

Cohort Profile

Title: The Survey of the Health of Wisconsin (SHOW) Program: An infrastructure for Advancing Population Health Sciences

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Abstract

Purpose: The Survey of the Health of Wisconsin (SHOW) was established in 2008 by the University of Wisconsin (UW) School of Medicine and Public Health (SMPH) with the goals of 1) providing a timely and accurate picture of the health of the state residents; and 2) serving as an agile resource infrastructure for ancillary studies. Today SHOW continues to serve as a vital population health research infrastructure.

Participants: SHOW currently includes 5,846 adult and 980 minor participants recruited between 2008-2019 in four primary waves. WAVE I (2008-2013) includes annual statewide representative samples of 3,380 adults ages 21 to 74 years. WAVE II (2014-2016) is a triannual statewide sample of 1957 adults (age ≥ 18 years) and 645 children. WAVE III (2017) consists of follow-up of 725 adults from the WAVE I and baseline surveys of 222 children in selected households. WAVES II and III include stool samples collected as part of an ancillary study in a subset of 784 individuals. WAVE IV consist of 517 adults and 113 children recruited from traditionally under-represented populations in biomedical research including African Americans and Hispanics in Milwaukee county, WI.

Findings to Date: The SHOW provides extensive data to examine the intersectionality of multiple social determinants and population health. SHOW includes a large biorepository and extensive health data collected in a geographically diverse urban and rural population. Over 60 studies have been published covering a broad range of topics including, urban and rural disparities in cardio-metabolic disease and cancer, objective physical activity, sleep, green-space and mental health, transcriptomics, the gut microbiome, antibiotic resistance, air pollution, concentrated animal feeding operations and heavy metal exposures.

Future Plans: The SHOW cohort is available for continued longitudinal follow-up and ancillary studies including genetic, multi-omic and translational environmental health, aging, microbiome and COVID-19 research.

Article Summary

Strengths and limitations

- The Survey of the Health of Wisconsin (SHOW) is an infrastructure to advance population health sciences including biological sample collection and broader data on individual and neighborhood social and environmental determinants of health.
- The extensive data from diverse urban and rural populations offers a unique study sample to compare how socio-economic gradients shape health outcomes in different contexts.
- The objective health data supports novel interdisciplinary research initiatives and is especially suited for research in causes and consequences of environmental exposures (physical, chemical, social) across the life course on cardiometabolic health, immunity, and aging related conditions.
- The extensive biorepository supports novel omics research into common biological mechanisms underlying numerous complex chronic conditions including inflammation, oxidative stress, metabolomics, and epigenetic modulation.
- Ancillary studies, such as the Wisconsin Microbiome Study, have expanded the utility of the study to examine human susceptibility to environmental exposures and opportunities for investigations of the role of microbiome in health and disease.
- Long-standing partnerships and recent participation among traditionally under-represented populations in biomedical research offer numerous opportunities to support community-driven health equity work.
- No biological samples were collected among children.
- The statewide sampling frame may limit generalizability to other regions in the United States.

Introduction

Why was the cohort set up?

Increasingly, it is understood that health and well-being are shaped by a myriad of interconnected factors. These factors operate at multiple levels from individual differences in genetics, environmental exposures and life experiences to the physical environment, social, cultural and economic contexts in which we live. Several long-term general population cohort studies, such as the Framingham Heart Study the Nurse's Health Study that began in mid-20th century,¹⁻³ have provided extensive information on determinants of priority health conditions including cardiovascular disease and cancer in the United States. Technological advances are leading to rapid discovery of biological markers and new population-based research infrastructures are needed to support novel translational research. Further, new resources are needed to capture the multi-level data with increased geographic granularity are necessary to advance population health sciences. Next-generation sequencing and "big-data" approaches have accelerated the pace of biomarker discovery, but how these biological factors are shaped by larger social, environmental and individual-level determinants within and between diverse populations across the lifecourse is less well understood.

The Survey of the Health of Wisconsin (SHOW) was established in 2008 by the University of Wisconsin School of Medicine and Public Health with funding from an institutional endowment with the goals of 1) providing a timely and accurate picture of the health of the state residents; and 2) serving as an agile resource infrastructure for ancillary studies that require access to community-based samples. Initially modeled after National Health and Nutrition Examination Survey (NHANES), SHOW provides a level of granularity to study the health status of individuals and determinants across rural and urban areas at a greater level of detail than national surveys.⁴ A decade later, the SHOW study sample continues to grow through multiple waves of data collection and ancillary studies and continues to serve as a state-of-the-art

infrastructure for population health research. SHOW's mission in 2021 is to **support ongoing population health monitoring and research, foster diverse partnerships, and support ongoing education in order to promote population health equity and well-being** in Wisconsin and beyond. Core funding for SHOW is provided by the Wisconsin Partnership Program and additional support comes from ancillary projects funded by the National Institutes of Health and the Wisconsin Department of Health Services, among others. Scientific direction is provided by experts in population health research from across the entire University of Wisconsin-Madison campus, including a Scientific Advisory Board.

Unique elements of the SHOW program include the geographically diverse study population, the breadth of objective and biological data collected, the ability to link social and environmental contextual data, and the flexibility of the program to support translational science and health equity research. To date, no other such statewide study sample exists. From its inception, SHOW aimed to capture multi-level determinants of data to examine proximate and distal factors shaping health and well-being. Questionnaire data include a variety of medical and family history, mental health, occupation, life experiences, physical activity, diet, sleep and neighborhood perception data. The detailed data on household address and residential history can now be integrated with objective health and biomarker data to support innovative research projects integrating contextual social and environmental data across the life-course with cutting-edge biomarker analyses to advance understanding of biological mechanisms underlying health inequalities. Field data collection continues today with numerous opportunities for investigators to inform longitudinal follow-up and clinical collaborations including opportunities for linkage with electronic health records and other administrative data.

SHOW provides a unique resource to advance population health and aging research. A substantial portion of the SHOW study sample are middle to older adults born during the last quarter of the 20th or early 21st century. Many lifestyle, economic and social factors have changed within these generations and SHOW offers numerous opportunities to examine how

these complex factors now influence health and well-being as participants age. More recently, focused recruitment efforts have aimed to expand the core study population to include children and increase the racial, ethnic and socio-economic diversity of the study population.

