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May 2024



Plan and Operations of the National Health and Nutrition Examination Survey, August 2021–August 2023

Programs and Collection Procedures



Centers for Disease
Control and Prevention
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Programs and Collection Procedures

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics

Hyattsville, Maryland
May 2024

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Plan and Operations of the National Health and Nutrition Examination Survey, August 2021–August 2023

by Ana L. Terry, M.S., R.D., Michele M. Chiappa, B.A., Juliana McAllister, M.A., David A. Woodwell, M.P.H., and Jessica E. Graber, Ph.D.

Abstract

Objective

The continuous National Health and Nutrition Examination Survey began data collection in 1999 and proceeded without interruption until operations were suspended in March 2020 in response to the COVID-19 pandemic. Once the Division of Health and Nutrition Examination Surveys was able to determine and resume safe field operations, the next survey cycle was conducted between August 2021 and August 2023. This report describes the survey content, procedures, and methodologies implemented in the August 2021–August 2023 National Health and Nutrition Examination Survey cycle.

Methods

To collect data in a pandemic environment successfully, the Division of Health and Nutrition Examination Surveys made key changes to the survey operations, including adding telephone administration of household and dietary interviews, significantly reducing the length of the household interview and examination, and adding screening and safety measures at the Mobile Examination Center.

Keywords: COVID-19 pandemic • field operations • Mobile Examination Center • survey design • NHANES

Introduction

The National Health Examination Survey has collected health-related data since 1959 and nutrition-related data since 1971 when it was renamed the National Health and Nutrition Examination Survey (NHANES). In March 2020, due to the COVID-19 pandemic, the Division of Health and Nutrition Examination Surveys (DHNES), National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC), suspended NHANES field operations. This was the first time survey operations were paused since continuous data collection started in 1999. This plan and operations report provides an overview on how DHNES planned, implemented, and conducted the August 2021–August 2023 NHANES. The first sections provide a brief history and describe the survey planning, including sample design and content development. The remaining sections describe data collection operations and data processing.

A Brief History of NHANES

The focus of NHANES has changed over the past 60 years to address different public health priorities, but has consistently included chronic diseases, environmental exposures, growth and development, and nutrition. The National Health Examination Survey was conducted periodically starting in 1959 to fulfill the National Health Survey Act of 1956,

which provides for a continuing survey and special studies “to secure accurate and current statistical information on the amount, distribution, and effects of illness and disability in the United States” (1). In 1971, to further emphasize the impact of nutrition on health, the first National Health and Nutrition Examination Survey was fielded. Beginning in 1999, NHANES began continuously collecting data on the health, nutritional status, and health behaviors of the U.S. civilian noninstitutionalized population. The goals of having an ongoing survey were to provide prevalence data on health conditions with high public health importance and associated risk factors; monitor trends in diseases, behaviors, and environmental exposures; explore emerging public health needs; and maintain nationally representative baseline information on health and nutritional status.

Each year, about 5,000 people from 15 different counties participate in NHANES. NHANES collects data from personal interviews, standardized health examinations, and laboratory tests. Health examinations are conducted in the NHANES Mobile Examination Center (MEC). Public and restricted-use data files are generally made available in 2-year cycles. For more information on the history of NHANES, its sample design and operational protocols through 2020, see the previously published plan and operations reports on the [NHANES website](#).

In March 2020, NHANES operations were suspended due to the COVID-19 pandemic. Because NHANES is a complex survey with specific operational requirements, restarting field operations in a pandemic environment posed several challenges that required DHNES to change longstanding survey protocols. To minimize the disruption in data collection operations, DHNES planned for a safe return to the field as soon as feasible. Substantial modifications were made to the survey operations to ensure participant and field staff safety. Data collection resumed in August 2021 and ran through August 2023. This report describes the changes made to the August 2021–August 2023 NHANES in response to the COVID-19 pandemic.

Planning for Data Collection

DHNES's primary goal when developing the August 2021–August 2023 NHANES protocol was to minimize transmission risk of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) to participants and staff, while continuing its mission of collecting nationally representative questionnaire and health measurement data. Data collection planning involved developing new procedures and revising existing protocols for a range of activities including, but not limited to, sample design, content development, field staff training, and field operations.

Shifting COVID-19 public health guidance challenged DHNES to be more flexible and informed decision making. All operational aspects of NHANES were assessed and, if needed, modified to meet new safety requirements while maintaining scientific rigor. Details of each element are described below.

Sample Design: Selection of Household Participants

Until 2020, the NHANES sample design included oversampling of certain race, Hispanic-origin, age, and income groups. This meant that large numbers of households needed to be screened for survey eligibility to identify enough NHANES participants from these population subgroups per cycle. In previous annual data collection cycles, NHANES selected and screened about 13,000 dwelling units (DUs) to identify, recruit, interview, and examine 5,000 participants (2). To limit possible SARS-CoV-2 exposure, the August 2021–August 2023 sample design was modified to eliminate oversampling by race, Hispanic origin, and income to reduce the number of DUs that needed to be screened (to about 7,000) to reduce face-to-face contact between NHANES field staff and the public. While this change reduced the number of DUs that field interviewers were required to contact, the annual target number of examined participants was maintained at 5,000, and at 10,000 for the full 2-year August 2021–August 2023 cycle. The total number of participants interviewed and examined is presented in [Table A](#).

Table A. Number of participants interviewed and examined: National Health and Nutrition Examination Surveys, 2015–2016 through August 2021–August 2023

| Survey cycle | Number of participants interviewed | Number of participants examined |
|---------------------------------------|------------------------------------|---------------------------------|
| 2015–2016 | 9,971 | 9,544 |
| 2017–2018 | 9,254 | 8,704 |
| 2019–2020 | Incomplete sample | Incomplete sample |
| August 2021– August 2023 | 11,933 | 8,860 |

SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Surveys, 2015–2016 through August 2021–August 2023.

