

Supplementary Material*

Mackey K, Ayers CK, Kondo KK, et al. Racial and ethnic disparities in COVID-19–related infections, hospitalizations, and deaths: a systematic review. *Ann Intern Med.* 2020. doi:10.7326/M20-6306

Supplement. Search Strategies

*Supplement Table 1. Measures of Exposure, Susceptibility, and Health Care Access Used in Statistical Models of SARS-CoV-2 Infection Rates, Hospitalizations, and Deaths**

Supplement Table 2. Quality Ratings for Cohort and Cross-sectional Studies

Supplement Table 3. Quality Ratings for Ecological Studies

Supplement Table 4. Ecological Studies of COVID-19 Incidence and Deaths (Population-Level Data)

Supplement Table 5. Studies That Adjusted for Susceptibility, Exposure, and/or Access Variables

* This supplementary material was provided by the authors to give readers further details on their article. The material was reviewed but not copyedited.

Supplement. Search Strategies

Ovid MEDLINE ALL 1946 to August 31, 2020

1 Coronavirus Infections/ or COVID-19.rs.

2 (((("Corona virinae" or "corona virus" or Coronavirinae or coronavirus or COVID or nCoV) adj4 ("19" or "2019" or novel or new)) or (("Corona virinae" or "corona virus" or Coronavirinae or coronavirus or COVID or nCoV) and (wuhan or china or chinese)) or "Corona virinae19" or "Corona virinae2019" or "corona virus19" or "corona virus2019" or Coronavirinae19 or Coronavirinae-19 or Coronavirinae2019 or Coronavirinae-2019 or coronavirus19 or coronavirus-19 or coronavirus2019 or coronavirus-2019 or COVID19 or COVID-19 or COVID2019 or COVID-2019 or nCoV19 or nCoV-19 or nCoV2019 or nCoV-2019 or SARS-CoV-2 or SARS-CoV2 or SARS-CoV or "severe acute respiratory").ti,ab,hw,kw.

3 or/1-2

4 Healthcare Disparities/ or Health Equity/ or Health Status Disparities/ or Culturally Competent Care/ or Social Determinants of Health/ or Sociology, Medical/ (35656)

5 (disadvantaged or discriminat* or disparat* or disparit* or disproportion* or unequal* or inequit* or unequal or underserved or under-served or (cultural* adj3 compet*) or (social* adj3 determin*)).ti,ab,kf. or (difference or different).ti.

6 Ethnic Groups/ or Minority Groups/ or African Americans/ or Arabs/ or Asian Americans/ or Hispanic Americans/ or Mexican Americans/ or Indigenous Peoples/ or exp Alaska Natives/

7 (ethnic* or race* or racial* or minority or minorities or "people of color" or African-American* or Black or Blacks or Hispanic* or Chican* or Latino* or Latina* or Latinx or Mexican-American* or Asian-American* or Chinese-American or Filipino* or Japanese or Korean or Vietnamese or Native American* or Indian or Indians or indigenous).ti,ab,kf.

8 Socioeconomic Factors/ or Economic Status/ or exp Employment/ or Homeless Persons/ or Medicaid/ or Medically Uninsured/ or exp Medicare/ or Poverty/ or Poverty Areas/ or Public Assistance/ or Public Housing/ or Social Class/ or "Transients and Migrants"/ or Undocumented Immigrants/ or Veterans/ or Working Poor/

9 ("blue collar" or impoverish* or homeless* or immigrant* or indigent or low-income or low-wage or lower-income or Medicaid or Medicare or migrant* or poverty or (public adj (assistance or housing)) or social or socio* or SES or undocumented or uninsured or veteran* or (working adj2 (class or poor))).ti,ab,kf.

10 Disabled Persons/ or Health Services for Persons with Disabilities/ or Persons With Hearing Impairments/ or Visually Impaired Persons/ or Vulnerable Populations/

11 (disabilit* or disabled or blind or deaf or handicapped or ((visual* or hearing or physical*) adj impair*) or vulnerab*).ti,ab,kf.

12 Rural Health/ or Rural Health Services/ or Rural Population/ or Urban Health/ or Urban Health Services/ or Urban Population/

13 (inner-city or metropol* or municipal* or neighborhood* or rural-urban or rural or urban or "New York" or "Los Angeles" or Chicago or Houston or Phoenix or Philadelphia or "San Antonio" or "San Diego" or Dallas or "San Jose" or "San Francisco" or Austin or Jacksonville or "Fort Worth" or Columbus or Charlotte or Indianapolis or Seattle or Denver or Washington or Boston or "El Paso" or Detroit or Nashville or Portland or Memphis or "Oklahoma City" or "Las Vegas" or Louisville or Baltimore or Milwaukee or Albuquerque or Tucson or Fresno or Mesa or Sacramento or Atlanta or "Kansas City" or "Colorado Springs" or Miami or Raleigh or Omaha or

"Long Beach" or "Virginia Beach" or Oakland or Minneapolis or Tulsa or Arlington or Tampa or "New Orleans").ti,ab,kf. or (city* or cities or county).ti,kf.

14 or/4-13

15 3 and 14

16 15 not (Beijing or "Hong Kong" or Huangshi or Hubei or Jiangsu or London or Paris or Qingdao or Shanghai or Shenzhen or Tianjin or "Wuhan city" or Zhuhai or Caribbean or Europe* or "South America" or "South Asia" or "Southeast Asia" or "East Asia" or "North Africa" or "East Africa" or "West Africa" or "Southern Africa" or Afghanistan or Albania* or Algeria* or Andorra or Angola or Antigua or Argentina* or Armenia* or Australia* or Austria* or Azerbaijan or Bahamas or Bahrain or Bangladesh* or Barbados or Belarus or Belgium or Belize or Benin or Bhutan* or Bolivia* or Bosnia* or Botswana or Brazil* or Britain* or Brunei or Bulgaria* or "Burkina Faso" or Burundi or "Cabo Verde" or Cambodia* or Cameroon* or Canada or Canadian* or "Central African Republic" or Chad or Chile* or China or Colombia* or Comoros or Congo* or "Costa Rica" or "Cote d'Ivoire" or Croatia* or Cuba or Cyprus or Czechia or Denmark or Djibouti or Dominica or "Dominican Republic" or Ecuador or Egypt* or "El Salvador" or England or "Equatorial Guinea" or Eritrea* or Estonia* or Eswatini or Ethiopia* or Fiji* or Finland or France or French or Gabon or Gambia* or Germany or German* or Ghana or Greece or Grenada or Guatemala* or Guinea or Guinea-Bissau or Guyana or Haiti* or Honduras or Hungary or Iceland or India or Indonesia* or Iran* or Iraq* or Ireland or Israel* or Italy or Jamaica* or Japan or Jordan* or Kazakhstan or Kenya* or Kiribati or Korea or Kosovo or Kuwait or Kyrgyzstan or Laos or Latvia* or Lebanon or Lesotho or Liberia* or Libya* or Liechtenstein or Lithuania* or Luxembourg or Madagascar or Malawi or Malaysia* or Maldives or Mali or Malta or "Marshall Islands" or Mauritania* or Mauritius or Mexico or Micronesia* or Moldova or Monaco or Mongolia* or Montenegro or Morocco or Mozambique or Myanmar or Namibia* or Nauru or Nepal* or Netherlands or "New Zealand" or Nicaragua* or Niger or Nigeria* or Macedonia* or Norway or Oman or Pakistan or Palau or Palestine or Panama or "Papua New Guinea" or Paraguay or Peru or Philippines or Poland or Portugal or Qatar or Romania* or Russia* or Rwanda* or "Saint Kitts" or "Saint Lucia" or "Saint Vincent" or "San Marino" or "Sao Tome" or Saudi* or Scotland or Senegal* or Serbia* or Seychelles or "Sierra Leone" or Singapore* or Slovakia* or Slovenia* or "Solomon Islands" or Somalia* or "South Africa" or "South Sudan" or Spain or "Sri Lanka" or Sudan* or Suriname or Sweden or Switzerland or Syria* or Taiwan* or Tajikistan or Tanzania* or Thailand or "Timor-Leste" or "East Timor" or Togo or Tonga* or Trinidad or Tunisia* or Turkey or Turkmenistan or Tuvalu or Uganda* or Ukraine or "United Arab Emirates" or "United Kingdom" or UK or Uruguay or Uzbekistan or Vanuatu or Venezuela* or Vietnam or Yemen or Zambia* or Zimbabwe*).ti.

17 limit 16 to english language

18 limit 17 to yr="2020 -Current"

Ovid PsycINFO 1806 to August 31, 2020

1 (((("Corona virinae" or "corona virus" or Coronavirinae or coronavirus or COVID or nCoV) adj4 ("19" or "2019" or novel or new)) or (("Corona virinae" or "corona virus" or Coronavirinae or coronavirus or COVID or nCoV) and (wuhan or china or chinese)) or "Corona virinae19" or "Corona virinae2019" or "corona virus19" or "corona virus2019" or Coronavirinae19 or Coronavirinae-19 or Coronavirinae2019 or Coronavirinae-2019 or coronavirus19 or coronavirus-19 or coronavirus2019 or coronavirus-2019 or COVID19 or COVID-19 or COVID2019 or

COVID-2019 or nCOV19 or nCOV-19 or nCOV2019 or nCOV-2019 or SARS-CoV-2 or SARS-CoV2 or SARS-CoV or "severe acute respiratory").ti,ab.