Cohort Description

The full study sample includes 5,846 adult (ages 18 years and over) and 980 minor (age 0-17 years) participants. **Table 1** depicts the multiple waves of data collection and highlights key additions and changes to the cohort composition, sampling strategy, inclusion and exclusion criteria and study components over time. In brief, participants have been recruited across three waves (WAVE 1: 2008-2013, WAVE II: 2014-2016, and WAVE IV: 2018-2019). The first follow-up of WAVE I participants was completed in 2017, and is referred to as WAVE III. Ongoing retention of the SHOW cohort is maintained through community outreach, dissemination of study findings online and at community events. Bi-annual newsletters are also disseminated via mail and email to facilitate successful follow-up. Standard SHOW protocols are implemented consistently across each wave of data and biosample collection. All methods are well-documented through meta-data and online codebooks to ensure rigor and reproducibility over time. Supplemental Table 1A shows improvement in response rates, measured as number of participants screened eligible willing to participate in the program, over time, by health region and ten counties corresponding to each health region. Health regions are defined as geographic clusters of counties within a public health service area defined by the Wisconsin Department of Health Services. Supplemental Table 1B shows response rates by urbanicity as defined by the U.S. Census. Details regarding the design and data collection for each wave of recruitment and data collection for the SHOW study to date are briefly described below.

WAVE I - The Original SHOW Study Sample (2008-2013)

WAVE I (2008-2013) includes annual statewide representative samples of 3,380 adults ages 21 to 74 years with key demographics presented in Table 1A. As previously described by Nieto et al., 2010, a state-wide address-based sampling frame and two-stage, area probability sampling without replacement (PPSWOR) was used to generate an annual statewide representative sample.⁵⁶ Selection criteria included age between 21-74 years, and residency within the state for longer than six months. Exclusion criteria included limited ability to consent independently, active-duty military service, being institutionalized, and undergoing community or home corrections monitoring. The annual sample size ranged from approximately 300 to 900 between 2008 and 2013. Response rates ranged from 43-87% depending on region across the state and, on average, tended to be higher in rural communities and lower in urban and lower income communities (Supplemental Table 1). Approximately 80% of participants who completed the household interview went on to complete all survey components (personal in-home interviews, self-administered questionnaire, physical exam, and biosample collection). Survey weights that incorporate design weights and adjustments for non-response and post-stratification, calibrated to the U.S. Census 2010 population totals by age, sex and race, improve the representativeness of statewide estimates, and design variables account for spatial clustering in the sample design.

WAVE II - SHOW Expansion (2014-2016)

WAVE II, SHOW 2014-2016, provided a newly recruited prospective tri-annual statewide representative sample of 1957 adults (age ≥ 18 years) and 645 children (< 18 years of age). Demographic data for the adult sample are presented in Table 1A while children are presented in Table 1C. Eligibility criteria for WAVE II expanded to add children (< 18) and adults over age 74 years. Exclusion criteria were the same as for Wave I. Similar to WAVE I, an area probability sampling design was used to randomly select households, where all eligible household members were invited to participate. The main change between the waves was that the two-stage sampling design was modified to three-stages with county as the primary sampling unit

(PSU) rather than Census block group (CBG). Eight PSUs, stratified by years of potential life lost, were randomly selected with probabilities proportional to size where the measure of size was occupied housing units. Two counties (Milwaukee and Dane) were selected with certainty (probability of selection=1) based on their large number of occupied housing units relative to the other counties. CBGs served as secondary sampling units with poverty stratification, and households within each CBG were randomly selected using simple random sampling.

Response rates were slightly higher on average in WAVE II with 64% of screened eligible individuals agreeing to participate. This higher response rate was attributed to additional focus on identifying field interviewers representative of the targeted community, and additional focus on community engagement and awareness campaigns, including endorsement by local officials prior to recruitment. Finally, we aimed to improve the ease of exam visits and sample collection by identifying exam visit locations in places of worship, or other locally respected locations that were convenient and centrally located for study participants. Design variables that account for clustering in the sampling design and survey weights based on design weights adjusted for non-response and calibrated to the U.S. Census Current Population Survey 2016 estimates by age, sex and race are available for WAVE II.

WAVE III – Follow-up

WAVE III included longitudinal follow-up of n=725 adults from WAVE I (see Table 1B) and baseline participation of 222 children (see Table 1C). The eligibility criteria for WAVE III were participation in WAVE I, consent to be contacted by SHOW for future studies, WAVE I residence in 13 select counties cover the full spectrum of urbanicity and county health rankings across Wisconsin. For Non-Hispanic white participants, additional eligibility criteria were completion of the physical examination and biomarker collection in Wave I. All children currently residing in follow-up participant households were also eligible.

WAVE III follow-up included an in-home interview, physical exam, core biospecimen collection (blood, urine) and stool and skin swabs collection for microbiome analysis funded via

ancillary study funding described below. Follow-up participation rate, determined based on number of those contacted who agreed to participate again, was estimated at 86% (see Supplemental Figure 1). Survey weights were not generated for WAVE III since it was not a random subsample of WAVE I.

WAVE IV – Focused Recruitment of Traditionally Under-Represented Populations in Biomedical Research

In 2018-2019 SHOW focused on engaging and recruiting participants from two traditionally under-represented populations in biomedical research including an oversample of 440 African American (339 adult and 101 minor) and 131 Hispanic (125 adult and 6 minor- See Table 2C) participants living in and around the City of Milwaukee (see Table 2B for demographic details on adults). Unlike in WAVES I and II, both two-stage area probability sampling and community engaged convenience sampling approaches using community-based events were employed as primary recruitment strategies. The two-stage area probability sampling design was analogous to WAVE I, with the exception that the PSU sampling frame was restricted to 236 CBGs in the City of Milwaukee with populations of at least 60% African Americans based on the American Community Survey from 2015.

Alternative convenience based recruitment strategies were developed collaboratively with and in response to community partners interests in using an asset-based, community-driven model to guide research in the City of Milwaukee. Collaborations were led by investigators with the University of Wisconsin Center for Community Engagement and Health Partnerships (CCEHP).⁷ The partnerships and stakeholders informed all aspects of recruitment, including promotion opportunities, use of community events and modifications to survey content relevant to stakeholder interests. Survey elements were modified for use in Hispanic populations and Spanish translation of the final survey content approved by CCEHP partner

organizations. Survey weights are not available for WAVE IV due to the hybrid nature of the sampling approach.

What has been measured?

Table 3 outlines the breadth of questionnaire, physical exam and biomarker data collected among SHOW participants. SHOW was not originally designed with a specific set of hypotheses in mind but with a broader mission to improve understanding of the multi-level determinants of health and equity, originally emphasizing chronic diseases in adult populations. Thus, the protocols are flexible enough to add new collection tools relevant to study hypotheses as needed.⁸ Tables 4A and 4B describe key findings on health status for WAVES I and II and WAVES II and IV respectively, Supplemental Table 2 highlights the distribution of questionnaires by survey wave.

