

NHANES Contributions to Public Health

Slide 1

50 Significant NHANES Contributions to Public Health

Slide 2

Data Used for Public Health Policies and Programs

Slide 3

Pediatric Growth Charts

- Developed by NCHS/CDC in 1977 and 2000
- Clinical tools to track children's growth
- Addition of BMI charts to track overweight
- Growth charts are one of the most widely used NCHS products
- 2007 WHO growth charts use NHANES data

Alternative text for image: picture of three babies and the growth charts

Slide 4

Monitoring Obesity in the US Over the Last Generation

In adults

- Increase in obesity between 1976-80 and 1988-94, with a continued upward trend through 2005-06

In children

- A similar increase documented between 1988-94 and 2005-06

NHANES weight and height data used for Federal nutrition recommendations, dietary programs and policy:

- USDA School Lunch and Breakfast programs
- WIC program eligibility
- Dietary Guidelines for Americans
- Obesity Education Initiative
- Shape Up America

Alternative text for images:

Newspaper article with the headline "Study Finds that in U.S., 1 in 3 are Obese."

Line graph showing increase in obesity for females, males and both genders

Slide 5

Evaluating Folic Acid Fortification

- FDA regulation to fortify grain products with folic acid (1998)
- NHANES data pre- and post- fortification showed increased blood folate levels in young women
- Vital Statistics data showed ultimate impact with declines in Spina Bifida rates
- Continuing data collection allows evaluation of fortification policy safety

Alternative text for images:

Picture of mother with baby reaching to touch a pregnant women's belly

Line graph showing increase in median RBC folate levels in women 15-45 years of age and children 4 years of age and older, and corresponding decrease in Spina bifida rates

Slide 6

Tracking Iron Deficiency Anemia

- Grain and cereal product iron fortification based on low iron levels from NHANES I (1970-73)
- WIC used NHANES cut-off values for participant eligibility
- NHANES II & III iron status used to set RDAs by Food and Nutrition Board (1989 & 2001) and to track progress on *Healthy People* objectives to reduce iron deficiency (1990-now)

Alternative text for image: cartoon drawing of a box and bowl of cereal

Slide 7

Monitoring Iodine Levels after Fortification Policy Changes

- Iodine deficiency disorders such as goiter, cretinism and stillbirth virtually eliminated through the iodization of salt
- NHANES I, III and 2000 data showed the dietary sufficiency of changes in iodine fortification decisions

Alternative text for image: cartoon drawing of salt and pepper shaker

Slide 8

First National Survey with Expanded Dietary Supplement Data

- Continuous NHANES uses label-based nutrient data for over 7,000 products
- In 1988-94 more detail was collected on dose, frequency, and manufacturer allowing quantification of nutrient intake from supplements

Alternative text for image: Line graph showing percentage of dietary supplement use among women, men, and both genders aged 20 years and older increasing from 1971-1974 to 2003-2006

Slide 9

Total Nutrient Intake - Nutrient Intake from Diet and Dietary Supplements

- Increasing prevalence of supplement use in the US
- Supplement use is an integral component of nutrient intake
- NHANES supplement data drove development of methods for estimating total intake
- First national estimates of total nutrient intake from NHANES III
- Data used for setting Dietary Reference Intakes (DRI) by National Academy of Sciences

Alternative text for image: Area graph showing the distribution of vitamin C intake for the total population from 1988-1994 and the proportion from diet alone and diet plus supplements.

Slide 10

First Measured Physical Activity Data in the US

- Measured PA significantly lower than self-reported PA
- Less than 5% of adults achieve recommended 30 minutes/day PA
- NHANES PA data used in Healthy People 2010 and to evaluate compliance with PA Guidelines

Alternative text for images:

Picture of accelerometer

Collage of pictures of people playing basketball, jogging, and walking

Line graph showing the step count for one person throughout the day

Slide 11

Monitoring Declines in High Cholesterol

NHANES measures National Cholesterol Education Program (NCEP) success

- Total cholesterol declined from 1960-2008: Healthy People 2010 goals met
- LDL cholesterol decline between 1976-2002 paralleled decreased dietary fat intake recommended in NCEP
- Total and LDL cholesterol declines since 1999 parallel introduction of statins

