from a southern state. *Popul Health Manag*. 2022;25(3):413-422. doi:10.1089/pop.2021.0216.
32. Cunningham-Erves J, Mayer CS, Han X, et al. Factors influencing intent to receive COVID-19 vaccination among Black and White adults in the southeastern United States, October - December 2020. *Hum Vaccin Immunother*. 2021;17(12):476-4798. doi:10.1080/21645515.2021.1984134.
33. Do TVC, Kammili ST, Reep M, Wisnieski L, Ganti SS, Depa J. COVID-19 vaccine acceptance among rural Appalachian healthcare workers (Eastern Kentucky/West Virginia): a cross-sectional study. *Cureus*. 2021;13(8):13. doi:10.7759/cureus.16842.
34. Dorman C, Perera A, Condon C, et al. Factors associated with willingness to be vaccinated against COVID-19 in a large convenience sample. *J Community Health*. 2021;46(5):1013-1019. doi:10.1007/s10900-021-00987-0.
35. Dowdle TS, Dennis J, Nugent KM, Byrd T. Intention to receive COVID-19 vaccine by U.S. health sciences university employees. *J Prim Care Community Health*. 2021;12:21501327211036611. doi:10.1177/21501327211036611.
36. Fadel T, Travis J, Harris S, Webb G. The roles of experiences and risk perception in the practice of preventative behaviors of COVID-19. *Pathog Glob Health*. 2022;116(1):30-37. doi:10.1080/20477724.2021.1957595.
37. Famuyiro TB, Ogunwale A, des Bordes J, Raji M. COVID-19: Perceived infection risk and barriers to uptake of Pfizer-BioNTech and Moderna vaccines among community healthcare workers. *J Racial Ethn Health Disparities*. 2022;9(4):1543-1549. doi:10.1007/s40615-021-01093-6.
38. Gatto NM, Lee J, Massai D, et al. Correlates of COVID-19 Vaccine acceptance, hesitancy and refusal among employees of a safety net California county health system with an early and aggressive vaccination program: results from a cross-sectional survey. *Vaccines (Basel)*. 2021;9(10):1152. doi:10.3390/vaccines9101152.
39. Green-McKenzie J, Shofer FS, Momplaisir F, et al. Factors associated with COVID-19 vaccine receipt by health care personnel at a major academic hospital during the first months of vaccine availability. *JAMA Netw Open*. 2021;4(12):e2136582. doi:10.1001/jamanetworkopen.2021.36582.
40. Huynh HP, Senger AR. A little shot of humility: Intellectual humility predicts vaccination attitudes and intention to vaccinate against COVID-19. *J Appl Soc Psychol*. 2021;51(4):449-460. doi:10.1111/jasp.12747.
41. Jasuja GK, Meterko M, Bradshaw LD, et al. Attitudes and Intentions of US veterans regarding COVID-19 vaccination. *JAMA Netw Open*. 2021;4(11):e2132548. doi:10.1001/jamanetworkopen.2021.32548.
42. Kantarcioglu B, Patel K, Lewis J, et al. Public perceptions of current COVID-19 vaccinations. results of a pilot survey. *Clin Appl Thromb Hemost*. 2021;27:10760296211066942. doi:10.1177/10760296211066942.
43. Khubchandani J, Sharma S, Price JH, Wiblishauser MJ, Sharma M, Webb FJ. COVID-19 vaccination hesitancy in the United States: a rapid national assessment. *J Community Health*. 2021;46(2):270-277. doi:10.1007/s10900-020-00958-x.
44. Killgore WDS, Cloonan SA, Taylor EC, Dailey NS. The COVID-19 vaccine Is here-now who is willing to get it? *Vaccines (Basel)*. 2021;9(4):339. doi:10.3390/vaccines9040339.
45. King WC, Rubinstein M, Reinhart A, Mejia R. Time trends, factors associated with, and reasons for COVID-19 vaccine hesitancy: a massive online survey of US adults from January-May 2021. *PLoS One*. 2021;16(12):e0260731. doi:10.1371/journal.pone.0260731.