Interviews and questionnaires

The in-home visit by field interviewers includes computer-assisted personal interviews (CAPI) to gather information on health history and important covariates such as occupation, home environment, health care access, medication use, and demographics.⁴ Several self-administered questionnaires either on paper or increasingly offered online are used to gather detailed information capturing a broad array of social determinants including food security and economic hardship, personal and family medical history, mental health and well-being, quality of life, every day and lifetime racial and other discrimination, life events, resilience, and coping scales. A neighborhood perceptions questionnaire captures community assets and perceived neighborhood stressors. A personal exposure history⁹⁻¹¹, includes information on residential history, household characteristics including the age of the home, pet ownership, use of indoor/outdoor pesticides, and smoking policies and water source (private well vs. municipal)¹² including use of water filtration. Health behaviors include physical activity, diet, sleep, smoking, and drug and alcohol use. Usual and most recent diet information are captured using both the NCI food frequency questionnaire (all WAVES) and the 24-hour dietary recall.

Physical and clinical measurements

In addition to survey data, participants undergo a brief physical exam that includes standardized measurements of blood pressure, weight, height, waist and hip circumference, respiratory function, and collection of blood and urine samples. Weight is measured in kilograms (to a precision of ± 0.1 kg) using digital scales with subjects wearing light clothing or surgical scrubs. Height, hip and waist circumference (all in cm) are measured twice. Sitting blood pressure and heart rate are measured using digital blood monitors with three measurements taken one minute apart after an initial 5-minute rest period. Lung function is assessed by spirometry using a Jaeger AM1+ electronic peak flow meter with filter mouthpiece. Testing provides data on FEV1 (forced expiratory volume in 1 second) and FVC (forced vital capacity).

Wearable Measurement of Objective physical activity and sleep measurements

Objective physical activity and sleep data are obtained using wearable technology. A detailed protocol for participant 7-day hip and wrist protocol using ActiGraph wGT3X-BT accelerometers (ActiGraph, Pensacola, FL) was developed for both adults, and children >6 years. Data are processed and analyzed using ActiLife software. Both raw and processed data are made available to investigators.

Biosample collection and biobanking

All participants providing biological samples are also asked to consent for use of these biological samples for DNA analyses and other future unspecified research. The growing biobank includes over 200,000 cryovials of urine, plasma, serum, PaxGene and DNA samples stored at -80 C for future unspecified research. Following an in-home visit, biological samples are collected either in participant homes or at local exam centers. Several tubes of venous blood (about 55-60 ml in total) are collected and immediately processed for serum and plasma, aliquoted into cryovials and frozen at -80C. A blood aliquot is sent to Marshfield Labs (Marshfield, WI) for complete blood cell count with differential, hematocrit, hemoglobin, HbA1c, glucose, creatinine, triglycerides, total and HDL cholesterol. Blood samples are sent to

Prevention Genetics (Marshfield, WI) for DNA extraction. Urine samples are centrifuged, aliquoted into cryovials and frozen. Starting in WAVE II, PAXgene tubes for RNA extraction were added to the collection protocol.

In 2016, ancillary study funding supported expansion of biological sample collection to stool, nasal, and skin swabs for microbiome analyses. Stool specimens are self-collected using a commercial "toilet hat" collection kit within 12 hours of the exam visit. Our current studies have over 95% adherence to this self-collection protocol, including shipping specimens in the correct containers and temperature.

DNA from a subset of n=650 participants were analyzed by the NIH Center for Inherited Disease Research (CIDR). The program provided genome-wide MEGA chip array data for identification of SNP polymorphisms, and DNA methylation for epigenetic analyses. The same subset of 650 individuals also have stool microbiome data available.

Linkages with Extant Environmental and Socio-Demographic Data

All participants are geocoded to the household address level that can be linked to social and environmental data at multiple geographic scales. In addition, all participants are consented for linkage with administrative databases including vital statistics and state cancer registry data. Ongoing efforts are being made to re-consent participants for linkage with electronic medical records and for deposition of genetic and epigenetic analyses into NIH dbGaP database. Socio-demographic and environmental measures can be linked to the data using a street address or other geography indicators (e.g., CBG). Environmental measures include air pollution exposure (fine particulate matter and traffic pollution),^{13 14} access to retail food outlets,¹⁵ access to health care facilities,¹⁶ measures of green space (vegetation index via satellite imagery and percent coverage from a tree canopy database)^{17 18} and drinking water source.¹⁹

Ancillary Studies

Numerous ancillary studies have either extended the focus of the baseline SHOW program or facilitated follow-up with cohort participants around particular etiologic, prevention or

intervention research questions. Examples include personalized vitamin D supplementation based on genetic analysis,²⁰ impacts of caregiver strain on telomere length and quality of life,²¹⁻²³ assessment of physical activity in rural women,^{24 25} incontinence research in older women,²⁶ examining how household context impacts personal health information management,²⁷⁻²⁹ chronic stress and cardio-metabolic risk,^{14 30} and epigenetic signatures of aging and health disparities, among others. SHOW also supports applied public health and surveillance. Examples of projects with the Wisconsin Department of Health include oral health screening,^{31 32} as well as a long-standing collaboration to examine the health impacts of Great Lakes fish consumption across the state, among anglers and in high-risk populations (e.g., Burmese immigrants).³³⁻³⁸

Wisconsin Microbiome and Other NIH Funded Research

In 2016, The Wisconsin Microbiome Study, was launched to investigate the presence of multi-drug resistant organisms (MDROs) and to characterize the human microbiome in the population.³⁹ SHOW added questionnaires on risk factors for MDRO colonization, diet history, and food-frequency. Stool and swab samples (skin, nasal, oral) were collected from 700 participants and analyzed for MDRO colonization; 16s rRNA gene sequencing data are available for all stool samples collected with this project. In 2018, 50% of Wisconsin Microbiome Study participants were invited to complete a follow-up visit. Stool and environmental samples (high-touch surface swab, household dust, and soil samples) were collected and are available for future analyses. Additional NIH research funded by the National Institutes of Aging and The National Institute of Allergy and Infectious diseases are ongoing.