The NHANES within-household selection of survey participants was modified so that instead of oversampling children ages 0–11 years, adolescents ages 12–19, or adults age 70 and older as in previous NHANES cycles, all people in a selected household ages 0–19 years and those 60 and older were eligible to participate. The number of people ages 20–59 selected for participation from a household depended on the total number of eligible people within that age group. For households with one to three eligible adults ages 20–59, one was randomly selected, and if there were four or more, two were randomly selected.

Content Development

DHNES has traditionally solicited new content for inclusion in each 2-year NHANES cycle. Due to time and resource constraints resulting from the pandemic, new content was not solicited for the August 2021–August 2023 cycle.

DHNES consulted with collaborators, stakeholders, and the NCHS Board of Scientific Counselors to identify changes needed to restart the survey in the COVID-19 environment. The aim was to protect both participants and staff by minimizing potential exposure to SARS-CoV-2 while collecting nationally representative public health surveillance data. One operational implication of this goal was to reduce the length of the survey (both the household questionnaires and the examinations in the MEC).

DHNES staff conducted a thorough review of questionnaire and MEC examination content from the 2019–2020 survey to consider it for inclusion in the August 2021–August 2023 survey. The criteria for questionnaire content was interview data that were: directly related to the interpretation of NHANES examination or laboratory data; used as covariates in analysis; used to provide prevalence estimates; or relevant to assessing the pandemic's impact on health behaviors and outcomes. Examination components were reviewed for safety, administration length, and usefulness for understanding the impact of the pandemic.

Historically, NHANES data collection has been conducted in person via computer-assisted personal household interviewing and MEC examination. When planning the August 2021–August 2023 survey, the mode of questionnaire administration was carefully considered to ensure that data collection could continue even if COVID-19 incidence rates impeded in-person data collection. To minimize face-to-face contact and lower exposure risk during field activities, DHNES modified the August 2021–August 2023 household questionnaires to be completed either in person or by telephone. The [household questionnaires](#) included a sample person (SP) questionnaire and family questionnaire.

Bilingual field interviewers administered interviews in Spanish and family members helped interpret for non-English, non-Spanish-speaking participants when interviews were conducted in person. Because it was burdensome to the respondent to interpret questionnaires into other languages over the telephone, phone interviews were conducted only in English and Spanish.

Sample person questionnaire

The SP questionnaire collected information on the participant’s demographic, socioeconomic, dietary, and health-related history. It was administered to all participants or their proxies (1). Of the 769 SP questionnaire items asked during the 2019–2020 in-person interviews, 337 questions were retained in the August 2021–August 2023 survey. DHNES discontinued the collection of water for fluoride and iodine testing, individual prescription medication data, and infant formula label information. Seventeen new questions were added, as well as a series of questions related to SARS-CoV-2 infection, vaccination, and testing, which were important for the interpretation of SARS-CoV-2 serology results. The COVID-19 questionnaire, unlike other NHANES questionnaire components, was revised throughout the August 2021–August 2023 survey cycle in response to changes in the COVID-19 environment and data needs.

Median interview time was reduced from 21 minutes for participants ages 0–15 years and 71 minutes for participants age 60 and older in 2019–2020 to 10 and 21 minutes, respectively. [Table B](#) describes the specific topics included in the SP questionnaire and each topic's age-group eligibility.

Family questionnaire

The family questionnaire collected information about the family and household. It was administered to the head of household or another adult household member. If the respondent for the family questionnaire was not a participant, questions related to demographics about the head of household were asked. Procedures for administering the family questionnaire are described in the [Interviewer Procedure Manual](#).

It is possible for a sampled DU to contain multiple families in the residence and, if so, a separate family questionnaire

Table B. Sample person questionnaire content: National Health and Nutrition Examination Survey, August 2021–August 2023

| Section | Description | Eligible age group (years) |
|--|---|----------------------------|
| Acculturation | Language spoken in the home | 3 and older |
| Audiometry | Hearing loss; reason for hearing loss; last hearing test; difficulty hearing with background noise | 1 and older |
| Blood pressure | High blood pressure diagnosis and treatment | 16 and older |
| COVID-19 | COVID-19 symptoms, testing, and vaccinations | All ages |
| Demographics | Education; marital status; military service; other demographic items | All ages |
| Dermatology | Sun exposure and sun protective behaviors | 20–59 |
| Diabetes | Diabetes diagnosis and treatment | 1 and older |
| Dietary behavior and nutrition | Breastfeeding duration; milk consumption and type of milk; school lunch program participation; community meal program participation for seniors | All ages |
| Early childhood | Weight at birth; current weight | 0–15 |
| Health insurance | Insurance status and type of insurance coverage | All ages |
| Hepatitis | History of hepatitis B virus infection | 6 and older |
| Spaceship utilization and access to care | Status of overall health; access to medical care | All ages |
| Immunization | Vaccination for hepatitis A and human papillomavirus | 2 and older |
| Kidney conditions | Kidney health | 20 and older |
| Medical conditions | Presence of different medical conditions, such as asthma | 1 and older |
| Occupation | Work in previous week or reasons for not working | 16 and older |
| Oral health | Health of teeth and gums | 1 and older |
| Physical activity and physical fitness | Physical activity; time spent being sedentary; screen time | 2 and older |
| Functioning | Impairment or health problems that limit abilities; use of wheelchairs or other items for assistance | 5 and older |
| Prescription medication | Number of prescription medications taken in the past 30 days; COVID-19 treatment; low-dose aspirin use | All ages |
| Sleep disorders | Sleeping habits | 16 and older |
| Smoking and tobacco use | Smoking behavior | 18 and older |
| Standing balance | Dizziness; falling | 20–69 |
| Weight history | Height; current weight; weight 1 year ago; whether tried to lose weight in past 12 months | 16 and older |

SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey, August 2021–August 2023.

