Sleep Health 3 (2017) 498–507

Contents lists available at ScienceDirect

Sleep Health

Journal of the National Sleep Foundation

journal homepage: sleephealthjournal.org

Self-report surveys of student sleep and well-being: a review of use in the context of school start times

Terra D. Ziporyn, PhD [a,*], Beth A. Malow, MD, MS [b], Kari Oakes, PA [a], Kyla L. Wahlstrom, PhD [c]

[a] Start School Later, Inc, PO Box 6105, Annapolis, MD 21146
[b] Sleep Disorders Division, Department of Neurology, Vanderbilt University School of Medicine, 1161 21st Ave South, Room A-0116 MCN,Nashville, TN 37232-2551
[c] Department of Organizational Leadership, Policy and Development, College of Education and Human Development, University of Minnesota, 210C Burton Hall, Minneapolis, MN 55455

ARTICLE INFO

Article history:
Received 31 May 2017
Received in revised form 31 August 2017
Accepted 6 September 2017

Keywords:
School start times
Adolescents
Bell times
High school
United States
School districts
Sleep duration
Teen sleep surveys
Self-reports

ABSTRACT

A large body of literature supports the need to delay high school starting times to improve student health and well-being by allowing students an opportunity to get sufficient and appropriately timed sleep. However, a dearth of uniform and standardized tools has hampered efforts to collect data on adolescent sleep and related health behaviors that might be used to establish a need for, or to evaluate outcomes of, bell time delays. To assess validated tools available to schools and contrast them with tools that schools have actually used, we identified and reviewed published, validated self-report surveys of adolescent sleep and well-being, as well as unpublished surveys, used to assess student sleep and related health measures in US high schools considering later high school start times. Only three of the surveys reviewed had adequate psychometric properties and covered an appropriately wide range of health and academic questions to allow for discernment of outcomes in pre-post educational settings. The surveys exhibited marked variability in numerous areas, including focus, terminology, calculation of sleep duration, mode of administration, context of administration, and follow-up procedures. Our findings provide sleep researchers and school administrators with an overview of surveys that school districts have used, along with a deeper understanding of the challenges of choosing, designing, and administering self-report surveys in the context of changing school schedules. They also highlight the opportunities presented by these instruments to assess outcomes of delaying bell times, compare communities meaningfully, and establish the need for later school start times in individual school districts.

Introduction

Since the Minnesota Medical Association issued its 1994 resolution calling to eliminate early school starting times, hundreds of US high schools have delayed their opening bell times, increasing opportunities for students to get sufficient and optimally timed sleep.[1,2] As part of the change process, many school districts have administered self-report surveys to students that collect measures of sleep habits and, often, concomitant measures of health, safety, and school performance. Data collected in this way can help school policymakers and researchers assess the need for later school start times, as well as assess the impact of bell time changes on sleep, health, and school performance. Many districts contemplating, planning, or evaluating later bell times have used published survey tools that were designed and validated to assess adolescent sleep and well-being. Others have designed, administered, and analyzed unique surveys. Some districts administer these surveys independently; other districts administer them in conjunction with public health or education policy researchers who may eventually publish survey findings in peer-reviewed journals.

The first self-report survey used to assess the impact of later school start times, the School Sleep Habits Survey (SSHS), was developed in 1994 by Bradley Hospital/Brown University Sleep Research Lab and administered to more than 3000 students in Rhode Island between 1994 and 1998. It was subsequently used in several countries to assess children's sleep[3] and administered by Wahlstrom[4] in 1998 to more than 7000 students, resulting in the first study documenting outcomes from a later high school start time. Findings from the SSHS, as well as from subsequent self-report surveys of adolescent sleep, have allowed researchers and school policymakers alike to assess the impact of bell time delays on a variety of health, safety, and school performance issues including sleep duration,[5–7] daytime sleepiness,[5,8] mood,[8,9] substance use,[5,6,8] car crashes,[5,10] attendance,[5,11] tardiness,[5,12]

* Corresponding author.
E-mail address: terra@startschoollater.net (T.D. Ziporyn).

https://doi.org/10.1016/j.sleh.2017.09.002
2352-7218/

discipline,[12] and graduation rate.[5–9,11] Findings from self-report surveys have also allowed researchers to compare the impact of school start time differences between schools and school districts. Wahlstrom et al,[5] for example, used the Teen Sleep Habits Survey (TSHS), an updated version of the SSHS, to compare students in 8 different high schools in 3 states, showing that students in schools that had shifted bell times to 8:35 AM or later were more likely to get sufficient sleep and had better attendance, reduced tardiness, and fewer car crashes. Such survey-based associations between early start times and adolescent sleep deprivation are also receiving increased attention from the clinical sleep community, given the association between adolescent sleep deprivation and attention, behavior, and learning problems[13–15] and an increased risk of accidents,[16–19] injuries,[20] hypertension,[21] obesity,[17,22–24] diabetes,[23] health-risk behaviors,[25–27] poor self-regulation,[28] and depression.[17,25,27] Combined with the many well-controlled studies about delayed sleep phase at adolescence,[3,29–34] findings from these surveys have established the potential of later bell times to mitigate both short duration and inappropriate timing of adolescent sleep on a population level.[35] They have also have led the American Academy of Pediatrics, American Medical Association, American Academy of Sleep Medicine, and other professional organizations to recommend that middle and high schools require attendance no earlier than 8:30 AM.[36–38]