2 Health Disparities/

3 (difference* or disadvantaged or discriminat* or disparat* or disparit* or disproportion* or inequal* or inequit* or unequal or underserved or under-served or (cultural* adj3 compet*) or (social* adj3 determin*)).ti,ab.

4 "Racial and Ethnic Differences"/ or "Race and Ethnic Discrimination"/ or "Racial and Ethnic Groups"/ or Racism/ or Minority Groups/ or Alaska Natives/ or American Indians/ or Arabs/ or exp Asians/ or Blacks/ or Hawaii Natives/ or exp Indigenous Populations/ or Jews/ or exp "Latinos/latinas"/

5 (ethnic* or race* or racial* or minority or minorities or "people of color" or African-American* or Black or Blacks or Hispanic* or Chican* or Latino* or Latina* or Latinx or Mexican-American* or Asian-American* or Chinese-American or Filipino* or Japanese or Korean or Vietnamese or Native American* or Indian or Indians or indigenous).ti,ab.

6 Blue Collar Workers/ or Community Welfare Services/ or exp Disadvantaged/ or exp Homeless/ or Homeless Mentally Ill/ or Immigration/ or Lower Class/ or Lower Income Level/ or Medicaid/ or Medicare/ or exp Poverty/ or Refugees/ or Shelters/ or Social Deprivation/ or Social Services/ or Socioeconomic Status/ or "underinsured (health insurance)"/ or "uninsured (health insurance)"/ or "Welfare Services (Government)"/

7 ("blue collar" or impoverish* or homeless* or immigrant* or indigent or low-income or low-wage or lower-income or Medicaid or Medicare or migrant* or poverty or (public adj (assistance or housing)) or social or socio* or SES or undocumented or uninsured or veteran* or (working adj2 (class or poor))).ti,ab.

8 Blind/ or Cognitive Impairment/ or Deaf/ or exp Disabilities/ or exp Intellectual Development Disorder/

9 (disabilit* or disabled or blind or deaf or handicapped or ((visual* or hearing or physical*) adj impair*)).ti,ab.

10 Communities/ or Neighborhoods/ or Rural Environments/ or Urban Environments/

11 (inner-city or metropol* or municipal* or neighborhood* or rural-urban or rural or urban or "New York" or "Los Angeles" or Chicago or Houston or Phoenix or Philadelphia or "San Antonio" or "San Diego" or Dallas or "San Jose" or "San Francisco" or Austin or Jacksonville or "Fort Worth" or (Columbus and (OH or Ohio)) or (Charlotte and (SC or Carolina*)) or Indianapolis or Seattle or Denver or Washington or Boston or "El Paso" or Detroit or Nashville or (Portland and Oregon) or Memphis or "Oklahoma City" or "Las Vegas" or Louisville or Baltimore or Milwaukee or Albuquerque or Tucson or Fresno or (Mesa and (AZ or Arizona)) or Sacramento or Atlanta or "Kansas City" or "Colorado Springs" or Miami or (Raleigh and (NC or Carolina)) or (Omaha and (NE or Nebraska)) or "Long Beach" or "Virginia Beach" or Oakland or Minneapolis or Tulsa or (Arlington and (TX or Texas)) or Tampa or "New Orleans").ti,ab. or (city* or cities or county).ti.

12 or/2-11

13 and/1,12

14 limit 13 to yr="2020 -Current"

EBM Reviews - Cochrane Central Register of Controlled Trials April 2020 | Cochrane Database of Systematic Reviews 2005 to August 31, 2020

1 (((("Corona virinae" or "corona virus" or Coronavirinae or coronavirus or COVID or nCoV) adj4 ("19" or "2019" or novel or new)) or (("Corona virinae" or "corona virus" or Coronavirinae or coronavirus or COVID or nCoV) and (wuhan or china or chinese)) or "Corona virinae19" or "Corona virinae2019" or "corona virus19" or "corona virus2019" or Coronavirinae19 or Coronavirinae-19 or Coronavirinae2019 or Coronavirinae-2019 or coronavirus19 or coronavirus-19 or coronavirus2019 or coronavirus-2019 or COVID19 or COVID-19 or COVID2019 or COVID-2019 or nCoV19 or nCoV-19 or nCoV2019 or nCoV-2019 or SARS-CoV-2 or SARS-CoV2 or SARS-CoV or "severe acute respiratory").ti,ab.

2 (disadvantaged or discriminat* or disparat* or disparit* or disproportion* or inequal* or inequit* or unequal or underserved or under-served or (cultural* adj3 compet*) or (social* adj3 determin*)).ti,ab. or (difference or different).ti.

3 (ethnic* or race* or racial* or minority or minorities or "people of color" or African-American* or Black or Blacks or Hispanic* or Chican* or Latino* or Latina* or Latinx or Mexican-American* or Asian-American* or Chinese-American or Filipino* or Japanese or Korean or Vietnamese or Native American* or Indian or Indians or indigenous).ti,ab.

4 ("blue collar" or impoverish* or homeless* or immigrant* or indigent or low-income or low-wage or lower-income or Medicaid or Medicare or migrant* or poverty or (public adj (assistance or housing)) or social or socio* or SES or undocumented or uninsured or veteran* or (working adj2 (class or poor))).ti,ab.

5 (disabilit* or disabled or blind or deaf or handicapped or ((visual* or hearing or physical*) adj impair*) or vulnerab*).ti,ab.

6 (inner-city or metropol* or municipal* or neighborhood* or rural-urban or rural or urban or "New York" or "Los Angeles" or Chicago or Houston or Phoenix or Philadelphia or "San Antonio" or "San Diego" or Dallas or "San Jose" or "San Francisco" or Austin or Jacksonville or "Fort Worth" or Columbus or Charlotte or Indianapolis or Seattle or Denver or Washington or Boston or "El Paso" or Detroit or Nashville or Portland or Memphis or "Oklahoma City" or "Las Vegas" or Louisville or Baltimore or Milwaukee or Albuquerque or Tucson or Fresno or Mesa or Sacramento or Atlanta or "Kansas City" or "Colorado Springs" or Miami or Raleigh or Omaha or "Long Beach" or "Virginia Beach" or Oakland or Minneapolis or Tulsa or Arlington or Tampa or "New Orleans").ti,ab. or (city* or cities or county).ti.

7 or/2-6

8 and/1,7

9 8 not (Beijing or "Hong Kong" or Huangshi or Hubei or Jiangsu or London or Paris or Qingdao or Shanghai or Shenzhen or Tianjin or "Wuhan city" or Zhuhai or Caribbean or Europe* or "South America" or "South Asia" or "Southeast Asia" or "East Asia" or "North Africa" or "East Africa" or "West Africa" or "Southern Africa" or Afghanistan or Albania* or Algeria* or Andorra or Angola or Antigua or Argentin* or Armenia* or Australia* or Austria* or Azerbaijan or Bahamas or Bahrain or Bangladesh* or Barbados or Belarus or Belgium or Belize or Benin or Bhutan* or Bolivia* or Bosnia* or Botswana or Brazil* or Britain* or Brunei or Bulgaria* or "Burkina Faso" or Burundi or "Cabo Verde" or Cambodia* or Cameroon* or Canada or Canadian* or "Central African Republic" or Chad or Chile* or China or Colombia* or Comoros or Congo* or "Costa Rica" or "Cote d'Ivoire" or Croatia* or Cuba or Cyprus or Czechia or Denmark or Djibouti or Dominica or "Dominican Republic" or Ecuador or Egypt* or "El Salvador" or England or "Equatorial Guinea" or Eritrea* or Estonia* or Eswatini or Ethiopia* or Fiji* or Finland or France or French or Gabon or Gambia* or Germany or German* or Ghana or Greece or Grenada or Guatemala* or Guinea or Guinea-Bissau or Guyana or Haiti* or Honduras

or Hungary or Iceland or India or Indonesia* or Iran* or Iraq* or Ireland or Israel* or Italy or Jamaica* or Japan or Jordan* or Kazakhstan or Kenya* or Kiribati or Korea or Kosovo or Kuwait or Kyrgyzstan or Laos or Latvia* or Lebanon or Lesotho or Liberia* or Libya* or Liechtenstein or Lithuania* or Luxembourg or Madagascar or Malawi or Malaysia* or Maldives or Mali or Malta or "Marshall Islands" or Mauritania* or Mauritius or Mexico or Micronesia* or Moldova or Monaco or Mongolia* or Montenegro or Morocco or Mozambique or Myanmar or Namibia* or Nauru or Nepal* or Netherlands or "New Zealand" or Nicaragua* or Niger or Nigeria* or Macedonia* or Norway or Oman or Pakistan or Palau or Palestine or Panama or "Papua New Guinea" or Paraguay or Peru or Philippines or Poland or Portugal or Qatar or Romania* or Russia* or Rwanda* or "Saint Kitts" or "Saint Lucia" or "Saint Vincent" or "San Marino" or "Sao Tome" or Saudi* or Scotland or Senegal* or Serbia* or Seychelles or "Sierra Leone" or Singapore* or Slovakia* or Slovenia* or "Solomon Islands" or Somalia* or "South Africa" or "South Sudan" or Spain or "Sri Lanka" or Sudan* or Suriname or Sweden or Switzerland or Syria* or Taiwan* or Tajikistan or Tanzania* or Thailand or "Timor-Leste" or "East Timor" or Togo or Tonga* or Trinidad or Tunisia* or Turkey or Turkmenistan or Tuvalu or Uganda* or Ukraine or "United Arab Emirates" or "United Kingdom" or UK or Uruguay or Uzbekistan or Vanuatu or Venezuela* or Vietnam or Yemen or Zambia* or Zimbabwe*).ti.

