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Advisory Committee on Immunization Practices Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger — United States, 2021

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At its October 2020 meeting, the Advisory Committee on Immunization Practices* (ACIP) approved the 2021 Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger. After Emergency Use Authorization of Pfizer-BioNTech COVID-19 vaccine by the Food and Drug Administration (FDA), ACIP issued an interim recommendation for use of Pfizer-BioNTech COVID-19 vaccine in persons aged ≥16 years at its December 12, 2020, meeting (*1*). In addition, ACIP approved an amendment to include COVID-19 vaccine recommendations in the child and adolescent immunization schedule. After Emergency Use Authorization of Moderna COVID-19 vaccine by FDA, ACIP issued an interim recommendation for use of Moderna COVID-19 vaccine in persons aged ≥18 years at its December 19, 2020, emergency meeting (*2*).

The 2021 child and adolescent immunization schedule summarizes ACIP recommendations, including several changes from the 2020 immunization schedule† on the cover page, two tables, and notes found on the CDC immunization schedule website (https://www.cdc.gov/vaccines/schedules). Health care providers are advised to use the tables and the notes together. This immunization schedule is recommended by ACIP (https://www.cdc.gov/vaccines/acip) and approved by CDC (https://www.cdc.gov), the American Academy of Pediatrics (https://www.aap.org), the American Academy of Family

* Recommendations for routine use of vaccines in children and adolescents are developed by ACIP, a federal advisory committee chartered to provide expert external advice and guidance to the CDC director on use of vaccines and related agents for the control of vaccine-preventable diseases in the civilian population of the United States. Recommendations for routine use of vaccines in children and adolescents are harmonized to the greatest extent possible with recommendations made by the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), the American College of Obstetricians and Gynecologists (ACOG), the American College of Nurse-Midwives (ACNM), the American Academy of Physician Assistants (AAPA), and the National Association of Pediatric Nurse Practitioners (NAPNAP). ACIP recommendations approved by the CDC director become agency guidelines on the date published in the *Morbidity and Mortality Weekly Report* (MMWR). Additional information about ACIP is available at https://www.cdc.gov/vaccines/acip

† Past immunization schedules are available at https://www.cdc.gov/vaccines/schedules/past.html

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Physicians (https://www.aafp.org), the American College of Obstetricians and Gynecologists (https://www.acog.org), the American College of Nurse-Midwives (https://www.midwife.org), the American Academy of Physician Assistants (https://www.aapa.org), and the National Association of Pediatric Nurse Practitioners (https://www.napnap.org).

ACIP's recommendations on use of each vaccine are developed after in-depth reviews of vaccine-related data, including the epidemiology and societal impacts, vaccine efficacy and effectiveness, vaccine safety, quality of evidence, feasibility of program implementation, and economic analyses of immunization policy (*3*). The child and adolescent immunization schedule is published annually to consolidate and summarize updates to ACIP recommendations on vaccination of children and adolescents, and to assist health care providers in implementing current ACIP recommendations. The use of vaccine trade names in this report and in the child and adolescent immunization schedule is for identification purposes only and does not imply specific product endorsement by ACIP or CDC.

For further guidance on the use of each vaccine, including contraindications and precautions, and any updates that might occur between annual updates to the child and adolescent immunization schedule, health care providers are referred to the respective ACIP vaccine recommendations at https://www.cdc.gov/vaccines/hcp/acip-recs.[§] Printable versions of the 2021 child and adolescent immunization schedule and ordering instructions are available at https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html.

Changes in the 2021 Child and Adolescent Immunization Schedule

Vaccine-specific changes in the 2021 child and adolescent immunization schedule for children and adolescents aged 18 years or younger include new or updated ACIP recommendations for influenza vaccine (*4*) meningococcal serogroups A, C, W, and Y (MenACWY) vaccines (*5*), and COVID-19 vaccines (*1,2*). Changes also include clarification of the recommendations for diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP), *Haemophilus influenzae* type b vaccine (Hib), hepatitis A vaccine (HepA), hepatitis B vaccine (HepB), human papillomavirus vaccine (HPV), pneumococcal

[§] CDC encourages organizations to use syndication as a more reliable method for displaying the most current and accurate immunization schedules on an organization's website rather than copying these schedules to their websites. Use of content syndication requires a one-time step that ensures an organization's website displays current schedules as soon as they are published or revised; instructions for the syndication code are available on CDC's website (https://www.cdc.gov/vaccines/schedules/syndicate.html). CDC also offers technical assistance for implementing this form of content syndication (e-mail request to ncirdwebteam@cdc.gov).

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vaccines (PCV13 and PPSV23), measles, mumps, and rubella virus vaccine (MMR), tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine (Tdap), and varicella vaccine (VAR). Following are the changes to the cover page, Tables 1 and 3, and the Vaccine Notes.

Cover page

- The American Academy of Physician Assistants and the National Association of Pediatric Nurse Practitioners have been added to the list of organizations that approve the child and adolescent immunization schedule.
- MenACWY-TT (MenQuadfi) and Diphtheria and Tetanus Toxoids and Acellular Pertussis Vaccine Adsorbed, Inactivated Poliovirus, *Haemophilus* b Conjugate and Hepatitis B Vaccine (Vaxelis) have been added to the table of vaccine abbreviations/trade names.
- The abbreviation for live attenuated influenza vaccine (LAIV) was changed to LAIV4.

Table 1

- **HepB row**: Arrows have been added to clarify the recommended ages for administering the second dose.
- **LAIV:** The abbreviation was changed to LAIV4.

Table 3

- **Legend:** The text that defines the red box has been edited to include "Vaccinate after pregnancy." The text now reads "Not recommended/contraindicated—vaccine should not be administered. *Vaccinate after pregnancy."
- **LAIV:** The abbreviation was changed to LAIV4.
- **MMR row:** An asterisk has been added in the pregnancy column. The asterisk links to the descriptive text "*Vaccinate after pregnancy" in the red box of the table's legend.
- **VAR row:** An asterisk has been added in the pregnancy column. The asterisk links to the descriptive text "*Vaccinate after pregnancy" in the red box of the table's legend.
- **HPV row:** The color for the pregnancy column has been changed from pink to red; an asterisk has also been added. The asterisk links to the descriptive text "*Vaccinate after pregnancy" in the red box of the table's legend.

Notes

- **Additional Information:** The section has been updated to include COVID-19 vaccination recommendations.
- **DTaP:** A "Special situations" section has been added that contains information regarding the recommendation for use of DTaP vaccine in wound management.
- **Hib:** Text has been added to clarify the recommendations for catch-up vaccination. A bullet has been added to indicate that no further doses are needed if a dose was administered at age ≥15 months.
- **HepA:** The note was updated to clarify information on the accelerated 4-dose series of combined HepA-HepB vaccine. The fourth dose at month 12 is a booster dose.
- **HepB:** Additional text has been added to emphasize the birth dose in the vaccination note. The sentence on recommendations for infants born to an HBsAg-negative mother and weighing <2,000 g has been updated with language to provide further clarification regarding when the vaccine can be administered.
- **HepB:** The note was updated to clarify information on the accelerated 4-dose series of combined HepA-HepB vaccine. The fourth dose at month 12 is a booster dose.
- **HPV:** The note has been updated to clarify that if the vaccination schedule is interrupted, the series does not need to be restarted.
- **Influenza vaccination:** The note has been updated to reflect the recommendations for the 2020–21 influenza season. The "Special situations" section was updated with language for persons who have egg allergy with symptoms other than hives, and two new bullets were added with information on severe allergic reactions after influenza vaccination. The abbreviation LAIV was changed to LAIV4. In addition, the bullets that outline circumstances under which LAIV4 should not be used were updated to include children aged <2 years, and more detailed information on the use of LAIV4 after receipt of influenza antiviral medications to account for newer antivirals with longer half-lives was added.
- **MenACWY:** MenACWY-TT (MenQuadfi) has been added to the list of vaccines in the sections on routine vaccination, catch-up vaccination, and special situations. In addition, the "Special situations" section has been updated with information on the recommendations for the use of MenACWY-CRM (Menveo) in infants who received dose 1 at age 3–6 months.
- **Pneumococcal vaccination:** Text has been added to the "Special situations" section of the note to clarify the recommendations for administering PPSV23 after PCV13.
- **Tdap:** A "Special situations" section has been added to the note that contains information regarding the recommendation for use of Tdap vaccine in wound management.

Additional Information

The Recommended Child and Adolescent Immunization Schedule, United States, 2021 is available at https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html. The full ACIP recommendations for each vaccine are also available at https://www.cdc.gov/vaccines/hcp/acip-recs. All vaccines

identified in Tables 1, 2, and 3 (except DTaP, rotavirus, and poliovirus vaccines) also appear in the Recommended Adult Immunization Schedule for Ages 19 Years or Older, United States, 2021, available at https://www.cdc.gov/vaccines/schedules/hcp/imz/adult.html. The notes for vaccines that appear in both the child and adolescent immunization schedule and the adult immunization schedule have been harmonized to the greatest extent possible.

Acknowledgments

Rosters of current and past members of the Advisory Committee on Immunization Practices (ACIP) are available at https://www.cdc.gov/vaccines/acip/committee/members-archive.html.

ACIP Combined Immunization Schedule Work Group

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References

1. Oliver SE, Gargano JW, Marin M, et al. The Advisory Committee on Immunization Practices' interim recommendation for use of Pfizer-BioNTech COVID-19 vaccine—United States. MMWR Morb Mortal Wkly Rep 2020;69:1922–4. PMID:33332292 https://doi.org/10.15585/mmwr.mm6950e2
2. Oliver SE, Gargano JW, Marin M, et al. The Advisory Committee on Immunization Practices' interim recommendation for use of Moderna COVID-19 vaccine—United States, December 2020. MMWR Morb Mortal Wkly Rep 2021;69:1653–6. PMID:33382675 https://doi.org/10.15585/mmwr.mm695152e1
3. CDC. Charter of the Advisory Committee on Immunization Practices. Atlanta, GA: US Department of Health and Human Services, CDC; 2018. https://www.cdc.gov/vaccines/acip/committee/acip-charter.pdf
4. Grohskopf LA, Alyanak E, Broder KR, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2020–21 influenza season. MMWR Recomm Rep 2020;69(No. RR-8). PMID:32820746 https://doi.org/10.15585/mmwr.rr6908a1
5. Mbaeyi SA, Bozio CH, Duffy J, et al. Meningococcal vaccination: recommendations of the Advisory Committee on Immunization Practices, United States, 2020. MMWR Recomm Rep 2020;69(No. RR-9). PMID:33417592 https://doi.org/10.15585/mmwr.rr6909a1

Advisory Committee on Immunization Practices Recommended Immunization Schedule for Adults Aged 19 Years or Older — United States, 2021

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At its October 2020 meeting, the Advisory Committee on Immunization Practices (ACIP)* approved the Recommended Immunization Schedule for Adults Aged 19 Years or Older, United States, 2021. After the Emergency Use Authorization of Pfizer-BioNTech COVID-19 vaccine by the Food and Drug Administration, ACIP issued an interim recommendation for use of Pfizer-BioNTech COVID-19 vaccine in persons aged ≥16 years at its December 12, 2020, emergency meeting (*1*). In addition, ACIP approved an amendment to include COVID-19 vaccine recommendations in the child and adolescent and adult immunization schedules. After Emergency Use Authorization of Moderna COVID-19 vaccine by the Food and Drug Administration, ACIP issued an interim recommendation for use of Moderna COVID-19 vaccine in persons aged ≥18 years at its December 19, 2020, emergency meeting (*2*).

The 2021 adult immunization schedule summarizes ACIP recommendations, including several changes from the 2020 immunization schedule† on the cover page, two tables, and accompanying notes found on the CDC immunization schedule website (https://www.cdc.gov/vaccines/schedules). Health care providers are advised to use the tables and the notes together. This adult immunization schedule is recommended by ACIP (https://www.cdc.gov/vaccines/acip) and approved by CDC (https://www.cdc.gov), the American College of Physicians (https://www.acponline.org), the American Academy of Family Physicians (https://www.aafp.org), the American College of Obstetricians and Gynecologists (https://www.acog.org), the American College of Nurse-Midwives (https://www.midwife.org), and the American Academy of Physician Assistants (https://www.aapa.org).

ACIP's recommendations on use of each vaccine are developed after in-depth reviews of vaccine-related data, including disease epidemiology and societal impacts, vaccine efficacy and effectiveness, vaccine safety, quality of evidence, feasibility of program implementation, and economic analyses of immunization policy (*3*). The adult immunization schedule is published annually to consolidate and summarize updates to ACIP recommendations on vaccination of adults and to assist health care providers in implementing current ACIP recommendations. The use of vaccine trade names in this report and in the adult immunization schedule is for identification purposes only and does not imply endorsement by ACIP or CDC.

For further guidance on the use of each vaccine, including contraindications and precautions, and any updates that might occur between annual updates to the adult immunization schedule, health care providers are referred to the respective ACIP vaccine recommendations at https://www.cdc.gov/vaccines/hcp/acip-recs.§ Printable versions of the 2021 adult immunization schedule and ordering instructions are available at https://www.cdc.gov/vaccines/schedules/hcp/adult.html#note.

Changes in the 2021 Adult Immunization Schedule

Vaccine-specific changes in the 2021 immunization schedules for adults aged ≥19 years include new or updated ACIP recommendations for influenza vaccine (*4*), hepatitis A vaccine (HepA) (*5*), hepatitis B vaccine (HepB) (*6*), human papillomavirus (HPV) vaccine (*7*), pneumococcal vaccines (*8*), meningococcal serogroups A, C, W, and Y (MenACWY) vaccines (*9*), meningococcal B (MenB) vaccines (*9*), and zoster vaccine (*10*).

* Recommendations for routine use of vaccines in adults are developed by ACIP, a federal advisory committee chartered to provide expert external advice and guidance to the CDC director on use of vaccines and related agents for the control of vaccine-preventable diseases in the civilian population of the United States. Recommendations for routine use of vaccines in adults are harmonized to the greatest extent possible with recommendations made by the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), and the American College of Obstetricians and Gynecologists (ACOG). ACIP recommendations approved by the CDC director become agency guidelines on the date published in the *Morbidity and Mortality Weekly Report* (MMWR). Additional information about ACIP is available at https://www.cdc.gov/vaccines/acip

† Past immunization schedules are available at https://www.cdc.gov/vaccines/schedules/past.html

§ CDC encourages organizations to use syndication as a more reliable method for displaying the most current and accurate immunization schedules on an organization's website rather than copying these schedules to their websites. Use of content syndication requires a one-time step that ensures an organization's website displays current schedules as soon as they are published or revised; instructions for the syndication code are available on CDC's website (https://www.cdc.gov/vaccines/schedules/syndicate.html). CDC also offers technical assistance for implementing this form of content syndication (requests can be e-mailed to ncirdwebteam@cdc.gov).

Cover page

- The abbreviation for live attenuated influenza vaccine (LAIV) was changed to LAIV4.
- The abbreviation for live recombinant influenza vaccine (RIV) was changed to RIV4.
- MenQuadfi has been added to the list of MenACWY vaccines.
- Abbreviations for the three types of MenACWY vaccines have been added.
- ZVL (zoster vaccine live or Zostavax) has been removed from the table and from the Injury Claims section because the vaccine is no longer available in the U.S. market.
- A link to FAQs for shared clinical decision-making has been added under the Helpful Information section.

Table 1

- **Tdap row:** This row has been split in half. The upper half is purple to indicate vaccination is recommended for adults with an additional risk factor or another indication (i.e., during each pregnancy and for wound management); the lower half is yellow, indicating vaccination is recommended for adults who meet age requirement, lack documentation of vaccination, or lack evidence of past infection. In addition, text overlay was added to the purple half of the row that states "1 dose Tdap with each pregnancy; 1 dose Td/Tdap for wound management (see notes) for clarification."
- **MMR row:** The yellow color was extended through age 50–64 years to reflect the age of persons born in or after 1957.
- **VAR row:** The line between the yellow color and the purple color has been shifted to the left to reflect the age of persons born in or after 1980.
- **Zoster row:** Zostavax (ZVL) was deleted because it is no longer available in the U.S. market, and the text "RZV is preferred" was deleted.
- **PCV13 row:** In the column for 65 years and older, the text overlay in the blue box was changed from "≥65 years" to "1 dose."

Table 2

- **MMR row**: An asterisk was added after "Not Recommended" to indicate that MMR vaccine should be administered after pregnancy. A line was added between the pregnancy column and the immunocompromised column to separate them.
- **VAR row**: An asterisk was added after "Not Recommended" to indicate that VAR vaccine should be administered after pregnancy. A line was added between the pregnancy column and the immunocompromised column to separate them. In the column for "HIV infection with a CD4 count ≥200 cells/mm^3," the color is now blue, indicating that vaccination is recommended, using shared clinical decision-making to reflect that this vaccine recommendation may be considered for this group.
- **Zoster row:** Zostavax (ZVL) has been removed because it is no longer available in the U.S. market. In the pregnancy column, the pink color for "Delay until after Pregnancy" has been replaced with gray because RZV is not recommended during pregnancy.
- **HPV row**: In the pregnancy column, the pink color for "Delay until after Pregnancy" has been replaced with red for "Not Recommended." This was changed to simplify the schedule because the vaccine is not recommended during pregnancy and should be delayed until after pregnancy. In addition, an asterisk was added after "Not Recommended" to indicate HPV vaccine should be administered after pregnancy. The text overlay spanning the columns "Asplenia, complement deficiencies" through "Men who have sex with men" has been changed to state "2 or 3 doses through age 26 years depending on age at initial vaccination or condition."
- **HepB row**: The text overlay has been changed to state "2, 3, or 4 doses, depending on vaccine or condition." In the diabetes column, the box has been split in half. The upper half is yellow and has text overlay "<60 years" to indicate hepatitis B vaccine is routinely recommended for adults aged <60 years with diabetes. The lower half is blue and has text overlay "≥60 years" to indicate shared clinical decision-making should be used for vaccinating persons aged ≥60 years who have diabetes with hepatitis B vaccine.

Notes

- The notes are presented in alphabetical order. Edits have been made throughout the Notes section to harmonize language between the child/adolescent and the adult immunization schedules to the greatest extent possible.
- **Additional Information:** A section has been added to include language for COVID-19 vaccination recommendations.
- **HepA:** Under "Travel in countries with high or intermediate endemic hepatitis A," text has been added for the accelerated Twinrix schedule: "HepA-HepB combination vaccine or Twinrix may be administered on an accelerated schedule of 3 doses at 0, 7, and 21–30 days, followed by a booster dose at 12 months."
- **HepB:** Under "Special Situations," text has been added to indicate that hepatitis B vaccination for persons aged ≥60 years with diabetes is recommended, using shared clinical decision-making.
- **HPV:** Minor wording changes were made to now read "HPV vaccination recommended for all persons through age 26 years." Under routine vaccination, the text was reformatted to match the Child/Adolescent schedule and

now reads "Age 15 years or older at initial vaccination: 3-dose series at 0, 1–2 months, 6 months (minimum intervals: dose 1 to dose 2: 4 weeks / dose 2 to dose 3: 12 weeks / dose 1 to dose 3: 5 months; repeat dose if administered too soon." In addition, a bullet was added stating that no additional doses of HPV are recommended after completing a series at the recommended dosing intervals using any HPV vaccine. Under "Shared Clinical Decision-Making," the text was modified to say "Some adults aged 27–45 years: based on shared clinical decision-making, 2- or 3-dose series as above." Under "Special situations," two bullets were added, one stating "Age ranges recommended above for routine and catch-up vaccination or shared clinical decision-making also apply in special situations" and the other stating "Immunocompromising conditions, including HIV infection: 3-dose series as above, regardless of age at initial vaccination."

