Strategies to Improve Physical Activity Surveillance among Youth in the United States

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Physical activity has well documented benefits for youth, including improved academic achievement, musculoskeletal health, cardiovascular health, adiposity, blood pressure, and mental health.[1-4] However, adherence to physical activity guidelines is low. Only a small portion of American children achieve the recommended 1 hour or more of moderate-to-vigorous physical activity daily.[5] National, state, and local programs and policies to promote physical activity in children rely on regular and comprehensive surveillance of physical activity behaviors in youth to assess critical areas of need and evaluate impact of programming.

Youth physical activity and physical fitness surveillance systems in the US are characterized by large and important gaps. These gaps include a lack of surveillance data on individual-level youth physical activity in critical areas such as physical activity levels in younger children (ages 2-14 years), specific forms of physical activity (eg, walking to and from school, team sports), and objectively measured levels of physical activity; and organizational supports that influence youth physical activity such as the availability of and access to physical activity policies and programs in school and nonschool contexts, including childcare settings and community-based organizations.

To address these critical gaps, the Physical Activity and Health Innovation Collaborative, an ad hoc activity affiliated with the Roundtable on Obesity Solutions (Health and Medicine Division of the National Academy of Sciences, Engineering, and Medicine) convened an expert meeting in April 2017.[6] The purpose of the meeting was to identify specific solutions to improve national physical activity surveillance in the US, including recommended strategies for implementing the solutions. During the meeting, the expert panel recommended strategies to improve surveillance of physical activity in youth in the US in the next 5 years. We will present the strategies recommended by the panel and suggest specific tactics and approaches to accomplish these recommended strategies.

ATUS	American Time Use Survey
CLASS	Classification of Laws Associated with School Students
HEDIS	Healthcare Effectiveness Data and Information Set
MEPS	Medical Expenditures Panel Survey
NAMCS	Natinal Ambulatory Medical Care Survey
NHAMCS	National Hospital Ambulatory Medical Care Survey
NHANES	National Health and Nutrition Examination Survey
NHTS	National Household Transportation Survey
NNYFS	NHANES National Youth Fitness Survey
SHPPS	School Health Policies and Practices Study
YRBS	Youth Risk Behavior Survey

Summary of Existing National Physical Activity Surveillance Systems for US Youth

Major existing national surveillance systems used for monitoring physical activity levels and organizational supports among children in the US are summarized in the **Table**. These systems serve a variety of functions including tracking historical changes in physical activity levels across time and setting benchmarks to evaluate gains in health. At the individual level, physical activity surveillance in the US currently includes national data collection through survey methods examining time use (eg, American Time Use Survey [ATUS]), transportation (eg, National Household Transportation Survey [NHTS]), and health (eg, Youth Risk Behavior Survey [YRBS], National Health And Nutrition Examination Survey [NHANES]). At the organizational level, there are fewer examples of surveillance systems that are specific to youth physical activity. The Classification of Laws Associated with School Students (CLASS) collected data on state level laws related to Physical Activity from 2003 to 2015. The School Health Policies and Practices Study (SHPPS) and the School Health Profiles also provide a comprehensive assessment of school health policies, practices, and programs. The Medical Expenditures Panel Survey (MEPS), and National Ambulatory Medical Care Survey (NAMCS) assess physical activity counseling in the healthcare setting. Despite the history and success of these existing national youth physical

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Table. Current national surveillance systems that collect individual and environment level physical activity data for youth on a recurring basis