Table C. Family questionnaire: National Health and Nutrition Examination Survey, August 2021–August 2023

| Section | Description |
|-------------------------|--|
| Demographic background | Head of household demographic information |
| Housing characteristics | Number of rooms in the home |
| Smoking | Tobacco smoking behavior of all people in the home |
| Consumer behavior | Food expenditures at the family level |
| Income | Monthly family income and cash assets |
| Food security | Household food security; participation in the Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) |
| Tracking and tracing | Name and address information for two friends or relatives |

SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey, August 2021–August 2023.

was completed for each identified family with at least one participant. [Table C](#) describes the content of the family questionnaire. The median time for this questionnaire was reduced from 15 minutes in 2019–2020 to 8 minutes in August 2021–August 2023.

Content of MEC examinations

To reduce possible exposure to SARS-CoV-2 by limiting the time participants spent in the MEC, DHNES shortened examination sessions from 4 hours to 2.5 hours. MEC components that were previously conducted in relatively small spaces or had prolonged examination times were modified or discontinued. The Balance component was reduced in scope and duration and the first dietary interview was completed by phone after the MEC examination instead of in person at the MEC as it was done in 1999–2020. Audiometry, words-in-noise, cognitive functioning, oral health, and human papillomavirus swab collection components were discontinued. Detailed information on the August 2021–August 2023 MEC examination is provided in the MEC Components section.

Ethical, Privacy, and Confidentiality Considerations

No changes in procedures from previous years regarding privacy and confidentiality procedures were needed. NHANES protocols were designed in accordance with the U.S. Health and Human Services regulations for the protection of human subjects in research. NHANES meets the definition of a surveillance project (as defined by the 2018 requirements of the Common Rule [45 CFR 46.102(l)(2)]) designed to assess and monitor the health and nutritional

status of adults and children in the United States. The survey protocols, procedures, questionnaires, consent documents, and participant materials were reviewed and approved by the Office of Management and Budget and the NCHS Ethics Review Board.

Collection of these data are authorized by Section 306 of the U.S. Public Service Act (24 U.S.C. 242k). All government and contractor staff working on NHANES are required to read and sign an affidavit of nondisclosure and are responsible for protecting the privacy and confidentiality of all survey participants. Information kept on interviewer tablets and MEC computers was secured through password protection, encryption, and other information technology security processes. For more information, see Data Processing and Information Technology.

Informed consent

Participation in NHANES is voluntary. Field interviewers and MEC staff informed participants about survey procedures and their rights as participants via written materials and consent scripts. Informed consent for NHANES has always been a multistage process and historically was obtained in person with a signature. In August 2021–August 2023, the process was modified in anticipation that many household interviews would be conducted via telephone rather than in participants’ homes. Verbal consent was obtained before administering the SP and family questionnaires, and written informed consent was obtained before the MEC examination (see the [Interviewer Procedure Manual](#)). In advance of their scheduled interviews, participants were provided with hard copy versions of the MEC examination consent/assent brochure, consent/assent form, consent/assent to conduct future studies form, a confidentiality brochure, and a health measurements list. These materials described the general goals of the survey, explained the voluntary nature of participation and the rights of participants, provided details about the MEC examination and laboratory assessments, and included examples of how NHANES data are used. All materials were available in English and Spanish.

Parents or guardians provided consent for their minor children’s participation. Minors ages 16–17 completed their own participant interview and were asked to provide assent after consent was obtained from their parent or guardian. Emancipated minors did not need parental permission. For cognitively impaired people, consent was obtained from guardians, parents, or representatives who had the legal right to consent to medical care on their behalf. Household interviews conducted via telephone were administered in English and Spanish. If the interview was conducted in person in a language other than English or Spanish, verbal consent was obtained using an interpreter.

At the completion of the household interview, the field interviewer introduced the MEC examination, described the various components, and introduced the participant to the MEC informed consent material. The participant was given

the opportunity to ask questions and, if they agreed to participate, a MEC appointment was scheduled.

MEC examinations occurred days or weeks after the household interview, depending on the preference of the participant and appointment availability. At the start of the MEC examination, a staff member administered informed consent for participation in the examination. Interpreters were available for participants who did not speak English or Spanish. The informed consent document that had been previously delivered and introduced by the field interviewer during the household interview was again provided to the participant for final review and signature on an electronic signature pad. Participants age 18 and older were asked to sign this form, and parents or guardians of participants younger than age 18 were asked to consent and sign for their children's participation. Minors age 7 and older provided their assent by signing for themselves on the same form as the parent or guardian. For children ages 7–11, the field interviewer read aloud a child assent brochure that explained MEC participation. The assent brochure was pictorial and written at a third-grade reading level.

Lastly, participants were asked to sign a separate consent form to allow NHANES to store their blood and urine specimens for future studies. This form was designed to answer participants' frequently asked questions and to collect electronic signatures for consent from participants age 18 and older and assent from participants ages 7–17.

Data Collection Operations

Data collection operations are inclusive of all activities related to the field implementation of NHANES and are designed to promote high response rates and collect data of the highest quality. In anticipation of collecting data in a pandemic environment, DHNES considered all operational aspects of the survey and made necessary safety adjustments to mitigate the risk of SARS-CoV-2 transmission. Operational elements included data collection schedules, advance planning and outreach in survey locations, field staff hiring and training, COVID-19 safety protocols, household eligibility screening, gaining participant cooperation, household interviewing, and MEC examinations. These are described in detail in the sections that follow.

Data Collection Schedule Development

Each NHANES sample design specifies that 15 locations are visited for data collection in a 12-month period to obtain a nationally representative sample. Dates of survey operations for each location are determined by several factors, including, but not limited to, the distance between locations and seasonal weather patterns. Data collection in each location occurs over about 9 weeks.

For the August 2021–August 2023 survey, DHNES added an initial location to pretest all systems and operations.

Pretesting was necessary to conduct quality control evaluations given the level of modifications made to the survey, the length of time the survey had been out of the field, and the number of new staff.

Advanced Planning and Outreach

To prepare for the arrival of NHANES staff at each survey location, logistical activities started 4–6 months before the start of data collection. These activities included notifying local public officials, identifying potential MEC site locations, and performing community outreach. Due to the COVID-19 pandemic, meetings with local health departments that had historically been held in person were held virtually or in hybrid form. The objectives of these meetings were to a) introduce NHANES and to provide a courtesy notification of the survey's arrival, b) discuss the benefits of participation and the importance of the community's endorsement in the success of survey operations, c) gather logistical information related to MEC placement, and d) share information about planned COVID-19 procedures to protect participants, visitors, and staff.