46. Latkin CA, Dayton L, Yi G, Colon B, Kong X. Mask usage, social distancing, racial, and gender correlates of COVID-19 vaccine intentions among adults in the US. *PLoS One*. 2021;16(2):e0246970. doi:10.1371/journal.pone.0246970.

47. Lazarus JV, Wyka K, Rauh L, et al. Hesitant or not? The association of age, gender, and education with potential acceptance of a COVID-19 vaccine: a country-level analysis. *J Health Commun*. 2020;25(10):799-807. doi:10.1080/10810730.2020.1868630.
48. Litaker JR, Tamez N, Lopez Bray C, Durkalski W, Taylor R. Sociodemographic factors associated with vaccine hesitancy in central Texas immediately prior to COVID-19 vaccine availability. *Int J Environ Res Public Health*. 2021;19(1):368. doi:10.3390/ijerph19010368.
49. Liu R, Li GM. Hesitancy in the time of coronavirus: Temporal, spatial, and sociodemographic variations in COVID-19 vaccine hesitancy. *SSM Popul Health*. 2021;15:100896. doi:10.1016/j.ssmph.2021.100896.
50. McElfish PA, Willis DE, Shah SK, Bryant-Moore K, Rojo MO, Selig JP. Sociodemographic determinants of COVID-19 vaccine hesitancy, fear of infection, and protection self-efficacy. *J Prim Care Community Health*. 2021;12:21501327211040746. doi:10.1177/21501327211040746.
51. Meier BP, Dillard AJ, Lappas CM. Predictors of the intention to receive a SARS-CoV-2 vaccine. *J Public Health (Oxf)*. 2022;44(3):713-715. doi:10.1093/pubmed/fdab013.
52. Milligan MA, Hoyt DL, Gold AK, Hiserodt M, Otto MW. COVID-19 vaccine acceptance: influential roles of political party and religiosity. *Psycho Health Med*. 2022;27(9):1907-1917. doi:10.1080/13548506.2021.1969026.
53. Momplaisir FM, Kuter BJ, Ghadimi F, et al. Racial/ethnic differences in COVID-19 vaccine hesitancy among health care workers in 2 large academic hospitals. *JAMA Netw Open*. 2021;4(8):e2121931. doi:10.1001/jamanetworkopen.2021.21931.
54. Neely SR, Eldredge C, Ersing R, Remington C. Vaccine Hesitancy and Exposure to Misinformation: a Survey Analysis. *J Gen Intern Med*. 2022;37(1):179-187. doi:10.1007/s11606-021-07171-z.
55. Nikolovski J, Koldijk M, Weverling GJ, et al. Factors indicating intention to vaccinate with a COVID-19 vaccine among older U.S. adults. *PloS One*. 2021;16(5):e0251963. doi:10.1371/journal.pone.0251963.
56. Parente DJ, Ojo A, Gurley T, et al. Acceptance of COVID-19 vaccination among health system personnel. *J Am Board Fam Med*. 2021;34(3):498-508. doi:10.3122/jabfm.2021.03.200541.
57. Mondal P, Sinharoy A, Su L. Sociodemographic predictors of COVID-19 vaccine acceptance: a nationwide US-based survey study. *Public Health*. 2021;198:252-259. doi:10.1016/j.puhe.2021.07.028.
58. Park VM, Dougan M, Meyer OL, et al. Vaccine willingness: findings from the COVID-19 effects on the mental and physical health of Asian Americans & Pacific Islanders survey study (COMPASS). *Prev Med Rep*. 2021;23:10. doi:10.1016/j.pmedr.2021.101480.
59. Patil U, Kostareva U, Hadley M, et al. Health literacy, digital health literacy, and COVID-19 pandemic attitudes and behaviors in U.S. college students: implications for interventions. *Int J Environ Res Public Health*. 2021;18(6):3301. doi:10.3390/ijerph18063301.
60. Reiter PL, Pennell ML, Katz ML. Acceptability of a COVID-19 vaccine among adults in the United States: how many people would get vaccinated? *Vaccine*. 2020;38(42):6500-6507. doi:10.1016/j.vaccine.2020.08.043.
61. Rodriguez RM, Torres JR, Chang AM, et al. The rapid evaluation of COVID-19 vaccination in emergency departments for underserved patients study. *Ann Emerg Med*. 2021;78(4):502-510. doi:10.1016/j.annemergmed.2021.05.026.