CINAHL (EBSCOhost)

Date searched: June 30, 2020 and August 31, 2020

S1 TI ((("Corona virinae" OR "corona virus" OR Coronavirinae OR coronavirus OR COVID OR nCoV) w4 ("19" OR "2019" OR novel OR new)) OR ("Corona virinae" OR "corona virus" OR Coronavirinae OR coronavirus OR COVID OR nCoV) w10 (wuhan OR china OR chinese)) OR "Corona virinae19" OR "Corona virinae2019" OR "corona virus19" OR "corona virus2019" OR Coronavirinae19 OR Coronavirinae-19 OR Coronavirinae2019 OR Coronavirinae-2019 OR coronavirus19 OR coronavirus-19 OR coronavirus2019 OR coronavirus-2019 OR COVID19 OR COVID-19 OR COVID2019 OR COVID-2019 OR nCOV19 OR nCOV-19 OR nCOV2019 OR nCOV-2019 OR SARS-CoV-2 OR SARS-CoV2 OR SARS-CoV OR "severe acute respiratory") OR AB ((("Corona virinae" OR "corona virus" OR Coronavirinae OR coronavirus OR COVID OR nCoV) w4 ("19" OR "2019" OR novel OR new)) OR ("Corona virinae" OR "corona virus" OR Coronavirinae OR coronavirus OR COVID OR nCoV) w10 (wuhan OR china OR chinese)) OR "Corona virinae19" OR "Corona virinae2019" OR "corona virus19" OR "corona virus2019" OR Coronavirinae19 OR Coronavirinae-19 OR Coronavirinae2019 OR Coronavirinae-2019 OR coronavirus19 OR coronavirus-19 OR coronavirus2019 OR coronavirus-2019 OR COVID19 OR COVID-19 OR COVID2019 OR COVID-2019 OR nCOV19 OR nCOV-19 OR nCOV2019 OR nCOV-2019 OR SARS-CoV-2 OR SARS-CoV2 OR SARS-CoV OR "severe acute respiratory"))

S2 TI ((difference* OR disadvantaged OR discriminat* OR disparat* OR disparit* OR disproportion* OR unequal* OR inequit* OR unequal OR underserved OR under-served OR (cultural* w3 compet*) OR (social* w3 determin*))) OR AB ((difference* OR disadvantaged OR discriminat* OR disparat* OR disparit* OR disproportion* OR unequal* OR inequit* OR unequal OR underserved OR under-served OR (cultural* w3 compet*) OR (social* w3 determin*))))

S3 TI ((ethnic* OR race* OR racial* OR minority OR minorities OR "people of color" OR African-American* OR Black OR Blacks OR Hispanic* OR Chican* OR Latino* OR Latina* OR Latinx OR Mexican-American* OR Asian-American* OR Chinese-American OR Filipino*

OR Japanese OR Korean OR Vietnamese OR Native American* OR Indian OR Indians OR indigenous)) OR AB ((ethnic* OR race* OR racial* OR minority OR minorities OR "people of color" OR African-American* OR Black OR Blacks OR Hispanic* OR Chican* OR Latino* OR Latina* OR Latinx OR Mexican-American* OR Asian-American* OR Chinese-American OR Filipino* OR Japanese OR Korean OR Vietnamese OR Native American* OR Indian OR Indians OR indigenous))

S4 TI (("blue collar" OR impoverish* OR homeless* OR immigrant* OR indigent OR low-income OR low-wage OR lower-income OR Medicaid OR Medicare OR migrant* OR poverty OR (public w1 (assistance OR housing)) OR social OR socio* OR SES OR undocumented OR uninsured OR veteran* OR (working w2 (class OR poor)))) OR AB (("blue collar" OR impoverish* OR homeless* OR immigrant* OR indigent OR low-income OR low-wage OR lower-income OR Medicaid OR Medicare OR migrant* OR poverty OR (public w1 (assistance OR housing)) OR social OR socio* OR SES OR undocumented OR uninsured OR veteran* OR (working w2 (class OR poor))))

S5 TI ((disabilit* OR disabled OR blind OR deaf OR handicapped OR ((visual* OR hearing OR physical*) w1 impair*))) OR AB ((disabilit* OR disabled OR blind OR deaf OR handicapped OR ((visual* OR hearing OR physical*) w1 impair*)))

S6 TI (city* OR cities OR county or inner-city OR metropol* OR municipal* OR neighborhood* OR rural-urban OR rural OR urban OR "New York" OR "Los Angeles" OR Chicago OR Houston OR Phoenix OR Philadelphia OR "San Antonio" OR "San Diego" OR Dallas OR "San Jose" OR "San Francisco" OR Austin OR Jacksonville OR "Fort Worth" OR Columbus OR Charlotte OR Indianapolis OR Seattle OR Denver OR Washington OR Boston OR "El Paso" OR Detroit OR Nashville OR Portland OR Memphis OR "Oklahoma City" OR "Las Vegas" OR Louisville OR Baltimore OR Milwaukee OR Albuquerque OR Tucson OR Fresno OR Mesa) OR Sacramento OR Atlanta OR "Kansas City" OR "Colorado Springs" OR Miami OR Raleigh OR Omaha OR "Long Beach" OR "Virginia Beach" OR Oakland OR Minneapolis OR Tulsa OR Arlington OR Tampa OR "New Orleans") OR AB (city* OR cities OR county or inner-city OR metropol* OR municipal* OR neighborhood* OR rural-urban OR rural OR urban OR "New York" OR "Los Angeles" OR Chicago OR Houston OR Phoenix OR Philadelphia OR "San Antonio" OR "San Diego" OR Dallas OR "San Jose" OR "San Francisco" OR Austin OR Jacksonville OR "Fort Worth" OR Columbus OR Charlotte OR Indianapolis OR Seattle OR Denver OR Washington OR Boston OR "El Paso" OR Detroit OR Nashville OR Portland OR Memphis OR "Oklahoma City" OR "Las Vegas" OR Louisville OR Baltimore OR Milwaukee OR Albuquerque OR Tucson OR Fresno OR Mesa) OR Sacramento OR Atlanta OR "Kansas City" OR "Colorado Springs" OR Miami OR Raleigh OR Omaha OR "Long Beach" OR "Virginia Beach" OR Oakland OR Minneapolis OR Tulsa OR Arlington OR Tampa OR "New Orleans")

S7 S2 OR S3 OR S4 OR S5 OR S6

S8 S1 AND S7

S9 TI Beijing OR "Hong Kong" OR Huangshi OR Hubei OR Jiangsu OR London OR Paris OR Qingdao OR Shanghai OR Shenzhen OR Tianjin OR "Wuhan city" OR Zhuhai OR Australia* OR Bangladesh OR Britain OR Canada OR China OR Europe* OR England OR France OR India OR Iran OR Ireland OR Italy OR Japan OR Pakistan OR Singapore OR Scotland OR Korea OR Thailand OR Turkey OR "United Kingdom" OR UK

S10 S8 NOT S9 Limiters - Published Date: 20200101-; English Language; Human; Language: English