During the data collection period, NHANES disseminated tailored outreach materials to local advocacy and community groups. When possible, NHANES staff worked closely with county-level public information officers to secure media coverage to engage broader community support.

Field Staff Hiring and Training

NHANES field interviewing and MEC staff were hired based on their previous experience, academic training, knowledge, skills, and abilities. Bilingual staff were hired to meet the needs of Spanish-speaking participants. All staff were required to pass a CDC background check and obtain security clearance. Household interviewing and MEC examination staff completed a rigorous multiday training before beginning field work. Trainings were multimode and included web-based self-study and remote and in-person classroom sessions led by instructors. Staff received additional training on COVID-19 procedures and protocols. Details of some of these hiring and training procedures can be found on the [NHANES website](#).

COVID-19 Protocols for NHANES Field Staff

NHANES operations followed CDC's COVID-19 guidance and adjusted protocols as needed to strictly adhere to changing guidance and recommendations. COVID-19 risk levels were monitored using multiple data sources to compute metrics and risk-level measures similar to those developed by the Harvard Global Health Institute (3). DHNES considered the 7-day average of new daily cases of COVID-19 per 100,000 people when deciding between in-person and telephone interviews in each survey location and whether

MEC operations could begin or continue. All field staff were required to be vaccinated against SARS-CoV-2 and encouraged to receive booster vaccinations. Daily self-assessments of symptoms were required before conducting in-person NHANES activities. Masks were required while interacting with participants and while in the MEC. The mask policy for staff conducting household interviews was adjusted depending on CDC guidelines and local COVID-19 incidence rates.

SARS-CoV-2 polymerase chain reaction (PCR) testing was conducted on a routine basis (one to two times weekly) for all field staff, and antigen testing was required for MEC staff on all working days. If staff had symptoms, they were required to immediately isolate, inform their supervisors, and take a PCR test. If the PCR result was **negative**, they remained isolated and returned to work only after they were medically cleared per CDC guidance.

Any NHANES staff member who was in close contact with a SARS-CoV-2 positive person (via NHANES or through off-duty community contact), was quarantined in their lodging for the length of time recommended by CDC. NHANES contract study managers maintained close communications with staff to monitor their health and well-being.

Household Eligibility Screening

Households were screened for eligibility for survey participation by compiling a list of all people living in a household and collecting their demographic characteristics. In August 2021–August 2023, eligibility was determined by primary residence in the household, civilian and noninstitutionalized status, and age.

Since the launch of the continuous NHANES in 1999, household eligibility screening has been conducted in person at the doorstep of each sampled DU. In 2021, to reduce the level of in-person contact between field interviewers and the public and therefore reduce SARS-CoV-2 exposure risk, DHNES implemented a multimode eligibility screener with both self-administered and interviewer-administered options.

Using a “push to web” approach that encouraged households to respond online, a series of four mailings to sampled DUs encouraged online eligibility screener completion. The mailings included a) an initial invitation letter, b) a follow-up postcard, c) a hard copy version of the screener with a prepaid Express Mail return envelope, and d) a final reminder letter notifying households of an upcoming visit by an NHANES field interviewer. All mailings included the screener website address and a secure, personalized login, as well as a toll-free number to complete the screener by telephone. Responses received by telephone were routed to trained NHANES staff who administered the screener on a secure laptop. Completed paper screener responses were electronically entered. Households that responded via web, mail, or telephone were excluded from subsequent mailings.

If multiple mailing attempts yielded no completed screener response, an NHANES field interviewer contacted the household in person. Typically, multiple in-person attempts were needed to contact and screen households. If successful, the eligibility screener questionnaire was conducted with a household member age 18 or older. When at least one household member was found to be eligible to participate, the relationship questions were administered to determine how many family units were in the household.

Gaining Cooperation

NHANES, like all federal surveys, has faced declining response rates in recent years (4). Significant efforts were made to mitigate this challenge. Field interviewers were trained in refusal aversion and conversion techniques. Brochures, videos, and other materials that clearly explained the purpose and benefits of NHANES to individual participants and the larger community were developed. NHANES materials were available in both English and Spanish. If other languages were highly prevalent in specific survey locations, materials were translated into those languages. Households that completed a screener via the web, telephone, or mail and provided a telephone number were called by a field interviewer who would introduce NHANES and encourage identified eligible participants to take part in the household interview. If no phone number was available, a field interviewer visited the household. Eligible participants were given detailed information about NHANES and encouraged to complete their household interview. If a participant was reluctant, field interviewers attempted to understand and address their specific concerns.

Participant incentives

A fundamental approach to gaining survey participant cooperation is the removal of potential barriers to participation. Barriers for NHANES participation included associated costs, such as transportation to the MEC or childcare. NHANES provided participants with financial assistance to mitigate these barriers.

Participants were given incentives on a debit card as they completed each stage of NHANES data collection. In August 2021–August 2023, the NHANES incentive schedule was changed to provide incentives after completion of each data collection event instead of after the MEC examination, as in past cycles. A \$25 incentive was given at the completion of the household interview. MEC incentive levels were originally adjusted to account for the significant reductions in the examination duration to \$40 for minors younger than age 12, \$60 for those ages 12–15, and \$85 for those 16 and older. However, after seeing lower MEC examination response rates in several locations, DHNES increased the incentive to \$125 for participants age 16 and older, an amount comparable to previous cycles, as part of an experiment to assess the impact of the increased incentive

on response rates. All incentives and changes to incentives were approved by the Office of Management and Budget.

Additional incentives were provided for each data collection event after the MEC examination based on participant burden. Upon completion of both day 1 and day 2 dietary telephone interviews, participants received a \$25 incentive. After completing the Flexible Consumer Behavior Survey (FCBS), participants received a \$15 incentive.