Surveys (website)	Collection methods (mode)	Relevant age range	Report types	Measures	Survey years
Individual levels					
American Time Use Survey (ATUS) (http://www.bls.gov/tus/)	One-d activity recall (telephone)	≥15 y	Self-report	Minutes spent in specific activities (active transportation, leisure-time, work) for one 24-hour period	2003-
National Health and Nutrition Examination Survey (NHANES) (http://www.cdc.gov/nchs/nhanes.htm)	Survey questions (in-person)	≥2 y	Parent proxy (2-11 y) Self-report (≥12 y)	Vigorous- or moderate-intensity activities and sports and frequency and length of time spent in those activities, walking and bicycling for travel, sitting, television viewing, and computer and video game use	2012-2016 2007-2016
	Accelerometry	≥2 y	Not applicable	Minutes per day of vigorous- and moderate-intensity physical activity (accelerometer placed on waist)	2003-2006
				Acceleration measurement (accelerometer placed on wrist)	2011-2014
NHANES National Youth Fitness Survey (NNYFS) (https://www.cdc.gov/nchs/nnyfs/index.htm)	Survey questions (in-person)	3-15 y	Parent proxy (3-11 y) Self-report (12-15 y)	Vigorous- or moderate-intensity activities and sports and frequency and length of time spent in those activities, walking and bicycling for travel, sitting, television viewing, and computer and video game use	2013
	Examination	3-15 y	Not applicable	Core muscle strength (3-15 y), gross motor skills (3-5 y), lower body muscle strength (6-15 y), upper body muscle strength (6-15 y), aerobic fitness (maximal and submaximal exercise test) (6-15 y)	
National Household Travel Survey (NHTS) (http://nhts.ornl.gov/)	One-d travel diary Survey questions (online, paper, telephone)	≥5 y	Parent proxy (5-15 y) Self-report (>15 y)	Active transportation (participants logged all trips on one day, including mode of travel and purpose)	1969-2009 2017
Youth Risk Behavior Survey (YRBS) (https://www.cdc.gov/healthyyouth/data/yrbs/index.htm)	Survey questions (self-administered)	High school students (9th-12th grade)	Self-report	Physical activity, sedentary behavior, physical education, sports participation	Odd years since 1991
Environment levels					
Classifications of Laws Associated with School Students (CLASS) (https://class.cancer.gov/)	Searches of primary legal research databases	Kindergarten-12th grade	Not applicable	State-level codified laws for physical education and nutrition in schools	2003-2008, (biennially) 2008- (annually)
Medical Expenditures Panel Survey (MEPS) (https://meps.ahrq.gov/mepsweb/)	Survey questions (in-person)	<18 y	Parent proxy	Healthcare provider counseling for physical activity	2001- (annually)
National Ambulatory Medical Care Survey (NAMCS) (https://www.cdc.gov/nchs/ahcd/about_ahcd.htm)	Checklist (self-administered paper)	0-18 y	Healthcare provider	Health education/counseling for exercise checkbox	1995- (annually)
National Hospital Ambulatory Medical Care Survey (NHAMCS) (https://www.cdc.gov/nchs/ahcd/about_ahcd.htm)	Interviews (computer-assisted)	0-18 y	Healthcare provider	Health education/counseling for exercise checkbox	1997- (annually)
School Health Policies and Practices Study (SHPPS) (https://www.cdc.gov/healthyyouth/data/shpps/index.htm)	Interviews (telephone/in-person) Survey (self-administered paper)	Kindergarten-12th grade	State education agency personnel, school personnel, physical education teachers	School district, school, and classroom level physical activity and physical education policies	1994, 2000, 2006, 2012, 2014, 2016
School Health Profiles (Profiles) (https://www.cdc.gov/healthyyouth/data/profiles/index.htm)	Survey (self-administered paper)	Middle (6th-8th grade) and high (9th -12th grade) school	Principals and lead health education teachers	School-level physical activity and physical education policies and practices	1996-2018 (every even y)

activity surveillance systems in the US, scientific advancements in physical activity assessment technology and understanding of factors influencing physical activity necessitate continued improvement of these surveillance systems. Below we highlight and discuss critical gaps and challenges in the US youth physical activity surveillance landscape that were identified at the expert meeting.

Gaps and Recommended Strategies for Physical Activity Surveillance among Youth

Individual Levels of Physical Activity in Youth

Young Children (Ages 2-14 Years). Gap: National surveillance data are lacking for young children (ages 2-14 years).

The YRBS only includes high school students (9th-12th grade), and the ATUS only includes individuals ages 15 years or older. One of the major challenges in assessing physical activity through self-report is that children under 11 years of age often lack cognitive ability to accurately recall physical activity levels.[7] The NHANES protocol includes a parent proxy-report question regarding children's physical activity for children ages 2-11 years. The NHTS also includes questions regarding active transportation in children reported by parent proxy for children ages 5-15 years.[8] However, parents may not be able to reliably report for times of the day when children are at school or with other caretakers. The 2013 NHANES National Youth Fitness Survey was a 1-time national assessment of muscle strength and fitness in children ages 3-15 years. However, there is not currently a system that routinely addresses regular assessment of fitness and nonscreen forms of sedentary behavior (eg, time spent reading, doing homework) in youth.