Scopus

Date searched: June 30, 2020 and August 31, 2020

(TITLE (disaster* OR earthquake* OR epidemic* OR hurricane* OR pandemic* OR post-disaster OR (public W/3 emergenc*) OR h1n1 OR sars OR zika OR "severe acute respiratory")) AND (((TITLE (disadvantaged OR discriminat* OR disparat* OR disparit* OR disproportion* OR inequal* OR inequit* OR unequal OR underserved OR under-served OR (cultural* W/3 compet*) OR (social* W/3 determin*)) OR TITLE (differen*))) OR ((TITLE ("blue collar" OR impoverish* OR homeless* OR immigrant* OR indigent OR low-income OR low-wage OR lower-income OR medicaid OR medicare OR migrant* OR poverty) OR TITLE (public W/1 (assistance OR housing)) OR social OR socio* OR ses OR undocumented OR uninsured OR veteran* OR (working W/2 (class OR poor)))) OR ((TITLE (ethnic* OR race* OR racial* OR minority OR minorities OR "people of color" OR african-american* OR black OR blacks OR hispanic* OR chican* OR latino* OR latina* OR latinx OR mexican-american*) OR TITLE (asian-american* OR chinese-american OR filipino* OR japanese OR korean OR vietnamese OR native AND american* OR indian OR indians OR indigenous))) OR (TITLE (disabilit* OR disabled OR blind OR deaf OR handicapped OR ((visual* OR hearing OR physical*) W/1 impair*) OR vulnerab*)) OR (TITLE (city OR cities OR county OR inner-city OR metropol* OR municipal* OR neighborhood* OR rural-urban OR rural OR urban OR "New York" OR "Los Angeles" OR chicago OR houston OR phoenix OR philadelphia OR "San Antonio" OR "San Diego" OR dallas OR "San Jose" OR "San Francisco" OR austin OR jacksonville OR "Fort Worth" OR columbus OR charlotte OR indianapolis OR seattle OR denver OR washington OR boston OR "El Paso" OR detroit OR nashville OR portland OR memphis OR "Oklahoma City" OR "Las Vegas" OR louisville OR baltimore OR milwaukee OR albuquerque OR tucson OR fresno OR mesa OR sacramento OR atlanta OR "Kansas City" OR "Colorado Springs" OR miami OR raleigh OR omaha OR "Long Beach" OR "Virginia Beach" OR oakland OR minneapolis OR tulsa OR arlington OR tampa OR "New Orleans"))) AND (LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (SUBJAREA , "MEDI") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (PUBYEAR , 2020))

Gray Literature Search

Date searched: August 11, 2020 and November 2, 2020

CDC Website Google Search

site:https://www.cdc.gov/ covid data disparity OR OR OR inequality OR OR OR unequal OR OR OR equity OR OR OR ethnicity OR OR OR race OR OR OR Black OR OR OR Hispanic OR OR OR Asian OR OR OR "American Indian" OR OR OR native OR OR OR Medicaid OR OR OR medicare OR OR OR insured OR OR OR insurance OR OR OR metropolitan OR OR OR urban OR OR OR rural

U.S. Dept. of Health and Human Services. Centers for Disease Control. Surveillance and Data Analytics, The Latest in COVID-19 Data and Surveillance.

<https://www.cdc.gov/coronavirus/2019-ncov/php/open-america/surveillance-data-analytics.html>. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. **Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET)**. <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covid-net/purpose-methods.html>. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. **CDC COVID Data Tracker. Demographic Trends of COVID-19 cases and deaths in the US reported to CDC**. <https://www.cdc.gov/covid-data-tracker/index.html#demographics>. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. **COVIDView**. <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/index.html>. Access August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. National Center for Health Statistics. **Health Disparities: Race and Hispanic Origin, Provisional Death Counts for Coronavirus Disease 2019 (COVID-19)**. https://www.cdc.gov/nchs/nvss/vsrr/covid19/health_disparities.htm. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. National Center for Health Statistics. **Excess Deaths Associated with COVID-19, Provisional Death Counts for Coronavirus Disease (COVID-19)**. https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. National Center for Health Statistics. **Provisional Death Counts for Coronavirus Disease (COVID-19): Index of COVID-19 Surveillance and Ad-hoc Data Files**. <https://www.cdc.gov/nchs/covid19/covid-19-mortality-data-files.htm>. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. National Center for Health Statistics. **Weekly Updates by Select Demographic and Geographic Characteristics Provisional Death Counts for Coronavirus Disease 2019 (COVID-19)**. https://www.cdc.gov/nchs/nvss/vsrr/covid_weekly/index.htm. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. National Center for Health Statistics. **Mental Health, Household Pulse Survey**. <https://www.cdc.gov/nchs/covid19/pulse/mental-health.htm>. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. National Center for Health Statistics. **Health Insurance Coverage, Household Pulse Survey**. <https://www.cdc.gov/nchs/covid19/pulse/health-insurance-coverage.htm>. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. National Center for Health Statistics. **Reduced Access to Care, Household Pulse Survey.** <https://www.cdc.gov/nchs/covid19/pulse/reduced-access-to-care.htm>. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. **COVID-19 Hospitalization and Death by Race/Ethnicity.** <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html>. Accessed August 11, 2020

U.S. Dept. of Health and Human Services. Centers for Disease Control. National Center for Health Statistics. **Reduced Access to Care, RANDS during COVID-19.** <https://www.cdc.gov/nchs/covid19/rands/reduced-access-to-care.htm>. Accessed August 11, 2020.

U.S. Dept. of Health and Human Services. Centers for Disease Control. **People at Increased Risk, And Other People Who Need to Take Extra Precautions.** <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/index.html>. Access August 11, 2020

U.S. Dept. of Health and Human Services. Centers for Disease Control. **An Approach for Monitoring and Evaluating Community Mitigation Strategies for COVID-19.** <https://www.cdc.gov/coronavirus/2019-ncov/php/monitoring-evaluating-community-mitigation-strategies.html>. Accessed August 11, 2020.

General Google Search

covid data disparity OR OR OR inequality OR OR OR unequal OR OR OR equity OR OR OR ethnicity OR OR OR race OR OR OR Black OR OR OR Hispanic OR OR OR Asian OR OR OR "American Indian" OR OR OR native OR OR OR Medicaid OR OR OR medicare OR OR OR insured OR OR OR insurance OR OR OR metropolitan OR OR OR urban OR OR OR rural - www.cdc.gov

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MedRxIV.org

Date searched: August 11, 2020

Site: <https://www.medrxiv.org/> covid data disparity OR OR OR inequality OR OR OR unequal OR OR OR equity OR OR OR ethnicity OR OR OR race OR OR OR Black OR OR OR

Hispanic OR OR OR Asian OR OR OR "American Indian" OR OR OR native OR OR OR
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metropolitan OR OR OR urban OR OR OR rural

Supplement Table 1. Measures of Exposure, Susceptibility, and Health Care Access Used in Statistical Models of SARS-CoV-2 Infection Rates, Hospitalizations, and Deaths*

Study	Exposure	Susceptibility	Access
<i>Cohort and cross-sectional studies</i>			
Ahmed(20) (preprint)	Known SARS-CoV-2 contact		
Azar(22)	Homelessness, income quartiles according to a median income levels by Census Zip Code Tabulation area	Tobacco use, DM, HTN CHF, cardiovascular disease, cancer, COPD, asthma, depression	Insurance
Ebinger(28)		Obesity, HTN, DM, Elixhauser comorbidity score, prior myocardial infarction or heart failure, COPD or asthma, ACE-I or ARB use	
Golestaneh(32)	Average household size, % living under poverty level, % completed HS, % with active internet subscription, % using public transportation to commute to work, % Black residents	DM, HTN, asthma, Charlson comorbidity score, smoking, obesity	
Gu(34)	Persons per square mile, less than HS education, unemployed, annual income below FPL	Comorbidity score (defined from aggregated ICD codes)	
Fox(70)		Age, sex, BMI, COPD, asthma, HF, CAD, HTN, atrial fibrillation, CKD	
Kim(38)		Tobacco use, HTN, obesity, DM, chronic lung disease, cardiovascular disease, neurologic disease, renal disease, immunosuppression, hematologic disorders, rheumatologic or autoimmune disease	
Killerby(37)		Obesity, smoking status, insurance status, HTN, DM, cardiovascular disease, chronic respiratory disease, CKD	
Lara(39)		ECOG performance status, ≥ 3 , history of smoking, number of comorbidities (HTN, DM, malignancy, asthma, COPD, obstructive sleep apnea, CAD, autoimmune disease, and/or CKD)	

Study	Exposure	Susceptibility	Access
McCarty(41)		Obesity, cardiac disease, pulmonary disorders, HTN, DM	
Moscola(42)	Borough/county of residence, job function, PCR test (negative or positive), self-reported suspicion of virus exposure, primary work location, direct patient care, work in a COVID-19-positive unit		
Petrilli (43)		Smoking, BMI, DM, asthma/COPD, CKD, cancer	
Price-Haywood(44)	Zip codes where the % low-income residents exceeded 39.5% as defined by Uniform Data System Mapper (www.udsmapper.org)	Charlson Comorbidity Index score, obesity, respiratory rate, levels of AST, venous lactate, creatinine, bilirubin, procalcitonin, and C-reactive protein, counts of lymphocytes and platelets	Insurance plan
Rentsch(46) (<i>preprint</i>)		Asthma, cancer, CKD, COPD, DM, HTN, liver disease, vascular disease	
Salacup(49)		BMI, COPD and asthma, DM, HTN, CHF, cirrhosis, CKD	
Shah(50)		BMI, HTN, CAD, CHF, COPD, asthma, CKD, DM, immunosuppression, chronic liver disease, cancer, tobacco smoking	
Vahidy(51)	Zip code household income	Charlson Comorbidity Index score, HTN, DM, obesity	Insurance type
Van Gerwen(52)		BMI, smoking status, HTN, CAD, atrial fibrillation, CHF, PVD, CVA/TIA, dementia, DM, hypothyroidism, CKD, malignancy, asthma, COPD, prior VTE	
Wang, Z.(53) (<i>preprint</i>)		Duration of stay, vital signs, smoking status, asthma, COPD, HTN, obesity, DM, HIV, cancer, care in ICU, WBC, creatinine >1.2, ALT at hospital admission	
Yehia(54)	Neighborhood deprivation index***	Elixhauser Comorbidity Index, asthma, cancer, CKD, COPD, CHF, CAD, DM, and obesity	Insurance
Ecological studies			
Goldstein(57) (<i>preprint</i>)	County-level geographic region		