- **Influenza vaccination:** In "Special situations," regarding an "Egg allergy – any symptom other than hives," this text was added: "If using an influenza vaccine other than RIV4 or ccIIV4 , administer in medical setting under supervision of health care provider who can recognize and manage severe allergic reactions." Two additional bullets were added: "Severe allergic reactions to any vaccine can occur even in the absence of a history of previous allergic reaction. Therefore, all vaccination providers should be familiar with the office emergency plan and certified in cardiopulmonary resuscitation" and "A previous severe allergic reaction to influenza vaccine is a contraindication to future receipt of the vaccine." Lastly, an additional bullet about LAIV4 and antivirals was added: "LAIV4 should not be used if influenza antiviral medications oseltamivir or zanamivir was received within the previous 48 hours, peramivir within the previous 5 days, or baloxavir within the previous 17 days."
- **Meningococcal vaccination:** Under "Special situations for MenACWY," MenQuadfi (MenACWY-TT) vaccine was added to all relevant sections because it is now licensed. For MenACWY booster doses, text was added to say "Booster dose recommendations for groups listed under 'Special situations' and in an outbreak setting (e.g., in community or organizational settings, and among men who have sex with men) and additional meningococcal vaccination information, see https://www.cdc.gov/mmwr/volumes/69/rr/rr6909a1.htm." For MenB booster doses, text was added to say "Booster dose recommendations for groups listed under 'Special situations' and in an outbreak setting (e.g., in community or organizational settings and among men who have sex with men) and additional meningococcal vaccination information, see https://www.cdc.gov/mmwr/volumes/69/rr/rr6909a1.htm."
- **Pneumococcal vaccination:** The link has been updated for routine vaccination in persons aged ≥65 years (https://www.cdc.gov/mmwr/volumes/68/wr/mm6846a5.htm?s_cid). Under the Shared clinical decision-making section, bullets have been reordered as follows:
  - PCV13 and PPSV23 should not be administered during the same visit.
  - If both PCV13 and PPSV23 are to be administered, PCV13 should be administered first.
  - PCV13 and PPSV23 should be administered at least 1 year apart.
- **Tdap:** The information for wound management has been updated: "Wound management: Persons with 3 or more doses of tetanus toxoid-containing vaccine: For clean and minor wounds, administer Tdap or Td if more than 10 years since last dose of tetanus toxoid-containing vaccine; for all other wounds, administer Tdap or Td if more than 5 years since last dose of tetanus toxoid-containing vaccine. Tdap is preferred for persons who have not previously received Tdap or whose Tdap history is unknown. If a tetanus toxoid-containing vaccine is indicated for a pregnant woman, use Tdap. For detailed information, see https://www.cdc.gov/mmwr/volumes/69/wr/mm6903a5.htm."
- **Zoster vaccination:** References have been removed to previous receipt of ZVL (zoster vaccine live or Zostavax) dose when considering vaccination of persons aged ≥50 years with RZV (recombinant zoster vaccines or Shingrix) and the bullet about ZVL for persons aged ≥60 years was deleted because ZVL is no longer available in the U.S. market.

Additional Information

The Recommended Adult Immunization Schedule, United States, 2021, is available at https://www.cdc.gov/vaccines/schedules/hcp/adult.html and in the *Annals of Internal Medicine*. The full ACIP recommendations for each vaccine are also available at https://www.cdc.gov/vaccines/hcp/acip-recs/index.html. All vaccines identified in Tables 1 and 2 (except zoster vaccine) also appear in the Recommended Immunization Schedule for Children and Adolescents, United States, 2021 (https://www.cdc.gov/vaccines/schedules/downloads/child/0-18yrs-child-combined-schedule.pdf). The notes for vaccines that appear in both the adult immunization schedule and the child and adolescent immunization schedule have been harmonized to the greatest extent possible.

Acknowledgments

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References

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2. Oliver SE, Gargano JW, Marin M, et al. The Advisory Committee on Immunization Practices' interim recommendation for use of Moderna COVID-19 vaccine—United States, December 2020. MMWR Morb Mortal Wkly Rep 2021;69:1653–6. PMID:33382675 https://doi.org/10.15585/mmwr.mm695152e1
3. CDC. Charter of the Advisory Committee on Immunization Practices. Atlanta, GA: US Department of Health and Human Services, CDC; 2018. https://www.cdc.gov/vaccines/acip/committee/acip-charter.pdf
4. Grohskopf LA, Alyanak E, Broder KR, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2020–21 influenza season. MMWR Recomm Rep 2020;69(No. RR-8). PMID:32820746 https://doi.org/10.15585/mmwr.rr6908a1
5. Doshani M, Weng M, Moore KL, Romero JR, Nelson NP. Recommendations of the Advisory Committee on Immunization Practices for use of hepatitis A vaccine for persons experiencing homelessness. MMWR Morb Mortal Wkly Rep 2019;68:153–6. PMID:30763295 https://doi.org/10.15585/mmwr.mm6806a6
6. Schillie S, Vellozzi C, Reingold A, et al. Prevention of hepatitis B virus infection in the United States: Recommendations of the Advisory Committee on Immunization Practices. MMWR Recomm Rep 2018;67(No RR-1). PMID:29939980 https://doi.org/10.15585/mmwr.rr6701a1
7. Meites E, Szilagyi PG, Chesson HW, Unger ER, Romero JR, Markowitz LE. Human papillomavirus vaccination for adults: updated recommendations of the Advisory Committee on Immunization Practices. MMWR Morb Mortal Wkly Rep 2019;68:698–702. PMID:31415491 https://doi.org/10.15585/mmwr.mm6832a3
8. Matanock A, Lee G, Gierke R, Kobayashi M, Leidner A, Pilishvili T. Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine among adults aged ≥65 years: updated recommendations of the Advisory Committee on Immunization Practices. MMWR Morb Mortal Wkly Rep 2019;68:1069–75. PMID:31751323 https://doi.org/10.15585/mmwr.mm6846a5
9. Mbaeyi SA, Bozio CH, Duffy J, et al. Meningococcal vaccination: recommendations of the Advisory Committee on Immunization Practices, United States, 2020. MMWR Recomm Rep 2020;69(No. RR-9). PMID:33417592 https://doi.org/10.15585/mmwr.rr6909a1
10. Dooling KL, Guo A, Patel M, et al. Recommendations of the Advisory Committee on Immunization Practices for use of herpes zoster vaccines. MMWR Morb Mortal Wkly Rep 2018;67:103–8. PMID:29370152 https://doi.org/10.15585/mmwr.mm6703a5

Comorbidities Among Young Adults with Congenital Heart Defects: Results from the Congenital Heart Survey To Recognize Outcomes, Needs, and well-beinG — Arizona, Arkansas, and Metropolitan Atlanta, 2016–2019

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An estimated 1.4 million adults in the United States live with congenital heart defects (CHDs), yet their health outcomes are not well understood (*1*). Using self-reported, cross-sectional data from 1,482 respondents in the 2016–2019 Congenital Heart Survey To Recognize Outcomes, Needs, and well-beinG (CH STRONG) (*2*), CDC and academic partners estimated the prevalence of comorbidities among adults with CHDs aged 20–38 years born in Arizona (AZ), Arkansas (AR), and metropolitan Atlanta, Georgia (GA) compared with the general population (aged 20–38 years) from the National Health and Nutrition Examination Survey (NHANES) during 2015–2018 (*3*) and the AZ, AR, and GA Behavioral Risk Factor Surveillance Systems (BRFSS) during 2016–2018 (*4*). Adults with CHDs were more likely than those in the general population to report cardiovascular comorbidities, such as a history of congestive heart failure (4.3% versus 0.2%) and stroke (1.4% versus 0.3%), particularly those with severe CHDs (*2*). Adults with CHDs were more likely to report current depressive symptoms (15.1% versus 8.5%), but less likely to report previous diagnoses of depression (14.2% versus 22.6%), asthma (12.7% versus 16.9%), or rheumatologic disease (3.2% versus 8.0%). Prevalence of noncardiovascular comorbidities was similar between adults whose CHD was considered severe and those with nonsevere CHDs. Public health practitioners and clinicians can encourage young adults with CHDs to seek appropriate medical care to help them live as healthy a life as possible.

Adults with CHDs born during 1980–1997 were identified from population-based birth defects registries in AZ, AR, and GA. During October 2016–January 2019, eligible participants were surveyed regarding their CHDs, cardiovascular comorbidities, other comorbidities, quality of life, education, work history, and health care usage (*2*). Using questions from NHANES and BRFSS, CH STRONG participants were asked if they had ever been told by a doctor or other health professional that they had any cardiovascular comorbidities (congestive heart failure, hypertension, myocardial infarction, or stroke) or noncardiovascular comorbidities (asthma, cancer, mood disorder or depression, diabetes [type 1 or type 2, excluding gestational diabetes], or rheumatologic disease [arthritis, gout, lupus, or fibromyalgia]). Current depressive symptoms among adults with CHDs were assessed using the Patient Health Questionnaire-2 (PHQ-2) (*5*). Overweight/obesity was assessed using body mass index (BMI); persons with BMI ≥25 kg/m^2 were considered to be overweight/have obesity. Among the general population, self-reported, clinician-diagnosed cardiovascular comorbidities and depressive symptoms (assessed by PHQ-2) were obtained from the 2015–2018 NHANES (*3*). Self-reported, clinician-diagnosed noncardiovascular comorbidities were obtained from the 2016–2018 BRFSS (*4*).

The CH STRONG sample was limited to persons aged 20–38 years (to match NHANES age groups for cardiovascular comorbidities) and to those without missing data for demographics or comorbidities. Furthermore, for the analyses of current depressive symptoms assessed using the PHQ-2, CH STRONG participants who did not self-report were excluded (to match the NHANES self-report data). To reduce nonresponse bias and generate population-based estimates, the CH STRONG participant population was standardized to the CH STRONG eligible population (9,312) by sex, birth cohort, maternal race/ethnicity, place of birth, and CHD severity. In addition, the general population samples (NHANES and BRFSS) aged 20–38 years were standardized to the CH STRONG eligible population by available demographic variables to reduce confounding. Standardized prevalence estimates were calculated for each cardiovascular and noncardiovascular comorbidity, as well as 95% confidence intervals (CIs) and p values for the difference in mean proportions between the standardized CH STRONG analytic sample and the standardized general population samples.

The CH STRONG sample was divided into two groups: those with severe CHDs and those with nonsevere CHDs (*2*). The unstandardized prevalence of cardiovascular and noncardiovascular comorbidities and the odds ratios between these two groups were measured and adjusted for sex, birth cohort, maternal race/ethnicity, and place of birth (adjusted odds ratios [aORs]). All analyses were conducted using SAS-callable SUDAAN (version 9.4; RTI International).

Among 9,312 eligible adults with CHDs, surveys were sent to 6,947 with available addresses; 1,656 surveys were returned (24% response rate). Of those, 1,626 were aged 20–38 years, 1,482 (91.1%) of whom included data on

the variables of interest. Among these, 54% were female, 76% were non-Hispanic White, and the mean age was 26.1 (standard deviation = 4.6) years (Table 1). One third of the respondents had severe CHDs. A total of 1,174 eligible participants (79.2%) completed the survey via self-report, with the remainder by proxy.

Compared with the general population, adults with CHDs were more likely to report a history of congestive heart failure (4.3% versus 0.2%, p<0.001) and stroke (1.4% versus 0.3%, p<0.001), but there were no significant differences for hypertension or myocardial infarction (Figure). Adults with severe CHDs were significantly more likely than the general population to have had at least one cardiac comorbidity (19.8% versus 9.0%, p<0.05), but those with nonsevere CHD (11.0%) were not.

Persons with CHDs were more likely to report depressive symptoms at the time of the survey than those in the general population (15.1% versus 8.5%, p<0.001), but were less likely to have reported a prior diagnosis of depression (14.2% versus 22.6%, p<0.001). Adults with CHDs were also less likely than the general population to have asthma (12.7% versus 16.9%, p<0.001) or rheumatologic disease (3.2% versus 8.0%, p<0.001) (Figure).

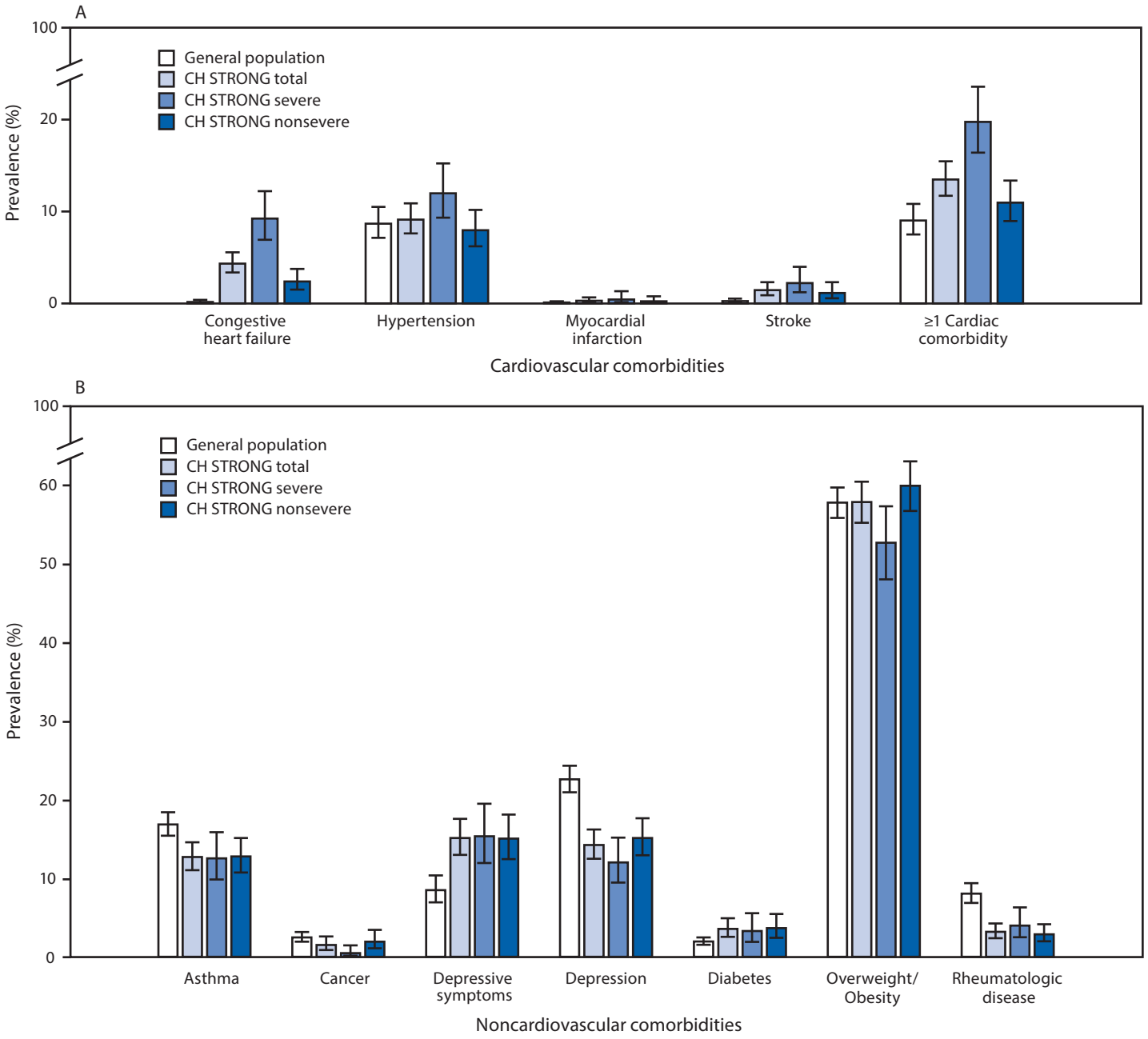
Results differed by severity of CHDs for cancer, diabetes, and overweight/obesity when compared with the general population. Those with severe CHDs reported a lower prevalence of cancer (0.5% versus 2.5%, p<0.001) and overweight/obesity (52.7% versus 57.8%, p = 0.048) compared with the general population, but no difference for diabetes. Those with nonsevere CHDs reported a higher prevalence of diabetes

TABLE 1. Selected characteristics of adults with congenital heart defects (CHDs) and the general population — United States, 2015–2019

				General population			
	CH STRONG 2016–2019*			NHANES, 2015–2018†		BRFSS, 2016–2018§	
Characteristic	Total (1,482)	Unstandardized, %	Standardized, %	Unstandardized weighted, %	Standardized weighted, %	Unstandardized weighted, %	Standardized weighted, %
Sex							
Female	**805**	54.3	48.8	49.7	48.6	48.0	48.6
Male	**677**	45.7	51.3	50.3	51.5	52.0	51.5
Birth cohort¶							
1980–1985	**214**	14.4	14.5	35.4	14.4	25.9	14.4
1986–1990	**450**	30.4	28.0	30.1	28.3	30.8	28.3
1991–1997	**818**	55.2	57.5	34.5	57.3	43.3	57.3
Race/Ethnicity**							
White, non-Hispanic	**1,125**	75.9	65.3	55.0	65.1	52.4	65.1
Black, non-Hispanic	**210**	14.2	21.7	13.0	10.6	23.2	15.0
Hispanic	**105**	7.1	9.5	20.5	16.0	16.0	13.3
Other, non-Hispanic	**42**	2.8	3.4	11.4	8.4	8.4	6.7
Region							
Arizona	**438**	29.6	25.4	NA††	NA††	26.6	25.3
Arkansas	**572**	38.6	46.8	NA††	NA††	16.0	47.1
Georgia	**472**	31.9	27.8	NA††	NA††	57.4	27.7
Respondent type							
Self-report	**1,174**	79.2	77.3	99.4	99.4	100.0	100.0
Proxy report	**288**	19.4	21.3	0.6	0.6	0.0	0.0
Missing	**20**	1.4	1.4	0.0	0.0	0.0	0.0
Severity							
Severe	**494**	33.3	28.7	NA§§	NA§§	NA§§	NA§§
Nonsevere	**988**	66.7	71.3	NA§§	NA§§	NA§§	NA§§

Sources: Congenital Heart Survey To Recognize Outcomes, Needs, and well-beinG (CH STRONG, 2016–2019); National Health and Nutrition Examination Survey (NHANES, 2015–2018); Behavioral Risk Factor Surveillance System (BRFSS, 2016–2018).
Abbreviation: NA = not applicable.
* Standardized to CH STRONG eligible population (n = 9,312) by sex, birth cohort, maternal race/ethnicity, place of birth, and CHD severity.
† NHANES 2015–2018 data used as general population comparison group, standardized to CH STRONG eligible population by sex, birth cohort, and race/ethnicity. The NHANES population is based on nationally representative sample of noninstitutionalized, civilian U.S. population.
§ BRFSS, 2016–2018 data from Arizona, Arkansas, and Georgia used as general population comparison group, standardized to CH STRONG eligible population by sex, birth cohort, race/ethnicity, and current residence.
¶ Approximate birth year was calculated for the general population by subtracting survey year of completion by survey age. For NHANES, the survey cycle midpoint was chosen to calculate birth cohort. For BRFSS, reported year of survey was used to calculate birth cohort.
** Maternal race/ethnicity was used to standardize the CH STRONG respondents to the CH STRONG eligible population. NHANES and BRFSS self-reported race/ethnicity was used to standardize to the CH STRONG eligible population.
†† Data by region applicable only to CH STRONG and BRFSS.
§§ Data by congenital heart defect severity applicable only to CH STRONG.

FIGURE. Prevalence of cardiovascular* (A) and noncardiovascular† (B) comorbidities among adults aged 20–38 years with congenital heart defects§ (CHDs) compared with the general population aged 20–38 years — United States,¶ 2015–2019



Sources: Congenital Heart Survey To Recognize Outcomes, Needs, and well-beinG (CH STRONG, 2016–2019); National Health and Nutrition Examination Survey (NHANES, 2015–2018); Behavioral Risk Factor Surveillance System (BRFSS, 2016–2018).

* General population group for history of diagnosis for congestive heart failure, hypertension, myocardial infarction, stroke, and ≥1 cardiac comorbidity is from NHANES, 2015–2018, standardized to CH STRONG eligible population by sex, age group, and race/ethnicity.

† General population group for history of diagnosis for asthma, cancer, depression, diabetes, rheumatologic disease, and overweight/obesity is from the state-based Arizona, Arkansas, and Georgia BRFSS, 2016–2018 data used as general population comparison group, standardized to CH STRONG eligible population by sex, age group, and race/ethnicity. For depressive symptoms, the general population is from NHANES, 2015–2018, standardized to CH STRONG eligible population by sex, age group, and race/ethnicity; the CH STRONG population excluded responses by proxy report (CH STRONG denominator = 1,174). Participants with a score of ≥3 on the Patient Health Questionnaire-2 were considered to have depressive symptoms at time of survey completion. Overweight/obesity defined as body mass index ≥25 kg/m^2 based on self-reported height and weight.