62. Ruiz JB, Bell RA. Predictors of intention to vaccinate against COVID-19: Results of a nationwide survey. *Vaccine*. 2021;39(7):1080-1086. doi:10.1016/j.vaccine.2021.01.010.
63. Salmon DA, Dudley MZ, Brewer J, et al. COVID-19 vaccination attitudes, values and intentions among United States adults prior to emergency use authorization. *Vaccine*. 2021;39(19):2698-2711. doi:10.1016/j.vaccine.2021.03.034.
64. Shaw J, Hanley S, Stewart T, et al. Health Care Personnel (HCP) attitudes about COVID-19 vaccination after emergency use authorization. *Clin Infect Dis*. 2021;75:e814-e821. doi:10.1093/cid/ciab731.
65. Shih SF, Wagner AL, Masters NB, Prosser LA, Lu Y, Zikmund-Fisher BJ. Vaccine hesitancy and rejection of a vaccine for the novel coronavirus in the United States. *Front Immunol*. 2021;12:558270. doi:10.3389/fimmu.2021.558270.
66. Thompson HS, Manning M, Mitchell J, et al. Factors associated with racial/ethnic group-based medical mistrust and perspectives on COVID-19 vaccine trial participation and vaccine uptake in the US. *JAMA Netw Open*. 2021;4(5):e2111629. doi:10.1001/jamanetworkopen.2021.11629.
67. Tram KH, Saeed S, Bradley C, et al. Deliberation, dissent, and distrust: understanding distinct drivers of COVID-19 vaccine hesitancy in the United States. *Clin Infect Dis.* 2021;74:1429-1441doi:10.1093/cid/ciab633
68. Travis J, Harris S, Fadel T, Webb G. Identifying the determinants of COVID-19 preventative behaviors and vaccine intentions among South Carolina residents. *PLoS One*. 2021;16(8):e0256178. doi:10.1371/journal.pone.0256178.
69. Unroe KT, Evans R, Weaver L, Rusyniak D, Blackburn J. Willingness of long-term care staff to receive a COVID-19 vaccine: a single state survey. *J Am Geriatr Soc*. 2021;69(3):593-599. doi:10.1111/jgs.17022.
70. Upenieks L, Ford-Robertson J, Robertson JE. Trust in God and/or science? Sociodemographic differences in the effects of beliefs in an engaged god and mistrust of the COVID-19 vaccine. *J Relig Health*. 2021;30:5. doi:10.1007/s10943-021-01466-5.
71. Willis DE, Presley J, Williams M, Zaller N, McElfish PA. COVID-19 vaccine hesitancy among youth. *Hum Vaccin Immunother.* 2021;3:1989923. doi:10.1080/21645515.2021.1989923.
72. Zhang M, Gurung A, Anglewicz P, et al. Acceptance of COVID-19 vaccine among refugees in the United States. *Public Health Rep*. 2021;136(6):774-781. doi:10.1177/00333549211045838.

73. Higginson JD, Tumin D, Kuehhas TC, et al. COVID-19 vaccine hesitancy among deployed personnel in a joint environment. *Mil Med*. 2021;188:e32-e36. doi:10.1093/milmed/usab518.
74. Ioannou GN, Green P, Locke ER, Berry K. Factors associated with early receipt of COVID-19 vaccination and adherence to second dose in the Veterans Affairs healthcare system. *PLoS One*. 2021;16(12):e0259696. doi:10.1371/journal.pone.0259696.
75. Andrejko KL, Pry J, Myers JF, et al. Prevention of COVID-19 by mRNA-based vaccines within the general population of California. *Clin Infect Dis*. 2021;74:1382-1389. doi:10.1093/cid/ciab640.
76. Latkin C, Dayton LA, Yi G, et al. COVID-19 vaccine intentions in the United States, a social-ecological framework. *Vaccine*. 2021;39(16):2288-2294. doi:10.1016/j.vaccine.2021.02.058.