In addition to contributing to the academic literature and to professional policy recommendations, self-report surveys are used by school districts to document in their particular student population the extent and impact of sleep problems and related measures of health and performance that might be affected by later bell times. Findings or subsets of findings are frequently disseminated to community stakeholders through publications, public forums, and web sites to inform and potentially influence community opinion about proposed schedule changes.[39–43] For example, surveys that generate data suggesting widespread sleep deprivation, depression, and stimulant use among local high school students may be described by school officials, reporters, or advocates in ways that increase community support for delaying bell times. Conversely, surveys documenting that high school students are well rested and thriving despite very early school start times may be used in ways that reinforce community reluctance or opposition to change.[44–49]

Given the central role of self-report surveys to public health and policy research, as well as their potential impact on school policy decisions, researchers and school districts need accessible, validated survey instruments that allow them to assess adolescent sleep health as well as related aspects of health, safety, and school performance. Valid and consistent baseline data are necessary to assess the need for and impact of delaying bell times in individual school communities, as well as to make meaningful comparisons between communities. Recent calls for additional evidence-based studies exploring the impact of delaying bell times in several recent review articles reinforce this need.[50,51]

The previously mentioned issues prompted us to identify and review the range and use of both published and unpublished self-report surveys of adolescent sleep and well-being administered in US school districts considering or implementing later high school start times. This overview is intended to inform sleep researchers and school communities about the variety of surveys used, along with a deeper understanding of the challenges and opportunities these instruments present.

Methods

To identify self-report surveys that districts considering implementing or that have implemented later school start times have used to measure adolescent sleep and well-being, we first conducted a literature search using 4 search engines covering peer-reviewed education, psychological, medical, and public health journals: Google Scholar, PsychINFO, JSTOR, and PubMed. Searches of these bodies of literature enabled us to identify published, validated surveys that had been used to measure adolescent sleep together with related measures of well-being, with results limited to surveys that had been used in districts that were considering or had implemented later start times. Search terms included students, adolescents, school health, school health policy, school start times, sleep, and adolescent sleep. We also identified published and validated surveys of adolescent sleep noted in 2 recent review articles on school start times and their impact on health and academic outcomes.[50,52]

To identify additional self-report surveys used by school districts but not necessarily mentioned in the academic literature, we reached out to a network of about 100 school board members, community activists, pediatricians, and researchers who work with or advise Start School Later (SSL), a nonprofit coalition aiming to raise awareness about sleep and school start times and to ensure school schedules compatible with sleep health.[53] We posted on the SSL Chapter Leader Facebook group and sent personal e-mail requests to all chapter leaders and advisory board members requesting surveys to assess student sleep health and wellness used in their own school districts or that they were aware had been administered by specific districts. In response, we received 28 total surveys conducted between 2004 and 2017, 17 of which were intended to be completed by high school students.

To ensure representation from communities that did not necessarily have an active group of stakeholders advocating for later school start times, we also conducted an Internet search using the term "school start time survey" and included the first 17 results that did not duplicate results obtained from the SSL network and that had been used by specific schools or districts that were considering or had implemented later start times to assess sleep health or patterns in high school students. We excluded surveys that assessed only community opinion on the need for, desirability of, and/or projected impact of changing bell times or of specific bell time changes, unless they also assessed sleep health and related behaviors, attitudes, and/or health measures.

We analyzed the surveys administered by the 34 districts identified in the SSL/Internet searches together with 4 of the 5 validated surveys that had already been identified in the literature search. The fifth validated survey, the US National Comorbidity Survey: Adolescent Supplement, was conducted from 2001 to 2004 and includes various questions about sleep as well as life stresses, health, and sociodemographic correlates of mental disorders.[54] We excluded this survey from subsequent analysis because it is no longer being conducted and was not used in any of the school districts we examined. All other identified surveys were analyzed quantitatively by categorizing and then tabulating issues assessed (e.g., bedtime, duration of sleep, use of alarms, whether breakfast is eaten on schooldays, etc) and qualitatively by reviewing survey focus, design, length, phrasing, mode of administration, and, for surveys obtained from the SSL/Internet searches, context of administration and comments provided by survey administrators in the specific districts that had administered them. Questions on several surveys were obtainable only as parts of reports on findings rather than in the original survey format. At least 2 authors analyzed every survey.