Alternative text for images:

Cartoon drawing of stoplight with cholesterol levels

Line graph showing Healthy People 2010 Target of 200 mg/dL cholesterol goal and average total cholesterol for men and women decreasing over time

Slide 12

Tracking Hypertension

- Used to track hypertension prevalence by Joint National Committee on Detection Evaluation and Treatment of High Blood Pressure since 1980
 - Decline between 1976-80 and 1988-1994
 - Increase between 1988-94 and 1999-2000
- Since 1988-94 interview plus measured blood pressure data allow estimation of awareness, treatment, and control of hypertension

Alternative text for images:

Picture of interviewer interviewing participant in her home

Picture of participant having his blood pressure measured by a doctor in the Mobile Examination Center

Bar chart showing awareness of hypertension among hypertensive adults in the United States from 2005-2006

Line graph showing measured blood pressure from 1960-1962 to 1999-2002

Slide 13

Monitoring Increase in Diabetes, Measuring Disease Management & Undiagnosed Disease

Monitor Diagnosed and Undiagnosed Disease

- Diagnosed diabetes doubled from 3.4% to 7.7 % between 1976-80 and 2005-2006
- 12.9% of adults age \geq 20 years have diagnosed or undiagnosed diabetes (2005-2006)
- 42% of adults age \geq 20 years have diabetes or pre-diabetes (2005-2006)

Monitor Improvements in Diabetes Management

- Hemoglobin A1C declined from 7.8% to 7.2% between 1999-2004 (good control = 7.0%)

Alternative text for images: Bar chart showing percentage of population with diabetes and pre-diabetes in 2005-2006. 7.7% are diagnosed; 5.1% were undiagnosed; 29.5 % had impaired fasting glucose or impaired glucose tolerance.

Slide 14

Chronic Kidney Disease (CKD) – Less Than 5% Aware

- Risk factors include diabetes, hypertension & obesity
- CKD can lead to end-stage renal disease (stage 5)
- CKD increased from 10% to 13.1% (1988-94 to 1999-04)
- Awareness ranged from 3.7% (stage 1) to 41.8% (stage 4)

Alternative text for image:

Ultrasound cross-section of kidneys

Slide 15

First National Estimates of Lower Extremity Disease (LED)

Peripheral Neuropathy (PN)

- 14.8% of adults \geq 40 years
- 19.4% of diabetics

Peripheral Arterial Disease (PAD)

- 4.5% of adults \geq 40 years
- 7.5% of diabetics

Alternative text for images:

Screenshot of software used to record lower extremity disease results

Picture of equipment used to gather data on peripheral arterial disease

Slide 16

First Exam-based Study of Gallbladder Disease

- NHANES III was the 1st US population-based study to use ultrasonography to detect gallbladder disease.
- Analyses revealed Mexican-American ethnicity a significant risk factor for gallbladder disease in women

Alternative text for image:

Illustration of abdomen highlighting gall bladder

Slide 17

Principal Data Source of Measured Arthritis

Rheumatoid Arthritis (RA)

- First national estimates from NHES
- Updated prevalence using revised criteria (NHANES III)

Osteoarthritis (OA)

- Estimates based on X-ray results
- 37% older adults had knee OA (NHANES III)

Back Pain

- Seminal low back pain estimates from NHANES II
- First national survey of Spondyloarthritis (NHANES 2009-10)

Alternative text for images:

Picture of arthritic hands

X-ray of knees

Illustration of regions of the spinal column

Picture of person having their back measured

Slide 18

Characterized Osteoporosis in the US and Established International Reference Database

- First national survey to include Dual Energy X-ray Absorptiometry in mobile exam setting
- NHANES III femur bone mineral density data adopted as reference standard by International Committee for Standards in Bone Measurement
- Reference database used by WHO for calculation of absolute fracture risk scores (FRAX™)

Alternative text for images:

Whole body X-ray

Inset of whole body X-ray showing hip bone

Slide 19

Documented Emerging Infectious Diseases

HIV

- 1st prevalence estimates of HIV infection in US household population (NHANES III)
- Findings assisted in prevention campaigns and treatment program development