§ Full list of congenital heart defect lesions included in CH STRONG has been previously published (https://doi.org/10.1016/j.ahj.2019.12.021). Common severe lesions included single ventricle lesions, endocardial cushion defects, tetralogy of Fallot, transposition of the great arteries, truncus arteriosus, coarctation of the aorta, and interrupted aortic arch.

¶ Compared with the general population, the total CH STRONG population was more likely to report history of congestive heart failure, stroke, and current depressive symptoms and were less likely to report history of asthma, depression diagnosis, or rheumatologic disease. Those with severe CHDs reported a lower prevalence of cancer and overweight/obesity compared with the general population, and those with nonsevere CHDs reported a higher prevalence of diabetes compared with the general population.

(3.7% versus 2.0%, p = 0.03) compared with the general population, but no differences for cancer or overweight/obesity.

Within CH STRONG, cardiovascular comorbidities were more common among persons with severe CHDs than among those with nonsevere CHDs: history of congestive heart failure (9.3% versus 2.1%, aOR = 4.4), hypertension (12.2% versus 7.1%, aOR = 1.9), and stroke (2.4% versus 0.8%, aOR = 3.8). Overall, persons with severe CHDs had 2.4 times the odds of reporting one or more cardiac comorbidity. The prevalence of noncardiovascular comorbidities was similar in the two groups (Table 2).

Discussion

Advancements in the medical and surgical treatment of CHDs have led to a growing population of adults living with these conditions (*6*). With this growth has come an increasing need to understand the medical needs of these persons, especially as they age. These CH STRONG findings indicate that adults with CHDs are more likely than are adults in the general population to experience significant cardiovascular comorbidities, such as congestive heart failure or stroke. Regarding noncardiovascular comorbidities, results varied when comparing adults with CHDs with the general population. Persons with severe CHDs were more likely to have cardiovascular comorbidities than were those with nonsevere CHDs; the odds of having noncardiovascular comorbidities was similar between the two groups.

Similar to these findings, a recent study of a German nationwide registry of patients with CHDs found comorbidities to be common, with 57% of patients with CHDs aged <40 years having at least one comorbidity, including 22% with diseases of the circulatory system (*7*). Consistent with the increased odds of current depressive symptoms among CH STRONG participants, a recent international collaborative study noted that adults cared for at a CHDs center, especially those with cyanotic heart disease, were more likely than were those in the general population to report depressive symptoms (*8*). In contrast to the findings of CH STRONG, an analysis of U.S. commercial claims data during 2010–2016 among privately insured adults aged 18–40 years found higher rates of not only cardiovascular comorbidities but also noncardiovascular comorbidities among those with CHDs compared with a matched cohort without CHDs (*9*). In the same study, persons with severe CHDs had lower risks of cardiovascular comorbidities than did those with nonsevere CHDs, but higher risks of noncardiovascular comorbidities. The differences in findings between CH STRONG and the study of U.S. commercial claims data might be explained by methods used to identify CHD patients, inclusion of only those with recent medical encounters, differences in age distribution, timeframe for comorbidities, or varying definitions of CHD severity.

TABLE 2. Prevalence and adjusted odd ratios of comorbidity history among adults aged 20–38 years with congenital heart defects (CHDs), by CHD severity — Congenital Heart Survey To Recognize Outcomes, Needs, and well-beinG (CH STRONG), 2016–2019

	Severe*		Nonsevere		Severe versus nonsevere
Comorbidity	Total (n = 494)	Unstandardized, % (95% CI)	Total (n = 988)	Unstandardized, % (95% CI)	aOR† (95% CI)
Cardiovascular comorbidities					
Congestive heart failure	46	9.3 (7.1–12.2)	21	2.1 (1.4–3.2)	4.4 (2.5–7.5)
Hypertension	60	12.2 (9.6–15.3)	70	7.1 (5.6–8.9)	1.9 (1.3–2.8)
Myocardial infarction	3	0.6 (0.2–1.9)	3	0.3 (0.1–0.9)	1.5 (0.3–8.1)
Stroke	12	2.4 (1.4–4.2)	8	0.8 (0.4–1.6)	3.8 (1.5–9.7)
≥1 Cardiac comorbidity§	97	19.6 (16.4–23.4)	96	9.7 (8.0–11.7)	2.4 (1.7–3.3)
Noncardiovascular comorbidities					
Asthma	60	12.2 (9.6–15.3)	130	13.2 (11.2–15.4)	0.9 (0.6–1.2)
Cancer	3	0.6 (0.2–1.9)	16	1.6 (1.0–2.6)	0.4 (0.1–1.3)
Current depressive symptoms¶	56	14.6 (11.4–18.4)	114	14.7 (12.3–17.3)	1.0 (0.7–1.5)
Depression	63	12.8 (10.1–16.0)	154	15.6 (13.5–18.0)	0.9 (0.6–1.2)
Diabetes	12	2.4 (1.4–4.2)	28	2.8 (2.0–4.1)	0.8 (0.4–1.7)
Overweight/Obesity**	250	50.6 (46.2–55.0)	573	58.0 (54.9–61.0)	0.8 (0.6–1.0)
Rheumatologic disease††	17	3.4 (2.2–5.5)	31	3.1 (2.2–4.4)	1.2 (0.7–2.3)

Abbreviations: aOR = adjusted odd ratio, CI = confidence interval.

* Common severe lesions included single ventricle lesions, endocardial cushion defects, tetralogy of Fallot, transposition of the great arteries, truncus arteriosus, coarctation of the aorta, and interrupted aortic arch.

† Unstandardized CH STRONG estimates adjusted for sex, maternal race/ethnicity, birth cohort, and site.

§ Composite variable of adults with ≥1 cardiovascular comorbidities.

¶ Participants with a score of ≥3 on the two-item Patient Health Questionnaire-2, with proxy report removed. In CH STRONG, 1,174 self-report participants answered both questions.

** Overweight/obesity defined as body mass index ≥25 kg/m^2 based on self-reported height and weight.

†† Arthritis, gout, lupus, or fibromyalgia.

Summary

What is already known about this topic?

There are now more adults than children living in the United States with congenital heart defects (CHDs), but their long-term outcomes are unknown.

What is added by this report?

In the 2016–2019 Congenital Heart Survey To Recognize Outcomes, Needs, and well-beinG, young adults with CHDs were more likely than young adults in the general population to report significant cardiovascular comorbidities such as congestive heart failure or stroke. Prevalence of noncardiovascular comorbidities did not differ by congenital heart defect severity.

What are the implications for public health practice?

Public health practitioners and clinicians can encourage young adults with CHDs to seek appropriate medical care to help them live as healthy a life as possible.

The findings in this report are subject to at least four limitations. First, patient-reported outcomes can be limited by low health literacy or inaccurate recall. This limitation might affect the overall prevalence estimates among the CH STRONG and general populations; however, given that questions on the CH STRONG and general population surveys were identical, the comparisons between groups are expected to be valid. Second, if those with CHDs were more likely to suffer mortality from certain comorbidities (e.g., cancer) than the general population, the results might be subject to survivor bias. Third, the data from CH STRONG were from AZ, AR, and GA, whereas the available comparison group for cardiovascular comorbidities was from the national NHANES sample. These groups may not be directly comparable, despite attempts to standardize the NHANES data to the CH STRONG population by various demographics. Finally, these findings might be limited by the CH STRONG response rate of 24%. The standardization methods previously described were employed to minimize the effects of potential response bias.

Based on these CH STRONG findings, adults with CHD might be more likely to experience cardiovascular morbidity, particularly those with severe CHDs. CHD severity does not appear to be associated with the prevalence of certain noncardiovascular comorbidities. These findings can inform providers, policy makers, patients, and families of the expectations and needs of a growing population of adults with CHDs. Awareness and education efforts aimed at clinicians can help improve the care across the lifespan for this population. Public health practitioners and clinicians can encourage young adults with CHDs to seek appropriate medical care to help them live as healthy a life as possible.

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References

1. Gilboa SM, Devine OJ, Kucik JE, et al. Congenital heart defects in the United States: estimating the magnitude of the affected population in 2010. Circulation 2016;134:101–9. PMID:27382105 https://doi.org/10.1161/CIRCULATIONAHA.115.019307
2. Farr SL, Klewer SE, Nembhard WN, et al. Rationale and design of CH STRONG: Congenital heart survey to recognize outcomes, needs, and well-beinG. Am Heart J 2020;221:106–13. PMID:31986287 https://doi.org/10.1016/j.ahj.2019.12.021
3. CDC. National Health and Nutrition Examination Survey questionnaires, datasets, and related documentation. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://wwwn.cdc.gov/nchs/nhanes/Default.aspx
4. CDC. Behavioral Risk Factor Surveillance System survey data & documentation. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/brfss/data_documentation/index.htm
5. Kessler RC, Andrews G, Colpe LJ, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. Psychol Med 2002;32:959–76. PMID:12214795 https://doi.org/10.1017/S0033291702006074
6. Spector LG, Menk JS, Knight JH, et al. Trends in long-term mortality after congenital heart surgery. J Am Coll Cardiol 2018;71:2434–46. PMID:29793633 https://doi.org/10.1016/j.jacc.2018.03.491
7. Maurer SJ, Bauer UMM, Baumgartner H, Uebing A, Walther C, Tutarel O. Acquired comorbidities in adults with congenital heart disease: an analysis of the German National Register for Congenital Heart Defects. J Clin Med 2021;10:314. PMID:33467024 https://doi.org/10.3390/jcm10020314
8. Moons P, Luyckx K, Thomet C, et al.; APPROACH-IS Consortium and the International Society for Adult Congenital Heart Disease (ISACHD). Physical functioning, mental health, and quality of life in different congenital heart defects: comparative analysis in 3538 patients from 15 countries. Can J Cardiol 2021;37:215–23. PMID:32739453 https://doi.org/10.1016/j.cjca.2020.03.044
9. Agarwal A, Thombley R, Broberg CS, et al. Age- and lesion-related comorbidity burden among US adults with congenital heart disease: a population-based study. J Am Heart Assoc 2019;8:e013450. PMID:31575318 https://doi.org/10.1161/JAHA.119.013450

Trends and Geographic Patterns in Drug and Synthetic Opioid Overdose Deaths — United States, 2013–2019

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Deaths involving synthetic opioids other than methadone (synthetic opioids), which largely consist of illicitly manufactured fentanyl; psychostimulants with abuse potential (e.g., methamphetamine); and cocaine have increased in recent years, particularly since 2013 (*1*,*2*). In 2019, a total of 70,630 drug overdose deaths occurred, corresponding to an age-adjusted rate of 21.6 per 100,000 population and a 4.3% increase from the 2018 rate (20.7) (*3*). CDC analyzed trends in age-adjusted overdose death rates involving synthetic opioids, psychostimulants, cocaine, heroin, and prescription opioids during 2013–2019, as well as geographic patterns in synthetic opioid- and psychostimulant-involved deaths during 2018–2019. From 2013 to 2019, the synthetic opioid-involved death rate increased 1,040%, from 1.0 to 11.4 per 100,000 age-adjusted (3,105 to 36,359). The psychostimulant-involved death rate increased 317%, from 1.2 (3,627) in 2013 to 5.0 (16,167) in 2019. In the presence of synthetic opioid coinvolvement, death rates for prescription opioids, heroin, psychostimulants, and cocaine increased. In the absence of synthetic opioid coinvolvement, death rates increased only for psychostimulants and cocaine. From 2018 to 2019, the largest relative increase in the synthetic opioid-involved death rate occurred in the West (67.9%), and the largest relative increase in the psychostimulant-involved death rate occurred in the Northeast (43.8%); these increases represent important changes in the geographic distribution of drug overdose deaths. Evidence-based prevention and response strategies including substance use disorder treatment and overdose prevention and response efforts focused on polysubstance use must be adapted to address the evolving drug overdose epidemic.

Drug overdose deaths were identified in the National Vital Statistics System multiple cause-of-death mortality files* by using *International Classification of Diseases, Tenth Revision (ICD-10)* underlying cause-of-death codes X40–44 (unintentional), X60–64 (suicide), X85 (homicide), or Y10–14 (undetermined intent). Drug categories were defined using the following ICD-10 multiple cause-of-death codes: synthetic opioids other than methadone (T40.4), psychostimulants with abuse potential (T43.6), cocaine (T40.5), prescription opioids (T40.2 or T40.3), and heroin (T40.1). Deaths involving more than one type of drug were included in the rates for each applicable drug category; categories are not mutually exclusive.†

Annual age-adjusted death rates§ were examined during 2013–2019 and stratified by drug category and synthetic opioid coinvolvement. The percentage of 2019 drug overdose deaths and change in 2018–2019 age-adjusted death rates involving synthetic opioids and psychostimulants were examined by U.S Census region¶ and state. States with inadequate drug specificity, too few deaths to calculate stable estimates, or too few deaths to meet confidentiality requirements were excluded from state-level analyses.**,†† Analyses of rate changes used z-tests when deaths were ≥100 and nonoverlapping confidence intervals based on a gamma distribution when deaths were <100.§§ Changes presented in text represent statistically significant ($p<0.05$) findings unless otherwise specified. Statistical analyses were conducted in SAS (version 9.4; SAS Institute) and maps were created using QGIS (version 3.4.11-Madeira; QGIS Association).

* https://www.cdc.gov/nchs/nvss/deaths.htm

† A death involving prescription opioids and heroin would be included in the prescription opioid and heroin death counts and rates.

§ Age-adjusted death rates were calculated by applying age-specific death rates to the 2000 U.S. Census standard population age distribution and are reported per 100,000 population. https://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_04.pdf

¶ *Northeast*: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; *Midwest*: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; *South*: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; *West*: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

** State-level analyses of the percentage of drug overdose deaths involving synthetic opioids excluded one state and involving psychostimulants excluded two states that did not meet the following criteria: >80% of drug overdose death certificates named at least one specific drug in 2019 and ≥10 deaths occurred in 2019 in the specific drug category.

†† State-level analyses comparing death rates from 2018 to 2019 excluded nine states that did not meet the following criteria: >80% of drug overdose certificates named at least one specific drug in 2018 and 2019 and ≥20 deaths occurred during 2018 and 2019 in the drug category examined.

§§ Z-tests were used if the number of deaths was ≥100, and $p<0.05$ was considered to be statistically significant. Nonoverlapping confidence intervals based on the gamma method were used if the number of deaths was <100 in 2018 or 2019. The method of comparing confidence intervals is a conservative method for statistical significance; caution should be exercised when interpreting a nonsignificant difference when the lower and upper limits being compared overlap only slightly. https://www.cdc.gov/nchs/data/NVSR/NVSR61/NVSR61_04.pdf

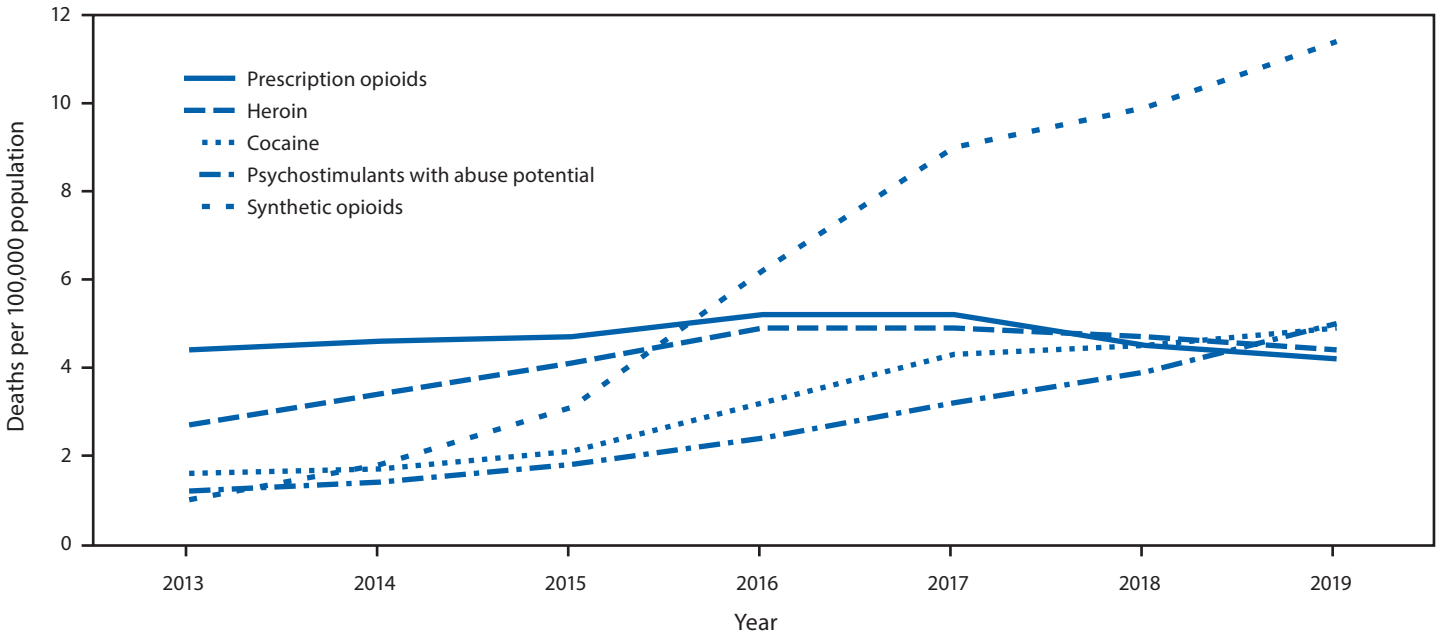
In 2019, a total of 70,630 drug overdose deaths occurred in the United States, corresponding to an age-adjusted rate of 21.6 per 100,000 population and a 56.5% increase above the 2013 rate of 13.8. From 2013 to 2019, the synthetic opioid-involved death rate increased 1,040%, from 1.0 to 11.4 per 100,000 age-adjusted (3,105 to 36,359) (Figure 1). The psychostimulant-involved death rate increased 317%, from 1.2 (3,627) in 2013 to 5.0 (16,167) in 2019. Smaller but meaningful increases were observed during this period for cocaine (206%; 1.6 to 4.9) and heroin (63%; 2.7 to 4.4). The prescription opioid-involved death rate decreased 4.5% from 4.4 in 2013 to 4.2 in 2019.

In the presence of synthetic opioid coinvolvement, age-adjusted death rates for all drug categories increased from 2013 to 2019: psychostimulants (0.1 to 1.8), cocaine (0.1 to 3.2), heroin (0.1 to 2.7) and prescription opioids (0.3 to 1.8) (Figure 2). In the absence of synthetic opioid coinvolvement, the age-adjusted death rate increased from 2013 to 2019 for psychostimulants (1.1 to 3.2) and cocaine (1.5 to 1.7); however, rates decreased for prescription opioid- (4.1 to 2.4) and heroin-involved deaths (2.6 to 1.6).

In 2019, a total of 49,860 (70.6%) drug overdose deaths involved opioids, 36,359 (51.5%) involved synthetic opioids, and 16,167 (22.9%) involved psychostimulants. The percentage of drug overdose deaths that involved synthetic opioids was highest in the Northeast (71.0%) and lowest in the West (26.4%). In nine states, ≥70% of overdose deaths involved synthetic opioids (Figure 3); the percentage was highest in New Hampshire (84.3%).

From 2018 to 2019, the age-adjusted synthetic opioid-involved death rate increased 15.2%, from 9.9 to 11.4. In 2019, the Northeast had the highest percentage and rate of deaths involving synthetic opioids, but the smallest relative (5.2%) and absolute (1.0) rate increases from the previous year (19.1 in 2018 to 20.1 in 2019). In contrast, the West experienced the largest relative (67.9%) and absolute (1.9) rate increases from 2.8 in 2018 to 4.7 in 2019. From 2018 to 2019, a total of 20 states experienced relative increases in their synthetic opioid-involved death rate, with the highest rate

FIGURE 1. Age-adjusted rates* of drug overdose deaths† involving prescription opioids,§ heroin,¶ cocaine, psychostimulants with abuse potential,†† and synthetic opioids other than methadone§§,¶¶ — United States, 2013–2019**



Source: National Vital Statistics System, Mortality File. https://wonder.cdc.gov/

* Rate per 100,000 population age-adjusted to the 2000 U.S. standard population using the vintage year population of the data year.