Results

Self-report surveys identified

Stanford Survey of Adolescent School Experiences

The Stanford Survey is an online survey of about 70 questions designed to measure the perspectives of middle and high school students on issues related to sleep, homework, physical health, stress,

parental expectations, academic engagement, academic integrity, and teacher support. The survey takes about 30 to 40 minutes to complete and has been administered in more than 100 schools since 2009, including the San Ramon Valley High School in Danville, CA, in 2015 as part of the Stanford University School of Education's Challenge Success project.[55] It asks students to estimate the average hours of sleep they get on a typical school night as well as to report difficulties sleeping as one of several measures of stress-related physical symptoms. Additional questions survey students regarding aspects of school climate and student engagement such as cheating behavior, time spent on homework, and academic pressures.

School Sleep Habits Survey/Teen Sleep Habits Survey

The SSHS, a 63-question machine-scored questionnaire, was developed in 1994 by Bradley Hospital/Brown University Sleep Research Lab. Four different scales were created from survey items: a depressed mood scale taken from Kandel and Davies,[56] the Superscience Morningness/Eveningness Scale as described by Carskadon et al,[57] a sleepiness scale, and a sleep/wake problems behavior scale.[58] Originally designed to be completed on paper in a classroom setting, it can now be completed online. Students are asked a wide variety of sleep-related questions, including estimated hours of sleep on school and non–school nights, bedtime, fall-asleep time, rise time, napping behavior, daytime sleepiness, alarm use, and sleepiness in a variety of situations including class, watching television, attending a performance, and doing homework. Additional sleep-related questions address nightmares, insomnia, reasons for sleep and wake times, and sleeping in. Health and activities questions are part of the survey as well, asking students about things such as sports, afterschool and weekend employment, homework, health-risk behaviors, and caffeine consumption. Respondents are also asked to estimate their level of physical maturation and provide detailed answers about the nature and demands of afterschool jobs and extracurricular activities in terms of hours spent, number of days per week, and sleepiness during these activities. Like the Stanford Survey, the SSHS asks questions about race/ethnicity, sex, age/grade, and mental health, but it adds to these questions about height, weight, who lives in the home, educational aspirations, disabilities, chronic illnesses, general health, attention-deficit/hyperactivity disorder and other learning disabilities, and Individual Education Programs or other special help. Some questions ask respondents to predict how they would behave or feel under hypothetical circumstances (e.g., if you did not have to wake up at a specific time, if you could take a test whenever you wanted, and if you did not have homework).[58]

The SSHS was updated and the language slightly revised in 2009 by Wahlstrom when she conducted a 3-year national study of outcomes and school start times via a Centers for Disease Control and Prevention (CDC) grant. The revised version of the SSHS is called the TSHS. The minor changes involved adding questions about the use of electronics, including an inquiry about the presence and use of a cell phone in the bedroom, and eliminating some questions not directly relevant to bell time change or that school districts felt might compromise student confidentiality (e.g., birthdate and degree of physical maturation). The 4 scales validated in the earlier SSHS remained unaltered. The TSHS was administered to more than 9000 students in 8 high schools in 3 states during the period 2010–2013.[5,6] An online version using most of the same questions was administered for the first time in an urban high school in 2014.

Youth Risk Behavior Survey

The National Youth Risk Behavior Survey (YRBS) is a nationwide survey of adolescent health-risk and health-protective behaviors conducted by the CDC. It is one of many separate surveys that make up the Youth Risk Behavior Surveillance System developed in 1990 by the National Institutes of Health to monitor priority health-risk behaviors among American youth and adults.[59] These behaviors, which include alcohol use, drug use, tobacco use, sexual behaviors related to unintended pregnancy and sexually transmitted infections, driving safety, and unhealthy diet and inadequate physical activity, are measured through both the National YRBS and other YRBS surveys conducted by departments of health and education in individual states, large urban school districts, US territories, and tribal governments participating in the Youth Risk Behavior Surveillance System.

Using a representative sample of public and private high school students, the National YRBS is administered biennially in a single class period as an anonymous, self-administered questionnaire, with responses recorded on a scan sheet or booklet. Although designed to be representative of high school students throughout the United States, data sets do not contain information from every state, nor are they constructed to provide representative data at state, regional, or individual school levels.[60,61] Participation is optional, with parent permission procedures determined by local policy. The survey contains only a single sleep question, which states, "On an average school night, how many hours of sleep do you get?"[62] Findings from the YRBS have been used to examine the association between sleep duration and injury-related risk behaviors among high school students, including driving safety, as well as in assessments of school start times.[20,63]

Fairfax County Youth Survey

The Fairfax County Youth Survey (FCYS) is a comprehensive, anonymous survey given each year to students in grades 6, 8, 10, and 12 in Fairfax County, VA. A collaboration of Fairfax County Government and the Fairfax County Public Schools, it examines variables influencing the health and well-being of county youth to provide data that local schools, organizations, and government agencies can use to assess their effectiveness in fostering healthy choices and to guide future prevention efforts.[64,65] The FCYS is administered in classrooms, and students may only opt out with written parental permission. In the 2016–2017 school year, the version of the survey administered to grades 8, 10, and 12 had 164 items.[66] Versions vary slightly in alternate years, focusing in odd-numbered years on health-related behaviors to coincide with the YRBS and focusing in even-numbered years on risk and protective factors of community concern. Both versions include questions about extracurricular participation, homework, diet, exercise, illegal drug use, stress management, bullying, fighting, electronics use, sexual identity and behavior, driving, stress, depression, suicidal ideation, sleep duration, and energy drink consumption, which may be associated with sleep problems.[67–71] The FCYS has been used in research related to the benefits of longer sleep duration in teens, including aspects of mental health and substance abuse, and in studies of later school start times.[7,25]