Key Findings to Date

The breadth and nature of data collected by the SHOW program allows for multidisciplinary research on various health topics. The main findings to-date have focused on population health priorities including obesity, cardiometabolic and pulmonary health, mental health, and cancer prevention and control.^{13-17 32 40-44} SHOW supports comprehensive

assessment of health disparities, associated with neighborhood environment, access to healthy food, health care, oral health and experiences of discrimination.¹⁴⁻¹⁶ Food insecurity is highly prevalent in inner city and rural communities across the state, with several adverse metabolic and cardiovascular outcomes.^{42 45} SHOW has also supported research on biological effects of multiple social determinants of health including caregiver strain,²¹⁻²³ and neighborhood stress.¹⁴ Objective and subjective measures of physical activity and the built environment continue to support novel methods for behavioral and built environment research in both child and adult populations.^{24 46-49} The complete list of over 60 publications is available at www.med.wisc.edu/show. Below is a brief summary of key findings including those related to COVID-19 follow-up.

COVID-19 Impacts on Population Health

Recently, a subset of SHOW study population participated in two COVID-19 specific research efforts which are described in more detail elsewhere.^{50 51} In brief, the randomly selected population-based study has provided a robust platform for COVID-19 antibody surveillance in collaboration with the Wisconsin Department of Health Services and the Wisconsin State Laboratory of Hygiene, the only randomly selected statewide sample to date.⁴⁷ The SHOW program also is currently conducting online survey of COVID-19 impacts on health and well-being over time (May-June, 2020; January-February, 2021; and later May-June 2021) in past SHOW participants.⁴⁶

Environmental Health and Microbiome Research

SHOW was among the first to examine associations between green space and mental health, now a growing area of research.¹⁷ We found that a positive neighborhood perception and green space correlates with better sleep quality.^{18 52} Chronic low-level air pollution exposure has shown adverse associations with lung function, and respiratory allergies that vary by level of neighborhood perception of safety and aesthetics.^{13 14} The Wisconsin Microbiome

Ancillary Study in children and adults demonstrated the role of xenobiotics and other settings in shaping the human gut microbiome and increased risk for MDRO colonization.⁵³⁻⁵⁵ This represents an important and novel area for metabolic, aging and population health research.

Obesity and cardiovascular health

Numerous studies examine predictors of obesity, and determinants of metabolic syndrome in the SHOW population.^{15 40 42 44 48 56} Objective measures of obesity indicate that over 70% of the state population is overweight or obese, and that a higher level of obesity is correlated with multiple co-morbidities.⁴⁴ Obesity has also been shown to modify associations of respiratory outcomes with air pollution and smoking exposure in the study sample, suggesting SHOW is a valuable resource for examining the role of obesity in increasing human susceptibility to environmental exposures and the biological mechanisms underlying these associations.

Multi-omics Research

Recent analysis of whole blood mRNA levels among SHOW participants revealed differential gene expression in stress and toxicity pathways in obese smokers compared to non-obese smokers⁵⁷. This work highlights the potential for SHOW to serve as an infrastructure for emerging precision-health initiatives. In 2018, the MEGA Chip Array and EPIC Chip Array analysis was performed on a subset of Wave II SHOW participants that will enable future investigations of gene-environment interactions and studies of biological pathway mediating effects of social determinants on health including epigenetics modifications via DNA methylation pathways.

Community and policy research

The program also offers opportunities for measuring the impact of natural experiments related to significant policy changes.⁴¹ For example, a survey of private well-owners in rural communities found limited knowledge, education, and resources to be barriers to well testing, a known evidence-based strategy for identifying potential adverse environmental exposures in drinking water supplies.¹⁹ Examples of community-based research include use of abbreviated

SHOW surveys in the community to promote community-driven health assessments,⁵⁸ the implementation of an "eating smart" intervention to promote healthy eating,^{59 60} and the objective assessment of the social and built environment.⁴⁸

Further Details

Strengths – SHOW was designed using rigorous sampling strategies and provides high quality measures of health and well-being that are comparable to other well-known surveys including the National Health and Nutrition Exam Survey. A breadth of objective and subjective data (over 2000 variables) from a diverse statewide sample offer an invaluable resource for population health research. The biosamples support rigorous translational research including novel biomarkers of response to environmental exposures. Availability of DNA and RNA provides opportunities for future precision health and omics-integration (genomic, epigenomic and transcriptomic) projects. Similarly, stool, plasma/serum and urine samples offer new opportunities for metabolomics and exposure assessment. The program serves as a cost-effective research infrastructure allowing for investigator-initiated ancillary studies. Existing baseline data support future interventions and community-based partnerships for program planning and evaluation. Major strengths of the program also include the ability to link SHOW data to other databases and registers including vital statistics, state cancer registry, and environmental exposure data.

The SHOW program also offers an opportunity to study aging across the life course, including a well-characterized large young-adult, middle-aged, and older adult population. Middle-aged adulthood is a time when many pathological changes of disorders begin, but are still clinically undetectable. Thus, SHOW population samples enable studies exploring early biomarkers of age-related disorders and the potential for long-term follow-up. Increasingly new models of research are looking toward electronic health records for understanding health trajectories over time. SHOW also has consented individuals for linkages with electronic records and other administrative data, allowing for new efforts in data integration, and method validation

to emerge. Many additional ongoing ancillary studies are capitalizing on this infrastructure for advancing multi-level population health research in children, adults and among under-represented populations. A recent focus of the program has been community engagement and outreach among minority populations and rurally isolated populations to identify opportunities to collect additional data and leverage additional resources to support community-based intervention work.

The SHOW sample includes a significant number of genetically related (parent-child; siblings) and unrelated (husband-wife) participants with similar exposures or lifestyles. Such sample structure allows various types of investigations on health determinants and variability in human responses to similar factors.

Limitations – Conducting SHOW as a comprehensive population-based survey is both resource- and time-intensive. SHOW's sampling strategy was designed to ensure a statewide representative sample leading to both logistical and monetary costs. Although the resulting sample characteristics may be a strength for many types of epidemiological studies, it may be a limitation for other studies requiring a more substantial proportion of non-white participants, as the vast majority of state residents are white and less than 12% of the state's total population self-identifies as non-white. SHOW has recognized this limitation and in 2018-2019 conducted focused recruitment of persons of color in highly diverse communities.

Data Availability

Any qualified researcher, or community academic or applied public health practitioner can request data and biospecimens from the SHOW biobank. A public use data set including sampling weights and use of sampling weights for analyzing SHOW data will be made available on the SHOW website www.show.wisc.edu in the near future. Details on survey instruments and

variables and request forms for restricted data (data with unique geographic identifiers, biological samples, genetic and epigenetic, and microbiome data) are also available. SHOW data science core supports students and other faculty in use of SHOW data. SHOW also provides consultation services on the use of SHOW for future ancillary studies, including longitudinal follow-up of select or the full cohort sample.