Recommended strategy: Establish and administer at regular intervals a protocol for monitoring physical activity, sedentary behavior, and physical fitness in nationally representative school-based samples of youth, ages 2-14 years, through proxy and self-report. To address these gaps, the YRBS and ATUS should be expanded to include youth ages 11-14 years as there is evidence that children within that age range can reliably self-report physical activity levels.[9] To augment parent proxy reports in NHANES, muscular and fitness testing should be added to NHANES for children ages 2 years and older. These assessments should be done on the existing measurement schedules using the NHANES Mobile Examination Center (MEC) as was done for the 2013 National Youth Fitness Survey. Furthermore, the assessment of nonscreen forms of sedentary behavior should be added to the YRBS, ATUS, and NHANES.

Specific Types of Physical Activity. Gap: National surveillance systems typically have not assessed participation in specific types of activities (eg, walking, bicycling), which can be important for guiding the focus of targeted policies and interventions. However, there have been some exceptions. For example, the 2017 YRBS queried high school students' participation in physical education classes and sports teams.[10] In 2010, the National Youth Physical Activity and Nutrition Survey[11] included a detailed report of students' participation in specific forms of physical activity. However, currently there are no plans to replicate this survey. The NHANES National Youth Fitness Survey (NNYFS) included items that provided information on specific forms of physical activity.[12] However, that survey was conducted in 2012, and no plans exist to replicate it on a regular basis. Similar survey items were included in the primary NHANES protocol for years 2013-2016 but were deleted in the 2017 survey.

Recommend strategy: Monitor participation of youth, ages 2-18 years, in specific types of physical activity and sedentary behavior by incorporating state-of-the-art self-report and proxy instruments into existing programs and surveillance systems. National surveillance efforts that assess prevalence of participation in specific forms of physical activity and social/physical environmental contexts in which these activities are performed, such as those included in the 2010 National Youth Physical Activity and Nutrition Survey and/or the 2012 NNYFS, should be replicated on a regular schedule. State-of-the-art self- and proxy-report approaches could include the use of smartphone apps and sensor-informed Ecological Momentary Assessment to record specific physical activities in real time or at frequent intervals.[13,14] Further, the surveys should cover the entire range of school age children, including middle (child report) and elementary school (parent proxy report).

Objective Monitoring Using Wearable Devices. Gap: Device-based measurement of physical activity is suitable for youth ≥2 years of age.[15,16] The NHANES protocol added objective assessment of physical activity among children using accelerometers in select years (2003-2004, 2005-2006, 2011-2012, and 2013-2014). However, enthusiasm about device-based measurement of physical activity in national surveillance studies has been tempered by poorer compliance with wearing the waist device among youth, especially adolescents.[5] The 2011-2012 and 2013-2014 NHANES surveys attempted to address some of these problems by switching to wrist placement, which resulted in much improved compliance and may prove better at capturing nonambulatory and specific forms of activity.[17] Other than the select years of the NHANES protocol, no other national surveillance systems have used objective device-based measures of physical activity.

Recommended strategy: Expand objective monitoring of children's physical activity by incorporating validated wearable technologies into existing surveillance systems. Synthesis of lessons learned from NHANES should lead to implementation of the next round of device-based national physical activity surveillance among youth ≥2 years of age at the national level. Such a system should complement rather than replace surveillance via self-report or proxy. A national physical activity surveillance system that combined both measurement modalities would allow triangulation of the resulting observed trends in physical activity in youth and increased confidence that the health surveillance system was capturing valid estimates of behavior. Some attention should be paid to the possibility that wearable devices could influence behavior. Past studies suggest that modest amounts of reactivity can occur in children and adolescents.[18] However, other studies report little or no reactivity,[19] including an analysis of accelerometer use in a US national survey.[20]

Environments that Influence Physical Activity in Youth

School-Based (K-12) Surveillance Systems. Gap: Regular monitoring of school-based policies and practices that support physical activity is critical for educators and policy/decision makers to make informed decisions where to improve physical activity and physical education

programming in schools. However, CLASS data on state level laws related to physical activity have not been collected since 2015. Furthermore, the SHPPS district, school-, and classroom-level questionnaires are only administered every 4 years. The state-level questionnaire was eliminated after it was last administered in 2012. Furthermore, SHPPS might potentially be cut back or discontinued. As the most comprehensive, nationally representative study of school-based K-12 physical activity and physical education policies and practices, eliminating this system would leave a large gap in knowledge, ongoing information, and a lack of trend analyses. Limitations to the School Health Profiles survey include a lack of comprehensive information about frequency of physical education provided to students and the absence of elementary school data.