Study	Exposure	Susceptibility	Access
Khanijahani(60) (<i>preprint</i>)	Household size, % age >25 with less than high school diploma, % unemployed, population density and Core Based Statistical Area status, average household size, geographical census region, financial hardship, % using public transportation		% uninsured
Karaye(59)	Population size, population density, average daily sunlight, precipitation, air temperature, heat index, fine PM		Number of people tested
Li(63)	Population density, GDP per capita, poverty rate, average % reduction in cellphone movement from day of first confirmed case to end of study, % living in overcrowded housing, % living in rural areas, Food Environment Index, rate of violent crime per 100,000 people, average temperature from 10 days before the first case to the end of the study, air quality (average annual ambient PM2.5 concentrations)	% in fair or poor health, DM, obesity, physical inactivity, % alcohol and tobacco use, liver disease, HTN, mortality per 100,000 people due to coronary heart disease and chronic respiratory disease, % sleeping <7 hours per night	COVID-19 tests per 100,000 people (state level data), patient to primary care physician ratio, % without health insurance, % who received the flu vaccine
Millet(64)	% unemployed, household occupancy per room, urbanicity, fine PM, social distancing score, days since first case	DM, heart disease deaths, cerebrovascular and HTN deaths, HIV	% uninsured
Nayak(65) (<i>preprint</i>)		CMS average Hierarchical Condition Category score	
Sehra(66)	Case rate per 100,000, population density	% obese	% private insurance
Sy(67) (<i>preprint</i>)	Median income		Number of tests
Whittle(68)	Income inequality, median household income, unemployment, % of population below poverty threshold	Male to female ratio, % of the total population age <18 and >65	Uninsured, hospital beds per 1,000 within 5 km
Zhang(69)	Population density, % below poverty		% uninsured, % of population tested

*Groupings adapted from Quinn and Kumar framework.(32) Table excludes demographic variables (age, gender).

Abbreviations: ACE-I=Angiotensin-converting enzyme inhibitors; ALT=Alanine aminotransferase; ARB=angiotensin receptor blocker; AST=Aspartate aminotransferase; BMI=Body Mass Index; CAD=Coronary artery disease; CHF; CKD=Chronic kidney disease; CMS=Centers for Medicare & Medicaid Services; COPD=Chronic obstructive pulmonary disease; COVID-19=Coronavirus disease 2019; FPL=Federal Poverty Level; GDP=Gross Domestic Product;

HIV=Human immunodeficiency virus; HS=High school; ICD=International Classification of Diseases; ICU=Intensive Care Unit; km=Kilometers; PM=Particulate Matter; SARS-CoV-2=Severe acute respiratory syndrome coronavirus 2; WBC=White blood cells.

Supplement Table 2. Quality Ratings for Cohort and Cross-sectional Studies

Study	1	2	3	4	5	6	7	8	9	10	Applicability (34)	Quality comments	Overall methodologic quality
Adegunsoye(19)	Y	Y	Y	U	Y	Y, A&B	Y	Y	U	U	Fair	Statistical methods not well-described. Unclear if follow-up long enough for outcomes to occur and whether all patients were included in outcome analysis.	Fair
Ahmed(20) (<i>preprint</i>)	Y	Y	Y	U	Y	Y, B	Y	U	N	Y	Fair	Statistical methods not well-described. No age adjustment.	Fair
Anyane-Yeboah(21)	Y	Y	Y*	U	Y	Y, B	Y	U	N	Y	Fair	Population characteristics and missing data not reported. Only adjusted for population of race/ethnicity in each state. Most applicable to states with higher SARS-CoV-2 infection rates.	Fair
Azar(22)	Y	Y	Y	U	Y	Y, A&B	Y	Y	N	U	Fair	Unclear if follow-up long enough for outcomes to occur and whether all patients were included in outcome analysis.	Fair
Baggett(23) (<i>preprint</i>)	Y	Y	U	U	Y	N	Y	Y	Y	Y	Poor	Missing data NR. No adjustment for age or other confounders. Specific population (residents of homeless shelter) with limited applicability to total population.	Fair
Blitz(24)	Y	Y	Y	NA	U	N	Y	NA	Y	Y	Fair	Universal testing, reducing risk of selection bias. Unclear ascertainment of exposure. Participant age NR (although all pregnant women). No control for confounders. Specific population (pregnant) engaged in care with limited applicability to total population.	Fair
Caraballo(25)	Y	Y	U	U	Y	Y, A&B	Y	U	N	U	Poor	Missing data NR. Not all analysis results reported. Unclear if follow-up long enough for outcomes to occur and whether all patients were included in outcome analysis. Specific population (adults with heart failure) with limited applicability to total population.	Fair
Chamie(26)	Y	Y	Y	U	Y	Y, A&B	Y	Y	Y	Y	Fair	Low barrier community-based screening with an estimated 60% of adult residents participating. Unclear if participants with missing race/ethnicity	Good

Study	1	2	3	4	5	6	7	8	9	10	Applicability (34)	Quality comments	Overall methodologic quality
												data are similar to participants with known race/ethnicity. Urban and predominantly Hispanic population limiting applicability to total population.	
Chow(27) (preprint)	Y	Y	Y	U	Y	N	Y	Y	N	Y	Fair	No adjustment for confounders.	Fair
Ebinger(28)	Y	Y	Y	U	Y	Y, A&B	Y	Y	NA	Y	Fair	Missing race/ethnicity data NR. Outcomes reported for all participants.	Good
Emeruwa(29)	Y	Y	Y	U	Y	N	Y	Y	N	Y	Fair	No adjustment for confounders. Specific population (pregnant) engaged in care with limited applicability to total population.	Fair
Flannery(30)	Y	Y	Y	U	Y	N	Y	Y	N	U	Fair	Universal testing, reducing risk of selection bias. No adjustment for confounders. Specific population (pregnant) engaged in care with limited applicability to total population.	Fair
Fox(70)	Y	Y	Y	NA	U	Y, A&B	Y	Y	N	Y	Fair	Excluded patients still hospitalized and those with missing data from analysis (9% of total sample).	Fair
Goldfarb(31)	N	U	NA	U	Y	N	N	Y	N	Y	Poor	Small, non-representative study with no control for confounders—although age was similar among participants.	Poor
Golestaneh(32)	Y	Y	Y	NA	Y	Y, A&B	Y	Y	U	U	Fair	Large sample size. Risk of misclassification of outcome, as not all participants in cohort received tests. Unclear if outcomes were assessed for all participants due to possible follow-up outside the study health system. No assessment of differences between participants lost to follow up and those with outcomes.	Fair
Gross(33)	N	N	U	U	U	Y, A&B	U	N	N	N	Poor	Data incomplete and from early stage in pandemic. Collection and analysis not well described	Poor
Gu(34)	Y	Y	Y	U	Y	Y, A&B	Y	Y	N	Y	Fair	Missing data handled by using a complete case analysis. Attrition (whether all participants were included in outcome assessment) NR.	Fair

Study	1	2	3	4	5	6	7	8	9	10	Applicability (34)	Quality comments	Overall methodologic quality
Holtgrave(35)	N	Y	N	U	Y	N	Y	N	N	N	Poor	Study sample not representative and recruitment methods not clearly described. Large proportion of sample missing race data. Short study period. Statistical tests and confidence intervals not reported.	Poor
Jehi(36)	Y	Y	Y	NA	Y	N	Y	Y	NA	Y	Fair	Large sample size. No age adjustment. Single medical system across two states. Focus is on building prediction models, not assessing association.	Fair
Killerby(37)	U	Y	Y	U	Y	Y, A&B	Y	Y	N	Y	Fair	Unclear whether all hospitals in this hospital system were included/were representative of Atlanta. Missing race data for 15% of cohort (for non-hospitalized patients 23% missing race data).	Fair
Kim(38)	Y	Y	Y	U	Y	Y, A&B	Y	Y	Y	Y	Fair	---	Good
Lara(39)	Y	Y	Y	NA	Y	Y, A&B	Y	Y	U	N	Fair	Small percentage of patients still hospitalized at study end.	Fair
Martinez(40)	Y	Y	U	U	Y	N	Y	Y	U	Y	Fair	Large sample across 5 hospitals. Missing data. Results unadjusted. Unclear if outcomes were assessed for all participants.	Fair
McCarty(41)	Y	Y	Y	NA	Y	Y, A&B	Y	Y	Y	Y	Fair	---	Good
Moscola(42)	N	Y	Y	U	Y	Y, A&B	Y	U	N	U	Fair	Risk of selection bias due to voluntary participation. Methods not well-described.	Poor
Petrilli(43)	N	Y	U	U	Y	Y, A&B	Y	Y	U	N	Fair	Excluded those not seen previously in the health system and those lacking data other than basic demographics. 6% of participants still hospitalized at the end of the study period.	Poor
Price-Haywood(44)	Y	Y	NA	U	Y	Y, A&B	Y	Y	N	Y	Fair	Attrition (whether all participants were included in outcome assessment) NR.	Fair
Reichberg(45)	Y	Y	N	U	Y	N	Y	Y	N	Y	Poor	Large study. Race/ethnicity data only reported for 37.6% of sample.	Poor