Patient and Public Involvement

The core survey contents were determined using a social determinants of health framework to prioritize questions. Whenever possible, questions were selected from previously validated questionnaires. Several ancillary study projects have been done in collaboration with community partners who have extracted a smaller number of survey questions important for goals and dissemination. The core infrastructure values community engagement in all aspects of ancillary study development. Trained field interviewers review consent documents and checklists to assure that participants are informed of all aspects of survey participation prior to consent. Participants may choose to not answer any questions and that they are not required to complete all SHOW components. Incentives for the participation in the program are offered and vary by completion of each survey component. Anonymous feedback forms with self-addressed stamped envelopes are provided to participants following completion of the survey. Participants are allowed to opt out of data sharing for future unspecified research and can opt out of any future participation. SHOW has also obtained an NIH Certificate of Confidentiality, to further ensure data will not be shared for reasons outside the original scope of the survey.

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	WAVE I	WAVE II	WAVE III	WAVE IV
	Baseline	Baseline	Follow up	Baseline
Timeline	2008-2013	2014-2016	2017	2018-2019

Table 1. SHOW Survey Participant Summary, Sampling Strategy and Components by WAVE

Number of participants enrolled	Adults: 3380	Adults: 1957 Minors: 645	Adults: 725 Minors: 222	Adults: 517 Minors: 113
Sampling strategy	Annual state-wide representative samples	Tri-annual state-wide representative sample	Wave I participants	Focused recruitment among African Americans and Hispanics
Response rate	57.5%	63.5%	85.6%	NA
Eligibility criteria	Age 21-74 WI resident for at least 6 months	All ages WI resident for at least 6 months	Participation in Wave I; minors living in participants households	All ages WI resident for at least 6 months
Exclusion criteria	<ul style="list-style-type: none"> - Active duty military service - Being institutionalized - Undergoing correction monitoring - Limited ability to consent independently 	<ul style="list-style-type: none"> - Active duty military service - Being institutionalized - Undergoing correction monitoring - Limited ability to consent independently 	<ul style="list-style-type: none"> - Active duty military service - Being institutionalized - Undergoing correction monitoring - Limited ability to consent independently 	<ul style="list-style-type: none"> - Active duty military service - Being institutionalized - Undergoing correction monitoring - Limited ability to consent independently
Survey components	<ul style="list-style-type: none"> - CAPI - physical measurements - SAQ - Biosample collection 	<ul style="list-style-type: none"> - CAPI - physical measurements - SAQ - Biosample collection 	<ul style="list-style-type: none"> - CAPI - physical measurements - SAQ - Biosample collection 	<ul style="list-style-type: none"> - CAPI - physical measurements - SAQ - Biosample collection

Table 2-A. SHOW Adults WAVES I and II Characteristics, Weighted for Statewide Sample Estimation

Demographic characteristics	N*	WAVE I 2008-2013		N*	WAVE II 2014-2016	
		Mean or %**	Range or 95% CI**		Mean or %**	Range or 95% CI**
Age (years)	3380	45.6	21 - 74	1957	48.7	18 - 98
18 to 29	512	16.6	(14.3, 18.9)	278	15.8	(12.5, 19.1)
30 to 39	592	20.7	(18.4, 23.1)	346	20.7	(17.4, 24.1)
40 to 49	690	21.3	(19.3, 23.3)	255	14.2	(11.4, 16.9)
50 to 59	813	23.1	(21.2, 25.1)	353	19.2	(17.4, 21.0)
60 to 74	773	18.2	(16.5, 20.0)	525	22.5	(18.8, 26.2)
75 or older	NA	NA	NA	200	7.6	(6.0, 9.1)
Gender						
Male	1479	50.1	(48.5, 51.8)	864	49.1	(47.2, 50.9)
Female	1901	49.9	(48.2, 51.5)	1093	50.9	(49.1, 52.8)
Race / ethnicity						
Non-Hispanic white	2867	85.1	(83.0, 87.3)	1623	85.0	(81.7, 88.2)
Non-Hispanic black	243	6.1	(4.7, 7.6)	151	6.3	(3.6, 9.1)
Hispanic	108	4.1	(2.8, 5.3)	77	3.9	(2.8, 5.0)
Other	154	4.7	(3.3, 6.0)	104	4.8	(3.9, 5.7)
Education						
Less than HS	258	7.5	(6.3, 8.7)	132	6.5	(4.9, 8.1)
HS degree or some college	1416	40.7	(38.1, 43.3)	775	40.1	(37.7, 42.4)
Associate's degree or higher	1701	51.8	(49.1, 54.4)	1048	53.5	(50.2, 56.7)
Poverty						
≤ 200% FPL	985	29.0	(26.4, 31.5)	556	30.5	(26.7, 34.2)
> 200% FPL	2249	71.0	(68.5, 73.6)	1303	69.5	(65.8, 73.3)
Employed (among the economic labor force)						
Yes	2283	91.1	(89.7, 92.5)	1115	92.6	(90.7, 94.5)
No	238	8.9	(7.5, 10.3)	92	7.4	(5.5, 9.3)
Health insurance coverage over the last 12 months						
0	316	9.1	(7.7, 10.4)	75	4.1	(2.3, 5.9)

1 to 11	216	6.3	(5.3, 7.3)	146	8.3	(7.0, 9.5)
12	2833	84.6	(82.9, 86.4)	1742	87.6	(84.7, 90.5)
Census 2010 urban / rural classification						
Urban	2139	67.1	(61.4, 72.7)	1339	69.9	(48.8, 90.9)
Rural	1241	32.9	(27.3, 38.6)	618	30.1	(9.1, 51.2)

* Unweighted

** Weighted and adjusted for the stratification and clustering in the complex survey sampling design.

Frequencies may not add to the total sample size due to missing values.