† Deaths were classified using the *International Classification of Diseases, Tenth Revision*. Drug overdoses are identified using underlying cause-of-death codes X40–X44 (unintentional), X60–X64 (suicide), X85 (homicide), and Y10–Y14 (undetermined).

§ Drug overdose deaths, as defined, that involve natural and semisynthetic opioids (T40.2) or methadone (T40.3).

¶ Drug overdose deaths, as defined, that involve heroin (T40.1).

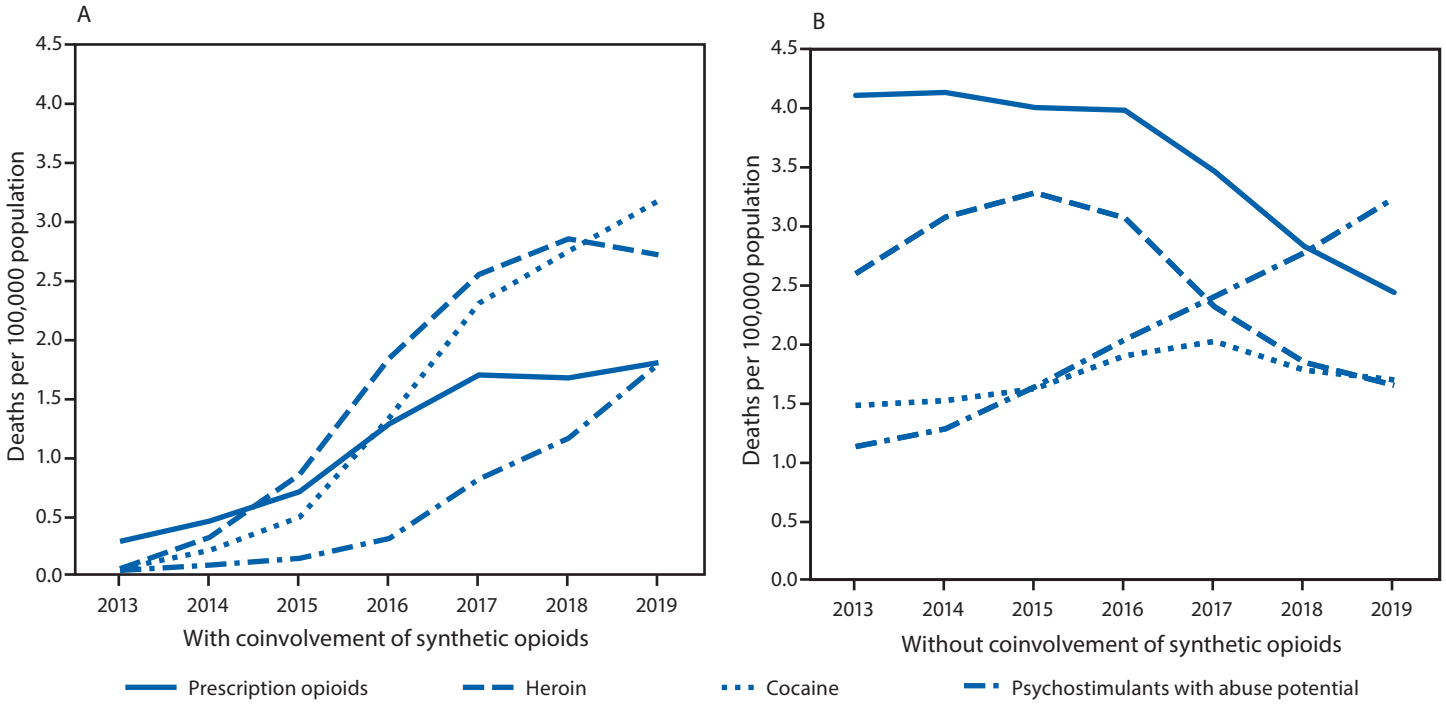
** Drug overdose deaths, as defined, that involve cocaine (T40.5).

†† Drug overdose deaths, as defined, that involve psychostimulants with abuse potential (T43.6).

§§ Drug overdose deaths, as defined, that involve synthetic opioids other than methadone (T40.4).

¶¶ Because deaths might involve more than one drug, some deaths are included in more than one category. In 2019, 6.3% of drug overdose deaths did not include information on the specific type of drug(s) involved.

FIGURE 2. Age-adjusted rates* of drug overdose deaths† involving prescription opioids,§ heroin,¶ cocaine, and psychostimulants with abuse potential,†† with (A) and without (B) synthetic opioids other than methadone§§,¶¶ — United States, 2013–2019**



Source: National Vital Statistics System, Mortality File. https://wonder.cdc.gov/

* Rate per 100,000 population age-adjusted to the 2000 U.S. standard population using the vintage year population of the data year.

† Deaths were classified using the *International Classification of Diseases, Tenth Revision*. Drug overdoses are identified using underlying cause-of-death codes X40–X44 (unintentional), X60–X64 (suicide), X85 (homicide), and Y10–Y14 (undetermined).

§ Drug overdose deaths, as defined, that involve natural and semisynthetic opioids (T40.2) or methadone (T40.3).

¶ Drug overdose deaths, as defined, that involve heroin (T40.1).

** Drug overdose deaths, as defined, that involve cocaine (T40.5).

†† Drug overdose deaths, as defined, that involve psychostimulants with abuse potential (T43.6).

§§ Drug overdose deaths, as defined, that involve synthetic opioids other than methadone (T40.4).

¶¶ Because deaths might involve more than one drug, some deaths are included in more than one category. In 2019, 6.3% of drug overdose deaths did not include information on the specific type of drug(s) involved.

in 2019 in Delaware (38.4). The largest relative rate increase occurred in Colorado (95.5%), and the largest absolute rate increase occurred in the District of Columbia (7.6). No state experienced a significant decrease.

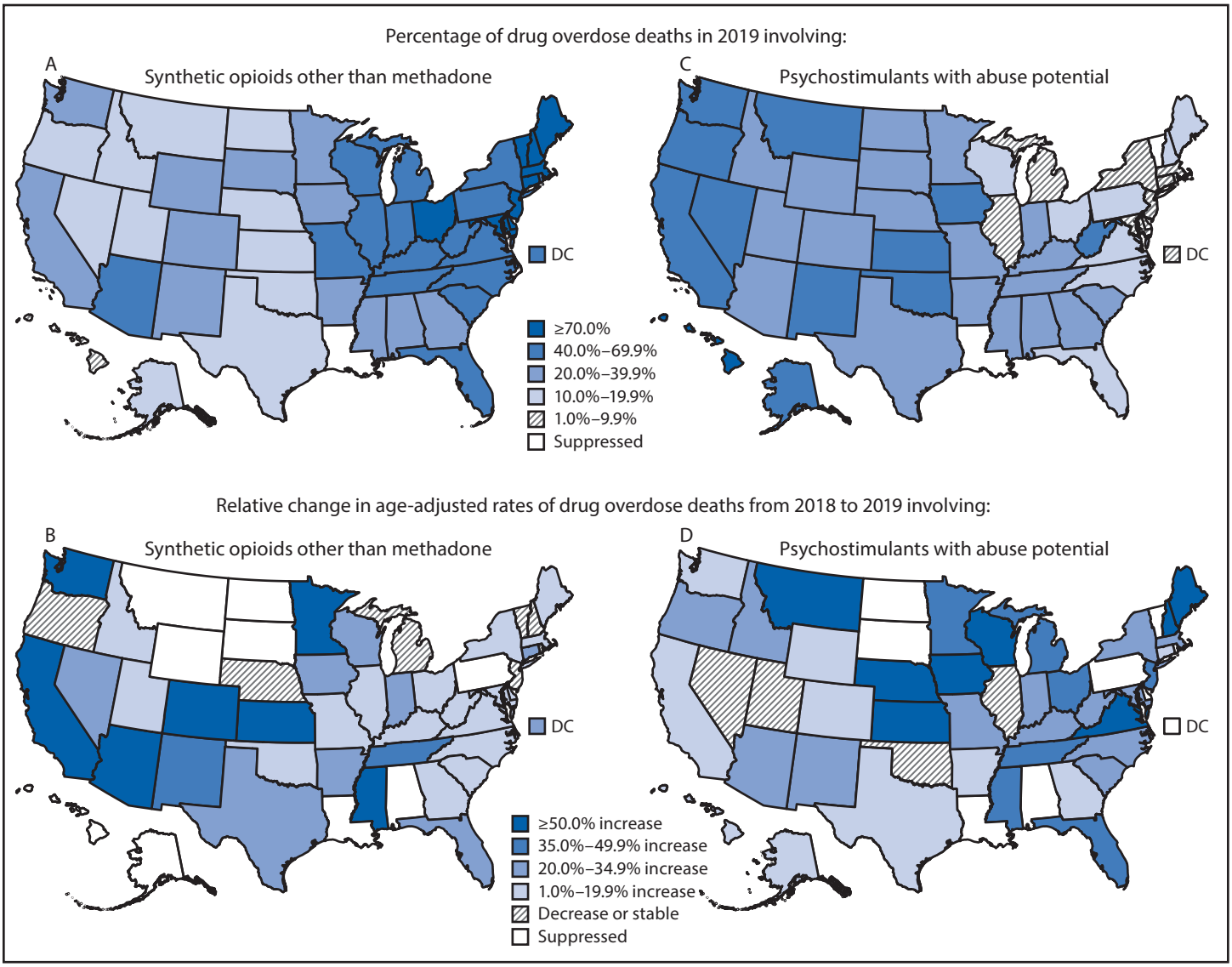
The percentage of deaths involving psychostimulants was highest in the West (43.5%) and lowest in the Northeast (7.9%) in 2019. The same geographic pattern was observed with psychostimulant-involved deaths that did not coinvolve synthetic opioids. In all northeastern states, fewer than 20% of drug overdose deaths involved psychostimulants. In 12 states, mostly in the West and Midwest, ≥40% of overdose deaths involved psychostimulants. Among these, the percentage was highest in Hawaii (70.2%) and Oklahoma (50.7%). The percentage was lowest in Maryland (3.3%).

From 2018 to 2019, the age-adjusted rate of psychostimulant-involved deaths increased 28.2%, from 3.9 to 5.0. The Northeast experienced the largest relative (43.8%), but smallest absolute (0.7), rate increase. The Midwest (36.1%) and South (32.4%) experienced similar relative but slightly larger absolute (1.3 and 1.2, respectively) rate increases. Although the percentage of 2019 drug overdose deaths involving psychostimulants was highest in the West, the relative rate increase (17.5%) was lowest there. Twenty-four states experienced an increase in the rate of psychostimulant-involved deaths. Kansas experienced the largest relative increase (107.1%) and third largest absolute rate increase (3.0). West Virginia had the highest 2019 rate (24.4) and the largest absolute rate increase (5.1); New York had the lowest 2019 rate (1.3). No state had a significant decrease (Supplementary Table, https://stacks.cdc.gov/view/cdc/101757).

Discussion

In 2019, a total of 70,630 drug overdose deaths occurred in the United States; approximately one half involved synthetic opioids. From 2013 to 2019, the age-adjusted synthetic opioid death rate increased sharply by 1,040%, from 1.0 to 11.4.

FIGURE 3. Percentage* and relative change in age-adjusted rates†,§,¶, of drug overdose deaths†† involving synthetic opioids other than methadone (A, B)§§ and psychostimulants with abuse potential (C, D)¶¶,*** — United States, 2018–2019**



Source: National Vital Statistics System, Mortality File. https://wonder.cdc.gov/
Abbreviation: DC = District of Columbia.

* State-level analyses of the percentage of drug overdose deaths involving synthetic opioids excluded one state and involving psychostimulants excluded two states that did not meet the following criteria: >80% of drug overdose death certificates named at least one specific drug in 2019 and ≥10 deaths occurred in 2019 in the specific drug category.

† Rate per 100,000 population age-adjusted to the 2000 U.S. standard population using the vintage year population of the data year.

§ Z-tests were used if the number of deaths was ≥100 in both 2018 and 2019, and $p<0.05$ was statistically significant. Nonoverlapping confidence intervals (CIs) based on the gamma method were used if the number of deaths was <100 in 2018 or 2019. The method of comparing CIs is a conservative method for statistical significance; caution should be observed when interpreting a nonsignificant difference when the lower and upper limits being compared overlap only slightly. https://www.cdc.gov/nchs/data/NVSR/NVSR61/NVSR61_04.pdf

¶ States with a statistically significant change in age-adjusted rate of drug overdose deaths involving synthetic opioids other than methadone during 2018–2019 were Arizona, California, Colorado, Connecticut, District of Columbia, Florida, Georgia, Illinois, Indiana, Kentucky, Minnesota, Mississippi, New Mexico, New York, Ohio, Tennessee, Texas, Virginia, Washington, and Wisconsin. States with a statistically significant change in age-adjusted rate of drug overdose deaths involving psychostimulants with abuse potential during 2018–2019 were Arizona, California, Florida, Indiana, Iowa, Kansas, Kentucky, Maine, Michigan, Minnesota, Missouri, New Jersey, New Mexico, New York, North Carolina, Ohio, Oregon, South Carolina, Tennessee, Texas, Virginia, Washington, West Virginia, and Wisconsin.

** State-level analyses comparing death rates from 2018 to 2019 excluded nine states that did not meet the following criteria: >80% of drug overdose death certificates named at least one specific drug in 2018 and 2019 and ≥20 deaths occurred during 2018 and 2019 in the drug category examined.

†† Deaths were classified using the *International Classification of Diseases, Tenth Revision*. Drug overdoses are identified using underlying cause-of-death codes X40–X44 (unintentional), X60–X64 (suicide), X85 (homicide), and Y10–Y14 (undetermined).

§§ Drug overdose deaths, as defined, that involve synthetic opioids other than methadone (T40.4).

¶¶ Drug overdose deaths, as defined, that involve psychostimulants with abuse potential (T43.6).

*** Because deaths might involve more than one drug, some deaths are included in more than one category. In 2019, 6.3% of drug overdose deaths did not include information on the specific type of drug(s) involved.

Death rates involving prescription opioids and heroin increased in the presence of synthetic opioids (from 0.3 to 1.8 and from 0.1 to 2.7, respectively), but not in their absence. Death rates involving psychostimulants increased 317% overall, regardless of synthetic opioid coinvolvement. Synthetic opioid- and psychostimulant-involved deaths shifted geographically from 2018 to 2019. From 2015 to 2016, states in the East had the largest increases in deaths involving synthetic opioids, and from 2016 to 2017, the Midwest had the largest increases in deaths involving psychostimulants (*2*,*4*). In contrast, from 2018 to 2019, the largest relative increase in death rates involving synthetic opioids occurred in the West (67.9%); the largest relative increase in death rate involving psychostimulants occurred in the Northeast (43.8%).

Sharp increases in synthetic opioid- and psychostimulant-involved overdose deaths in 2019 are consistent with recent trends indicating a worsening and expanding drug overdose epidemic (*1*,*2*,*4*–*6*). Synthetic opioids, particularly illicitly manufactured fentanyl and fentanyl analogs, are highly potent, increasingly available across the United States, and found in the supplies of other drugs (*7*,*8*). Co-use of synthetic opioids with other drugs can be deliberate or inadvertent (i.e., products might be adulterated with illicitly manufactured fentanyl or fentanyl analogs unbeknownst to the user). Similarly, psychostimulant-involved deaths are likely rising because of increases in potency, availability, and reduced cost of methamphetamine in recent years (*9*). The increase in synthetic-opioid involved deaths in the West and in psychostimulant-involved deaths in the Northeast signal broadened geographic use of these substances, consistent with increases in the number of drug submissions to forensic laboratories in those regions during 2018–2019 (*8*).

The findings in this report are subject to at least two limitations. First, forensic toxicology testing protocols varied by time and jurisdiction, particularly for synthetic opioids. Therefore, some of the increases in overdose deaths reported by drug categories could be attributed to the increases in testing as well as the use of more comprehensive tests. Second, geographic analyses excluded states with inadequate drug specificity or too few deaths to calculate stable rates.

The worsening and expanding drug overdose epidemic in the United States now involves potent synthetic drugs, often in combination with other substances, and requires urgent action. As involved substances and geographic trends in drug overdose deaths change, timely surveillance and evidence-based prevention and response strategies remain essential. CDC's Overdose Data to Action[¶¶] cooperative agreement funds health departments in 47 states, the District of Columbia, two territories, and 16 cities and counties to obtain high-quality, comprehensive, and timely data on fatal and nonfatal drug overdoses to inform prevention and response efforts. To help curb this epidemic, Overdose Data to Action strategies focus on enhancing linkage to and retention in substance use disorder treatment, improving prescription drug monitoring programs, implementing postoverdose protocols in emergency departments, including naloxone provision to patients who use opioids or other illicit drugs, and strengthening public health and public safety partnerships, enabling data sharing to help inform comprehensive interventions.[***] Other approaches[†††] should include expanded naloxone distribution and education that potent opioids might require multiple doses of naloxone, improved access to substance use disorder treatment (including medications for opioid use disorder or programs addressing polysubstance use), expanded harm reduction services, and continued partnerships with public safety to monitor trends in the illicit drug supply, including educating the public that drug products might be adulterated with fentanyl or fentanyl analogs unbeknownst to users. A comprehensive and coordinated approach from clinicians, public health, public safety, community organizations, and the public must incorporate innovative and established prevention and response strategies, including those focused on polysubstance use.

Summary

What is already known about this topic?

Deaths involving synthetic opioids other than methadone, cocaine, and psychostimulants have increased in recent years.

What is added by this report?

From 2013 to 2019, the age-adjusted rate of deaths involving synthetic opioids other than methadone increased 1,040%, and for psychostimulants increased 317%. During 2018–2019, the largest relative increase in synthetic opioid-involved death rates occurred in the West (67.9%), and the largest relative increase in psychostimulant-involved death rates occurred in the Northeast (43.8%).

What are the implications for public health practice?

Evidence-based prevention and response strategies, including substance use disorder treatment and overdose prevention and response efforts focused on polysubstance use, must be adapted to address the changing drug overdose epidemic.