Study	1	2	3	4	5	6	7	8	9	10	Applicability (34)	Quality comments	Overall methodologic quality
Rentsch(46) (preprint)	Y	Y	U	U	Y	Y, A&B	Y	Y	N	Y	Fair	Attrition (whether all participants were included in outcome assessment) NR. Missing race/ethnic data not reported.	Fair
Rentsch(47) (preprint)	Y	Y	U	U	Y	Y, A&B	Y	Y	N	Y	Fair	Attrition (whether all participants were included in outcome assessment) NR. Missing race/ethnic data not reported.	Fair
Rosenberg(48)	Y	Y	Y	U	Y	Y, B	Y	Y	N	U	Fair	No adjustment for age.	Fair
Salacup(49)	N	Y	Y	NA	Y	Y, A&B	Y	Y	Y	N	Fair	Small, single-center study. 31% of patients were still in hospital at end of study period. 6% of patients excluded for incomplete data. Excluded those who received convalescent plasma and Remdesivir.	Poor
Shah(50)	N	Y	Y	U	Y	Y, A&B	Y	Y	Y	Y	Fair	Excluded patients still hospitalized and patients transferred to other hospitals due to capacity or need for treatments not available at the study hospital. Missing race/ethnic data not reported. Rural setting may have limited applicability to total population.	Poor
Vahidy(51)	Y	Y	Y	U	Y	Y, A&B	Y	Y	N	Y	Fair	---	Fair
Van Gerwen(52)	Y	Y	Y	U	Y	Y, A&B	Y	Y	N	N	Fair	1.3% of the study population was still hospitalized at the time of data collection.	Fair
Wang, Z.(53) (preprint)	Y	Y	U	U	Y	Y, A&B	Y	Y	U	Y	Fair	Missing race/ethnic data not reported. Attrition (whether all participants were included in outcome assessment) NR.	Fair
Yehia(54)	Y	Y	Y	U	Y	Y, A&B	Y	Y	N	Y	Fair	Attrition (whether all participants were included in outcome assessment) NR.	Fair

N=No; NA=Not applicable; U=Unclear; Y=Yes

*Race/ethnicity data sourced from US Census Bureau.

Criteria (Adapted Newcastle-Ottawa(56)):

Selection:

1. Sample representative?

Yes = Truly representative of the average in the target population (all subjects or random sampling); or, somewhat representative of the average in the target population. (non-random sampling)

No = Selected group of users

Unclear = No description of the sampling strategy.

2. Sample size justified and satisfactory?
Yes/no
3. Complete race/ethnicity data?:
Yes <20% missing race data
No \geq 20 % missing race data
Unclear = did not report proportion of missing data
4. Is the population with missing race data similar to the population with race data?
Yes/No
Unclear = not reported
5. Ascertainment of the exposure (risk factor) appropriate?
Yes = Adequately described
Unclear = Not adequate description of the measurement tool.

Comparability:

6. The subjects in different outcome groups are comparable, based on the study design or analysis. Confounding factors are controlled.
Yes = specify A, B, OR A&B
 - a) The study controls for the most important factor (age).
 - b) The study control for any additional factor.No = no adjustment for potential confounders

Outcome:

7. Assessment of the outcome appropriate?
Yes = Independent blind assessment or record linkage.
Partial = Self report.
unclear = No description.
8. Statistical test described and appropriate (including measurement of the association, including CIs and probability level [p- value])?
Yes/no/unclear
9. Reporting of attrition, adherence, and contamination?
Yes/no/unclear
10. Follow-up long enough for outcomes to occur?
Yes/no/unclear

Supplement Table 3. Quality Ratings for Ecological Studies

Study	1	2	3	4	5	6	7	8	Applicability(34)	Quality comments	Overall methodologic quality
Abedi, May 2020(55)	Y	Y	Y	U	Y	Y, A&B	Y	Y	Good	---	Good
Bilal, May 2020(56) (preprint)	Y	Y	Y†	U	Y	Y, A&B	Y	Y	Good	---	Good
Goldstein, June 2020(57) (preprint)	Y	Y	Y	U	Y	Y, A&B	Y	Y	Good	---	Good
Guha, April 2020(58) (preprint)	Y	Y	Y*	U	Y	Y, A&B	Y	Y	Good	---	Good
Karaye, June 2020(59)	Y	Y	Y‡	U	Y	Y, A&B	Y	Y	Good	---	Good
Khanijahani, June 2020(60) (preprint)	Y	Y	Y†	U	Y	Y, A&B	Y	Y	Good	---	Good
Khazanchi, June 2020(61)	Y	Y	Y‡	U	Y	Y, B	Y	Y	Good	No control for age.	Fair
Khose, June 2020(62)	Y	Y	Y*	U	Y	N	Y	Y	Fair	No control for potential confounders.	Fair
Li, April 2020(63)	Y	Y	Y§	U	U	Y, B	Y	U	Fair	Ascertainment of risk factors not fully reported.	Fair
Millett, May 2020(64)	Y	Y	Y†	U	Y	Y, A&B	Y	Y	Good	---	Good
Nayak, April 2020(65) (preprint)	Y	Y	Y‡	U	Y	Y, A&B	Y	Y	Good	---	Good
Sehra(66)	Y	Y	Y†	U	Y	Y, A&B	Y	Y	Fair		Good
Sy, May 2020(67) (preprint)	Y	Y	Y†	U	Y	Y, A&B	Y	Y	Poor	---	Good
Whittle, April 2020(68)	Y	Y	Y†	U	Y	Y, A&B	Y	Y	Fair	---	Good
Zhang, June 2020(69)	Y	Y	Y†	U	Y	Y, A&B	Y	Y	Good	---	Good

N=No; U=Unclear; Y=Yes

* Race/ethnicity data sourced from US Census Bureau.

† Race/ethnicity data sourced from the American Community Survey 2014-2018 (Census Bureau).

‡ Race/ethnicity data “Minority status and language” category from the Social Vulnerability Index (CDC).

§ Race/ethnicity data sourced from County Health Rankings & Roadmaps Database.

[¶]Race/ethnicity data sourced from Center for Systems Science and Engineering (CSSE) at Johns Hopkins University.

Criteria (Adapted Newcastle-Ottawa(56)):

Selection:

1. Sample representative?
Yes = Truly representative of the average in the target population (all subjects or random sampling); or, somewhat representative of the average in the target population. (non-random sampling)
No = Selected group of users
Unclear = No description of the sampling strategy.
2. Sample size justified and satisfactory?
Yes/No
3. Complete race/ethnicity data?:
Yes <20% missing race data
No \geq 20 % missing race data
Unclear = did not report proportion of missing data
4. Is the population with missing race data similar to the population with race data?
Yes/No
Unclear = not reported
5. Ascertainment of the exposure (risk factor) appropriate?
Yes = Adequately described
Unclear = Inadequate description of the measurement tool.