Table 2-B. SHOW Adults WAVES III and IV Characteristics, Unweighted

Demographic characteristics	WAVE III Follow-up 2017			WAVE IV Focused Population Oversample		
	N	Mean or %	Range or 95% CI	N	Mean or %	Range or 95% CI
Age (years)	725	54.1	25 - 82	517	46.8	18 - 91
18 to 29	29	4.0	(2.6, 5.4)	92	17.8	(14.5, 21.1)
30 to 39	114	15.7	(13.1, 18.4)	94	18.2	(14.8, 21.5)
40 to 49	128	17.7	(14.9, 20.4)	94	18.2	(14.8, 21.5)
50 to 59	157	21.7	(18.6, 24.7)	110	21.3	(17.7, 24.8)
60 to 74	238	32.8	(29.4, 36.3)	111	21.5	(17.9, 25.0)
75 or older	59	8.1	(6.1, 10.1)	16	3.1	(1.6, 4.6)
Gender						
Male	288	39.7	(36.2, 43.3)	199	38.5	(34.3, 42.7)
Female	437	60.3	(56.7, 63.8)	318	61.5	(57.3, 65.7)
Race / ethnicity						
Non-Hispanic white	575	79.5	(76.6, 82.5)	33	6.4	(4.3, 8.5)
Non-Hispanic black	96	13.3	(10.8, 15.8)	339	65.6	(61.5, 69.7)
Hispanic	22	3.0	(1.8, 4.3)	125	24.2	(20.5, 27.9)
Other	30	4.1	(2.7, 5.6)	20	3.9	(2.2, 5.5)
Education						
Less than HS	47	6.5	(4.7, 8.3)	159	30.8	(26.8, 34.7)

HS degree or some college	272	37.5	(34.0, 41.0)	249	48.2	(43.8, 52.5)
Associate's degree or higher	406	56.0	(52.4, 59.6)	109	21.1	(17.6, 24.6)
Poverty						
≤ 200% FPL	167	23.7	(20.5, 26.8)	344	74.9	(71.0, 78.9)
> 200% FPL	539	76.3	(72.2, 79.5)	115	25.1	(21.1, 29.0)
Employed (among the economic labor force)						
Yes	450	95.3	(93.4, 97.2)	220	72.6	(67.6, 77.7)
No	22	4.7	(2.8, 6.6)	83	28.4	(22.3, 32.4)
Health insurance coverage over the last 12 months						
0	12	1.7	(0.7, 2.6)	55	12.3	(9.3, 15.4)
1 to 11	30	4.1	(2.7, 5.6)	50	11.2	(8.3, 14.2)
12	681	94.2	(92.5, 95.9)	341	76.5	(72.5, 80.4)
Census 2010 urban / rural classification						
Urban	575	79.3	(76.4, 82.3)	517	100.0	NA
Rural	150	20.7	(17.7, 23.6)	NA	NA	NA

Frequencies may not add to the total sample size due to missing values.

Table 2-C. SHOW Children in WAVES II, III and IV Characteristics

Demographic characteristics	WAVE II 2014-2016			WAVE III 2017			WAVE IV 2018-2019		
	N*	Mean or %**	Range or 95% CI**	N*	Mean or %*	Range or 95% CI*	N*	Mean or %*	Range or 95% CI*
Age (years)	645	7.7	0 - 17	222	8.6	0 - 17	113	8.0	0 - 17
0-6	279	44.8	(39.4, 50.2)	71	32.0	(25.8, 38.2)	49	43.4	(34.1, 52.6)
7-11	182	28.1	(25.5, 30.8)	88	39.6	(33.2, 46.1)	27	23.9	(15.9, 31.9)
12-17	184	27.1	(22.2, 31.9)	63	28.4	(22.4, 34.4)	37	32.7	(24.0, 41.5)
Gender									
Male	332	51.1	(46.5, 55.8)	123	55.4	(48.8, 62.0)	59	52.2	(42.9, 61.6)
Female	313	48.9	(44.2, 53.5)	99	44.6	(38.0, 51.2)	54	47.8	(38.4, 57.2)
Race / ethnicity									
Non-Hispanic white	472	71.4	(62.9, 79.8)	149	67.4	(61.2, 73.6)	4	3.6	(0.1, 7.1)
Non-Hispanic black	103	16.8	(8.2, 25.5)	38	17.2	(12.2, 22.2)	101	90.2	(84.6, 95.8)
Hispanic	15	2.5	(0.2, 4.7)	23	10.4	(6.3, 14.5)	6	5.4	(1.1, 9.6)
Other	53	9.3	(5.5, 13.2)	11	5.0	(2.1, 7.9)	1	0.9	(0.0, 2.7)

* Unweighted

** Weighted and adjusted for the stratification and clustering in the complex survey sampling design.

Frequencies may not add to the total sample size due to missing values.

Table 3. SHOW Core Components

SHOW Core Components	
Primary Data Collection	Topics Covered
Self-administered questionnaires—online	<ul style="list-style-type: none"> Prevention and safety habits Diet (Block Screener,⁶¹ other dietary habits) Discrimination, adverse child/life events inventory Smoking and alcohol habits, food security⁶² Resilience, coping Food Security, USDA⁶³ Sleep habits and problems EuroQol (health-related quality of life)^{64 65} Mental health: depression(DASS)^{66 67} PHQ-8⁶⁸ Self-reported physical activity Perception on quality of local environment, safety Access to healthy food, green space, etc.
Computer Assisted Personal Interviews (CAPI)—over the phone, or in person if preferred	<ul style="list-style-type: none"> Tracking information Demographics and occupational history/military Environmental exposures, housing, pets etc. Health history, insurance, access & utilization Prescription and over the counter medications SF-12 (health-related quality of life)^{69 70} Cognitive function, health literacy (STOFHLA)⁶³ Residential history Cancer prevention and control, screening Consent for EHR, administrative data linkages
Physical exam, biological sample collection blood, urine, DNA, stool	<ul style="list-style-type: none"> Weight; height; waist, hip, and arm circumference Phlebotomy and urine collection Drop off of self-collected stool Sitting blood pressure and pulse, body fat⁷¹ Actigraphy, 7-day-NHANEs protocol^{72 73} (PA, Sleep) NCI 24-Hour Dietary recall (online)
Environmental Exposures and Response Biomarkers	Topics Covered
Biomarkers for Immediate Research	<ul style="list-style-type: none"> Blood – DNA extraction, baseline blood chemistry (CBC with differentials, a lipid panel including total cholesterol, HDL and LDL cholesterol, and triglycerides, glucose, and HbA1c) Stool - gut microbiome – 16srRNA sequencing, metagenomics Blood Chemistry
Biospecimen storage for future research and examples of potential uses	<ul style="list-style-type: none"> DNA for genetics, epigenetics, telomere and markers of DNA damage and repair Urine - nitrate, heavy metal exposures PBMCs cell specific response RNA for transcriptomics Whole blood, urine, plasma, serum for future unspecified research Stool DNA - metagenomic/deep sequencing for bacteria, fungi and viruses; PCR for specific pathogens Plasma/Serum – untargeted and targeted metabolomic analyses for xenobiotics and functional assessment of metabolic pathways, biomarkers of inflammation
GIS-based indicators* of social determinants, health care access, and environmental determinants	<ul style="list-style-type: none"> Demographics, area deprivation index Income, housing and racial inequality⁷⁴⁻⁷⁶ Proximity to health care Land use/CAFOs Traffic use/density; air quality Density of grocery/convenience stores/fast food Green space proximity to parks, trails, clinics Drinking water source, treatment
* All participants' household addresses at time of survey will be geocoded for linkage with GIS based data including census, landstat, and zoning	