77. Diaz P, Reddy P, Ramasahayam R, Kuchakulla M, Ramasamy R. COVID-19 vaccine hesitancy linked to increased internet search queries for side effects on fertility potential in the initial rollout phase following Emergency Use Authorization. *Andrologia*. 2021;53(9):e14156-n/a. doi:10.1111/and.14156.
78. Diaz P, Zizzo J, Balaji NC, et al. Fear about adverse effect on fertility is a major cause of COVID-19 vaccine hesitancy in the United States. *Andrologia*. 2022;54(4):e14361. doi:10.1111/and.14361.
79. Lis-Kuberka J, Berghausen-Mazur M, Orczyk-Pawiłowicz M. Attitude and level of COVID-19 vaccination among women in reproductive age during the fourth pandemic wave: a cross-sectional study in Poland. *Int J Environ Res Public Health*. 2022;19(11):6872. doi:10.3390/ijerph19116872.
80. Skirrow H, Barnett S, Bell S, et al. Women's views on accepting COVID-19 vaccination during and after pregnancy, and for their babies: a multi-methods study in the UK. *BMC Pregnancy Childbirth*. 2022;22(1):33-33. doi:10.1186/s12884-021-04321-3.
81. Azucar D, Slay L, Valerio DG, Kipke MD. Barriers to COVID-19 vaccine uptake in the LGBTQIA community. *Am J Public Health*. 2022;112(3):405-407. doi:10.2105/ajph.2021.306599.
82. Courtenay WH. Constructions of masculinity and their influence on men's well-being: a theory of gender and health. *Soc Sci Med*. 2000;50(10):1385-1401. doi:10.1016/S0277-9536(99)00390-1.
83. Courtenay WH. Engendering Health: A Social Constructionist Examination of Men's Health Beliefs and Behaviors. Psychology of men & masculinity. *Psychology of men & masculinity*. 2000;1(1):4-15. doi:10.1037/1524-9220.1.1.4.
84. Otterbring T, Festila A. Pandemic prevention and personality psychology: gender differences in preventive health behaviors during COVID-19 and the roles of agreeableness and conscientiousness. *J Safety Sci Resilience*. 2022;3(1):87-91. doi:10.1016/j.jnlssr.2021.11.003.
85. Iwamoto DK, Cheng A, Lee CS, Takamatsu S, Gordon D. Man-ing" up and getting drunk: the role of masculine norms, alcohol intoxication and alcohol-related problems among college men. *Addict Behav*. 2011;36(9):906-911. doi:10.1016/j.addbeh.2011.04.005.
86. Sileo KM, Fielding-Miller R, Dworkin SL, Fleming PJ. A scoping review on the role of masculine norms in men's engagement in the HIV care continuum in sub-Saharan Africa. *AIDS Care*. 2019;31(11):1435-1446. doi:10.1080/09540121.2019.1595509.
87. Green JD, Kearns JC, Ledoux AM, Addis ME, Marx BP. The association between masculinity and nonsuicidal self-injury. *Am J Mens Health*. 2018;12(1):30-40. doi:10.1177/1557988315624508.
88. Cassino D, Besen-Cassino Y. Of masks and men? Gender, sex, and protective measures during COVID-19. *Politics & Gender*. 2020;16(4):1052-1062. doi:10.1017/S1743923X20000616.
89. Roccato M, Pacilli MG, Orlando G, Russo S. Masculinity, perceived vulnerability to COVID-19, and adoption of protective behaviors. *Sex Cult*. 2022;26(6):2171-2186. doi:10.1007/s12119-022-09991-5.
90. Schermerhorn NEC, Vescio TK. Men's and women's endorsement of hegemonic masculinity and responses to COVID-19. *J Health Psychol*. 2023;28(3):251-266. doi:10.1177/13591053221081905.
91. Levant RF, McDermott RC, Pryor S, Barinas J. Masculinity and compliance with Centers for Disease Control and Prevention recommended health practices during the COVID-19 pandemic. *Health Psychol*. 2022;41(2):94-103. doi:10.1037/hea0001119.
92. Heidari S, Durrheim DN, Faden R, et al. Time for action: towards an intersectional gender approach to COVID-19 vaccine development and deployment that leaves no one behind. *BMJ Glob Health*. 2021;6(8):e006854. doi:10.1136/bmjgh-2021-006854.