NHANES offered other incentives to reduce the burden of participation. The parent of a minor child who was selected to participate received a \$20 incentive if the parent was not also selected. Participants received an allowance towards childcare or elder care expenses to cover costs during their time spent at the MEC. Transportation to the MEC was offered in the form of a taxi, rideshare (for example, Lyft or Uber), or a transportation allowance with rates based on the distance to the MEC and the local area's level of urbanization. Prepaid transportation incentives were often provided when MEC appointments were scheduled to discourage cancellations and no-shows.

Household Interviewing

NHANES August 2021–August 2023 data collection protocols were developed for both telephone and in-person administration of the SP and family questionnaires. This flexible design allowed real time adaptation to COVID-19 guidelines while ensuring continuous data collection. Depending on local COVID-19 incidence rates, household interviews could be conducted via telephone, inside participants' homes, or outdoors using appropriate safety precautions.

Field interviewers were trained to administer questionnaires using this mixed mode approach. This required comfort with conducting interviews over the telephone and guiding participants through the previously provided hard copy materials (informed consent documentation, show cards with response categories, etc.).

Scheduling MEC appointments

Once the household interview had been administered, the NHANES field interviewer introduced the MEC examination and its components as described in the Informed Consent Brochure. If more than one person in a household was eligible to participate, MEC examinations were typically scheduled when all participants in a household could attend. If a participant refused participation in the MEC examination, refusal conversion attempts were made throughout the duration of data collection in that survey location.

One to two days before a scheduled MEC examination, participants received reminder telephone calls or text messages to confirm their appointments. At that time, they were asked a brief set of COVID-19 screening questions based on CDC's [COVID-19 Facility Access Tool](#) to detect

possible infection or exposure. If the participant did not pass COVID-19 screening, the MEC examination was canceled for all participants in that household and, if possible based on CDC guidelines, appointments were rescheduled.

MEC Examinations

All NHANES examinations took place in the MEC. Before the launch of the August 2021–August 2023 data collection cycle, NHANES modified the MEC layout and procedures to increase participant and staff safety in the COVID-19 environment as described in the following section. Additional information can be found in the [procedures manuals](#) for each MEC component on the NHANES website.

Modifications to the MEC

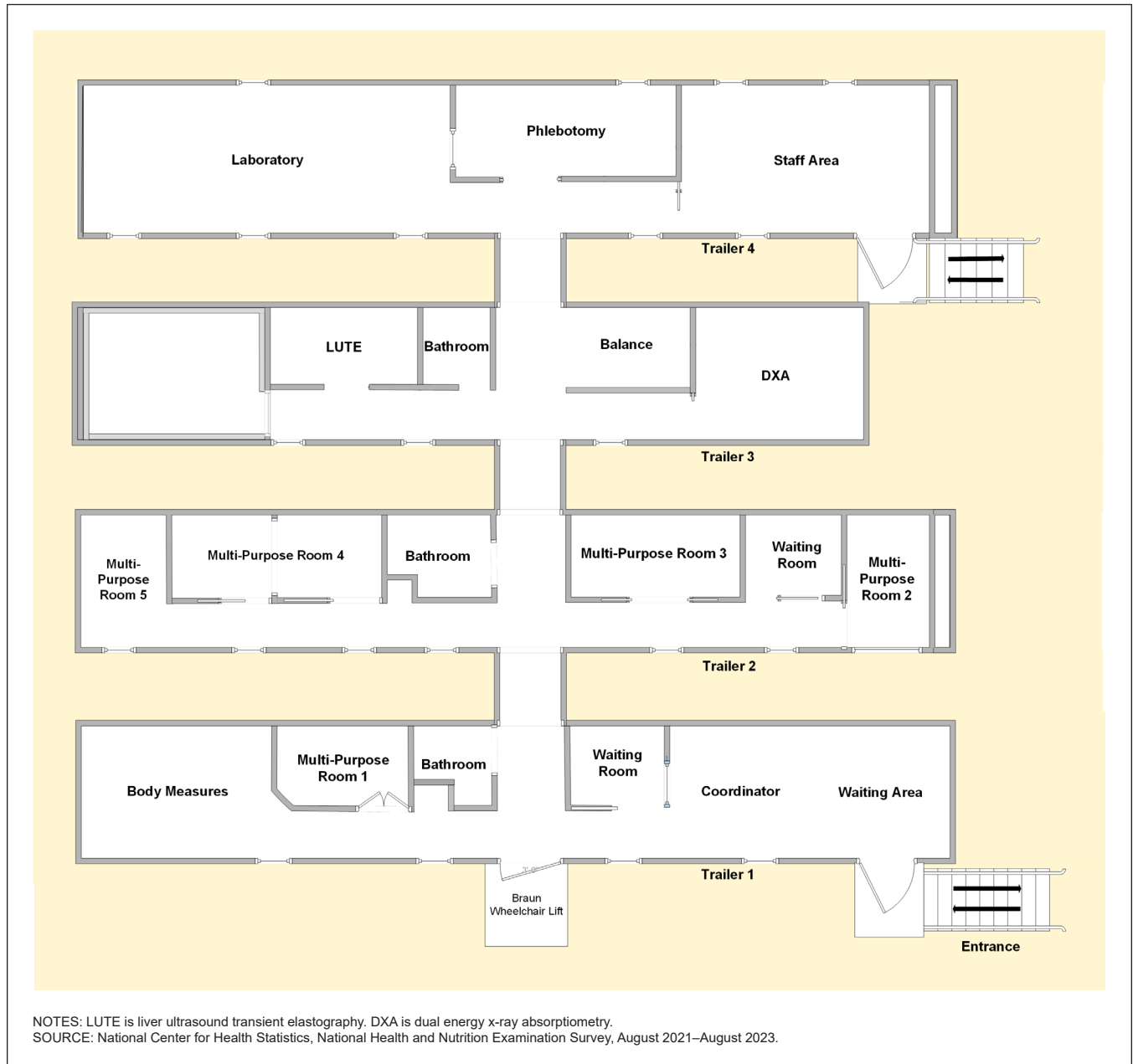
The NHANES MECs are designed to standardize the collection of health measures and laboratory specimens to minimize error. There are three MECs, two of which are in operation at any point in time, while the third travels to the next survey location. Each MEC consists of four individual trailers parked side by side that are linked by interconnecting hallways. The design and layout of all MECs were identical to minimize variation between survey locations. To facilitate social distancing between participants and MEC staff, room sizes were enlarged ([Figure](#)). Larger rooms also made it possible for participants to complete multiple examination components without changing rooms. Waiting rooms were created to prevent participants from different families from congregating in common areas.