Surveys obtained from the SSL network and the Internet

The student surveys obtained from the SSL network and Internet searches were administered between 2004 and 2017 by 34 individual US school districts. These districts represented a wide range of geographic areas and included school populations ranging from single-high-school districts to Fairfax County, Virginia, the 10th largest school district in the country comprising 33 high schools and serving more than 188,000 students. Most surveys obtained from the SSL network and Internet searches were unpublished and most had not been validated, although 5 districts administered one of the validated surveys we had found in the published literature without alteration: 1 used the Stanford Survey, 1 the YRBS, one the FCYS, and 2 the TSHS. Each of the remaining 29 districts administered a unique survey tailored to its school community ("district-specific" surveys).

Survey analysis

Table 1 lists key features of the 4 validated self-report surveys identified in our search of the academic literature that are still in use. We analyzed these surveys together with the district-specific surveys and found considerable variation in focus, length, level of detail, specific questions, and mode of administration (paper or online). When we examined the way the 34 districts identified in the SSL/Internet searches had used self-report surveys, we found that several surveys were administered twice, once to collect baseline data and then in the school year after a bell time change. The SSHS/TSHS was by far the longest and most comprehensive assessment of sleep in any of the surveys we examined, whereas the YRBS, with its single question asking high school students how many hours they sleep on school nights, was the shortest.

Several surveys obtained from the SSL network and Internet searches, particularly those administered by academic researchers, combined multiple published surveys or adapted them so that they could be administered online. Others borrowed select questions from validated tools or adapted them by removing, reordering, updating, or rephrasing selected items. East Greenwich, RI, for example, administered a survey described by its developers as borrowing heavily from the SSHS, which was designed as a paper survey, but administered it using Research Electronic Data Capture, a secure Web application for building and managing online surveys. Cherry Creek, CO, derived questions for its survey (along with 2 separate surveys aimed at different age levels) from (1) the Patient-Reported Outcomes Measurement Information System[72]; (2) the SSHS; (3) the Children's Report of Sleep Patterns, a self-report measure of sleep for children aged 8 to 12 years[73]; (4) Healthy Pathways Child–Report Scales[74]; and (5) questions used previously the district in their Climate, Safety and Wellness Survey and their Academic Achievement Survey. Glens Falls, NY, assessed students before and after a start time change by combining 4 separate published and validated tools—the Epworth Sleepiness Scale, Depression Anxiety Stress Scales, the Owl-Lark Scale, and the Pittsburgh Sleep Quality Assessment, none of which have been validated in adolescents or children or differentiate sleep patterns on school days from those on non–school days.[12] In one case (Arlington, VA), student self-reports were supplemented with attendance and performance measures from school records.

With the exception of the validated surveys, most of the surveys that districts used combined questions about sleep and wellness with questions gathering information about extracurricular activities and community needs, eliciting opinions about proposed bell time schedules, and sometimes providing an opportunity for open-ended comments. As with the SSHS, many of these customized surveys asked respondents hypothetical questions, including "push-poll" questions that required predicting how schedule changes would impact sports, jobs, commutes, daycare, and other aspects of community life. Some examples are: "if school ended later in the day, how would your [athletics, afterschool job job/activities, commute, family day care, traffic patterns] be affected?" "How difficult would it be to change those arrangements to a later school schedule?" and "Do you think you would go to bed later if school started later?" A few surveys also included background information about why later bell times were being considered, current knowledge about developmental changes in adolescent sleep needs and patterns, or outcome studies from other districts that have moved to later bell times.

For measures of sleep duration and patterns, as well as most other data points measuring student experiences, attitudes, and behaviors, the surveys varied widely in content, design, and mode of administration. Most of the surveys assessed duration of sleep on school nights and differentiated that from non–school nights, and most of the district-specific surveys assessed sleepiness during the school day. Even for these questions, however, the surveys we examined included a wide variety of question formats that yielded answers with widely divergent levels of specificity, including dichotomous questions, multiple choice questions, a matrix of possible responses, open-ended questions, interval scale questions, and ratio scale questions. Only a handful of surveys asked respondents to supply sex, age, developmental stage, socioeconomic status, or to answer questions about mood, tardiness, or absences. Only a few of the surveys included items specifically addressing electronic use before bed or consistency of bedtime and rise time throughout the week. The surveys also showed notable variation in the following:

- *Validation.* All of the surveys found via the published academic literature had been validated, whereas most of the surveys found via the SSL network and Internet searches, while often adapted from validated surveys, had not been validated in their revised format.
- *Focus.* Many of the surveys found outside the published literature focused on assessing community reactions to a proposed bell time change, although a few focused almost exclusively on quantifying the number of hours of sleep that students obtained on school nights. As Table 1 shows, the validated surveys we identified in the published literature varied greatly in focus, with the SSHS focused largely on providing a comprehensive assessment of adolescent sleep, the FCYS and Stanford Survey on more general aspects of youth health and well-being, and the YRBS on health-risk behaviors specifically.
- *Appropriateness for adolescent populations*. Some of the surveys obtained from individual districts had already been validated for high-school–aged populations or were minimally modified versions of validated surveys from the published literature. Others consisted of selected parts of these surveys or surveys validated for younger children or adult populations. Still others had been constructed *de novo* for that particular school district and never validated.
- *Context for administration.* The introduction and context given to students about the district-administered surveys were highly variable. Some schools or districts constructed elaborate web sites to compile research and other educational materials related to adolescent sleep and school start times and administered surveys from these sites. Some prefaced the survey with explanatory information about adolescent sleep and circadian rhythms, or placed the link to the survey at the bottom of a letter from the principal or superintendent outlining the rationale for considering change. Others simply conducted the survey, or made the link available, with little or minimal introduction.
- *Phrasing/word choice.* (e.g., "weekends" vs "non–school days" and "bedtime" vs "fall-asleep time"). Some surveys asked about behaviors or feelings over a specific period of time (e.g., the past 2 weeks), whereas others asked about a "typical" or "average" day. For example, some surveys asked students how much sleep they got "on school nights," whereas others asked how many hours they get on a "typical school night" or "on a school night on average." To assess sleep patterns on non–school days, some surveys asked about sleep on "non–school days," others on "weekends," and still others "on days when you don't need to wake up at particular time for school, a job, a sporting event, etc."
- *Precision*. Some surveys asked respondents to provide exact times to the minute, whereas others requested a specific hour or a range of times. Some surveys asked students if they drove

Table 1
Self-report surveys of adolescent sleep and well-being[a]

	SSHS/TSHS	Stanford Survey of Adolescent School Experiences	Fairfax County Youth Survey	Youth Risk Behavior Survey[b]
General information				
Internet link	http://www.sleepforscience.org/contentmgr/showdetails.php/id/93 (SSHS) www.teensleep.umn.edu (TSHS)	http://www.challengesuccess.org/schools/school-surveys/	http://www.fairfaxcounty.gov/demogrph/youth_survey/pdfs/sy2016_17_fairfax_county_survey_instrument.pdf	https://www.cdc.gov/healthyyouth/data/yrbs/pdf/2017/2017_yrbs_standard_hs_questionnaire.pdf
Intended age/grade range	Grades 9–12	Grades 6–12	Grades 6, 8, 10, 12	Grades 9–12
No. of questions	SSHS: 63 TSHS: 47	70	164	89
Average administration time	SSHS: 30 min TSHS: 20 min	30-40 min	50 min	45 min
Mode(s) of administration	Scan sheet or online	Online	Scan sheet	Scan sheet
Validated subscales	Yes	Yes	Yes	Yes
Expectation for valid use	Scripted administration	Scripted administration	Scripted administration	Trained administrator
District-level estimates	X[c]	X	X	
Cost/access	Free, with permission	$2750-$5000+	Sample viewable online	Sample viewable online
Demographics				
Age and/or grade level, race/ethnicity	X	X	X	X
Sex	X		X	X
Sleep questions				
Bedtime on school nights	X	X		
Bedtime on non–school nights	X			
Wake time on school days	X			
Wake time on non–school days	X			
Fall-asleep time and bedtime differentiated	X			
Sleep duration	X	X	X	X
Napping	X			
Daytime sleepiness	X			
Sleep difficulties (nightmares, insomnia, difficulty waking)	X	X		
Substance use questions				
Caffeine/energy products	X		X	
Illegal drugs	X		X	X
Cigarettes	X		X	X
Alcohol	X		X	X
Mental health questions				
Anxiety, stress	X	X	X	X
Depression, suicidal ideation	X	X	X	X
Physical health questions				
Physical maturation	X (SSHS only)			
Height and weight	X			X
General health/sick days	X	X		
Chronic conditions/disabilities	X			X
Medications	X			
Health-risk behavior questions				
Sexual experience			X	X
Bullying/delinquency			X	X
Eating/snacking	X		X	X
Physical activity	X		X	X
Driving	X		X	X
Electronics use	X	X	X	X
School experience questions				
Grades	X	X	X	X
Absenteeism	X		X	
School climate		X	X	
Academic engagement		X	X	
Academic worries		X	X	
Homework, time spent	X	X	X	

Table 1 *(continued)*

	SSHS/TSHS	Stanford Survey of Adolescent School Experiences	Fairfax County Youth Survey	Youth Risk Behavior Survey[b]
Extracurricular questions				
Afterschool jobs, time spent	X	X	X	
Sports, time spent	X	X	X	
Clubs/Music, time spent	X	X	X	

SSHS, School Sleep Habits Survey; TSHS, Teen Sleep Habits Survey.