H. Pylori

- 1st estimates of H. Pylori prevalence in U.S. adults (NHANES III)
- Indicated almost one third of adults infected with H. Pylori

MRSA

- 1st national estimates of staphylococcus & MRSA carriage (NHANES 2001-2004)
- Characterization of predominant subtypes and changes in these patterns helped shape prevention policies

Alternative text for images:
Cartoon drawing of germ

Slide 20

Infectious Disease Data Used to Shape Vaccine Policy

Hepatitis B (HBV)

- 1st estimates of HBV in U.S. household population (NHANES II)
- Findings instrumental in implementation of HBV universal vaccination of children

Human Papilloma Virus (HPV)

- NHANES 2003-2004 showed 1 in 4 females 14 - 59 years old infected with HPV
- Findings informed ACIP as they developed recommendations for HPV vaccination

Alternative text for images:

Picture of mother holding baby while doctor gives the baby a vaccination shot

Picture of a girl getting a vaccination shot from a doctor

Slide 21

NHANES used to Monitor Vaccination Policy

- 1st national estimates of vaccine-preventable disease immunity (NHANES III)
 - Tetanus
 - Pertussis
 - Diphtheria
 - Rubella
 - Varicella
 - Measles
- National Foundation of Infectious Diseases started 2004 immunization campaign "The Power of 10" based on NHANES III findings
- Raises awareness for 10-year tetanus and diphtheria booster

Alternative text for images:

Carton drawing of virus with bottle labeled vaccine and hypodermic needle

Slide 22

Documented Declines of Blood Lead Levels after Removal of Lead from Gasoline, Paint and Other Household Agents

- Provided key information in the policy decision to eliminate leaded gasoline in the US
- Continuous monitoring of additional lead exposure and helped to target screening of children in inner-city areas

Alternative text for images:

Line graph showing predicted blood lead, gasoline lead, and observed lead levels

Bar chart showing percent of U.S. children 1-5 years of age with blood levels greater than or equal to 10 micrograms per deciliter – 88% in 1976-1980; 4% in 1991-1994 and 2% in 1999-2000.

Slide 23

First US Population-based Assessment of Mercury Exposures in Women and Children

- Comprehensive assessment with biological specimens of blood, urine, hair, and related behaviors such as fish and shellfish consumption
- Essential information to help formulate dietary recommendations on fish consumption for pregnant women
- Important baseline data to track long term policies to reduce methyl mercury exposure

Alternative text for images:

Line graph showing blood mercury levels

Bar chart showing frequency of fish consumption in past 30 days

Bar chart showing percentage of women 16-49 years of age having blood mercury concentrations greater than those associated with exposures considered higher than U.S. EPA's RfD for MeHg.

Cartoon drawing of a fish listing species lower in Mercury concentration.

Slide 24

Elucidating Exposure to Second Hand Smoke (SHS) & Monitoring Reduction Policies

- 1st measured biological assessment of SHS in US (NHANES III)
- Documented widespread SHS exposure – 84% of non-smokers
- Trend analysis showed decline of 45% among nonsmokers between 1988-94 and 1999-2004
- Inverse relationship between smoke-free law coverage and SHS exposure

Alternative text for images:

Picture of children with cartoon cigarette with no smoking symbol superimposed

Bar chart showing decrease in smokers as a percentage of the U.S. population from 84% in 1988-1994 to 46% in 1999-2004.

Slide 25

Lung Disease Prevalence Estimates and Spirometry Reference Data

- First national estimates of asthma and COPD (exam-based)
- NHANES III spirometry data used to establish U.S. reference ranges
- Allergy components expand asthma epidemiology
- Interdisciplinary research including environmental and occupational lung disease and mortality

Alternative text for images:

Collage of woman having her lung capacity tested in the Mobile Examination Center, an interviewer taking an allergen sample from a participant's home, screenshots of the software used to record data.

Slide 26

Tracking Oral Health and Monitoring Prevention Initiatives

- 1st standardized dental exam to collect national oral health data (HES)
- 1st estimates of US dental conditions (HES)
- NHANES data used in 1st Surgeon General's Report on Oral Health in the US in 2000
- NHANES used as baseline data for oral health for Healthy People

Alternative text for image: cartoon drawing of a mouth showing teeth

Slide 27

Monitoring Visual Health in the U.S.