[¶¶] https://www.cdc.gov/drugoverdose/od2a/index.html

[***] https://www.cdc.gov/drugoverdose/pubs/featured-topics/evidence-based-strategies.html

[†††] https://emergency.cdc.gov/han/2020/han00438.asp

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. Wilson N, Kariisa M, Seth P, Smith H 4th, Davis NL. Drug and opioid-involved overdose deaths—United States, 2017–2018. MMWR Morb Mortal Wkly Rep 2020;69:290–7. PMID:32191688 https://doi.org/10.15585/mmwr.mm6911a4
2. Kariisa M, Scholl L, Wilson N, Seth P, Hoots B. Drug overdose deaths involving cocaine and psychostimulants with abuse potential—United States, 2003–2017. MMWR Morb Mortal Wkly Rep 2019;68:388–95. PMID:31048676 https://doi.org/10.15585/mmwr.mm6817a3
3. Hedegaard H, Miniño AM, Warner M. Drug overdose deaths in the United States, 1999–2019. NCHS Data Brief, no 394. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2020. https://www.cdc.gov/nchs/data/databriefs/db394-H.pdf
4. Seth P, Scholl L, Rudd RA, Bacon S. Overdose deaths involving opioids, cocaine, and psychostimulants—United States, 2015–2016. MMWR Morb Mortal Wkly Rep 2018;67:349–58. PMID:29596405 https://doi.org/10.15585/mmwr.mm6712a1
5. Gladden RM, O'Donnell J, Mattson CL, Seth P. Changes in opioid-involved overdose deaths by opioid type and presence of benzodiazepines, cocaine, and methamphetamine—25 states, July–December 2017 to January–June 2018. MMWR Morb Mortal Wkly Rep 2019;68:737–44. PMID:31465320 https://doi.org/10.15585/mmwr.mm6834a2
6. O'Donnell J, Gladden RM, Mattson CL, Hunter CT, Davis NL. Vital signs: characteristics of drug overdose deaths involving opioids and stimulants—24 states and the District of Columbia, January–June 2019. MMWR Morb Mortal Wkly Rep 2020;69:1189–97. PMID:32881854 https://doi.org/10.15585/mmwr.mm6935a1
7. Wilde M, Pichini S, Pacifici R, et al. Metabolic pathways and potencies of new fentanyl analogs. Front Pharmacol 2019;10:238. PMID:31024296 https://doi.org/10.3389/fphar.2019.00238
8. Drug Enforcement Administration, Diversion Control Division. National Forensic Laboratory Information. System: NFLIS-Drug 2019 annual report. Springfield, VA: US Department of Justice, Drug Enforcement Administration; 2020. https://www.nflis.deadiversion.usdoj.gov/DesktopModules/ReportDownloads/Reports/NFLIS-Drug-AR2019.pdf
9. Drug Enforcement Administration. 2019 national drug threat assessment. Washington, DC: US Department of Justice, Drug Enforcement Administration; 2019. https://www.dea.gov/sites/default/files/2020-01/2019-NDTA-final-01-14-2020_Low_Web-DIR-007-20_2019_1.pdf

Observed Face Mask Use at Six Universities — United States, September–November 2020

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On February 5, 2021, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Approximately 41% of adults aged 18–24 years in the United States are enrolled in a college or university (*1*). Wearing a face mask can reduce transmission of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19) (*2*), and many colleges and universities mandate mask use in public locations and outdoors when within six feet of others. Studies based on self-report have described mask use ranging from 69.1% to 86.1% among adults aged 18–29 years (*3*); however, more objective measures are needed. Direct observation by trained observers is the accepted standard for monitoring behaviors such as hand hygiene (*4*). In this investigation, direct observation was used to estimate the proportion of persons wearing masks and the proportion of persons wearing masks correctly (i.e., covering the nose and mouth and secured under the chin*) on campus and at nearby off-campus locations at six rural and suburban universities with mask mandates in the southern and western United States. Trained student observers recorded mask use for up to 8 weeks from fixed sites on campus and nearby. Among 17,200 observed persons, 85.5% wore masks, with 89.7% of those persons wearing the mask correctly (overall correct mask use: 76.7%). Among persons observed indoors, 91.7% wore masks correctly. The proportion correctly wearing masks indoors varied by mask type, from 96.8% for N95-type masks and 92.2% for cloth masks to 78.9% for bandanas, scarves, and similar face coverings. Observed indoor mask use was high at these six universities with mask mandates. Colleges and universities can use direct observation findings to tailor training and messaging toward increasing correct mask use.

Direct in-person observation is used in health care settings to measure adherence to infection prevention and control recommendations, such as hand hygiene and the correct use of personal protective equipment (*4*). A similar approach was used to directly observe mask use at universities, using a protocol and sampling methodology based on one from Resolve to Save Lives, an initiative promoting the measuring and adoption of face mask use to reduce transmission of COVID-19 (*5*). CDC staff members discussed the direct observation protocol with 12 universities, six of which chose to participate in this investigation. The participating universities included five public universities with student populations ranging from 29,000 to 52,000 and one private university with a student population of 2,300; five universities were in the South U.S. Census region (two in East South Central and three in South Atlantic), and one was in the West. Approximately 10 student observers per university were trained by one CDC staff member who conducted training for all participating universities using a standard protocol.† Universities selected approximately 10 observation locations where mask use was mandated.§ Indoor mask use was mandated by all selected universities and their surrounding communities. Outdoor mask use was mandated when other physical distancing measures were difficult to maintain.¶ Observation locations could be either indoors or outdoors; however, because determining whether persons observed outdoors should have been wearing a mask was not always possible, the analyses focused on indoor mask use. For up to 8 weeks (range: 2 to 8 weeks across universities), observers tracked mask use on varying days and times from fixed sites on campus (e.g., libraries, classroom buildings, dining facility entrances, student centers, and lobbies of recreation centers and workout facilities) and, at five universities, at nearby off-campus, public locations frequented by students (e.g., grocery stores, pharmacies, and cafes). Observers modeled correct mask wearing, remained inconspicuous, and refrained from interacting with the persons they were observing. Each observer was instructed to record 40 observations at a single location or to observe for 1 hour, whichever came first, for a total of approximately 400 observations per week per university by the 10 observers. Correct mask use was recorded if the mask completely covered the nose and mouth and was secured under the chin. Observers were advised to record only what they could see; for example, if a person's face could not be observed

* https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-to-wear-cloth-face-coverings.html

† Protocol, training materials, and data collection form are available. https://www.train.org/cdctrain/course/1094943

§ Locations or situations in which mask use was not mandated (e.g., while eating, exercising in gyms, or in individual rooms) were not included in the observation locations.

¶ Difficulty maintaining physical distancing measures was defined in various ways in university mask policies, including when persons are with others with whom they are not cohabitating, when persons cannot maintain >6 feet of distance from others, and gatherings of ≥10 persons.

but mask straps were visible behind the person's head or ears, mask use was recorded as "unknown." Observers were asked to remain stationary and record 1) whether a mask was worn, 2) whether the mask was worn correctly, and 3) the type of mask worn (cloth, surgical, gaiter, masks that appeared to be N95 respirators [referred to as N95 type], or other) for every third person passing a prespecified location, such as a building entrance. If foot traffic was too high to observe every third person, observers were asked to select every tenth person for the entire observation period (*5*). Observation times varied during the mornings and afternoons and at night and occurred on weekdays and weekends. Because social groups might exhibit more similar mask use behaviors, only one person from a social group (e.g., an easily identifiable family unit, group of friends, or sports team) was sampled to avoid the effects of clustering. Observers were instructed to observe the first person in the group who corresponded to the third person following the preceding observation and then skip remaining group members and resume counting every third person after the group passed. Observations were restricted to persons who appeared to be aged ≥12 years and were not limited to students. One participating university released weekly media reports highlighting their data from this assessment to encourage mask use in their community. A second university released a single media report after 3 weeks of data collection. The remaining four universities did not publicize this investigation.

Data collection was standardized through common training materials and data collection forms to provide comparable data across the six universities. Data were collected using a paper form and entered into REDCap (version 9.7; Vanderbilt University) electronic data capture and management tools hosted at CDC or collected directly using the REDCap tools. Each week, data for each university were compiled and returned to the university, including the proportion of persons observed wearing masks, the proportion of those persons wearing masks correctly, and the most common type of mask worn. Staff members at universities performed quality control processes weekly and provided updated, corrected data to CDC. All analyses were conducted with SAS (version 9.4; SAS Institute). Frequencies and ranges were calculated for mask use, correct mask use, type of mask worn, and locations observed. Chi-squared tests were used to compare indoor mask use and indoor correct mask use for on-campus and nearby off-campus locations. The Tukey honestly significant difference test was used to compare mask types among the proportion used correctly indoors; p-values <0.05 were considered statistically significant. This activity was reviewed by CDC and was conducted consistent with applicable federal laws and CDC policies.**

** 45 C.F.R. part 46; 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

A total of 17,200 persons were observed at six universities (ranging from 438 persons observed during 2 weeks of data collection to 8,580 during 8 weeks of data collection) (Table 1). Two thirds (66.6%) of the observations took place indoors, and 69% took place on campus. Most (85.5%) observed persons wore masks, with 89.7% of those wearing them correctly (overall correctly wearing masks: 76.7% [range: 72.2%–93.6%]). Cloth masks were most common (68.3%), followed by surgical masks (25.7%). Less common were gaiters (3.8%) and N95-type masks (1.9%). Other face coverings, such as bandanas and scarves, were rarely observed (0.3%). Overall, mask use was significantly more common indoors (94.0%) than outdoors (67.6%) (p<0.001). Among observations conducted indoors, mask use was more prevalent at on-campus (94.8%) than at nearby off-campus locations (90.6%) (p<0.001), as was correct mask use among those wearing masks (92.1% versus 90.0%, respectively; p = 0.002) (Table 2). Correct mask use indoors differed by mask type, with N95-type masks most likely to be worn correctly indoors (96.8%), followed by cloth masks (92.2%), surgical masks (90.8%), gaiters (86.8%), and other face coverings (78.9%) (Table 3). These mask types accounted for 1.7%, 68.2%, 26.1%, 3.7%, and 1%, respectively, of observed masks worn indoors.

Discussion

Mask mandates have been shown to decrease SARS-CoV-2 case transmission,†† and widespread mask use is a core intervention for curbing the COVID-19 pandemic (*6*,*7*). Direct observation at six universities indicated that mask use was high on campuses in locations where masks were mandated. Mask use was similarly high at nearby, indoor off-campus locations where masks were mandated. Mask use was lower outdoors in areas where use was mandated only when physical distancing could not be maintained. These data provide evidence that adherence to university mask mandates is high (*5*). However, correct mask use varied by mask type.

Universities have several opportunities to enforce policies such as mask mandates. For example, universities could impose sanctions for noncompliance with university policy. Universities also could use multimodal education and messaging to reinforce mask use, as well as messaging specific to mask type and that is focused on correct use. One university found that having students sign a compact agreeing to mask use, physical distancing, and testing might also be effective in promoting these behaviors (*8*).

Observational investigations can provide rapid feedback to universities on the prevalence and type of mask use in their population. Using trained student volunteers, participating universities can quickly organize and collect substantial amounts of data weekly at low to no cost and review the data quickly to assess and report on mask use. Universities and their communities can

†† https://www.medrxiv.org/content/10.1101/2020.10.28.20221705v2

TABLE 1. Observed number and percentage of persons wearing face masks on six university campuses* and at nearby off-campus locations,† by selected characteristics — United States, September–November 2020

Characteristic	No. (%) of persons observed						
	Total	University A (observed 8 wks)	University B (observed 7 wks)	University C (observed 6 wks)	University D (observed 5 wks)	University E (observed 2 wks)	University F (observed 2 wks)
Overall mask use	**17,200 (100)**	8,580 (49.9)	3,144 (18.3)	2,922 (17.0)	1,460 (8.5)	438 (2.5)	656 (3.8)
Mask worn	**14,704 (85.5)**	7,018 (81.8)	2,637 (83.9)	2,619 (89.6)	1,384 (94.8)	430 (98.2)	616 (93.9)
Mask worn correctly	**13,189 (89.7)**	6,434 (91.7)	2,269 (86.0)	2,320 (88.6)	1,171 (84.6)	410 (95.3)	585 (95.0)
Type of mask							
Cloth	**10,042 (68.3)**	5,042 (71.8)	1,645 (62.4)	1,587 (60.6)	1,079 (78.0)	278 (64.7)	411 (66.7)
Surgical	**3,774 (25.7)**	1,592 (22.7)	804 (30.5)	839 (32.0)	236 (17.1)	134 (31.2)	169 (27.4)
Gaiter	**563 (3.8)**	200 (2.8)	154 (5.8)	125 (4.8)	56 (4.0)	5 (1.2)	23 (3.7)
N95 type	**280 (1.9)**	175 (2.5)	29 (1.1)	48 (1.8)	10 (0.7)	10 (2.3)	8 (1.3)
Other	**45 (0.3)**	9 (0.1)	5 (0.2)	20 (0.8)	3 (0.2)	3 (0.7)	5 (0.8)
Location							
Indoors	**11,451 (66.6)**	4,686 (54.6)	1744 (55.5)	2,758 (94.4)	1,279 (87.6)	438 (100)	546 (83.2)
Outdoors	**5,546 (32.2)**	3,734 (43.5)	1,400 (44.5)	121 (4.1)	181 (12.4)	—§	110 (16.8)
On bus	**203 (1.2)**	160 (1.9)	—	43 (1.5)	—	—	—
Campus							
On campus	**11,875 (69.0)**	5,884 (68.6)	2,709 (86.2)	905 (31.0)	1,460 (100)	329 (75.1)	588 (89.6)
Nearby off campus	**5,122 (29.8)**	2,536 (29.6)	435 (13.8)	1,974 (67.6)	—	109 (24.9)	68 (10.4)
On bus	**203 (1.2)**	160 (1.9)	—	43 (1.5)	—	—	—

* Includes five public universities with student populations ranging from 29,000 to 52,000 and one private university with a student population of 2,300; five universities were in the South U.S. Census region (two in East South Central and three in South Atlantic), and one was in the West.
† Data are from five universities. Nearby, indoor and outdoor off-campus locations in the surrounding community that were known to be frequented by students (e.g., grocery stores, pharmacies, and cafes) in counties where mask use was mandated indoors or outdoors if 6 feet of distance could not be maintained.
§ Data not collected.

use these data to tailor and evaluate the effectiveness of messages and education to reinforce and increase mask use and to identify locations with lower adherence for policy enforcement.

The findings in this report are subject to at least three limitations. First, because the period of observation ranged from 2 to 8 weeks among universities, overall percentages are influenced by the universities with more data. However, all six universities are continuing to collect data during the 2021 spring semester. Second, observations were sampled without recording information about the persons observed and were not limited to university students, staff members, or faculty members. Off-campus locations likely included more persons not affiliated with the university, and off-campus percentages should be considered a measure of community mask use. Finally, none of the universities mandated outdoor mask use, unless physical distancing could not be maintained. Observers did not record whether physical distancing was or was not maintained.

Compliance with CDC's recommended COVID-19 mitigation strategy of mask wearing exceeded 80% at six U.S. universities. Mask use is likely to remain a critical COVID-19 mitigation strategy, and CDC has made the training materials used in this study available for universities that would like to monitor mask use on their campuses. However, in addition to mask mandates, universities have implemented multicomponent strategies that included reduced residential density; surveillance and entry testing; educational campaigns; and other campus and community mitigation strategies. Monitoring mask use, tailoring messages to promote healthy behaviors (e.g., mask use, handwashing, and physical distancing) on and off campus, and developing measures to enforce or ensure compliance with healthy behaviors have the potential to improve implementation and effectiveness of public health strategies to protect persons on campus and in the surrounding communities by preventing the spread of SARS-CoV-2.

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TABLE 2. Observed overall number and percentage of persons wearing face masks indoors* and wearing face masks indoors correctly on six university campuses† and at nearby, indoor off-campus locations§ — United States, September–November 2020

Characteristic	No. (%) of persons observed		
	Total wearing masks	On campus	Nearby off campus
Mask worn indoors¶	**10,760 (94.0)**	8,648 (94.8)	2,112 (90.6)
Mask worn indoors correctly**	**9,862 (91.7)**	7,962 (92.1)	1,900 (90.0)

* Indoor, on-campus locations where mask use was mandated (e.g., libraries, classroom buildings, dining facility entrances, student centers, and lobbies of recreation centers and workout facilities).
† Includes five public universities with student populations ranging from 29,000 to 52,000 and one private university with a student population of 2,300; five universities were in the South U.S. Census region (two in East South Central and three in South Atlantic), and one was in the West.
§ Data are from five universities. Nearby, indoor off-campus locations in the surrounding community that were known to be frequented by students (e.g., grocery stores, pharmacies, and cafes) in counties where mask use was mandated indoors or outdoors if 6 feet of distance could not be maintained.
¶ p<0.001. Total number observed = 11,451, on-campus indoor observed = 9,119, and nearby off-campus observed = 2,332. The chi-squared test was used to assess the difference between masks worn indoors on campus and at nearby off-campus locations in the surrounding community.
** p = 0.002. Total number observed indoors = 10,758, excluding 693 observations (no mask use or unknown mask use) and missing data for two observations. The chi-squared test was used to assess the difference between correct mask use indoors on campus and at nearby off-campus locations in the surrounding community.

TABLE 3. Observed number and percentage of persons wearing face masks indoors correctly among all persons wearing face masks on six university campuses* and at nearby, indoor off-campus locations,† by mask type — United States, September–November 2020

Type of mask§	Mask worn indoors	Mask worn indoors correctly
	No.	No. (%)
Total	**10,760¶**	**9,862 (91.7)**
Cloth	7,334	6,760 (92.2)
Surgical	2,807	2,549 (90.8)
Gaiter	394	342 (86.8)
N95 type	187	181 (96.8)
Other**	38	30 (78.9)

* Includes five public universities with student populations ranging from 29,000 to 52,000 and one private university with a student population of 2,300; five universities were in the South U.S. Census region (two in East South Central and three in South Atlantic), and one was in the West.
† Nearby, indoor off-campus locations in the surrounding community that were known to be frequented by students (e.g., grocery stores, pharmacies, and cafes) in counties where mask use was mandated indoors or outdoors if 6 feet of distance could not be maintained.
§ p<0.05. Post hoc comparisons using the Tukey honestly significant difference test indicated differences between mask type and the proportion used correctly indoors. Significant differences were observed between all mask types, except cloth and surgical (p = 0.24), cloth and N95 type (p = 0.18), and gaiter and other (p = 0.32).
¶ Total observed indoors = 11,451, excluding 691 observations (no mask use or unknown mask use).
** Other face coverings include bandanas and scarves.

Summary

What is already known about this topic?

Correct use of face masks limits COVID-19 transmission. Many institutions of higher education mandate masks in public indoor locations and outdoors when within six feet of others.

What is added by this report?

During September–November 2020, mask use was directly observed at six universities with mask mandates. Among persons observed indoors, 91.7% wore masks correctly, varying by mask type, from 96.8% for N95-type masks and 92.2% for cloth masks to 78.9% for bandanas, scarves, and similar face coverings.

What are the implications for public health practice?

Direct observation provides rapid feedback on mask use prevalence. Institutions of higher education can use this feedback to tailor training and messaging for correct mask use.

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References

1. National Center for Education Statistics. Digest of education statistics, table 302.60. Washington, DC: National Center for Education Statistics; 2019. https://nces.ed.gov/programs/digest/d19/tables/dt19_302.60.asp
2. CDC. Scientific brief: community use of cloth masks to control the spread of SARS-CoV-2. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/more/masking-science-sars-cov2.html
3. Hutchins HJ, Wolff B, Leeb R, et al. COVID-19 mitigation behaviors by age group—United States, April–June 2020. MMWR Morb Mortal Wkly Rep 2020;69:1584–90. PMID:33119562 https://doi.org/10.15585/mmwr.mm6943e4
4. Boyce JM. Hand hygiene compliance monitoring: current perspectives from the USA. J Hosp Infect 2008;70(Suppl 1):S2–7. PMID:18994674 https://doi.org/10.1016/S0195-6701(08)60003-1
5. Resolve to Save Lives. Promoting mask-wearing during the COVID-19 pandemic: a policymaker's guide. New York City, NY: Vital Strategies, Resolve to Save Lives; 2020. https://preventepidemics.org/wp-content/uploads/2020/08/Promoting-Mask-Wearing-During-COVID-19.pdf
6. Lyu W, Wehby GL. Community use of face masks and COVID-19: evidence from a natural experiment of state mandates in the U.S. Health Aff (Millwood) 2020;39:1419–25. PMID:32543923 https://doi.org/10.1377/hlthaff.2020.00818
7. CDC. Considerations for institutions of higher education. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/community/colleges-universities/considerations.html
8. Denny TN, Andrews L, Bonsignori M, et al. Implementation of a pooled surveillance testing program for asymptomatic SARS-CoV-2 infections on a college campus—Duke University, Durham, North Carolina, August 2–October 11, 2020. MMWR Morb Mortal Wkly Rep 2020;69:1743–7. PMID:33211678 https://doi.org/10.15585/mmwr.mm6946e1

Decline in COVID-19 Hospitalization Growth Rates Associated with Statewide Mask Mandates — 10 States, March–October 2020

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SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), is transmitted predominantly by respiratory droplets generated when infected persons cough, sneeze, spit, sing, talk, or breathe. CDC recommends community use of face masks to prevent transmission of SARS-CoV-2 (*1*). As of October 22, 2020, statewide mask mandates were in effect in 33 states and the District of Columbia (*2*). This study examined whether implementation of statewide mask mandates was associated with COVID-19–associated hospitalization growth rates among different age groups in 10 sites participating in the COVID-19–Associated Hospitalization Surveillance Network (COVID-NET) in states that issued statewide mask mandates during March 1–October 17, 2020. Regression analysis demonstrated that weekly hospitalization growth rates declined by 2.9 percentage points (95% confidence interval [CI] = 0.3–5.5) among adults aged 40–64 years during the first 2 weeks after implementing statewide mask mandates. After mask mandates had been implemented for ≥3 weeks, hospitalization growth rates declined by 5.5 percentage points among persons aged 18–39 years (95% CI = 0.6–10.4) and those aged 40–64 years (95% CI = 0.8–10.2). Statewide mask mandates might be associated with reductions in SARS-CoV-2 transmission and might contribute to reductions in COVID-19 hospitalization growth rates, compared with growth rates during <4 weeks before implementation of the mandate and the implementation week. Mask-wearing is a component of a multipronged strategy to decrease exposure to and transmission of SARS-CoV-2 and reduce strain on the health care system, with likely direct effects on COVID-19 morbidity and associated mortality.