Table 4-A. Select Health Indicators for SHOW Adults WAVES I and II, Weighted for Statewide Sample Estimation

Select Health Indicators	WAVE I 2008-2013			WAVE II 2014-2016		
	N*	Mean %**	or 95% CI**	N*	Mean %**	or 95% CI**
Body Mass Index (kg/m ²), mean	2930	29.5	(29.1, 29.9)	1914	29.7	(29.1, 30.3)
Underweight (<18.5 kg/m ²)	36	1.2	(0.8, 1.7)	21	1.1	(0.5, 1.7)
Normal weight (18.5 to 24.9 kg/m ²)	780	26.5	(24.2, 28.9)	497	26.3	(23.5, 29.0)
Overweight (25.0 to 29.9 kg/m ²)	935	33.2	(30.7, 35.6)	609	31.6	(28.7, 34.4)
Obese (≥ 30 kg/m ²)	1179	39.1	(36.5, 41.6)	787	41.1	(37.7, 44.5)
Hemoglobin A1c (%), mean	2563	5.7	(5.6, 5.7)	1376	5.5	(5.4, 5.5)
< 5.7	1462	59.8	(57.2, 62.4)	1028	77.7	(74.2, 81.1)
5.7 to 6.4	885	33.0	(30.7, 35.3)	224	14.1	(11.6, 16.6)
≥ 6.5	216	7.2	(6.0, 8.5)	124	8.2	(6.6, 9.8)
Diabetes						
A1c ≥ 6.5% or previous diagnosis	269	8.8	(7.3, 10.2)	169	11.1	(9.4, 12.8)
Awareness	187	65.6	(59.6, 71.6)	147	87.6	(83.2, 92.0)
Treatment with medication (among aware)	156	84.0	(79.7, 88.3)	119	83.4	(74.4, 92.3)
Control, A1c ≤ 7.0 (among treated)	72	44.8	(39.1, 50.4)	57	44.8	(35.9, 53.7)
Hypertension						
≥ 140/90 mmHg or medication use	996	31.3	(29.0, 33.5)	612	34.8	(30.4, 39.1)
Awareness	741	70.0	(66.4, 73.6)	441	71.3	(67.1, 75.5)
Treatment with medication (among aware)	669	87.9	(84.5, 91.2)	404	89.7	(86.7, 92.6)
Control, < 140/90 (among treated)	475	69.3	(65.1, 73.4)	226	57.9	(52.8, 63.0)
Lung function (FEV1/FVC), mean	2351	0.84	(0.83, 0.84)	1642	0.82	(0.79, 0.85)
0.80 to 1.00	1804	78.3	(75.7, 80.8)	1167	70.3	(61.3, 79.2)
< 0.80	658	21.7	(19.2, 24.3)	475	29.7	(20.8, 38.7)

Depression Scale, mean							
	Urban	1824	2.54	(2.32, 2.77)	1143	2.86	(2.51, 3.21)
	Rural	1131	2.20	(1.78, 2.61)	568	2.41	(2.25, 2.56)
Anxiety Scale, mean							
	Urban	1818	1.59	(1.42, 1.76)	1144	1.90	(1.69, 2.11)
	Rural	1131	1.31	(1.13, 1.50)	569	1.62	(1.37, 1.86)
Stress Scale, mean							
	Urban	1822	3.52	(3.31, 3.73)	1142	4.12	(3.79, 4.45)
	Rural	1131	3.01	(2.73, 3.30)	569	3.70	(3.47, 3.94)
Food insecurity concern in the last 12 months							
		352	12.3	(10.5, 14.2)	275	15.1	(12.3, 17.9)
Lifetime discrimination instances							
0		1319	45.0	(42.3, 47.6)	801	45.7	(40.9, 50.5)
1 or 2		1010	34.2	(31.9, 36.6)	549	31.0	(27.4, 34.5)
3 or more		628	20.8	(18.6, 22.9)	389	23.3	(21.1, 25.6)
Neighborhood safe from crime							
Not very safe or not at all safe		84	2.7	(2.1, 3.3)	90	5.3	(3.4, 7.2)

* Unweighted

** Weighted and adjusted for the stratification and clustering in the complex survey sampling design.

Frequencies may not add to the total sample size due to missing values.

Table 4-B. Select Health Indicators for SHOW Adults WAVES III and IV, Unweighted

Select Health Indicators	WAVE III 2017			WAVE IV 2018-2019		
	N*	Mean %*	or 95% CI**	N*	Mean or %**	95% CI**
Body Mass Index (kg/m ²), mean	716	30.9	(30.4, 31.5)	501	32.1	(31.4, 32.8)
Underweight (<18.5 kg/m ²)	6	0.8	(0.2, 1.5)	6	1.2	(0.2, 2.2)
Normal weight (18.5 to 24.9 kg/m ²)	156	21.8	(18.8, 24.8)	77	15.4	(12.2, 18.5)
Overweight (25.0 to 29.9 kg/m ²)	204	28.5	(25.2, 31.8)	139	27.7	(23.8, 31.7)
Obese (≥ 30 kg/m ²)	350	48.9	(45.2, 52.6)	279	55.7	(51.3, 60.1)
Hemoglobin A1c (%), mean	508	5.7	(5.6, 5.8)	343	6.1	(6.0, 6.3)
< 5.7	348	68.5	(64.5, 72.6)	144	42.0	(36.7, 47.2)
5.7 to 6.4	114	22.4	(18.8, 26.1)	129	37.6	(32.4, 42.8)
≥ 6.5	46	9.1	(6.6, 11.6)	70	20.4	(16.1, 24.7)
Diabetes						
A1c ≥ 6.5% or previous diagnosis	60	11.8	(8.8, 14.8)	79	23.1	(18.6, 27.6)
Awareness	49	81.7	(71.6, 91.7)	51	65.4	(54.6, 76.1)
Treatment with medication						
(among aware)	41	83.7	(72.9, 94.4)	45	88.2	(79.1, 97.4)
Control, A1c ≤ 7.0 (among treated)	20	48.8	(32.8, 64.8)	17	37.8	(23.0, 52.5)
Hypertension						
≥ 140/90 mmHg or medication use	303	42.4	(38.8, 46.1)	237	48.6	(44.1, 53.0)
Awareness	223	73.6	(68.6, 78.6)	207	87.3	(83.1, 91.6)
Treatment with medication						
(among aware)	200	89.7	(85.7, 93.7)	188	90.8	(86.9, 94.8)
Control, < 140/90 (among treated)	113	56.5	(49.6, 63.4)	112	59.6	(52.5, 66.7)
Lung function (FEV1/FVC), mean	652	0.84	(0.83, 0.85)	292	0.81	(0.79, 0.82)
0.80 to 1.00	524	80.4	(77.3, 83.4)	227	61.5	(56.5, 66.5)
< 0.80	128	19.6	(16.6, 22.7)	142	38.5	(33.5, 43.7)
Depression Scale, mean						
Urban	480	2.71	(2.35, 3.07)	346	4.36	(3.81, 4.90)
Rural	137	2.34	(1.77, 2.92)	NA	NA	NA
Anxiety Scale, mean						