NHANES also upgraded the MEC ventilation systems. Ventilation systems that had reached their end of life were replaced with systems that had minimum efficiency reporting values of 13, which have been shown to remove viruses from circulated air. Remaining systems were modified to install duct-mounted, needlepoint bipolar ionization systems that have been shown to enhance the efficiency of existing filters.

MEC participant schedule

In previous NHANES data collection cycles, NHANES participants could spend up to 4 hours at their MEC session, depending on the number of examinations for which they were eligible and the number of participants scheduled during that session. Maintaining this schedule during the COVID-19 pandemic was not feasible or safe. Each MEC session was reduced to 2.5 hours and restricted to no more than five participants to meet capacity guidelines set by CDC based on the MEC's square footage. MECs were open for appointments 5 days per week, including weekends, for about 6 weeks in each location. Before starting examinations in any location, a dry-run session was held to calibrate and test all equipment. Volunteers, often from local community stakeholder groups, served as participants for dry-run examinations.

Figure. Floor plan of the Mobile Examination Center: National Health and Nutrition Examination Survey, August 2021–August 2023



MEC COVID-19 procedures

NHANES implemented strict cleaning, social distancing, and other safety procedures while operating during the pandemic. Before entering the MEC, all staff, participants, and visitors (interpreters, contractors, consultants, etc.) were required to complete a COVID-19 self-assessment, adapted from CDC’s [COVID-19 Facility Access Tool](#). Study participants completed this screening twice: once during a reminder telephone call, and again at the MEC just before entry. MEC staff administered this screener and took temperature readings. Those with a temperature of 100.4 or higher, with reported symptoms, or who had recent contact with other SARS-CoV-2 positive people were not allowed to

enter the MEC and their examinations were rescheduled. Face masks were required of all participants, and NHANES provided surgical-grade masks to ensure an appropriate level of protection. Participants were asked to wash their hands after changing clothes in the MEC bathroom. Hand sanitizer was available in each examination room, and three handwashing stations were located throughout the MEC.

MEC staff wore personal protective equipment including surgical masks, disposable paper gowns or jackets, and gloves. Technicians also minimized the need for close contact as much as possible while conducting examinations. After each participant completed each MEC component, staff

disinfected surfaces with CDC-recommended, Environmental Protection Agency-registered cleaning products.

MEC components

The following sections describe the examination components administered in the MEC during the August 2021–August 2023 NHANES cycle. Eligibility for each component was determined by the participant’s age and sex (Table D). Before venipuncture (taking blood) and examinations, participants were screened for exclusionary conditions. Detailed protocols and procedures can be found in the [2019–2020 Procedure Manual](#) and the [August 2021–August 2023 Procedure Manual](#).

Anthropometry (body measures)

The anthropometry component collected body measures data to: a) estimate the prevalence of overweight and obesity in the U.S. population; b) study the association between body measures and body composition; c) study associations between weight and body measures and health conditions and health risk factors such as cardiovascular disease, diabetes, hypertension, physical inactivity, and dietary patterns; and d) monitor growth and development in children and adolescents. Age ranges varied for each body measurement. No changes from past protocols were made to this component for the August 2021–August 2023 data collection cycle.

Balance

NHANES first measured balance in 1999–2004 and reintroduced this component in 2019–2020 to assess the prevalence of standing balance dysfunction and explore associated risk factors. To reduce the length of the examination, in August 2021–August 2023 the component was limited to the Modified Romberg Test. Binocular static acuity, dynamic visual acuity, contrast sensitivity, and lensmeter tests were discontinued. Age-group eligibility

Table D. Mobile Examination Center examination components: National Health and Nutrition Examination Survey, August 2021–August 2023

| Component | Eligible age group (years) |
|---|----------------------------|
| Anthropometry or body measures | All ages |
| Blood pressure | 8 and older |
| Dietary scheduler | All ages |
| Dual-energy x-ray absorptiometry | 8–59 |
| Liver ultrasound transient elastography | 12 and older |
| Mobile Examination Center interview | 12 and older |
| Venipuncture | 1 and older |
| Urine | 3 and older |

SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey, August 2021–August 2023.

changed from age 40 and older in 2019–2020 to ages 20–69 in August 2021–August 2023.

Blood pressure

Health technicians measured participants' blood pressure and pulse using the Omron HEM-907 XL device to assess the prevalence and trends in hypertension and monitor risk factors for major cardiovascular conditions. Blood pressure measurements were taken for participants age 8 and older. The only change made to this component was that the measurement of resting pulse rate was not performed for children ages 0–7 years.