Data on statewide mask mandates during March 1–October 22, 2020, were obtained by CDC and the University of Nevada, Las Vegas, from state government websites containing executive or administrative orders, which were analyzed and coded to extract effective dates of statewide mask mandates. A statewide mask mandate was defined as the requirement that persons operating in a personal capacity (i.e., not limited to specific professions or employees) wear a mask 1) anywhere outside their home or 2) in retail businesses and in restaurants or food establishments. All coding and analyses underwent secondary review and quality assurance checks by two or more raters; upon agreement among all raters, coding and analyses were published in a freely available data set (*2*).

Cumulative COVID-19–associated hospitalization rates for each week during March 1–October 17, 2020, (33 weeks) were obtained from COVID-NET, a population-based surveillance system (*3*). COVID-NET provides laboratory-confirmed, COVID-19–associated hospitalization rates (hospitalizations per 100,000 persons) in 99 counties located in 14 states, commencing the week of March 1, 2020* (*4*). Certain counties in each state participate in COVID-NET, except Maryland, where all counties participate. A group of counties participating in COVID-NET within a state is termed a site. Sites in states that did not have statewide mask mandates during March 1–October 17, 2020, were excluded from the analyses. For analyses, cumulative hospitalization rates for each week of the study period for seven age cohorts (adults aged 18–29, 30–39, 40–49, 50–64, 65–74, 75–84, and ≥85 years) were aggregated into three age groups (18–39, 40–64, and ≥65 years)†; sites with a cumulative hospitalization rate of zero per 100,000 persons were imputed to 0.1 per 100,000. Hospitalizations among children and adolescents aged <18 years were not included because few hospitalizations were reported among this age group during the study period.

* Counties by state in COVID-NET surveillance: California (Alameda, Contra Costa, and San Francisco counties); Colorado (Adams, Arapahoe, Denver, Douglas, and Jefferson counties); Connecticut (New Haven and Middlesex counties); Georgia (Clayton, Cobb, DeKalb, Douglas, Fulton, Gwinnett, Newton, and Rockdale counties); Iowa (one county represented); Maryland (Allegany, Anne Arundel, Baltimore, Baltimore City, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, St. Mary's, Somerset, Talbot, Washington, Wicomico, and Worcester counties); Michigan (Clinton, Eaton, Genesee, Ingham, and Washtenaw counties); Minnesota (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington counties); New Mexico (Bernalillo, Chaves, Doña Ana, Grant, Luna, San Juan, and Santa Fe counties); New York (Albany, Columbia, Genesee, Greene, Livingston, Monroe, Montgomery, Ontario, Orleans, Rensselaer, Saratoga, Schenectady, Schoharie, Wayne, and Yates counties); Ohio (Delaware, Fairfield, Franklin, Hocking, Licking, Madison, Morrow, Perry, Pickaway, and Union counties); Oregon (Clackamas, Multnomah, and Washington counties); Tennessee (Cheatham, Davidson, Dickson, Robertson, Rutherford, Sumner, Williamson, and Wilson counties); and Utah (Salt Lake County).

† The analysis for adults aged 18–39 years used observations of adults aged 18–29 and 30–39 years; the analysis for adults aged 40–64 years used observations of adults aged 40–49 and 50–64 years; the analysis for adults aged ≥65 years used observations of adults aged 65–74, 75–84, and ≥85 years.

The outcome was the hospitalization growth rate, defined as the weekly percentage change in cumulative COVID-19 hospitalizations per 100,000 persons. The weekly percentage change was calculated as the difference of logarithms in cumulative COVID-19 hospitalization rates by week.[§] The association between mask mandates and COVID-19–associated hospitalization growth rates was measured using a time-based categorical variable with four mutually exclusive categories based on the week (Sunday through Saturday), with the effective date of the mask mandate ("implementation week") characterized as follows: ≥4 weeks before the implementation week; <4 weeks before the implementation week (reference); <3 weeks after the implementation week; and ≥3 weeks after the implementation week.[¶] Week zero (implementation week) was defined as the week that included the date the mask mandate went into effect and was included in the reference period. The hospitalization rate ≥4 weeks before implementation of the mask mandate was compared with that during the reference period to test whether sites with mask mandates had differential trends in COVID-19–associated hospitalization rates before issuance of mask mandates

This study used a regression model with panel data to compare COVID-19–associated hospitalization growth rates at COVID-NET sites with mandates before and after the dates that statewide mask mandates became effective (*5*). Using hospitalization growth rates before mask mandates were implemented (i.e., the reference period: <4 weeks before the implementation week and the implementation week), the model predicted hospitalization growth rates after mask mandates, assuming mandates had not been implemented. Then the model compared the predicted values with the observed hospitalization growth rates after mask mandates were implemented. The study controlled for mask mandates, state, age group, and time (i.e., week of the year).[**] The study also controlled for statewide closing and reopening as determined by the date of stay-at-home orders and business closures (Supplementary Table, https://stacks.cdc.gov/view/cdc/101127).[††] P-values <0.05 were considered statistically significant. Analyses were conducted separately for three age groups (18–39, 40–64, and ≥65 years) and for all adults aged ≥18 years using Stata software (version 16.1; StataCorp). This study was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§§]

Ten of the 14 COVID-NET participating sites were in states that had issued statewide mask mandates since March 2020 (Table 1). The overall COVID-19–associated hospitalization growth rates among all adults declined 2.4 percentage points (p-value = 0.04) <3 weeks after the implementation week and declined 4.9 percentage points (p-value <0.01) during the period ≥3 weeks after the implementation week (Table 2). The declines were statistically significant.

Among persons aged 18–39 years, the hospitalization growth rates <3 weeks after the implementation week were lower than were those during the <4 weeks before the implementation week and the implementation week (reference period) when no mask mandate existed, but the estimated percentage point difference (–2.1) was not statistically significant (p-value = 0.31) (Figure) (Table 2). However, in this population, mask mandates were associated with a statistically significant 5.5 percentage-point decline in COVID-19 hospitalization growth rates (p-value = 0.03) ≥3 weeks after the implementation week. Among adults aged 40–64 years, mask mandates were associated with a 2.9 percentage-point reduction in COVID-19 hospitalization growth rates (p-value = 0.03) <3 weeks after the implementation week. Hospitalization growth rates declined by 5.5 percentage points (p-value = 0.02) during ≥3 weeks after the implementation week. Among adults aged ≥65 years, COVID-19 hospitalization growth rates declined <3 weeks after the implementation week (1.1 percentage points) and ≥3 weeks

[§] Weekly cumulative hospitalization growth rate ($HGrowth_{ast}$) for age cohort *a* in site *s* during week *t* is defined as the weekly percentage change in COVID-19 hospitalizations per 100,000 persons, estimated by $HGrowth_{ast}$ = ((log (HR_{ast})-log ($HR_{as(t-1)}$))×100, where HR_{ast} = cumulative hospitalization rate per 100,000 population for age cohort *a* in site *s* in week *t*. The log of the cumulative hospitalization growth rate is similar to the log of the cumulative cases per week, as the denominators are equivalent.

[¶] Each period might include different numbers of weeks by site. For ≥4 weeks before the implementation week (i.e., –4 or before), the maximum number of weeks included was 17 (–20 through –4), and the minimum was 3 (–6 through –4). For the periods of <4 weeks before the implementation week (i.e., –3 through 0), all sites have 4 weeks. For <3 weeks after the implementation week (i.e., 1 through 2), all sites have 2 weeks. For ≥3 weeks after the implementation week (i.e., 3 or after), the maximum number of weeks included is 24 (3 through 26), and the minimum is 10 (3 through 12).

[**] The event study design was adopted from a previous study (https://www.healthaffairs.org/doi/10.1377/hlthaff.2020.00818) and modified for the current analyses. Regression models used National Center for Health Statistics vintage 2018 bridged-race population estimates (https://www.cdc.gov/nchs/nvss/bridged_race.htm) for each site as analytic weights. The model used was a weighted least squares regression which accounted for heteroskedasticity by estimating the standard errors using age cohort-state clusters.

[††] The date of the statewide closing was the earlier of 1) the date persons were required to stay home or 2) the date that restaurants were required to cease on-premises dining and that nonessential retail businesses were ordered to close. The date of the statewide reopening was the earlier of 1) the date the stay-at-home order was lifted or 2) the date that restaurants were allowed to resume on-premises consumption and that nonessential retail businesses were permitted to reopen.

[§§] 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 501 et seq.

TABLE 1. Effective dates of statewide mask mandates — 10 COVID-19–Associated Hospitalization Surveillance Network sites with statewide mask mandates, March–October 2020

State	Effective date of statewide mask mandate	Source
California	Jun 18, 2020	California Health Order (Jun 18, 2020) https://www.countyofnapa.org/DocumentCenter/View/17945/Guidance-for-Face-Coverings_06-18-2020)
Colorado	Jul 16, 2020	Colorado Executive Order No. D 2020–138 (Jul 16, 2020) https://www.colorado.gov/governor/sites/default/files/inline-files/D%202020%20138%20Mask%20Order.pdf)
Connecticut	Apr 20, 2020	Connecticut Executive Order No. 7BB (Apr 17, 2020) (https://portal.ct.gov/-/media/Office-of-the-Governor/Executive-Orders/Lamont-Executive-Orders/Executive-Order-No-7BB.pdf)
Maryland	Apr 18, 2020	Maryland Executive Order No. 20–04–15–01 (Apr 15, 2020) (https://governor.maryland.gov/wp-content/uploads/2020/04/Masks-and-Physical-Distancing-4.15.20.pdf)
Michigan*	Apr 26, 2020	Michigan Executive Order No. 2020–59 (Apr 24, 2020) (https://content.govdelivery.com/attachments/MIEOG/2020/04/24/file_attachments/1435194/EO%202020-59.pdf)
Minnesota	Jul 24, 2020	Minnesota Emergency Executive Order 20–81 (Jul 22, 2020) (https://mn.gov/governor/assets/EO%2020-81%20Final%20Filed_tcm1055-441323.pdf)
New Mexico	Jun 1, 2020	New Mexico Health Order (Jun 1, 2020) (https://cv.nmhealth.org/wp-content/uploads/2020/06/060120-PHO.pdf)
New York	Apr 17, 2020	New York Executive Order No. 202.17 (Apr 15, 2020) (https://www.governor.ny.gov/news/no-20217-continuing-temporary-suspension-and-modification-laws-relating-disaster-emergency)
Ohio	Jul 23, 2020	Ohio Health Order (Jul 23, 2020) (https://coronavirus.ohio.gov/static/publicorders/Directors-Order-Facial-Coverings-throughout-State-Ohio.pdf)
Oregon	Jul 1, 2020	Oregon Health Order (Jun 30, 2020) (https://web.archive.org/web/20200702101516/https://sharedsystems.dhsoha.state.or.us/DHSForms/Served/le2288K.pdf)

Abbreviation: COVID-19 = coronavirus disease 2019.
* Because of a ruling from Michigan's supreme court, a 3-day lapse in Michigan's statewide mask mandate occurred during October 2–4. The analyses did not consider this lapse. All other statewide mask mandates were continuous throughout the study period.

TABLE 2. Estimated association between mask mandates and COVID-19–associated hospitalization growth rates in sites with statewide mask mandates, by age group — 10 COVID-19–Associated Hospitalization Surveillance Network sites,*,† March–October 2020

Time relative to week mask mandate was implemented	All (≥18 yrs)		18–39 yrs		40–64 yrs		≥65 yrs	
	Percentage point change* (95% CI)	p-value	Percentage point change* (95% CI)	p-value	Percentage point change* (95% CI)	p-value	Percentage point change* (95% CI)	p-value
≥4 weeks before	−4.3 (−10.5 to 1.9)	0.17	−4.7 (−16.9 to 7.5)	0.43	−4.0 (−13.3 to 5.3)	0.38	−5.3 (−14.9 to 4.3)	0.27
<4 weeks before§	Referent	—	Referent	—	Referent	—	Referent	—
<3 weeks after	−2.4 (−4.7 to −0.1)	0.04	−2.1 (−6.4 to 2.2)	0.31	−2.9 (−5.5 to −0.3)	0.03	−1.1 (−3.9 to 1.6)	0.41
≥3 weeks after	−4.9 (−8.5 to −1.2)	<0.01	−5.5 (−10.4 to −0.6)	0.03	−5.5 (−10.2 to −0.8)	0.02	−0.5 (−5.2 to 4.1)	0.83

Abbreviations: CI = confidence interval; COVID-19 = coronavirus disease 2019.
* Percentage points are coefficients from the regression models. Reported numbers are from regression models, which controlled for state, age group, time (week), and statewide closing and reopening.
† California, Colorado, Connecticut, Maryland, Michigan, Minnesota, New Mexico, New York, Ohio, and Oregon.
§ This period includes the implementation week (i.e., week zero).

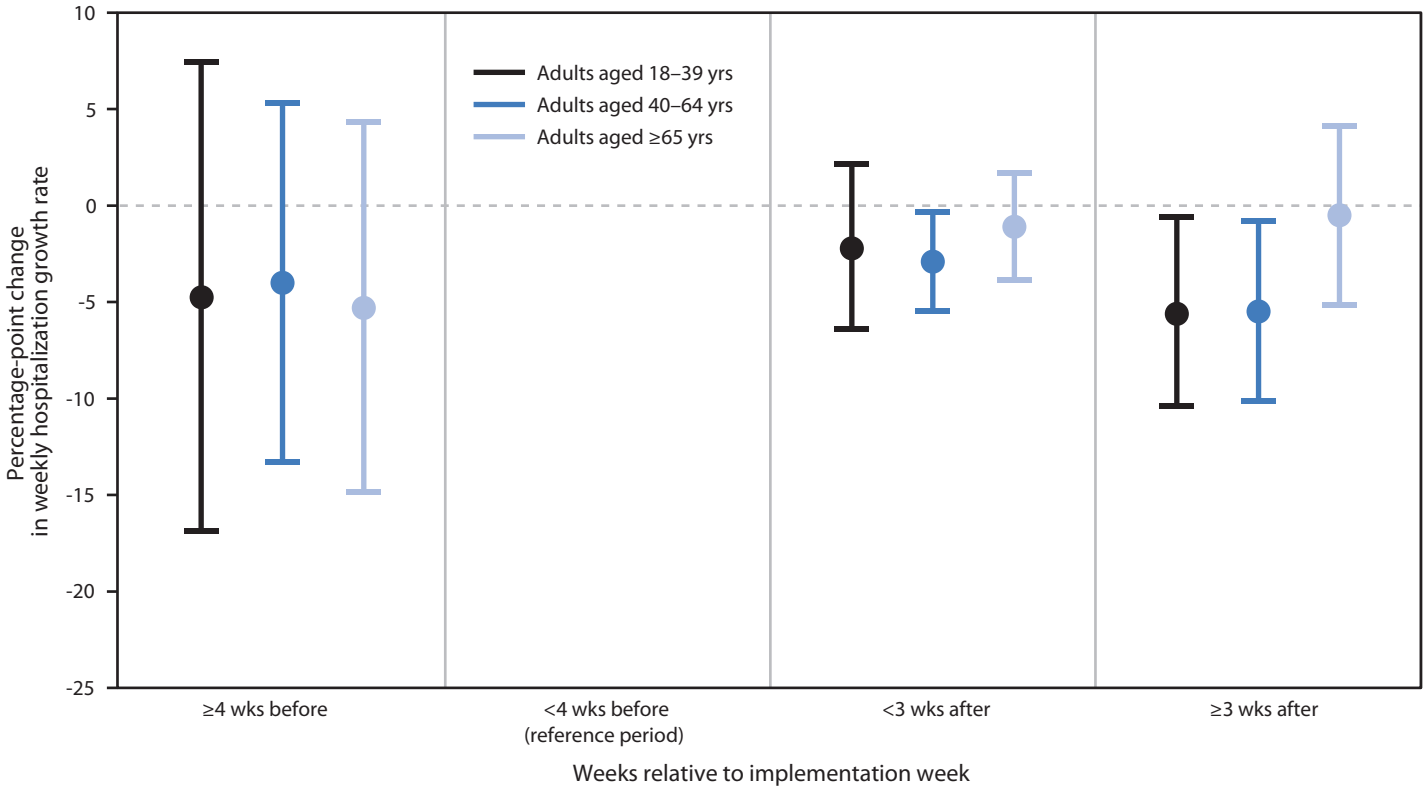
after the implementation week (0.5 percentage points); however, the declines were not statistically significant.

In the ≥4 weeks before the implementation week, COVID-19–associated hospitalization growth rates were lower than were those <4 weeks before the implementation week and during the implementation week (reference). However, the percentage point differences were not statistically significant.

Discussion

Masks are intended to reduce emission of virus-laden respiratory droplets, which is especially relevant for persons who are infected with SARS-CoV-2 but are asymptomatic or presymptomatic; masks also help reduce inhalation of respiratory droplets by the wearer (*1*). Findings from this study suggest that statewide mask mandates were associated with statistically significant declines in weekly COVID-19 hospitalization growth rates for adults aged 40–64 years <3 weeks after the week that the mandate was implemented, and for adults aged 18–64 years ≥3 weeks after the implementation week. The declines in hospitalization growth rates <3 weeks after the implementation week are consistent with the incubation period of SARS-CoV-2; in a report based on an analysis of publicly reported confirmed COVID-19 cases, the median estimated incubation period was 5.1 days, and most symptomatic patients reported symptoms within 11.5 days after exposure (*6*). Therefore, <3 weeks after the implementation

FIGURE. Estimates of association between implementation of statewide mask mandates and laboratory-confirmed COVID-19–associated hospitalization growth rates,*,†,§ by age group — 10 COVID-19–Associated Hospitalization Surveillance Network sites¶ with statewide mask mandates, March–October 2020



Abbreviation: COVID-19 = coronavirus disease 2019.
* With error bars indicating 95% confidence intervals.
† Relative to <4 weeks before implementation week (reference period, which includes the implementation week).
§ Reported numbers are coefficients from the regression models, which controlled state, age group, time (week), and statewide closing and reopening.
¶ California, Colorado, Connecticut, Maryland, Michigan, Minnesota, New Mexico, New York, Ohio, and Oregon.

of mask mandate would be long enough to identify an association between mask mandates and COVID-19–associated hospitalization growth rates. Previous studies have shown that the various physical distancing measures, including mask mandates, were associated with immediate declines in COVID-19 case growth rates (*5*,*7*).

This study did not demonstrate a statistically significant decline in COVID-19–associated hospitalization growth rates for adults aged ≥65 years, suggesting that there might have been less of a decline in this age group, compared with that of other adults, although CIs were wide. A study conducted during May 2020 indicated that approximately 70% of U.S. adults aged ≥65 years reported always wearing a mask in public, compared with only 44% of those aged 18–24 years (*8*). As a result, statewide mask mandates might have had a lesser impact on the masking behaviors of adults aged ≥65 years, compared with behaviors among other adults because of relatively high baseline level of mask use among this age group during the

Summary

What is already known about this topic?

Wearing masks is recommended to mitigate the spread of COVID-19.

What is added by this report?

During March 22–October 17, 2020, 10 sites participating in the COVID-19–Associated Hospitalization Surveillance Network in states with statewide mask mandates reported a decline in weekly COVID-19–associated hospitalization growth rates by up to 5.5 percentage points for adults aged 18–64 years after mandate implementation, compared with growth rates during the 4 weeks preceding implementation of the mandate.

What are the implications for public health practice?

Mask-wearing is a component of a multipronged strategy to decrease exposure to and transmission of SARS-CoV-2 and reduce strain on the health care system, with likely direct effects on COVID-19 morbidity and associated mortality.

reference period (i.e., <4 weeks before the implementation week and the implementation week).

Declines in hospitalization growth rates during March 1–October 17, 2020, might also have resulted in a substantial decrease in health care costs associated with COVID-19. CDC has determined that COVID-19–related hospital costs per adult hospitalization varied from $8,400 in a general ward to >$50,000 in an intensive care unit with a ventilator (*9*). Because COVID-19 can lead to prolonged illness and require long-term treatment (*10*), the expected savings associated with the decline in hospitalization rates could be much higher than these reduced hospital costs associated with COVID-19.