Urban	480	1.88	(1.63, 2.12)	352	3.56	(3.11, 4.02)
Rural	138	1.34	(0.98, 1.70)	NA	NA	NA
Stress Scale, mean						
Urban	481	3.88	(3.55, 4.21)	349	4.81	(4.31, 5.32)
Rural	138	3.28	(2.70, 3.85)	NA	NA	NA
Food insecurity concern in the last 12 months	84	11.7	(9.3, 14.0)	146	30.2	(26.1, 34.3)
Lifetime discrimination instances						
0	287	45.7	(41.7, 49.5)	88	26.0	(21.3, 30.6)
1 or 2	194	30.8	(27.2, 34.5)	101	29.8	(24.9, 34.7)
3 or more	148	23.5	(20.2, 26.9)	150	44.2	(38.9, 49.6)
Neighborhood safe from crime						
Not very safe or not at all safe	39	6.2	(4.3, 8.1)	141	38.3	(33.3, 43.3)

Frequencies may not add to the total sample size due to missing values.

Supplemental Table 1A. SHOW Participation by Health Region or County by Waves I - III, 2008-2017.

Health Region	WAVE I 2008-2013	County in Health Region	WAVE II 2014-2016	WAVE III 2017
North	66.5%	Wood	60.1%	100%
Northeast	57.8%	Brown Waushara	64.7% 80.2%	82.3%
South	62.0%	Dane	65.3%	88.8%
Southeast	50.8%	Milwaukee Racine Ozaukee	54.4% 63.1% 63.0%	85.3%
West	59.9%	La Crosse Eau Claire Polk	53.0% 71.7% 73.1%	80.0%

Supplemental Table 1B. SHOW Participation Rates by Phase and Urbanicity. Rates are estimated as the percent of adult individuals who screened eligible who agree to participate based on cohort year and urban/rural status of resident census tract. A more detailed summary of participation rates by health region (2008-2013 and 2017) and by County (2014-2016) is presented in Supplemental Table 1 and available online.

Response Rates	Overall %	Urban %	Rural %
WAVE I	57.5	56.1	60.5
WAVE II	63.5	62.0	70.4
WAVE III	85.6	84.9	85.9

Supplemental Table 2: Survey components WAVES I-IV

	WAVE I SHOW 2008- 2013 21-74 old	2008- years	WAVE II SHOW 2016 All ages	2014- years	WAVE III* SHOW 2017 follow up All ages	2017	WAVE IV
Questionnaires							
<i>Demographics</i>		✓		✓		✓	✓
<i>Health and health history</i>	✓		✓		✓		✓
<i>Mental health</i>	✓		✓		✓		✓
<i>Health care and medication</i>	✓		✓		✓		✓
<i>Health related behaviors</i>	✓		✓		✓		✓
<i>Physical and built environment</i>	✓		✓		✓		✓
<i>Social and economic determinants</i>	✓		✓		✓		✓
Clinical measurements							
<i>Weight</i>	✓		≥ 3 years old		≥ 3 years old		≥ 3 years old
<i>Height</i>	✓		≥ 3 years old		≥ 3 years old		≥ 3 years old
<i>Waist and hip circumference</i>	✓		≥ 3 years old		≥ 3 years old		≥ 3 years old
<i>Bioimpedance</i>	✓						
<i>Blood pressure and heart rate</i>	✓		≥ 3 years old		≥ 3 years old		≥ 3 years old
<i>Spirometry (lung function)</i>	✓		≥ 6 years old		≥ 6 years old		≥ 6 years old
Accelerometry (hip, wrist)			≥ 6 years old		≥ 6 years old		≥ 6 years old
Blood testing							
<i>CBC</i>	✓		≥ 18 years old		≥ 18 years old		≥ 18 years old
<i>Triglycerides</i>			≥ 18 years old		≥ 18 years old		≥ 18 years old
<i>Total and HDL cholesterol</i>	✓		≥ 18 years old		≥ 18 years old		≥ 18 years old
<i>HbA1c</i>	✓		≥ 18 years old		≥ 18 years old		≥ 18 years old
<i>Glucose</i>	✓		≥ 18 years old		≥ 18 years old		≥ 18 years old
<i>Creatinine</i>	✓		≥ 18 years old		≥ 18 years old		≥ 18 years old
Biosample collection and banking							
<i>Serum</i>	✓		≥ 18 years old		≥ 18 years old		≥ 18 years old
<i>Plasma</i>	✓		≥ 18 years old		≥ 18 years old		≥ 18 years old
<i>Urine</i>	✓		≥ 18 years old		≥ 18 years old		≥ 18 years old
<i>DNA</i>	✓		≥ 18 years old		≥ 18 years old		≥ 18 years old
<i>PAXgene tubes for RNA</i>			≥ 18 years old		≥ 18 years old		≥ 18 years old
<i>Stool, nasal, skin swab</i>			≥ 18 years old only in 2016		≥ 18 years old subset		≥ 18 years old subset

* Phase III was a follow-up survey of adults participating in SHOW Phase I during which children were not included. Children living in Phase I households in 2017 were eligible to participate in Phase III. Children enrolled in Phase III completed a baseline survey.

Figure 1. SHOW Survey WAVES and Follow-up Participation (through February 2021)