Comparability:

6. The subjects in different outcome groups are comparable, based on the study design or analysis. Confounding factors are controlled.
Yes, specify A, B, OR A&B
 - a) The study controls for the most important factor (age).
 - b) The study control for any additional factor.
No = no adjustment for potential confounders

Outcome:

7. Assessment of the outcome appropriate?
Yes = Independent blind assessment or record linkage.
Partial = Self report.
Unclear = No description.
8. Statistical test described and appropriate (including measurement of the association, including CIs and probability level [p- value])?
Yes/No/Unclear

Supplement Table 4. Ecological Studies of COVID-19 Incidence and Deaths (Population-Level Data)

Author, Date, N	Predictor and Outcome(s) <i>compared to NH-white unless otherwise stated</i>	Model(s) adjusted for	Result(s)
SARS-CoV-2 Infections (in order of level of analysis smallest to largest)			
Bilal(56) (<i>preprint</i>) N=307 zip codes	Predictor: 1 SD increase in % NH white per zip code Outcome: COVID-19 cases per population	Unadjusted.	Chicago RR: 0.77 (95% CI: 0.66 to 0.87) NYC RR: 0.89 (95% CI: 0.84 to 0.94) Philadelphia RR: 0.81 (95% CI: 0.72 to 0.90)
Guha(58) (<i>preprint</i>) N=442 zip codes (93,170 COVID-19+ cases)	Predictor: 1% increase in proportion of racial/ethnic group per zip code Outcome: COVID-19 cases per zip code	Unadjusted.	AA/Black β^* : 0.23 (95% CI: 0.13 to 0.34)
Sy(67) (<i>preprint</i>) N=126 zip codes and 4 boroughs	Predictor: 10% increase in proportion of non-white and Hispanic population per zip code Outcome: COVID-19 cases per 100,000	Number of tests and median income.	Non-white and Hispanic RR: 1.04 (95% CI: 1.01 to 1.06)
Whittle(68) N=177 zip codes	Predictor: % of population that identify as white (alone or in combination with another race) per zip code Outcome: COVID-19 cases in NYC	Male to female ratio, % of the total population age <18 and >65, income inequality, median household income, unemployment, % of population below poverty threshold, uninsured, hospital bed per 1000 within 5 km.	NH white β^* : -0.0026 (95% CI: -0.0053 to 0.0002)
Abedi(55) N=369 counties	Predictor: 1% increase in proportion of racial/ethnic group per county	State.	AA/Black women β^* : 0.47 (95% CI: 0.32 to 0.62) ; AA/Black men β^* : 0.35 (95% CI: 0.20 to 0.51)

Author, Date, N	Predictor and Outcome(s) <i>compared to NH-white unless otherwise stated</i>	Model(s) adjusted for	Result(s)
	Outcome: COVID-19 cases per million		Hispanic women β^* : 0.49 (95% CI: 0.34 to 0.64) ; Hispanic men β^* : 0.46 (95% CI: 0.31 to 0.62) Asian β^* women: 0.32 (95% CI: 0.20 to 0.44) ; Asian β^* men: 0.32 (95% CI: 0.20 to 0.43)
Karaye(59) N=2,844 counties	Predictor: 1% increase in % minority and % who speak English "less than well" per county Outcome: COVID-19 cases per 100,000	Population size, population density, number of people tested, average daily sunlight, precipitation, air temperature, heat index, fine particulate matter.	Minority status and language e^{β^*} : 6.69 (P<0.001)
Khanijahani(60) (preprint) N=2,738 counties	Predictor: 1% increase in proportion of racial/ethnic group per county Outcome: % increase in COVID-19 cases per 100,000	Median age, % female, household size, % age >25 with less than high school diploma, % uninsured, % unemployed, population density and Core Based Statistical Area status, average household size, geographical census region. Above plus financial hardship and % using public transportation.	AA/Black β^* : 3.34 (95% CI: 2.98 to 3.70) Hispanic β^* : 1.03 (95% CI: 0.57 to 1.50) AA/Black β^* : 3.10 (2.72 to 3.49) Hispanic β^* : 0.92 (0.45 to 1.38)
Khazanchi,(61) N=2,754 counties	Predictor: SVI variables for race, ethnicity, and English language proficiency (most vulnerable v least vulnerable quartiles) Outcome: COVID-19 cases per capita	Unadjusted.	Minority status and language RR: 4.94 (95% CI: 3.91 to 6.24)
Khose(62) N=253 counties	Predictor: Counties with population of >20% and \leq 20% NH Black Outcome: Cumulative COVID-19 cases per 100,000 population	NA	>20% NH Black IR: 49.66 (95% CI: 47.51 to 51.91) \leq 20% NH Black IR: 36.87 (95% CI: 36.07 to 37.70)

Author, Date, N	Predictor and Outcome(s) <i>compared to NH-white unless otherwise stated</i>	Model(s) adjusted for	Result(s)
Li(63) N=661 counties	Predictor: 1% increase in proportion of racial/ethnic group per county Outcome: COVID-19 cases per 100,000	County macroeconomic and COVID-19-specific variables, county demographics and environmental variables, medical comorbidities, access to health care [†] .	AA/Black β^* : 11.29 (95% CI: 5.44 to 17.13)
Millett(64) N=3142 counties	Predictor: Proportion of Black residents per county Outcome: Rate ratios (third versus first quartile) COVID-19 cases per county	% older than 65 years, % unemployed, % uninsured, household occupancy per room, chronic disease [‡] , urbanicity, fine particulate matter in the air, social distancing score, days since first case.	AA/Black RR: 1.23 (95% CI: 1.17 to 1.33)
Nayak(65) (<i>preprint</i>) N=433 counties (283,256 COVID-19+ cases)	Predictor: 1-unit increase in SVI score for race, ethnicity, and English language proficiency Outcome: COVID-19 cases per 1,000	% of population, age > 65, CMS average Hierarchical Condition Category score.	Minority status and language RR: 1.97 (95% CI: 1.44 to 2.70)
Zhang(69) N=1,624 counties	Predictor: % Minority population Outcome: COVID-19 cases per county	Population density, % age 65 years old and above, % below poverty, % uninsured, % of population tested.	Minority β^* : -2.70 (SE=6.07)
COVID-19 Deaths (in order of level of analysis smallest to largest)			
Goldstein(57) (<i>preprint</i>) N=322 counties	Predictor: % race/ethnic group Outcome: COVID-19 mortality per-capita	Age.	AA/Black RR: 2.73 (CI NR)
			Hispanic RR: 1.89 (CI NR)
			Asian RR: 1.25 (CI NR)
		Age and county-level geographic region.	AA/Black RR: 1.8 (CI NR)
			Hispanic RR: 1.54 (CI NR)
		Asian RR: 0.98 (CI NR)	

Author, Date, N	Predictor and Outcome(s) <i>compared to NH-white unless otherwise stated</i>	Model(s) adjusted for	Result(s)
Khanijahani(60) <i>(preprint)</i> N=2,738 counties	Predictor: 1% increase in proportion of racial/ethnic group per county Outcome: % increase in COVID-19 deaths per 100,000	Median age, % female, household size, % age >25 with < high school diploma, average household size, % uninsured, % unemployed, Core Based Statistical Area status, geographical census region, all deaths in 100,000 county population, hospital beds per 1,000 population.	AA/Black β^* : 2.57 (95% CI: 2.08 to 3.06) Hispanic β^* : 0.49 (95% CI: -0.14 to 1.13)
		Above plus COVID-19 cases per 100,000.	AA/Black β^* : 0.29 (95% CI: -0.12 to 0.71) Hispanic β^* : -0.15 (95% CI: -0.67 to 0.37)
Khazanchi(61) N=2,754 counties	SVI variables for race, ethnicity, and English language proficiency (most vulnerable v least vulnerable quartiles) Outcome: COVID-19 cases per capita	Unadjusted.	Minority status and language RR: 4.74 (95% CI: 3.55 to 6.32)
Li(63) N=661 counties	Predictor: 1% increase in proportion of racial/ethnic group per county Outcome: COVID-19 deaths per 100,000	County macroeconomic and COVID-19-specific variables, county demographics and environmental variables, medical comorbidities and access to health care [†] .	AA/Black β^* : 0.35 (95% CI: 0.09 to 0.61)
Millett(64) N=3,142 counties	Predictor: Proportion of Black residents per county Outcome: Rate ratios (third v first quartile) COVID-19 deaths per county	% population age 65+, % unemployed, % uninsured, household occupancy per room, chronic disease [‡] , urbanicity, fine particulate matter in the air, social distancing score, days since first case.	AA/Black RR: 1.18 (95% CI: 1.00 to 1.40)

Author, Date, N	Predictor and Outcome(s) <i>compared to NH-white unless otherwise stated</i>	Model(s) adjusted for	Result(s)
Nayak(65) (<i>preprint</i>) N=433 counties (283,256 COVID-19+ cases)	Predictor: 1 unit increase in SVI score for race, ethnicity, and English language proficiency Outcome: COVID-19 case-fatality rate (deaths per 100 confirmed COVID-19 cases) by county	% population age 65+, and CMS average Hierarchical Condition Category score.	Minority status and language RR: 1.55 (95% CI: 1.18 to 2.07)
Zhang(69) N=1,624 counties	Predictor: % Minority population Outcome: COVID-19 deaths per county	Population density, % population age 65+, % below poverty level, % uninsured, % of population tested.	Minority β^* : -1.801 (SE=0.624)
Sehra(66) N=50 states	Predictor: % AA/Black per 1% of population Outcome: Rate of daily deaths from COVID-19	Case rate per 100,000, population density, % >65 and <18 years and % obese (per 1% of population), % private insurance.	AA/Black IRR 1.07 (95% CI: 1.02 to 1.12) before stay-at-home orders AA/Black IRR: 1.07 (95% CI: 1.02 to 1.12) after stay-at-home orders

Bold=statistically significant

*In studies using multiple linear regression, β refers to the beta coefficient = the degree of change in the outcome variable for every 1-unit of change in the predictor variable. e^β = change in odds for the outcome variable for every 1-unit of change in the predictor variable.