The findings in this report are subject to at least four limitations. First, the model did not control for other policies that might affect hospitalization growth rates, including school closing and physical distancing recommendations; however, it did control for the dates of statewide closing and reopening, based on statewide stay-at-home orders and business closures. Second, these findings are limited to state-issued statewide mask mandates and do not account for local variability, such as county-level mask mandates.¶¶ Third, the findings are based on sites participating in COVID-NET and are limited to persons aged ≥18 years and therefore might not be generalizable to the entire U.S. population. Finally, it was assumed that the estimated effect in hospitalization growth rates after mask mandate implementation week did not depend on the issuance dates (e.g., Monday versus Friday), although number of days after the issuance of mask mandates in week zero varied by issuance date. Also, it was assumed that the mask mandates could not affect the hospitalization growth rates during the implementation week.

At the individual level, the prevention benefit of using a mask increases as more persons use masks consistently and correctly. Studies have confirmed the benefit of masking for SARS-CoV-2 control; each study demonstrated that, after implementation of directives from organizational or political leadership for universal masking, new infections decreased significantly (*1*). This study supports community masking to reduce the transmission of SARS-CoV-2. It also demonstrates that statewide mask mandates were associated with a reduction in COVID-19–associated hospitalization growth rates among adults aged 18–64 years and might affect age groups differently. Mask-wearing is part of a multipronged application of evidence-based strategies that prevent the transmission of SARS-CoV-2; wearing a mask reduces exposure, transmission, and strain on the health care system with likely direct effects on COVID-19 morbidity and associated mortality (*1*).

¶¶ Some states issued orders that applied to certain counties, and others authorized counties to apply for and receive variances from mitigation measures if certain thresholds were met (e.g., COVID-19 percentage of positive test results below a specified level in that county). Cities and counties might have also issued local mask mandates.

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References

1. CDC. COVID-19. Scientific brief: community use of cloth masks to control the spread of SARS-CoV-2. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/more/masking-science-sars-cov2.html
2. CDC. State and territorial COVID-19 orders and proclamations requiring masks in public. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://ephtracking.cdc.gov/DataExplorer/?c=33&i=165
3. CDC. Coronavirus Disease 2019 (COVID-19)–Associated Hospitalization Surveillance Network (COVID-NET). Atlanta, GA: US. Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covid-net/purpose-methods.html
4. Garg S, Kim L, Whitaker M, et al. Hospitalization rates and characteristics of patients hospitalized with laboratory-confirmed coronavirus disease 2019—COVID-NET, 14 states, March 1–30, 2020. MMWR Morb Mortal Wkly Rep 2020;69:458–64. PMID:32298251 https://doi.org/10.15585/mmwr.mm6915e3
5. Lyu W, Wehby GL. Community use of face masks and COVID-19: evidence from a natural experiment of state mandates in the US. Health Aff (Millwood) 2020;39:1419–25. PMID:32543923 https://doi.org/10.1377/hlthaff.2020.00818
6. Lauer SA, Grantz KH, Bi Q, et al. The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. Ann Intern Med 2020;172:577–82. PMID:32150748 https://doi.org/10.7326/M20-0504
7. Courtemanche C, Garuccio J, Le A, Pinkston J, Yelowitz A. Strong social distancing measures in the United States reduced the COVID-19 growth rate. Health Aff (Millwood) 2020;39:1237–46. PMID:32407171 https://doi.org/10.1377/hlthaff.2020.00608
8. Czeisler MÉ, Tynan MA, Howard ME, et al. Public attitudes, behaviors, and beliefs related to COVID-19, stay-at-home orders, nonessential business closures, and public health guidance—United States, New York City, and Los Angeles, May 5–12, 2020. MMWR Morb Mortal Wkly Rep 2020;69:751–8. PMID:32555138 https://doi.org/10.15585/mmwr.mm6924e1
9. Adhikari BB, Arifkhanova A, Coronado F, et al. COVIDTracer and COVIDTracer Advanced. Atlanta, GA: US. Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/php/contact-tracing/COVIDTracerTools.html
10. World Health Organization. What we know about long-term effects of COVID-19: the latest on the COVID-19 global situation & long-term sequelae. Geneva, Switzerland: World Health Organization; 2020. https://www.who.int/docs/default-source/coronaviruse/risk-comms-updates/update-36-long-term-symptoms.pdf?sfvrsn=5d3789a6_2

COVID-19 Vaccination Intent, Perceptions, and Reasons for Not Vaccinating Among Groups Prioritized for Early Vaccination — United States, September and December 2020

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As of February 8, 2021, 59.3 million doses of vaccines to prevent coronavirus disease 2019 (COVID-19) had been distributed in the United States, and 31.6 million persons had received at least 1 dose of the COVID-19 vaccine (*1*). However, national polls conducted before vaccine distribution began suggested that many persons were hesitant to receive COVID-19 vaccination (*2*). To examine perceptions toward COVID-19 vaccine and intentions to be vaccinated, in September and December 2020, CDC conducted household panel surveys among a representative sample of U.S. adults. From September to December, vaccination intent (defined as being absolutely certain or very likely to be vaccinated) increased overall (from 39.4% to 49.1%); the largest increase occurred among adults aged ≥65 years. If defined as being absolutely certain, very likely, or somewhat likely to be vaccinated, vaccination intent increased overall from September (61.9%) to December (68.0%). Vaccination nonintent (defined as not intending to receive a COVID-19 vaccination) decreased among all adults (from 38.1% to 32.1%) and among most sociodemographic groups. Younger adults, women, non-Hispanic Black (Black) persons, adults living in nonmetropolitan areas, and adults with lower educational attainment, with lower income, and without health insurance were most likely to report lack of intent to receive COVID-19 vaccine. Intent to receive COVID-19 vaccine increased among adults aged ≥65 years by 17.1 percentage points (from 49.1% to 66.2%), among essential workers by 8.8 points (from 37.1% to 45.9%), and among adults aged 18–64 years with underlying medical conditions by 5.3 points (from 36.5% to 41.8%). Although confidence in COVID-19 vaccines increased during September–December 2020 in the United States, additional efforts to tailor messages and implement strategies to further increase the public's confidence, overall and within specific subpopulations, are needed. Ensuring high and equitable vaccination coverage across all populations is important to prevent the spread of COVID-19 and mitigate the impact of the pandemic.

The Advisory Committee on Immunization Practices (ACIP) has issued interim recommendations for COVID-19 vaccine allocation, with initial limited supplies of vaccines recommended for health care personnel and residents of long-term care facilities (phase 1a); frontline essential workers and persons aged ≥75 years (phase 1b); and persons aged 65–74 years, persons aged 16–64 years at high risk for severe COVID-19 illness because of underlying medical conditions,* and other workers in essential and critical infrastructure sectors† not included in phases 1a and 1b (phase 1c) (*3*,*4*). Vaccinating a large proportion of persons in the United States against COVID-19 is critical for preventing SARS-CoV-2–associated morbidity and mortality and helping bring an end to the global pandemic.

During September 3–October 1, CDC conducted a probability-based Internet panel survey (IPSOS KnowledgePanel)§ of a nationally representative sample of 3,541 U.S. adult panelists aged ≥18 years to assess intent to receive a COVID-19 vaccine and perceptions about the vaccine (*5*). During December 18–20, CDC sponsored questions on two probability-based household panel omnibus surveys (IPSOS KnowledgePanel¶ and NORC Amerispeak**) administered to 2,033 panelists (approximately 1,000 panelists each) to reassess

* Persons with underlying medical conditions were defined as those who reported having any of the following conditions: cancer; chronic kidney disease; chronic obstructive pulmonary disease (COPD); heart conditions (e.g., heart failure, coronary artery disease, or cardiomyopathies); immunocompromised state (weakened immune system) from solid organ transplant; obesity; pregnancy; sickle cell disease; smoking; and type 2 diabetes mellitus. Respondents aged 18–64 years reporting diagnosis of one or more of these conditions were classified as high-risk in the analyses. This list of underlying medical conditions does not include Down syndrome, which was added to the list on December 23, 2020. A complete list of underlying medical conditions is available at https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html

† Other essential workers include those who conduct a range of operations and services that are essential to continued critical infrastructure viability, including staffing operations centers, maintaining and repairing critical infrastructure, operating call centers, working construction, and performing operational functions, among others. Also included are workers who support crucial supply chains and enable functions for critical infrastructure. The industries they support represent, but are not limited to, medical and health care, telecommunications, information technology systems, defense, food and agriculture, transportation and logistics, energy, water and wastewater, and law enforcement.

§ https://www.ipsos.com/sites/default/files/ipsosknowledgepanelmethodology.pdf

¶ https://www.ipsos.com/en-us/solutions/public-affairs/knowledgepanel-omnibus

** https://amerispeak.norc.org/our-capabilities/Pages/AmeriSpeak-Omnibus.aspx

COVID-19 vaccination intent and related perceptions.[††] This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§§] The same questions about COVID-19 vaccine intentions, perceptions, and reasons for not receiving a COVID-19 vaccine were asked in the September and December surveys. However, most respondents were different for each survey; only 123 panelists (3.5%) completed both the September and December IPSOS survey. Intent was assessed by response to the following question: "If a vaccine against COVID-19 were available today at no cost, how likely would you be to get it?" Response options were "absolutely certain," "very likely," "somewhat likely," and "not likely." Respondents who answered "absolutely certain" or "very likely" to receive a COVID-19 vaccination were defined as intending to be vaccinated, and respondents who answered "not likely" were defined as not intending to be vaccinated. Vaccination intentions and related perceptions were stratified by the following three mutually exclusive groups representing the ACIP priorities for initial doses of COVID-19 vaccine after health care providers and long-term care residents: 1) essential workers,[¶¶] 2) adults aged 18–64 years with underlying medical conditions, and 3) adults aged ≥65 years.[***] Sample size for the December surveys was not large enough to stratify the analysis by age group (65–74 years versus ≥75 years) or essential worker subgroups (health care personnel, other frontline essential workers, and other non-frontline essential workers). Analyses were also conducted to provide estimates among all adults and among adults not included in the initial ACIP priority groups (aged 18–64 years with no underlying medical conditions and who were not essential workers). Responses to questions on intent, perceptions, and reasons for not getting vaccinated were examined by sociodemographic characteristics and priority groups for the September and December surveys. Because of similar sampling methods and characteristics of respondents, the averages of the estimates from the two December surveys were calculated, and the difference between the September survey and the average of the December surveys was determined using t-tests. All surveys were weighted to ensure representativeness of the U.S. population, and all analyses were conducted using SAS-callable SUDAAN (version 11.0; RTI International).

From September to December, the proportion of adults reporting intent to receive COVID-19 vaccine as absolutely certain or very likely increased significantly by 9.7 percentage points (from 39.4% to 49.1%), and the proportion reporting nonintent decreased by 6.0 percentage points (from 38.1% to 32.1%) (Table 1). Among priority groups, intent increased by 17.1 percentage points among adults aged ≥65 years (from 49.1% to 66.2%), by 8.8 percentage points among essential workers (from 37.1% to 45.9%), and by 5.3 percentage points among adults aged 18–64 years with underlying medical conditions (from 36.5% to 41.8%) (Supplementary Figure, https://stacks.cdc.gov/view/cdc/101583).

Vaccination nonintent differed by sociodemographic characteristics and decreased across most socioeconomic groups from September to December (Table 2). For example, nonintent decreased by 10.3 percentage points among adults aged 50–64 years and by 11.1 percentage points among adults aged ≥65 years. Although nonintent was higher among women, nonintent among both women and men decreased by 6.0 percentage points between September and December. Nonintent was highest among Black persons in September (56.1%) and December (46.5%) compared with other racial/ethnic groups, with the difference between months (–9.6) not statistically significant. Nonintent was higher among adults with lower educational attainment and lower income but decreased across most education and income categories: among adults with a high school diploma or less, nonintent decreased 7.9 percentage points, and in households with annual incomes of $35,000–$49,999, nonintent decreased by 10.8 percentage points. Vaccination nonintent also decreased in metropolitan statistical areas[†††] by 6.7 percentage points and among adults in all regions of the United States, except the Northeast, including decreases of 8.3 percentage points in the South, 6.8 in the Midwest, and 6.8 in the West. In December, nonintent was highest among persons without health insurance

[††] The panels from the September and December surveys use an address-based sampling methodology that covers nearly all households in the United States regardless of their phone or Internet status, with a cooperation rate (proportion of all cases interviewed among all eligible units ever contacted) of 69.7% (September IPSOS survey), 38.0% (December IPSOS survey), and 22.8% (December NORC survey). Surveys were fielded in English and Spanish, and non-Hispanic Black and non-Hispanic other race panel members were oversampled to ensure adequate sample size for subgroup analyses by respondent's race/ethnicity.

[§§] 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

[¶¶] Essential workers were defined as those who responded "yes" to the following question: "In your work or volunteer activities, are you classified as an essential worker?"

[***] Mutually exclusive groups were categorized in the following order: essential workers, adults aged ≥65 years, and adults aged 18–64 years with an underlying medical condition. Anyone who self-identified as an essential worker was categorized as an essential worker, regardless of age. Next, anyone aged ≥65 years was categorized as adult aged ≥65 years. Finally, anyone aged 18–64 years with an underlying medical condition was categorized as adult aged 18–64 years with an underlying medical condition. All others were categorized as adults aged 18–64 years who were not essential workers and had no underlying medical conditions.

[†††] Metropolitan statistical area (MSA) status was determined by census block group using the panelist's address. For a small number of panelists for whom the address was not available, ZIP code was used to determine MSA status. https://www.census.gov/programs-surveys/metro-micro.html

TABLE 1. COVID-19 vaccination intent among surveyed adults, by vaccination priority group — United States, September and December 2020

Characteristic	Weighted % (95% CI)				
	IPSOS, Sep 2020* (n = 3,541)	IPSOS, Dec 2020† (n = 1,005)	NORC, Dec 2020§ (n = 1,028)	Average of Dec IPSOS† and NORC§ estimates (n = 2,033)	Difference between Dec and Sep estimates¶
All adults					
Intent to get COVID-19 vaccine					
Absolutely certain/Very likely**	39.4 (37.7 to 41.2)	50.3 (46.9 to 53.6)	47.8 (42.7 to 52.8)	49.1 (46.0 to 52.1)	9.7 (6.2 to 13.2)
Somewhat likely	22.5 (21.0 to 24.0)	16.8 (14.2 to 19.4)	21.0 (17.4 to 24.8)	18.9 (16.4 to 21.4)	−3.6 (−6.5 to −0.7)
Not likely	38.1 (36.4 to 39.8)	33.0 (29.7 to 36.2)	31.2 (26.5 to 35.8)	32.1 (29.6 to 34.6)	−6.0 (−9.0 to −3.0)
Essential workers					
Intent to get COVID-19 vaccine					
Absolutely certain/Very likely**	37.1 (34.2 to 40.0)	49.0 (42.9 to 55.1)	42.8 (34.9 to 50.6)	45.9 (40.9 to 50.9)	8.8 (3.0 to 14.6)
Somewhat likely	22.8 (20.2 to 25.3)	14.4 (9.9 to 19.1)	23.0 (16.6 to 29.6)	18.7 (14.0 to 23.4)	−4.1 (−9.4 to 1.2)
Not likely	40.2 (37.3 to 43.2)	36.6 (30.7 to 42.3)	34.2 (25.8 to 42.6)	35.4 (30.8 to 40.0)	−4.8 (−10.3 to 0.7)
Adults aged ≥65 yrs					
Intent to get COVID-19 vaccine					
Absolutely certain/Very likely**	49.1 (45.6 to 52.6)	66.5 (60.0 to 73.0)	65.8 (59.0 to 72.6)	66.2 (61.5 to 70.8)	17.1 (11.3 to 22.9)
Somewhat likely	21.1 (18.3 to 23.9)	12.8 (8.4 to 17.2)	17.4 (12.0 to 22.9)	15.1 (11.6 to 18.6)	−6.0 (−10.5 to −1.5)
Not likely	29.8 (26.6 to 33.0)	20.6 (14.9 to 26.4)	16.8 (10.2 to 23.3)	18.7 (14.3 to 23.0)	−11.1 (−16.5 to −5.7)
Adults aged 18–64 yrs with underlying medical conditions					
Intent to get COVID-19 vaccine					
Absolutely certain/Very likely**	36.5 (33.4 to 39.6)	44.8 (38.0 to 51.5)	38.8 (32.6 to 45.1)	41.8 (37.2 to 46.4)	5.3 (−0.2 to 10.8)
Somewhat likely	23.0 (20.3 to 25.7)	19.2 (13.3 to 25.0)	20.6 (14.7 to 26.6)	19.9 (15.7 to 24.1)	−3.1 (−8.1 to 1.9)
Not likely	40.4 (37.3 to 43.7)	36.0 (29.4 to 42.8)	40.5 (34.5 to 46.5)	38.3 (33.8 to 42.8)	−2.1 (−7.6 to 3.4)
Adults aged 18–64 yrs without underlying medical conditions and nonessential workers					
Intent to get COVID-19 vaccine					
Absolutely certain/Very likely**	38.0 (34.5 to 41.4)	46.3 (40.5 to 52.1)	48.7 (40.0 to 57.4)	47.5 (42.3 to 52.7)	9.5 (3.3 to 15.7)
Somewhat likely	22.4 (19.4 to 25.2)	18.4 (13.8 to 23.1)	22.2 (13.2 to 31.3)	20.3 (15.2 to 25.4)	−2.1 (−8.0 to 3.8)
Not likely	39.8 (36.4 to 43.1)	35.2 (29.5 to 41.0)	29.0 (20.9 to 37.2)	32.2 (27.2 to 37.1)	−7.6 (−13.6 to −1.6)

Abbreviations: CI = confidence interval; COVID-19 = coronavirus disease 2019.
* IPSOS KnowledgePanel Survey, fielded September 3–October 1.
† IPSOS KnowledgePanel Omnibus Survey, fielded December 18–20.
§ NORC AmeriSpeak Omnibus Survey, fielded December 18–20.
¶ CIs for differences that exclude zero are statistically significant.
** Might include some persons who already received the COVID-19 vaccine.

(44.5%), compared with those who had private health insurance (30.7%) and public health insurance (29.6%), and was similar in September and December.

Among adults in the December surveys who did not intend to get vaccinated, the main reasons most frequently cited were concerns about side effects and safety of the COVID-19 vaccine (29.8%), planning to wait to see if the vaccine is safe and consider receiving it later (14.5%), lack of trust in the government (12.5%), and concern that COVID-19 vaccines were developed too quickly (10.4%) (Table 3). A larger percentage of the December survey participants than September participants reported safety concerns as a main reason (29.8% versus 23.4%), and a smaller percentage reported concern that vaccines were developed too quickly (10.4% versus 21.6%).