Vision assessed in HES, NHANES I & Continuous NHANES

Currently....

- 11million have visual impairment that can be corrected with glasses/contact lenses
- 3 million have visual impairment that cannot be corrected with glasses/contact lenses

Alternative text for image: Piechart with eye as background showing 83% of visual impairments can be corrected with glasses or contact lenses; 17% cannot be corrected with glasses or contact lenses

Slide 28

Setting National Audiometric Standards & Tracking Trends and Disparities in Hearing Loss

- 1st national prevalence estimates of hearing loss based on audiometric data (HES)
- Used to define normal audiograms
- Mainstay of public health tracking and risk assessment for hearing loss (NHANES I, II, III, 1999-2009)
- 16% of adults age 20-69 years have speech-frequency hearing loss (NHANES 1999-2004)
- Identified risk factors, e.g. noise, smoking, and environmental toxins
- Helped guide prevention efforts to reduce hearing loss

Alternative text for images:

Cartoon drawings of ears

Line charts showing frequencies in right and left ear

Slide 29

Informs Economic Benefits Analyses and Policy

NHANES key data for

- Modeling disease patterns and effects of healthcare intervention
- Modeling federal costs under alternative health policies

Alternative text for images:

Cartoon drawing of a man looking at bills

Images from health care reform

Slide 30

Population-based Resource for key Public Health Issues

Slide 31

Keystone of 21st Century US Nutrition

Integrated Source of Nutrition and Health data

- Develop Physical Activity Guidelines for Americans
- Revise Dietary Reference Intakes
- Track Healthy People Objectives
- Revise Dietary Guidelines for Americans

Alternative text for images:

Blocks labeled Consumer Behavior, Physical Activity, Dietary Supplements, Dietary Intake, Anthropometry, and Biochemical Measures, with a keystone labeled with the NHANES logo

Slide 32

Cornerstone of the CDC's National Biomonitoring Program and the US Environmental Exposure Report Card

- Monitoring environmental exposures through direct measures of over 200 chemicals in blood, urine, or hair
- Passive exposure monitors for volatile chemicals, household dust, allergen and water samples
- Data reported in CDC's National Report on Human Exposure to Environmental Chemicals

Alternative text for images:

Picture of the cover of the Third Report on Human Exposure to Environmental Chemicals (2005)

Picture of staff working the lab at the Mobile Examination Center

Slide 33

Linked Prescription Drug Use Status to Health Measures and Biochemistries

- Provide estimates of national prescription drug use
- Identify specific diseases or conditions
- Examine trends in drug use
- Identify patterns of use
- Examine impact of guidelines and standards

Alternative text for images:

Barchart showing percentage of Americans who used at least one prescription drug in the past month.

Picture of the cover of Health, United States, 2008

Cartoon drawing of pills

Slide 34

Population-based Estimates of Genetic Variation

- DNA specimens have been collected since NHANES III (1991-1994)
- High-throughput genotyping on NHANES III and NHANES 1999-2002 can generate 1-2 million genetic variants per sample
- Resource for investigating
 - Genetic variation & health
 - Population-based estimates of single nucleotide polymorphisms (SNPs) and other genetic variants

Alternative text for image: cartoon drawing of DNA helix

Slide 35

Nationally Representative Biological Sample Repository

- Major impetus for development of CDC/ATSDR Specimen and Data Repository
- Residual specimen storage for NHANES starting in 1988
- Specimens used in research on
 - emergence of new technologies
 - development and validation of micromethods
 - identification of new biomarkers
- Peer review system used as model by other specimen repositories

Alternative text for image:

Collage of pictures showing test tubes and pipettes

Slide 36

25 Years of Hispanic Health

Hispanic HANES conducted from 1982-84

- 1st NCHS survey of a specific ethnic subpopulation
- 1st NCHS Spanish-language questionnaire
- Puerto Rican, Mexican American & Cuban American health & nutrition estimates generated

Assessing race/ethnic differences and similarities

- Mexican Americans oversampled in NHANES III & Continuous NHANES
- Sample design adjusted in 2005 to allow “Total Hispanic” national estimates

Alternative text for image:

Picture of family standing on the beach

Slide 37

Fundamental Principles for Survey Operations and Adaptations to Changing Technology

Slide 38

Mobile Examination Center Provides Standardized Data Collection

- Systematic operation with travelling staff and standardized environment
- MEC design provides standardized specimen collection and exam protocols with regularly calibrated equipment
- Facilitates automated data collection
- Minimizes site-specific error

Alternative text for images: Collage of pictures showing participant’s receiving a variety of tests in the Mobile Examination Center.