Recommended strategy: Enhance existing surveillance systems for monitoring school-based physical activity policies and programs, including the CLASS, SHPPS, and the School Health Profiles. To address the significant gaps, efforts should be made to continue the types of data collected in CLASS and SHPPS to ensure the continued monitoring of trends on school-based policies and practices that support physical activity. Also, the School Health Profiles should be expanded by including elementary school-level questionnaires and adding more questions that are pertinent to physical activity and physical education. For SHPPS, it might be possible to reduce the length of the questionnaires by prioritizing the most critical information. For the School Health Profiles, expansion to elementary school level questionnaires would provide states, school districts, and territories a larger picture of K-12 physical activity and physical education policies.

Childcare Centers. Gap: Millions of American children under the age of 6 years receive care and spend substantial amounts of time in childcare centers and family childcare homes that are licensed by state agencies. In recent decades, many of these agencies have adopted policies that are intended to increase children's physical activity levels while they are in childcare settings.[21] State-level policies pertinent to physical activity in childcare settings have been tracked[22]; however, little is known about the extent to which practices that meet these policies are being implemented in those settings.

Recommended strategy: Develop and implement a system for monitoring physical activity policies and practices in childcare settings. To efficiently target policies that are intended to increase young children's physical activity in childcare settings and to determine the extent to which they are successful, a comprehensive national surveillance system is needed. It would be important that the system ensures monitoring of adoption of policies and implementation of best practices including staff training for promotion of physical activity in childcare settings. The population of interest in such a system would be all licensed providers of childcare in the US, including childcare centers, preschools, and family childcare homes. Because childcare is regulated at the state level, it would be ideal to include samples of providers that represent each state as well as the entire nation.

Healthcare Providers. Gap: Well-child visits offer an opportune time to assess children's physical activity, provide counseling, and refer youth to existing community resources if they are not sufficiently active. The 2007 Expert Committee Recommendations on childhood obesity preventive care recommended physical activity counseling for all children regardless of weight status.[23] This information is not consistently surveyed nor regularly summarized and included in publicly available reports. The latest available published data on counseling are from surveys conducted in 2008-2009[24] and 2008-2011.[25] These reports survey counseling from different perspectives, with results ranging from 18% of preventive care visits[10] to 39% of normal weight children.[11] Type or quality of counseling was not assessed. National data for physical activity assessment and referral are not available.

Recommended strategy: Modify existing surveillance systems to monitor prevalence of physical activity assessment, counseling and referral of children by healthcare providers. The MEPS, NAMCS, and NHAMCS all provide some information about primary care provider physical activity counseling for youth. Greater alignment across these systems may help avoid redundant and/or conflicting results. For instance, NAMCS and NHAMCS surveys collect information from medical visits, whereas the MEPS collects information from families, which can result in different and noncomparable prevalence rates. Although national recommendations include physical activity assessment, counseling, and referral by healthcare providers, currently only counseling is monitored. The National Committee for Quality Assurance, which has a Healthcare Effectiveness Data and Information Set measure for youth physical activity counseling, could specify metrics that indicate quality counseling. Numerous valid and reliable physical activity assessment measures are available, many of which are appropriate to implement in healthcare settings. For instance, Kaiser Permanente implemented a brief assessment of physical activity, the Exercise Vital Sign,[26] for adults, which can be adapted for youth. Items to assess physical activity referral are needed, and reliability and validity must be established prior to full-scale implementation.

Community-Based Organizations. Gap: Participation in organized sports, or activities (eg, instruction or group classes), has been shown to increase physical activity in youth.[27,28] Limited surveillance data on availability of community-based recreation facilities and programs exist. A national cross-sectional survey examining the availability of public park and recreation organization facilities and sponsored physical activity programs in 470 jurisdictions around the US between 2010 and 2012, found that over two-thirds (67%) offered an athletic or exercise program.[29] Although these data provide a much needed snap shot of availability of public recreational resources nationally, these

data have not been collected since 2012. Information on other community resources, such as private sports clubs and leagues, is also unknown.

Recommended strategy: Develop and implement a system for monitoring community-level availability of sports and other physical activity programs for youth. Given disparities of participation in organized sports and activities,[30,31] information is needed on community-based sports and physical activity programs, including how many days a week they are offered and for how many hours a day, and the costs associated with participating in the program. Surveillance of all community-based sports and other physical activity programs is potentially a huge undertaking with the number of unknown private clubs and leagues. However, a practical starting point, and one that has previously been tested,[29] is to develop ongoing surveillance of community-based programming provided by local park and recreation departments. Given the variability in the introduction/changes to park and recreation department programming, it is recommended that the survey be conducted every other year.