[a] Self-report surveys mentioned in published studies of later school start times in US school districts. The table does not include "district-specific" surveys or the US National Comorbidity Survey: Adolescent Supplement, which is no longer being conducted.

[b] National version.

[c] X indicates that the survey contains at least 1 question about the topic.

a motor vehicle, whereas others specifically asked them if they drove to school.

- *Calculation of sleep duration*. Some surveys relied on respondents to estimate the hours of nightly sleep, whereas others collected specific bedtimes and wake times, or specific fall-asleep times and wake times, and used these to calculate hours of nightly sleep. Many studies collected several of these measurements.
- *Differentiating bedtimes from "fall-asleep" times*. Only some of the surveys asked respondents to supply both the time they went to bed and the time they estimated falling asleep, or otherwise differentiated these 2 events.
- *Methods of assessing mood*. Some surveys included multiple questions from validated measures of mood disorders that were extracted from a preexisting instrument to assess depression and anxiety. Others constructed their own measures by using popular terms that might suggest a mood disorder, such as asking whether students stressed over schoolwork or have felt sad or worried, or had trouble having fun in the past week or two.
- *Lumping* vs *splitting*. Some surveys asked dichotomous questions about various experiences, whereas others sought highly detailed and specific information. One survey would ask whether or not students had jobs; for example, others would ask students to differentiate before-school, after-school, nightly, and weekend employment and specify the number of hours required by each per week. Similarly, many surveys asked students whether they ever used stimulants, whereas others asked them to specify which stimulants they used and under what circumstances. Other surveys asked about general daytime sleepiness, whereas others asked multiple questions about sleepiness in a wide variety of school and non–school settings.
- *Mode of administration*. The surveys differed widely in mode of initial administration. Some surveys were administered on paper, some with bubble-in score sheets or drop-down menus with a simple list of choices, and others offering a matrix of responses for different days of the week or variations in behaviors. Still others offered open-ended fill-in-the-blanks. Some surveys, particularly the most recent, were administered online, some requiring a secure log-in; others were accessible publicly so that they could be answered multiple times by the same person, and by anyone with the URL. Some surveys sampled a select group of students, either certain grade levels, a specific class, and/or a group paid or rewarded for participation (e.g., with an Amazon coupon); others surveyed the entire student body. Some surveys were administered in the classroom, some at home, some on a given day, and others over weeks or even months. When Fairfax County, VA, did not allow in-class administration of the Children's National Medical Center survey, for example, investigators sent out multiple reminders and extended the response period from March through early June to increase response.
- *Follow-up procedures*. Surveys administered to assess students before and after a bell time change also showed inconsistencies in the time of the school year in which baseline and follow-up surveys were conducted. Some districts gathered baseline data in early fall, for example, and then resurveyed students in the spring after a bell time change. Some surveys assessed sleep in the same cohort of students a year later, potentially adding a confounding variable of maturity, whereas others assessed 10th graders before a bell time change and then a new cohort of 10th graders after a bell time change.

Discussion

Our findings suggest that many districts considering or implementing bell time changes remain unaware of the need to use validated tools, or perhaps even of the existence of such tools, in assessing student sleep and well-being. Instead, we found that many school districts continue to use self-created surveys that do not necessarily generate useful, valid, and generalizable information. Researchers, in contrast, have had access to validated surveys such as the SSHS/TSHS over the years, but they, too, often face the issue of a short window between the time schedule changes are approved and the time they are implemented. Because schedule changes may be implemented only months after a decision to change bell times, researchers can easily miss the opportunity to gather meaningful baseline data, especially if they first must obtain research funding for an outcome study. The fact that districts sometimes reverse decisions to change schedules at any point in the process compounds the problem of coordinating funding with data collection, as do logistical difficulties of collecting baseline data in school populations (e.g., the need for institutional review board approval). For these reasons, the burden of gathering valid baseline data often falls on school communities, increasing the need for a widely available, uniform, validated assessment tool. Table 2 lists recommendations for choosing, designing, and administering self-report surveys in districts considering later school start times.

Our findings also highlight the need for caution whenever any survey tool is used to collect data on student sleep and wellness, whether the tool is administered by a researcher or a school district. The first concern is the choice of a survey itself. Surveys that collect data about only a few variables—such as sleep duration, absences, grades, test scores, or participation in sports—are too narrow to assess

Table 2
Self-report surveys in the context of school start time change: recommendations

	Recommendations
Survey choice	• Consider why the survey is being given. Surveys used to assess needs may differ from surveys used to evaluate the impact of a change. • Surveys that only measure current sleep health and any range of health or academic performance issues of community concern may be appropriately used in needs assessments. • Pre-post surveys used to examine the impact of bell-time changes should examine the status of a broad range of sleep, mood, and health measures. • Choose only surveys validated for the age group being surveyed.
Survey design	• Ensure that all survey questions are valid and reliable. • Include only survey questions required to inform decisions or assess outcomes. • Avoid vague, double-barreled, hypothetical, and push-poll questions. • Make sure response sets match the questions asked.
Survey administration	• Do not alter, reword, omit, or rearrange questions from a validated survey without providing for new validation. • Ensure consistent timing and context of administration. • Secure resources for data aggregation and analysis. • Administer needs assessment surveys in advance of an anticipated school start time change. • Administer the survey in the form in which it was designed and validated (eg, pencil-and-paper, online, in the classroom, and taken at home). • Ensure that online surveys can be taken only once by any individual and only taken by individuals intended to be surveyed. • Ensure confidentiality of respondents. • Collect data for at least 3 yrs after change to assess educational outcomes of a school start time change.