Slide 39

Adapting to Complex Data Needs

Each new generation of surveys –

- Added unique specimens, post-exam components, and follow-back surveys
- Required innovative survey design, operations, and methods
- Provided ability to integrate a breadth of interdisciplinary health data
- Enhanced utility of baseline survey data

Alternative text for images:

Picture of Urine specimen jar and USPS truck - Additional urine sample collected at home

Picture of Hair being cut by scissors - Hair sample for mercury measurement

Picture of Accelerometer - Physical activity monitor worn for 7 days

Picture of Faucet with running water - Tap water sample from home

Picture of Man with headset on at laptop - Hepatitis C and PSA follow-up interview by phone 6 months later

Picture of Food frequency questionnaire and mailbox - Food frequency questionnaire by mail

Cartoon drawing of patient in dentist's chair - Oral HPV rinse

Picture of women on phone and laptop - 2nd Dietary recall and FCBS follow-up interview by phone

Picture of staff collecting dust sample - Dust sample collected by vacuum

Picture of mother and teenage daughter - Self-administered vaginal swab

Slide 40

Lab and Exam Methods Research Identifies Optimal Techniques

- Survey collects data amidst
 - advances in exam equipment technology
 - evolving science in lab methods

- Multiple cross-over studies conducted to preserve comparability of data collected from prior surveys
- When no gold standard exists, NHANES specimens used to determine reliability and validity of candidate assays

Alternative text for images:

Collage of pictures of participants and equipment in the Mobile Examination Center

Slide 41

Maintains High Response Rates Through Intensified Outreach Efforts

- Interview Response Rates over 77%
- Examination response rates over 71%

- Advance Arrangements and outreach
 - National and community endorsements
 - Publicity and media campaign
 - New and improved outreach materials

Alternative text for images:

Line graph showing responses rates to the survey throughout NHANES history

Picture of participant materials

Slide 42

NHANES Report of Findings System Provides Prompt, Confidential Test Results to Survey Participants

- Each participant gets initial findings at the end of the mobile examination center exam
- Automated analysis of abnormal biologic specimen results received from the laboratory allows immediate notification to survey participants
- Confidential, password protected reporting system to provide sexually transmitted disease test results to survey participants
- Final reports of findings mailed twelve to sixteen weeks after examination

Alternative text for image:

Timeline showing Initial findings received after examination, then abnormal values are mailed, next participants call for STD results using their passwords, lastly they received the final report of findings

Slide 43

IT Architecture Innovations

- Instantaneous, centralized backup of data at NCHS from data collected at MEC sites anywhere in the US
- Continuous NHANES data released within 1 year of each survey cycle completion, compared to 3.5 years for NHANES III
- NHANES IT systems and software serve as the model for IT infrastructure for several national and community surveys

Alternative text for image:

Diagram showing data flowing from household interviews, to field office, to Mobile Examination Center to National Frame Relay Network; data flowing from labs and graders to National Frame Relay Network; and data flowing from NCHS to home office to National Frame Relay Network.

Slide 44

IT Industry Model for Data Collection and Security

Automated Data Collection

Biomedical examination devices interfaced with IT platforms to deliver data directly to NHANES databases

Data Security

NHANES early adopter of data encryption, firewall appliances, and security enhancements

Alternative text for image:
Cartoon drawing of laptops shaking hands

Slide 45

Innovative Survey Design and Analysis Methods

Slide 46

Innovative Research in Sample Design and Variance Estimation

- Design parameters: small sample size, limited number of PSUs and minority oversampling
- Evaluation of commercial address listings, nesting annual samples within multi-year samples, and Asian oversampling in 2011
- Contributed to development of BRR technique for variance estimation
- Creation of Masked Variance Units for public use files to address confidentiality issues

Alternative text for image: diagram showing NHANES sampling method from U.S. to county, to households, to people.