Summary, Challenges, and Next Steps

Systematically collected, nationally representative data are needed to understand children's individual levels of participation in physical activity,[32] especially for young children (ages 2-14 years), as these data are lacking. These data are particularly important for characterizing the extent to which youth achieve the types and amounts of physical activity to improve health outcomes as put forth in the recent 2018 Physical Activity Guidelines for Americans.[33] Furthermore, national level surveillance data are needed to characterize the availability and accessibility of programs, policies, and environments that promote physical activity among children. This information can identify critical gaps in support, sociodemographic and racial/ethnic disparities in access, and opportunities for federal policy change and program expansion such as the 2018 United States Report Card on Physical Activity for Children and Youth, which serves as an example of how surveillance data can be used to identify gaps and guide the implementation of sustained programs.[34] A useful preliminary step should be the release of a comprehensive report on the current state of youth physical activity surveillance in the US with a systematic catalogue of available national surveillance data, describing the source and type of data. Overall, achieving the recommended surveillance strategies in the next 5 years will require cooperation within and across federal agencies such as the National Center for Health Statistics, US Bureau of Labor Statistics, and the US Department of Transportation. It will also require input and participation from nonprofit (eg, National Physical Activity Plan Alliance), educational (eg, National Parent Teacher Association), healthcare (eg, American Academy of Pediatrics), and private sectors (eg, ActiGraph). A critical step in this process is the Committee on Strategies for Implementing Physical Activity Surveillance, convened by the National Academies of Sciences, Engineering, and Medicine in August 2018; which will identify specific strategies for implementing the strategies recommended by the 2017 Physical Activity and Health Innovation Collaborative expert panel.

Strategies to develop and implement these large-scale surveillance systems can take multiple forms. One approach is to sustain existing monitoring systems. For example, SHPPS might potentially be discontinued, owing partially to its labor and resource intensiveness. Exploring opportunities to transfer SHHPS and other surveillance resources slated for discontinuation to new partners and support systems (eg, government, nonprofit) that can continue these programs is critical. Also, maintaining continuous funding of NHANES and YRBS over years and decades to come should be a major focus. A second approach is to expand existing monitoring systems, which can save critical resources by leveraging available infrastructure and partnerships. Surveillance systems that have a long history of success such as the YRBS can be expanded to assess younger children (<14 years of age) and the objective activity monitoring component of NHANES can be extended. A third approach is to develop new monitoring systems. Although this strategy may be less desirable because it may require substantial resources, which are often difficult to secure, it may be a necessary step in surveillance of features (eg, community-level sports programs, policies in childcare centers and preschools) that have not been systematically assessed at the national level before.

There are continuing challenges and barriers to the development and expansion of surveillance systems for children's physical activity. These challenges include the need for consistency across systems in how physical activity is defined, as different systems question different aspects, such as aerobic, fitness, muscular, intensity, duration, and frequency aspects of bodily movement. Another challenge is the continued need for standardization across and within surveillance systems. Measures need to be tested for reliability and validity across time and populations, and show sensitivity to change in behavior within individuals. Lastly, lack of resources and feasibility limitations may pose significant barriers to the development and expansion of physical activity surveillance systems in children. For example, incorporating accelerometers into large-scale surveillance studies can be extremely costly and encounter challenges such as device non-wear, breakage, and loss. Fluctuations in federal funding over time may lead to lapses in surveillance and loss of critical data. However, developing public-private partnerships between federal agencies and industry-based wearable device makers may offer creative and practical solutions to these problems. Surveillance systems may be challenged to adequately capture and characterize physical activity among children from underrepresented groups and with special needs. However, these areas need to be a continued focus of effort and resources to collect representative information. Finally, there is potentially much to gain by ascertaining and modeling successful approaches taken by other countries and understanding how they overcame barriers similar to those faced in the US. Future work in this

area could benefit from a systematic review of physical activity surveillance systems in other countries.

Overall, the current surveillance systems for monitoring physical activity among children in the US have many gaps, which provide an incomplete picture of individual participation rates and available environments to support physical activity. Without the continuation, expansion, and development of new and existing physical activity surveillance systems, benchmarks to assess the success of national programs such as the National Physical Activity Plan and Healthy People 2020 are not available for children. Given rising rates of obesity and other life-long chronic diseases related to physical inactivity among children, these recommended strategies to improve physical activity surveillance among youth should be a national priority. ■

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