the impact of later start times on student health, well-being, and performance overall. In addition, surveys that do not assess and control for concurrent changes in student lives cannot be used to determine if any outcomes in a pre-post analysis are due specifically to a later start time. We found only 3 surveys that have adequate psychometric properties to yield valid and reliable results and that cover an appropriately wide range of both health and academic questions to discern outcomes when used in a pre-post educational setting: the Stanford Survey of Adolescent School Experiences, the FCYS, and the SSHS/TSHS. Other validated surveys for teens used by state and federal agencies to assess adolescent health and wellness, even those like the YRBS that include sleep-related questions and collect a wide range of information, do not provide representative estimates for individual schools or districts and, thus, cannot be used to determine health and educational outcomes related to a particular district's bell time changes. However, districts can use the National YRBS as a basis for constructing a district-specific YRBS. The CDC provides a guide for communities that wish to do so without technical or monetary support from the CDC.[75] Large, urban districts may be also able to use data from their local YRBS, although some of these surveys include private school students in their sampling frame.[60]

Although they did not appear in the published literature on school start times, other validated surveys related to adolescent sleep may be valuable tools for use in research related to delaying bell times as well. Examples include the Cleveland Adolescent Sleepiness Questionnaire,[76] the Pediatric Daytime Sleepiness Scale,[77] the Adolescent Sleep-Wake Scale,[78] the Adolescent Sleep Hygiene Scale,[78] and the Monitoring the Future Study.[79] Results about sleep from these surveys can be combined with health outcomes data to inform understanding of the ways that sleep and health are related in a school setting. They can also potentially be combined with measures such as truancy, tardiness, suspensions, and graduation rates to assess more directly the relationship of sleep, school start times, and school performance. Findings from actigraphy[80] and student diaries of sleep and behavior may also be useful and have been shown to correlate with the results of sleep habits surveys for adolescents, particularly on school nights.[81]

Just as critical as selecting an appropriate survey is ensuring a meaningful and consistent mode and timing of administration, context, and follow-up. Student sleep data gathered in the fall, for example, are not necessarily comparable to data gathered in the spring. Given the ebb and flow of both academic and extracurricular demands in the course of a school year, in addition to changing clocks and light patterns, this inconsistency could potentially mask changes, or lack thereof, in sleep patterns as well as other variables. In addition, inadequate consideration of the survey's format (e.g., paper/pencil or online and fill-in-the-blanks vs multiple-choice) and method of administration (e.g., in-class completion vs an open electronic portal that does not control for sample size or other demographic variables) can yield invalid and incomplete results.

Districts collecting data by survey, or any other means, for any purpose, also face several ethical challenges. First and foremost, the importance of ensuring confidentiality and anonymity cannot be overstated, even with a survey whose respondents are assumed to be anonymous. In addition, surveys should not include questions that will not be used in the analysis or to better understand an outcome. Thus, survey developers must continually ask themselves, "Why are we asking this question?" and "What do we plan to do with the answers?" If a clear answer cannot be given, then that question should be removed. Asking a question on a survey naturally causes respondents to assume answers will be used to shape a forthcoming decision. If that is untrue, it is unethical to be asking the question at all. For example, it is unethical to ask respondents if they want the start time to change after a superintendent or a school board has already decided to delay bell times. More ethical—and useful—would be asking respondents to share their concerns about the new schedules or gathering information to help assess logistical issues that might complicate the change process.

Districts that create their own surveys face additional challenges developing valid and reliable survey questions. Valid questions are those that measure what they purport to measure. Reliable questions are those that elicit consistent information when they are used under the same conditions. Entire graduate degree programs are devoted to the creation of surveys that are psychometrically defensible in these ways. The difficulties in crafting high-quality survey questions are reflected in the issues we found in many of the nonvalidated surveys, including unclear/vague words, "double-barreled" questions (i.e., asking 2 questions in a single question), or response sets that do not match the questions. The best surveys contain nonhypothetical questions, each asked with a clear purpose and phrased in ways that cannot be taken to have several meanings. Districts adhering to these standards avoid asking respondents to speculate about outcomes, a practice that may generate inaccurate responses that scuttle a planned policy change. They also avoid "push-poll" questions that are built on assumptions likely to skew responses (eg, "If school started later in the morning, how would this affect your athletics

schedule?" or "Would it be easy or difficult for you to change your extracurricular activities to accommodate a later school schedule?"). Accurate questions only ask for actual experiences connected with real actions; for example, "When X happens, what *is* your response?" Inaccurate suppositions about an outcome emerge when a question is alternatively phrased, for example, "If X happens, what do you *think* your reaction will be?"