Slide 47

Impact on Non-Response and Missing Data Research Methods

- Seminal follow-back surveys to identify reasons for non-response
- Classic non-response bias publications
- Influential multiple imputation methodology applications
- Component non-response weighting adjustment research

Slide 48

Stimulated Innovations in Analytic Methods

- First application of Wald statistics to survey data
- Development of general methods for analysis of complex surveys
- Methods to account for clustering and weighting of observation in data analysis
- Application of Bayesian models for small area estimation
- Development of comprehensive survey analysis software packages
 - SUDAAN
 - STATA

Alternative text for images: Collage of covers from government statistical reports

Slide 49

Analytic Potential from Active and Passive NHANES Follow-up

Analysis of health/nutrition measures & changes in health status, healthcare utilization and expenditure & mortality

- NHANES I Epidemiologic Follow-up Study (NHEFS)
- Medicare linkage – NHANES I, II, III
- National Death Index (NDI) linkage – NHANES I, II, III

Alternative text for images:

Collage of people of different ages and genders and screenshots of National Death Index and Medicare linkage sites

Slide 50

Innovative Web-based Tutorial for the NCHS Data User Community

- First web-tutorial developed for any NCHS survey
- Best practices guide for analyzing NHANES data
- Offers SAS, SUDAAN and Stata analysis tracks
- Accredited for continuing education
- Has reduced new user learning curve

Alternative text for image:

Screenshot of NHANES Web Tutorial website

Slide 51

Pioneer in Population Survey Collaboration and Knowledge Transfer

Slide 52

Model of Broad and Deep Federal Partnerships

Approximately 30 federal partners with various degrees of collaboration:

- Survey Planning and Content
- Financial Support
- Data Quality – Subject Matter Expertise
- Publication Co-authorship

Leveraging NHANES Infrastructure

- Efficient means for collecting interdisciplinary health data

Alternative text for images: collage of logos from federal agencies

Slide 53

Survey Integration

- A model for enhanced efficiency and relevance in national data collection
- In 1998 ARS and NCHS signed a Memorandum of Understanding to integrate CSFII and NHANES
- NHANES - What We Eat in America represents the collaboration of ARS and NCHS on the dietary portion of a single, continuous, population-based national nutrition survey

Alternative text for image: Department of Health and Human Services logo

United States Department of Agriculture logo

Collage of pictures of food, participant completing dietary interview at the Mobile Examination center, and What We Eat in America logo

Slide 54

Community HANES – Knowledge Transfer and Capacity Building

Community Health and Nutrition Examination Survey (CHANES) builds capacity for health- and bio-monitoring at the community level by leveraging the expertise, experience, methods, protocols, information technology, and equipment within the NCHS

Since 1999, the CHANES initiative has supported

- Brownsville-Matamoros Sister City Project
- Oregon Health Study
- Survey of the Health of Wisconsin
- New York City HANES

Alternative text for images:

Brownsville-Matamoros Sister City Project logo

Oregon Health Study logo

Survey of the Health of Wisconsin logo

New York City HANES logo

Slide 55

Publication of NHANES Laboratory Manuals - Technology Transfer to Raise the Quality of Lab Assays Worldwide

- A means of technology transfer - to share protocols and analyte specifications with other institutions
- Details standardized methods and quality control protocols for lab methods used to produce reference data
- Examples of use of standard reference materials in NHANES
 - CDC Lipid Standardization Program
 - National Glycohemoglobin Standardization Program
 - National Kidney Disease Education Program Creatinine Standardization

Alternative text for images:

Collage of covers of lab methods and protocols documents

Slide 56

International Model and Gold Standard for Examination Survey Development

- Actively involved in planning and execution of health examination surveys around the world including Canada, Germany, Australia, South Korea, South Africa, New Zealand, United Kingdom, Israel, France and the European Union.
- International collaborative efforts have, and will, provide the opportunity to make international comparisons on critical public health issues.

Alternative text for images:

World map with countries NHANES has collaborated with highlighted