Dual energy x-ray absorptiometry

The August 2021–August 2023 dual energy x-ray absorptiometry component obtained whole body scans of participants to provide information on lean mass, fat mass, percentage body fat, and regional body volume (including lung volume). NHANES provides nationally representative data on body composition to study associations between a) body composition and other health conditions and risk factors, such as cardiovascular disease, diabetes, hypertension, physical activity, and dietary patterns; and b) lung volume and other health conditions. Nonpregnant survey participants ages 8–59 were eligible for this examination. NHANES discontinued the osteoporosis assessment of the

Table E. Mobile Examination Center interview questionnaire components: National Health and Nutrition Examination Survey, August 2021–August 2023

| Questionnaire name | Description | Eligible age group (years) |
|--|--|----------------------------|
| Alcohol Use | Alcohol use | 12 and older |
| COVID-19 | COVID-19 symptoms, testing, and vaccinations | All ages |
| Current Health Status | HIV testing | 16 and older |
| Mental Health – Depression Screen | Depression symptoms over the past 2 weeks | 12 and older |
| Drug Use | Drug use | 12–59 |
| Kidney Conditions – Urinary Incontinence | Urinary incontinence | 20 and older |
| Physical Activity and Physical Fitness | Physical activity and physical fitness | 12–15 |
| Reproductive Health | Menstrual and pregnancy history | Females 12 and older |
| Sexual Behavior | Sexual behavior | 14–69 |
| Sexual Orientation | Sexual orientation | 18–59 |
| Tobacco Use | Tobacco use | 12 and older |

SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey, August 2021–August 2023.

proximal femur (hip) and anterior or posterior lumbar spine scans that had been done in the 2019–2020 cycle to reduce dual energy x-ray absorptiometry examination time.

Liver elastography

The liver elastography component, which was added to NHANES in 2017–2018, continued unchanged; this test provides data for population estimates for liver fibrosis for those age 12 and older.

MEC interview

The MEC interview consisted of questionnaires administered by a health technician in a private setting and self-administered questions conducted using an audio computer-assisted self-interview system. Data from the MEC interview are used as covariates with examination and laboratory data. Several changes were made to this component in August 2021–August 2023.

Participants were asked about health conditions and behaviors, including sexual orientation, sexual behavior, drug use, depression, reproductive health, tobacco use, alcohol use, incontinence, and recent physical activity. The number of questions on alcohol use, drug use, kidney conditions, reproductive health, sexual behavior, and tobacco use was reduced. Questions about cognitive functioning, pesticide use, and weight history from the 2019–2020 survey cycle were discontinued in August 2021–August 2023. A questionnaire related to COVID-19 was added to the household interview and the MEC interview. Age eligibility for the questionnaires varied by component (Table E). All MEC interview questions were self-administered except for the COVID-19 questions, which were asked by a health technician.

The purpose of the COVID-19 questionnaire in the MEC was to note any exposures or immunizations that occurred between the date of the household interview and the MEC examination. These data can be used to interpret laboratory results. Questionnaire instruments for the 2019–2020 and August 2021–August 2023 survey cycles can be found on the NHANES website.

Urine

A urine sample was collected from all participants age 3 and older to obtain laboratory results that provide prevalence estimates of disease, risk factors for examination components, and baseline information on health and nutritional status of the U.S. population. Specimens provided by female participants ages 12–59 and menstruating female participants ages 8–11 were also tested for pregnancy. There was no change to the urine collection in August 2021–August 2023 from the 2019–2020 protocol.

Venipuncture

The venipuncture protocol stayed the same as in the 2019–2020 survey cycle. Blood was drawn for participants age 1 and older to obtain laboratory results that provide prevalence estimates of disease, risk factors, and baseline information on health and nutritional status of the U.S. population. The amount of blood drawn varied by age: 10 mL (0.3 ounces) for children ages 1–2 years; 20 mL (0.7 ounces) for children ages 3–5; 45 mL (1.5 ounces) for children ages 6–11; and 112 mL (3.8 ounces) for those age 12 and older.

The Clinical Laboratory Improvement Amendments-approved MEC laboratory was equipped with a biohood, complete blood count and differential analyzer, two centrifuges, refrigerators, and freezers. Blood was aliquoted into vials, stored, and shipped to outside laboratories for analysis. Complete blood count testing was performed in the MEC. For participants who consented, specimens were banked for future studies. Excess serum that remained after testing at remote laboratories was also shipped to NHANES repositories and stored for future research for consenting participants.

SARS-CoV-2 serology—A blood test for SARS-CoV-2 antibodies was added for the August 2021–August 2023 survey for participants who provided a blood sample. Two antibody tests were performed, one to detect antibodies to the spike protein from both natural infection and vaccination and a second to detect antibodies to the nucleocapsid protein from natural infection. The goal was to produce nationally representative prevalence estimates of past infection or vaccine-induced immunity for people age 1 and older. This information can be used in conjunction with other examination and laboratory data to further assess the impact of the COVID-19 pandemic on the nation's health.

Liver elastography genetics—The NHANES liver elastography genetic blood test assesses the risk of developing chronic liver disease and related conditions in a nationally representative U.S. population by combining the liver ultrasound transient elastography observations, liver enzyme laboratory data, viral hepatitis serology, and questionnaire data (which includes alcohol use) with data on genetic variants and DNA methylation. Participants age 18 and older were eligible to participate in this component. There was no change to this blood test in August 2021–August 2023.

Post-MEC Interviews

The August 2021–August 2023 NHANES protocol included three telephone interviews that occurred after the MEC examination: the day 1 dietary interview, the day 2 dietary interview, and the FCBS. The day 1 dietary interview, which had been administered in person at the MEC in previous survey cycles, was changed to a telephone interview to minimize SARS-CoV-2 exposure.

Dietary interviews

In August 2021–August 2023, NHANES continued to conduct two dietary recalls through a partnership between the U.S. Department of Agriculture and the U.S. Department of Health and Human Services. As previously noted, NHANES changed the mode of the day 1 dietary interview from in person during the MEC examination to telephone after completion of the examination. This resulted in a significant reduction in participants' time at the MEC. It was not possible to conduct studies before data collection began, precluding analysis of potential effects from a change in mode of the day 1 dietary recall.

Dietary scheduler

During the MEC examination, all participants were asked to schedule an appointment to complete the day 1 dietary telephone interview. The dietary interview was scheduled 3–7 days after the MEC examination. Before leaving the MEC, participants received a [Food Model Booklet](#) and measuring aides to use during the telephone interview to estimate the amounts of foods and beverages consumed.