†County macroeconomic and COVID-19-specific variables = population density, GDP/capita, COVID-19 tests per 100,000 people (state level data), COVID-19 cases/100,000 people (deaths analysis only), a marker for which State the county is in, average percent reduction in cellphone movement from day of first confirmed case to end of study, the percent of population living in overcrowded housing, and the number of days since the first confirmed COVID-19 case; County demographics and environmental variables = percent of population over 65, proportion of Black residents, percent of the population that is female, percent of population living in rural areas, the Food Environment Index (a measure of accessibility and affordability of healthy food), the rate of violent crime per 100,000 people, the average temperature from 10 days before the first case to the end of the study, air quality measured as the average annual ambient concentrations of PM2.5, percent of the population considered to be in fair or poor health, and the poverty rate; medical comorbidities and access to health care = diabetes, obesity, physical inactivity, excessive drinking, and smoking were all reported as percent of the population; liver disease, hypertension, coronary heart disease, and chronic respiratory disease were reported as mortality per 100,000 people; and the patient to primary care physician ratio, the percent of people sleeping fewer than seven hours per night, the percent of the population without health insurance and the percent of the population who received the flu vaccine.

‡ Diabetes diagnoses, heart disease deaths, cerebrovascular and hypertension deaths, and HIV diagnoses.

Abbreviations: AA=African American; CI=Confidence Interval; CMS=Centers for Medicare & Medicaid Services; COVID-19=Coronavirus disease 2019; IR=Incidence rate; IRR=Incidence rate ratio; NA=Not applicable; NH=Non-Hispanic; NR=Not reported; NYC=New York City; OR=Odds Ratio; RR=relative risk; SARS-CoV-2=Severe acute respiratory syndrome coronavirus 2; SE=Standard error; SVI=Social Vulnerability Index.

Supplement Table 5. Studies That Adjusted for Susceptibility, Exposure, and/or Access Variables

Author, N	Outcome	Results adjusted for			
		Demographics	Demographics and Susceptibility*	Demographics and Exposure*	Demographics, Susceptibility, Exposure, Healthcare Access*
Individual-level studies					
Azar(22) N=1,052 COVID-19+ adults	<i>Adjusted for:</i>	<i>Age, gender</i>	<i>plus comorbidities</i>	---	<i>plus homelessness, income, insurance (full model)</i>
	Hospitalization OR (95% CI)	AA/Black: 4.36 (2.34 to 8.10) Hispanic 1.92 (1.28 to 2.86)	AA/Black: 3.80 (1.97 to 7.33) Hispanic 1.63 (1.06 to 2.52)	---	AA/Black: 2.67 (1.30 to 5.47) Hispanic 1.24 (0.78 to 1.98)
Golestaneh(32) N=1755 COVID-19+ adults	<i>Adjusted for:</i>	---	<i>Age, gender, DM, asthma, HTN, smoking, morbid obesity</i>	<i>plus SES, house-hold size, % Black residents, >60% residents using public transportation regularly</i>	---
	Case fatality OR (95% CI)	---	AA/black: 0.9 (0.6 to 1.5) Hispanic: 0.9 (0.5 to 1.4)	AA/black: 1.2 (0.7 to 2.0) Hispanic: 1.0 (0.6 to 1.7)	---
Gu(34) N=5,698 tested adults	<i>Adjusted for:</i>	<i>Age, gender, persons per square mile</i>	---	<i>plus unemployed, annual income below FPL, < high school education</i>	<i>plus comorbidity score (full model)</i>
	SARS-CoV-2 Infection OR (95% CI)	AA/Black: 3.56 (2.94 to 4.31)	---	AA/Black: 3.53 (2.88 to 4.33)	AA/Black: 3.51 (2.84 to 4.33)
	Hospitalization OR (95% CI)	AA/Black: 2.53 (1.73 to 3.20)	---	AA/Black: 1.66 (1.09 to 2.52)	AA/Black: 1.73 (1.13 to 2.65)
	Case-fatality OR (95% CI)	AA/Black: 2.24 (1.12 to 4.48)	---	AA/Black: 1.17 (0.40 to 3.45)	AA/Black: 0.96 (0.32 to 2.89)

Results adjusted for

Author, N	Outcome	Demographics	Demographics and Susceptibility*	Demographics and Exposure*	Demographics, Susceptibility, Exposure, Healthcare Access*
Price-Haywood(44) N=3,481 COVID-19+ adults	<i>Adjusted for:</i>	<i>Age, gender</i>	---	---	<i>plus Charlson Comorbidity Index score, obesity, residence in a low-income area, insurance plan (full model)</i>
	Hospitalization OR (95% CI)	AA/Black: 2.35 (1.97 to 2.80)	---	---	AA/Black: 1.96 (1.62 to 2.37)
	In-hospital mortality HR (95% CI)	AA/Black: 1.08 (0.84 to 1.38)	---	---	AA/Black: 0.89 (0.68 to 1.17)
Rentsch(47) (preprint) N=62,098 tested adults	<i>Adjusted for:</i>	<i>Age</i>	<i>Comorbidities</i>	---	<i>5 or more COVID-19 cases, VA site of care (full model)</i>
	SARS-CoV-2 Infection OR (95% CI)	AA/Black: 3.13 (2.94 to 3.33) Hispanic 2.25 (2.04 to 2.49)	AA/Black: 2.83 (2.65 to 3.03) Hispanic: 1.80 (1.63 to 1.99)	---	AA/Black: 1.96 (1.81 to 2.12) Hispanic: 1.73 (1.53 to 1.96)
	30-day case-fatality OR (95% CI)	AA/Black: 1.10 (0.83 to 1.46) Hispanic 1.14 (0.71 to 1.85)	AA/Black: 0.93 (0.68 to 1.25) Hispanic 1.05 (0.64 to 1.72)	---	AA/Black: 0.93 (0.64 to 1.33) Hispanic 1.07 (0.61 to 1.87)
Population-level studies					
Li(63) N=661 counties	<i>Adjusted for:</i>	---	---	<i>County demographics, county macro-economics, COVID-19 specific variables, environmental variables[†]</i>	<i>plus medical co-morbidities and access to health care (full model[‡])</i>
	SARS-CoV-2 Infection/100,000 for % Black: β (95% CI)	---	---	% Black: 12.71 (8.09 to 17.33)	% Black: 11.29 (5.44 to 17.13)

Results adjusted for

Author, N	Outcome	Demographics	Demographics and Susceptibility*	Demographics and Exposure*	Demographics, Susceptibility, Exposure, Healthcare Access*
	COVID-19 Deaths/100,000 for % Black: β (95% CI)	---	---	% Black: 0.57 (0.36 to 0.79)	% Black: 0.35 (0.09 to 0.61)
Nayak(65) (preprint) N=433 counties and 283,256 COVID-19+ cases	Adjusted for:	% age ≥ 65	plus CMS average HCC score (full model)	---	---
	SARS-CoV-2 Infection RR [§] (95% CI)	Minority status and language [¶] : 2.04 (1.30 to 3.18)	Minority status and language [¶] : 1.97 (1.44 to 2.70)	---	---
	Case-fatality rate RR [§] (95% CI)	Minority status and language [¶] : 1.39 (1.07 to 1.82)	Minority status and language [¶] : 1.55 (1.18 to 2.07)	---	---

Bold results=statistically significant

* Susceptibility, exposure, and healthcare access groupings adapted from Quinn and Kumar framework.(32)

† Population density, GDP/capita, COVID-19 tests per 100,000 people (state level data), average percent reduction in cellphone movement from day of first confirmed case to end of study, the percent of population living in overcrowded housing, and the number of days since the first confirmed COVID-19 case; percent of population over 65, percent of the population that is female, percent of population living in rural areas, the Food Environment Index (a measure of accessibility and affordability of healthy food), the rate of violent crime per 100,000 people, the average temperature from 10 days before the first case to the end of the study, air quality measured as the average annual ambient concentrations of PM2.5, percent of the population considered to be in fair or poor health, and the poverty rate.

‡ COVID-19 cases/100,000 people, diabetes, obesity, physical inactivity, excessive drinking, and smoking were all reported as percent of the population; liver disease, hypertension, coronary heart disease, and chronic respiratory disease were reported as mortality per 100,000 people; and the patient to primary care physician ratio, the percent of people sleeping fewer than seven hours per night, the percent of the population without health insurance and the percent of the population who received the flu vaccine.

§ Per 1 unit increase in score.

¶ Subcategory of the Social Vulnerability Index.

Abbreviations: AA=African American; CI=Confidence Interval; CMS=Centers for Medicare & Medicaid Services; COVID-19=Coronavirus Disease 2019; DM=diabetes mellitus; HCC=Hierarchical Condition Category; HTN=hypertension; OR=Odds ratio; RR=Risk ratio; SARS-CoV-2=Severe Acute Respiratory Syndrome Coronavirus 2.