Discussion

From September to December 2020, vaccination intent increased among all adults by approximately 10 percentage points and across all priority groups, with the largest increase in intent to be vaccinated among adults aged ≥65 years; vaccination nonintent decreased among all adults by 6 percentage points and across most sociodemographic groups. However, despite increases in vaccination intent since September (*5*), only about half of persons aged 18–64 years surveyed in December reported being very likely to receive COVID-19 vaccination, even among those who were essential workers and persons aged 18–64 years with underlying medical conditions. Younger adults, women, Black persons, adults living in nonmetropolitan areas, and adults with lower educational attainment, with lower income, and without insurance were most likely to report that they did not intend to receive COVID-19 vaccination. Several studies found similar percentages and trends in vaccination intent and low likelihood of receiving a COVID-19 vaccine among groups disproportionately affected by COVID-19, including Black persons and those with lower educational attainment (*6*,*7*). Because many of these groups are at increased risk for COVID-19–associated morbidity and mortality (*8*),

TABLE 2. Prevalence of intent not to receive COVID-19 vaccine, by selected characteristics — United States, September and December 2020

Characteristic	Weighted % (95% CI)		
	IPSOS, Sep 2020* (n = 3,541)	Average of Dec IPSOS† and NORC§ estimates (n = 2,033)	Difference between Dec and Sep estimates¶
All adults, aged ≥18 yrs			
Age group, yrs			
18–49 (ref)	39.5 (36.9 to 42.0)	37.6 (33.5 to 41.7)	−1.9 (−6.7 to 3.0)
50–64	42.0 (38.9 to 45.2)	31.7 (26.6 to 36.8)	−10.3 (−16.3 to −4.3)
≥65	29.8** (26.6 to 33.0)	18.7** (14.3 to 23.1)	−11.1 (−16.5 to −5.7)
Sex			
Male	33.8** (31.4 to 36.2)	27.8** (24.7 to 30.9)	−6.0 (−9.9 to −2.1)
Female (ref)	42.1 (39.7 to 44.6)	36.0 (31.4 to 40.6)	−6.1 (−11.3 to −0.9)
Race/Ethnicity			
White, non-Hispanic (ref)	35.9 (33.8 to 38.1)	30.3 (27.4 to 33.2)	−5.6 (−9.2 to −2.0)
Black, non-Hispanic	56.1** (51.4 to 60.8)	46.5** (36.8 to 56.2)	−9.6 (−20.4 to 1.2)
Hispanic	36.4 (31.8 to 41.0)	32.4 (26.2 to 38.6)	−4.0 (−11.7 to 3.7)
Other/Multiple races, non-Hispanic	32.1 (27.4 to 36.8)	24.4 (17.0 to 31.9)	−7.7 (−16.5 to 1.1)
Educational status			
High school or less (ref)	47.0 (44.0 to 50.0)	39.1 (34.0 to 44.2)	−7.9 (−13.8 to −2.0)
Some college or college graduate	35.8** (33.4 to 38.2)	30.9** (27.9 to 33.8)	−4.9 (−8.7 to −1.1)
Above college graduate	23.8** (20.3 to 27.3)	15.7** (11.1 to 20.4)	−8.1 (−13.9 to −2.3)
Employment status			
Employed (ref)	38.6 (36.5 to 40.8)	32.3 (29.2 to 35.4)	−6.3 (−10.1 to −2.5)
Not employed/Not in workforce	36.6 (33.8 to 39.5)	31.5 (27.1 to 35.9)	−5.1 (−10.3 to 0.1)
Annual household income, $			
<35,000 (ref)	44.0 (40.2 to 47.7)	38.3 (32.4– to 44.1)	−5.7 (−12.6 to 1.2)
35,000–49,999	45.1 (40.0 to 50.2)	34.3 (26.7 to 41.9)	−10.8 (−20.0 to −1.6)
50,000–74,999	39.8 (35.5 to 44.2)	39.7 (34.5 to 44.9)	−0.1 (−6.9 to 6.7)
≥75,000	33.5** (31.1 to 35.9)	23.9** (20.6 to 27.3)	−9.6 (−13.7 to −5.5)
Region			
Northeast (ref)	35.2 (31.3 to 39.1)	35.5 (29.6 to 41.4)	0.3 (−6.8 to 7.4)
Midwest	36.7 (33.0 to 40.4)	30.3 (25.3 to 35.3)	−6.4 (−12.6 to −0.2)
South	41.1** (38.3 to 44.0)	32.8 (27.5 to 38.2)	−8.3 (−14.4 to −2.2)
West	36.7 (33.2 to 40.1)	29.9 (24.4 to 35.4)	−6.8 (−13.3 to −0.3)
Health insurance status			
Private health insurance (ref)	37.8 (35.6 to 40.0)	30.7 (27.2 to 34.3)	−7.1 (−11.3 to −2.9)
Public health insurance	35.3 (32.4 to 38.2)	29.6 (25.1 to 34.2)	−5.7 (−11.1 to −0.3)
No health insurance	48.7** (42.1 to 55.2)	44.5** (33.4 to 55.5)	−4.2 (−17.0–8.6)
MSA status			
Metro (ref)	36.9 (35.1 to 38.7)	30.2 (27.0 to 33.4)	−6.7 (−10.4 to −3.0)
Nonmetro	46.2** (41.3 to 51.1)	39.6** (33.5 to 45.7)	−6.6 (−14.4 to 1.2)
2020–21 influenza vaccination status			
Received influenza vaccination/Absolutely certain (ref)	23.3 (21.2 to 25.5)	14.7 (12.0 to 17.3)	−8.6 (−12.0 to −5.2)
Very likely/Somewhat likely	30.3** (27.0 to 33.6)	20.6 (14.6 to 26.5)	−9.7 (−16.5 to −2.9)
Not likely	67.0** (63.9 to 70.2)	68.3** (63.7 to 72.9)	1.3 (−4.3–6.9)
Concern about COVID-19 illness for self			
Very/Somewhat concerned (ref)	27.6 (25.6 to 29.8)	18.8 (15.9 to 21.7)	−8.8 (−12.4 to −5.2)
Slightly/Not concerned	50.1** (47.4 to 52.7)	51.3** (47.2 to 55.3)	1.2 (−3.6 to 6.0)
Concern about side effects of vaccine for self			
Very/Somewhat concerned (ref)	43.7 (41.5 to 46.0)	40.5 (36.7 to 44.2)	−3.2 (−7.6 to 1.2)
Slightly/Not concerned	28.9** (26.3 to 31.6)	21.5** (18.4 to 24.6)	−7.4 (−11.5 to −3.3)
Trust governmental approval process to ensure the COVID-19 vaccine is safe for the public			
Fully/Mostly trust (ref)	9.5 (7.9 to 11.2)	7.7 (5.6 to 9.9)	−1.8 (−4.5 to 0.9)
Somewhat trust/Do not trust	56.7** (54.4 to 58.9)	54.3 (50.4 to 58.2)	−2.4 (−6.9 to 2.1)

Abbreviations: CI = confidence interval; COVID-19 = coronavirus disease 2019; MSA = metropolitan statistical area; ref = reference category.

* IPSOS KnowledgePanel Survey, fielded September 3–October 1.

† IPSOS KnowledgePanel Omnibus Survey, fielded December 18–20.

§ NORC AmeriSpeak Omnibus Survey, fielded December 18–20.

¶ CIs for differences that exclude zero are statistically significant.

** p<0.05 compared with respective reference category for each variable (by t-test).

TABLE 3. Main reasons for not intending to get COVID-19 vaccine,* United States, September and December 2020

Main reasons	Weighted % (95% CI)		
	IPSOS, Sep 2020† (n = 3,541)	Average of Dec IPSOS§ and NORC¶ estimates (n = 2,033)	Difference between Dec and Sep estimates**
Concern about the side effects and safety of the vaccine	23.4 (20.9 to 25.9)	29.8 (26.2 to 33.4)	6.4 (2.0 to 10.8)
Concern that the vaccine is being developed too quickly	21.6 (19.3 to 24.1)	10.4 (7.6 to 13.2)	−11.2 (−14.9 to −7.5)
Plan to wait and see if it is safe and may get it later	18.0 (15.7 to 20.2)	14.5 (11.1 to 17.9)	−3.5 (−7.6 to 0.6)
Don't trust the government	9.8 (8.0 to 11.6)	12.5 (9.0 to 15.9)	2.7 (−1.2 to 6.6)
Plan to use masks/other precautions instead	3.4 (2.4 to 4.4)	3.7 (1.4 to 6.0)	0.3 (−2.2 to 2.8)
Don't like vaccines	3.2 (2.2 to 4.1)	5.4 (3.0 to 7.9)	2.2 (−0.4 to 4.8)
Not a member of any group that is at high risk for COVID-19	2.8 (1.9 to 3.8)	3.5 (1.8 to 5.1)	0.7 (−1.2 to 2.6)
COVID-19 is not a serious illness	2.6 (1.6 to 3.6)	1.9 (0.8 to 3.0)	−0.7 (−2.2 to 0.8)
The vaccine will not work	2.4 (1.5 to 3.3)	0.0 (—)	−2.4 (−3.3 to −1.5)
The vaccine could give me COVID-19	2.4 (1.5 to 3.3)	2.3 (0.0 to 5.4)	−0.1 (−2.9 to 2.7)
Had COVID-19 and should be immune	1.0 (0.4 to 1.6)	2.2 (1.0 to 3.5)	1.2 (−0.2 to 2.6)
Don't like needles	1.0 (0.5 to 1.6)	3.0 (0.1 to 6.0)	2.0 (−1.0 to 5.0)
Doctor has not recommended a COVID-19 vaccine to me	0.8 (0.4 to 1.4)	0.0 (—)	−0.8 (−1.3 to −0.3)
Didn't know I needed a vaccine against COVID-19	0.2 (0.0 to 0.5)	0.4 (0.0 to 1.0)	0.2 (−0.4 to 0.8)
Concern about the costs associated with the vaccine (such as office visit costs or vaccine administration fees)	0.2 (0.0 to 0.3)	0.2 (0.0 to 0.8)	0.0 (−0.4 to 0.4)

Abbreviations: CI = confidence interval; COVID-19 = coronavirus disease 2019.
* Among respondents who stated that they are not likely to receive the COVID-19 vaccine.
† IPSOS KnowledgePanel Survey, fielded September 3–October 1.
§ IPSOS KnowledgePanel Omnibus Survey, fielded December 18–20.
¶ NORC AmeriSpeak Omnibus Survey, fielded December 18–20.
** CIs for differences that exclude zero are statistically significant.

COVID-19 vaccination is important for protecting the health of these populations and reducing health inequities.

The findings in this report are subject to at least seven limitations. First, although panel recruitment methodology and data weighting were designed to produce nationally representative results, respondents might not be fully representative of the general U.S. adult population. Second, because the sample of persons surveyed in December was not derived from the sample of persons surveyed in September, longitudinal analysis of changes in perception from the same sample of persons was not possible. Third, small sample sizes prevented separate analyses of some priority groups identified by ACIP, such as health care personnel, frontline and other essential workers, and adults aged 65–74 years and ≥75 years. Fourth, because essential worker status and high-risk medical conditions were self-reported, there might be potential for misclassification. Respondents were also placed into mutually exclusive vaccine priority groups, which could not account for persons who fit within multiple groups (e.g., essential workers aged 18–64 years with underlying medical conditions). Fifth, attitudes and perceptions might change quickly, and these results might not be reflective of current reasons for not intending to receive a COVID-19 vaccine. Sixth, results are national estimates and cannot be generalized to the state or local level. Finally, results might not be comparable to other national polls or surveys because of potential differences in survey methods, sample population, and questions related to vaccination intent.

Summary

What is already known about this topic?

National polls conducted before vaccine distribution began suggested that many persons were hesitant to receive COVID-19 vaccination.

What is added by this report?

From September to December 2020, intent to receive COVID-19 vaccination increased from 39.4% to 49.1% among adults and across all priority groups, and nonintent decreased from 38.1% to 32.1%. Despite decreases in nonintent from September to December, younger adults, women, non-Hispanic Black adults, adults living in nonmetropolitan areas, and adults with less education and income, and without health insurance continue to have the highest estimates of nonintent to receive COVID-19 vaccination.

What are the implications for public health practice?

Ensuring high and equitable vaccination coverage among all populations, including by addressing reasons for not intending to receive vaccination, is critical to prevent the spread of COVID-19 and bring an end to the pandemic.

Continuing to promote vaccine confidence by tailoring information to address concerns of individual persons and communities is critical to preventing the spread of COVID-19. These findings suggest a decrease in nonintent over time as well as concerns about vaccine safety among priority populations in the United States and have implications for potential messages and strategies that could boost confidence in COVID-19

vaccines and educate essential workers, minority populations, and the general public about the safety of the vaccine development process, and the known effectiveness and safety of authorized COVID-19 vaccines (*9*). Health care providers are known to be a trusted source of information about vaccines for many persons and can use CDC-recommended guidance to have effective conversations with patients about the need for vaccination (*10*). Ensuring high and equitable vaccination coverage in all populations is critical to preventing the spread of COVID-19 and bringing an end to the pandemic.

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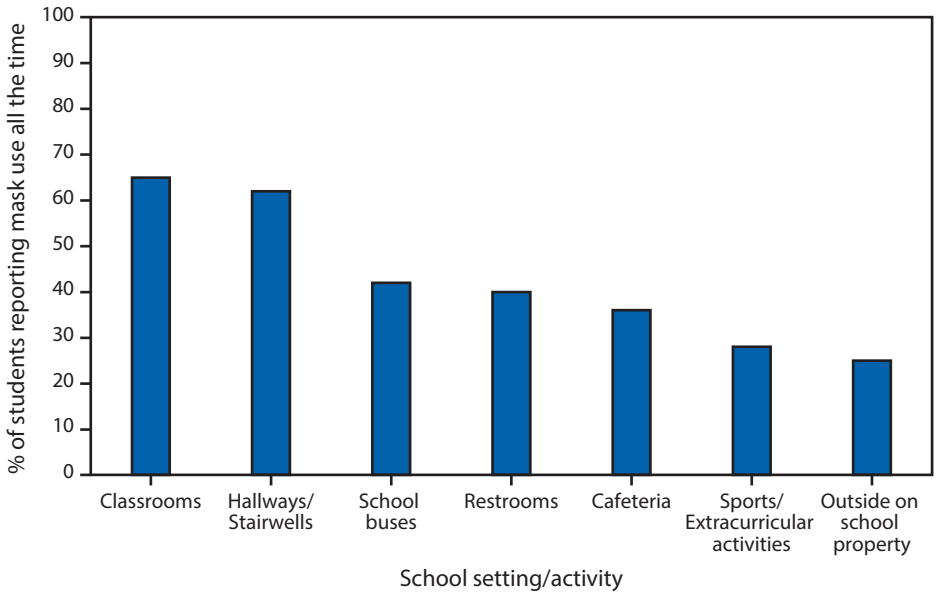
References

1. CDC. COVID data tracker: COVID-19 vaccinations in the United States. Accessed February 3, 2021. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. https://covid.cdc.gov/covid-data-tracker/#vaccinations
2. Kaiser Family Foundation. Coronavirus (COVID-19). KFF COVID-19 vaccine monitor: December 2020. San Francisco, CA: Kaiser Family Foundation; 2020. https://www.kff.org/coronavirus-covid-19/report/kff-covid-19-vaccine-monitor-december-2020/
3. Dooling K, McClung N, Chamberland M, et al. The Advisory Committee on Immunization Practices' interim recommendation for allocating initial supplies of COVID-19 vaccine—United States, 2020. MMWR Morb Mortal Wkly Rep 2020;69:1857–9. PMID:33301429 https://doi.org/10.15585/mmwr.mm6949e1
4. Dooling K, Marin M, Wallace M, et al. The Advisory Committee on Immunization Practices' updated interim recommendation for allocation of COVID-19 vaccine—United States, December 2020. MMWR Morb Mortal Wkly Rep 2021;69:1657–60. PMID:33382671 https://doi.org/10.15585/mmwr.mm695152e2
5. Nguyen KH, Kahn K, Hoehner J, et al. AdultVaxView: COVID-19 vaccination intent, perceptions, and reasons for not vaccinating among groups prioritized for early vaccination, United States, September 2020. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. https://www.cdc.gov/vaccines/imz-managers/coverage/adultvaxview/pubs-resources/COVID-online-report2020.html
6. Szilagyi PG, Thomas K, Shah MD, et al. National trends in the US public's likelihood of getting a COVID-19 vaccine—April 1 to December 8, 2020. JAMA 2020;325:396–8. PMID:33372943 https://doi.org/10.1001/jama.2020.26419
7. Malik AA, McFadden SM, Elharake J, Omer SB. Determinants of COVID-19 vaccine acceptance in the US. EClinicalMedicine 2020;26:100495. PMID:32838242 https://doi.org/10.1016/j.eclinm.2020.100495
8. Wortham JM, Lee JT, Althomsons S, et al. Characteristics of persons who died with COVID-19—United States, February 12–May 18, 2020. MMWR Morb Mortal Wkly Rep 2020;69:923–9. PMID:32673298 https://doi.org/10.15585/mmwr.mm6928e1
9. CDC. Vaccinate with confidence: strategy to reinforce confidence in COVID-19 vaccines. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/vaccines/covid-19/vaccinate-with-confidence.html
10. CDC. The community guide: vaccination. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.thecommunityguide.org/topic/vaccination

COVID-19 Stats

Percentage of Middle and High School Students Aged 13–21 Years Attending In-Person Classes Who Reported Observing Fellow Students Wearing a Mask All the Time,* by School Setting and Activity — United States, October 2020



* Based on responses by students participating in a Falcon-CDC Foundation cross-sectional web panel survey administered using Qaltrics. Students were asked the following question: "Thinking about students you see at school, how often do these students wear masks in the following locations?" Responses ranged from "all the time" to "never."

Mask wearing is a critical mitigation strategy in preventing the introduction and spread of SARS-CoV-2, the virus that causes coronavirus 2019 (COVID-19), within school settings. In October 2020, a sample of 3,953 middle and high school students aged 13–21 years who were attending in-person classes were asked about mask use by fellow students in several settings. Approximately 65% of students reported that fellow students wore a mask "all the time" in the classroom and in hallways or stairwells. However, reported use of masks all the time was lower in other indoor locations, including school buses (42%), restrooms (40%), and the cafeteria (when not eating) (36%). Reported observed mask use all the time was lowest during sports or extracurricular activities (28%) and outside on school property (25%).

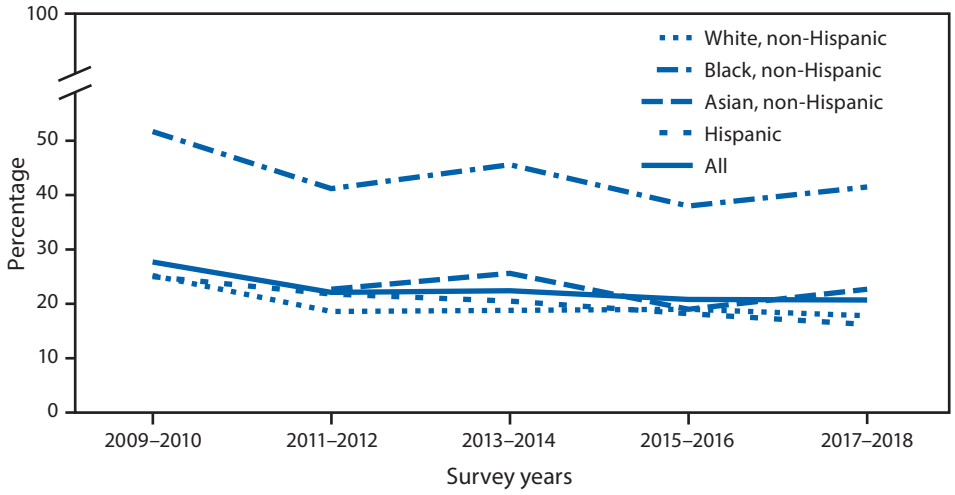
Source: Falcon Goal 1 Student Web Panel Survey, October 1–24, 2020.

Reported by: Wences Arvelo, MD, dwi4@cdc.gov; Melissa Fahrenbruch, MED; Marisa Hast, PhD; Richard Puddy, PhD.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Trends in Secondhand Smoke Exposure* Among Nonsmoking Adults, by Race† and Hispanic Origin — National Health and Nutrition Examination Survey, United States, 2009–2018



* Secondhand smoke exposure was defined as serum cotinine level of 0.05–10 ng/mL.
† All includes persons reporting other races not shown separately or more than one race. Data are not available for 2009–2010 for non-Hispanic Asian.

The percentage of nonsmoking adults exposed to secondhand smoke (SHS) declined from 27.7% in 2009–2010 to 20.7% in 2017–2018. During this period, decreasing trends in the percentage of persons with SHS exposure also were observed for nonsmoking non-Hispanic White, non-Hispanic Black, and Hispanic adults. There was no significant decline in the percentage of persons with exposure for nonsmoking non-Hispanic Asian adults from 2011–2012 to 2017–2018. The percentage of persons with SHS exposure was consistently higher for nonsmoking non-Hispanic Black adults throughout the period. During 2017–2018, 41.5% of nonsmoking non-Hispanic Black adults were exposed to SHS compared with 22.7% non-Hispanic Asian, 17.8% non-Hispanic White, and 16.2% nonsmoking Hispanic adults.

Source: Brody DJ, Faust E, Tsai, J. Secondhand smoke exposure among nonsmoking adults: United States, 2015–2018. NCHS data brief, no. 396. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2021.

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