First dietary interview

Highly trained interviewers administered the 24-hour dietary recall using the U.S. Department of Agriculture's Automated Multiple Pass Method in English and Spanish. Participants used a Food Model Booklet and other measuring aides to estimate the amounts of foods and beverages consumed during the previous 24 hours. The measuring aides consisted of a [set of measuring cups](#), [a set of measuring spoons](#), [a household tablespoon](#), and [a household teaspoon](#). The Food Model Booklet contained pictures of plates, mugs, glasses, bowls, mounds, wedges, grids, circles, a shape chart, and a chicken chart with labels. The median time of the dietary interview ranged from 31 minutes for participants ages 0–2 years to 43 minutes for adults age 60 and older.

Dietary Supplement Questionnaire

The Dietary Supplement Questionnaire to collect information on 30-day supplement use historically had been conducted during the household interview. For August 2021–August 2023, the questions were asked during the telephone day 1 dietary interview. To reduce participant burden, the 24-hour dietary supplement use questionnaire in the day 1 and day 2 dietary interviews was discontinued.

Methodology studies were not feasible before data collection began; thus, analysis of potential effects from a change in mode of the dietary supplements questionnaire was not possible.

Second Dietary Interview

A second 24-hour dietary recall interview was conducted to obtain a more complete picture of usual dietary intake

of the U.S. population. As in previous cycles, this interview continued to be administered by phone and was scheduled 3–10 days after the first recall on a different day of the week.

Flexible Consumer Behavior Survey

FCBS was unchanged in August 2021–August 2023. This 15-minute telephone interview was conducted after completion of a second dietary interview. The aim of the August 2021–August 2023 FCBS was to collect information on the participants' knowledge, attitudes, and beliefs about nutrition and food choices. The questions were administered at the individual level for participants age 16 and older and at the family level for children ages 1–15 years. Participants age 1 year and older who completed the Consumer Behavior Questionnaire in the Family Interview and the first 24-hour dietary recall were eligible for FCBS.

Report of Findings

Participants were provided with the results of the health measurements and laboratory tests performed in the MEC in stages. The NHANES Physician Advisory Group developed protocols for reporting results to participants and parents of minor participants. Participants were informed during the consent process about which results would be reported to them. Reporting protocols were reviewed and approved by the NCHS Ethics Review Board.

At the conclusion of their MEC examination, participants received a preliminary report of findings. This included all results that could be determined in the MEC, including height, weight, blood pressure, and a complete blood count. Emergency or Level I findings, such as a dangerously high blood pressure, were considered a medical emergency and handled immediately by the MEC clinician or by calling 911. Any other findings of concern (Level II) were addressed by the MEC clinician and local referrals were made if needed (for example, elevated blood pressure that needed monitoring by a health care provider, but not so high as to require immediate medical intervention).

Level II findings might also be detected by the NHANES Chief Medical Officer when results were obtained for testing performed in outside laboratories. These results were sent to participants by mail about 3–4 weeks after their examination as Early Reports and indicated items for which follow up with a health care provider was recommended. All survey participants received their Final Report of Findings (or Level III/Routine Findings) via mail about 4 months after their MEC examination. Contact information for the NHANES Chief Medical Officer was provided in all correspondence to participants in case they had questions or concerns about their results.

Results for sexually transmitted infection and HIV tests were provided over the telephone by trained DHNES counselors. During the MEC examination, the clinician explained the testing and provided pretest counseling. If participants

agreed to the testing, they set up personal passwords (or were provided a randomly generated password if they declined to provide a personal password) to retrieve their results. Once results were available, text and mail reminders were sent to encourage participants to call to speak with a counselor and receive their results.

Data Processing and Information Technology

DHNES uses a series of integrated systems to collect questionnaire, examination, and laboratory testing data; case management information; workflow processes; and administrative information. NHANES data were secured using encryption and protected from loss through regular automated backups and secure off-site storage.

NHANES released public-use data files of NHANES August 2021–August 2023 data with a 2-year sample. Data were edited for accuracy, consistency, and to protect participant confidentiality. Direct personal identifiers, as well as any indirect identifiers or other personal characteristics that might lead to the re-identification of a participant, were removed. All data were reviewed by the NCHS Disclosure Review Board and further edited to reduce disclosure risk based on their recommendations. Data not released publicly on the NHANES website may be accessed via the [NCHS Research Data Center](#) through a proposal process.

Conclusion

For NHANES August 2021–August 2023, many obstacles had to be overcome and changes made to allow NHANES data collection in pandemic and postpandemic environments. DHNES developed and implemented flexible safety protocols to address pandemic risk situations, ensured that sufficient staff, equipment, and supplies were available to meet data collection targets, and took necessary steps to minimize sources of bias in the data collection process.

NHANES strives to be responsive to current public health needs, and the COVID-19 pandemic provided a unique opportunity to contribute to the understanding of its impact on the health of the U.S. population.

For more information on the NHANES August 2021–August 2023 cycle, visit the [NHANES website](#).

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Glossary

Civilian noninstitutionalized population—Includes all people living in households and excludes those in institutional group quarters and those on active duty with the military. This is the target population for the National Health and Nutrition Examination Survey.

Household—The person or group of people living in an occupied dwelling unit.

Mobile Examination Center (MEC)—A group of four trailers parked side by side and connected by enclosed passageways. Partitions were custom built in each trailer to create areas where participants were checked in, health measurements were obtained, interviews were conducted, blood was drawn, and laboratory tests were performed. Three MECs were used in August 2021–August 2023 to collect survey data; two were in operation in two separate locations, while the third traveled to a new location. The MECs were designed to provide a standardized environment to minimize site-specific error. The layout was identical in the three MECs to avoid bias in data collection between survey locations ([Figure](#)).

Screener—A screening interview (usually short) consisting of a set of questions asked of a household member to determine if the household contains anyone eligible for the survey. In the National Health and Nutrition Survey, the screener consisted of compiling a household roster and collecting information about the sex, age, race, and Hispanic origin of all household members. In the National Health and Nutrition Examination Survey, only people age 18 and older were eligible to answer the screener.

Screening—The process of conducting, or attempting to conduct, the screening interview in the selected dwelling units. Occupied dwelling units (households) are screened using the screening interview. Other units can also be screened; the process for these units is simply verification that they are vacant or that they are not dwelling units.

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