Although designing, choosing, or administering a survey to discover the behaviors and concerns of the specific people impacted by a school start time or other policy change can be hugely beneficial to a school district, there are often "costs" connected to using a survey in this way. Creating or locating a reliable and valid survey tool that can be used before and/or after a change can take considerable time and resources, often including the costs of developing or purchasing the survey tool and paying for its subsequent analysis. A school or district choosing to proceed with the use of a survey will need to have access to a person qualified to aggregate the data and conduct appropriate analyses. Individuals trained to do this may be found in a district's research and evaluation departments, but smaller districts may need to seek qualified data analysts at a local community college or a state university's extension office, or purchase services from a private consultant specializing in data management and analysis. Even districts that have budgeted for these direct costs may fail to anticipate the "cost" of getting data back, indicating that a schedule change was poorly planned or that survey questions were poorly formed and the findings therefore useless. These costs reinforce the need to consider carefully the value of the survey to the issues at hand, as well as the potential effects of results on a school community when choosing, developing, or implementing surveys.

Finally, some of the inconsistencies we found in survey choice might be alleviated with more thought given to the *reasons* a survey is being conducted. Surveys that aim to assess timing of sleep, and not just duration, for example, should include questions about specific bed times and wake times on both school and non–school nights and not just the number of hours of sleep per night. Surveys that ask about concerns potentially needing to be addressed are best used only in advance of a change. On the other hand, surveys that seek to compare outcomes such as changes in health status and in sleep behavior and mood are best suited to pre-post comparisons. When combined with other data that are regularly collected about students, such as attendance and tardiness data, test scores, and behavioral referrals, this type of reporting allows a complete picture to emerge of whether or not the change has had an impact. Note, however, that 3 years of school-based data is usually needed before the overall educational outcomes of a schedule change can be known fully.[82] If a school or a district does not attempt to measure any changes systemically over those years, the real outcomes may never be substantiated, with only anecdotes left to tell the story.

Conclusions

Survey tools used during the process of changing school starting times can provide an enormous amount of information to school leaders as well as education, sleep, and public health researchers. However, the choice of a tool or other means to measure change is an important decision that requires significant thought and planning. Generating reliable, comparative data requires that surveys are appropriately chosen, developed, administered, and analyzed. With access to the available validated surveys, and a deeper understanding of the challenges and opportunities these instruments present, the research and school communities alike can better assess adolescent sleep needs and patterns, as well as collect the baseline and outcomes data essential to assessing the impact of later secondary school start times on student sleep, health, and well-being.

Identifying a single, standardized, validated tool that can be easily accessed and administered by both school districts and researchers would greatly facilitate all of these efforts and allow for more informed school policy decisions as well as more meaningful comparisons between school communities. In the future, an "item bank" of valid survey items from which to generate a survey that addresses local needs, questions, and conditions would be greatly beneficial. Until that time, school districts, sleep researchers, and health policy makers need to be acutely aware of the range of issues involved in selecting, developing, and administering valid and reliable survey instruments as they assess and evaluate later school start times.

Acknowledgments

The authors are grateful to the many Start School Later volunteers who provided surveys for this study and in particular to Lisa Meltzer, Judith Owens, Phyllis Payne, Deborah Putnam, Hagan Rivers, and Katherine Sharkey for their insights about survey design and administration.

References

1. Owens J, Drobnich D, Baylor A, Lewin D. School start time change: an in-depth examination of school districts in the United States. *Mind Brain Educ*. 2014;8(4):182–213.
2. Minnesota Sleep Society. Minnesota Medical Association 1994 policy statement on school start time. https://www.mnsleep.net/school-start-time-toolkit/appendix/minnesota-medical-association-1994-policy-statement-on-school-start-time/; 1994, Accessed date: 7 August 2017.
3. Wolfson AR, Carskadon MA. Sleep schedules and daytime functioning in adolescents. *Child Dev*. 1998;69(4):875–887.
4. Wahlstrom K. School start time study final report, volume 2: analysis of student survey data. *Analysis of Student Survey Data*. http://hdl.handle.net/11299/4249; 1998, Accessed date: 8 July 2017.
5. Wahlstrom K, Dretzke B, Gordon M, Peterson K, Edwards K, Gdula J. Examining the impact of later school start times on the health and academic performance of high school students: a multi-site study. http://conservancy.umn.edu/handle/11299/162769, Accessed date: 27 August 2017.
6. Wahlstrom KL, Berger AT, Widome R. Relationships between school start time, sleep duration, and adolescent behaviors. *Sleep Health*. 2017;3(3):216–221.
7. Lewin DS, Wang G, Chen YI, et al. Variable school start times and middle school student's sleep health and academic performance. *J Adolesc Health*. 2017;61(2):205–211.
8. Boergers J, Gable CJ, Owens JA. Later school start time is associated with improved sleep and daytime functioning in adolescents. *J Dev Behav Pediatr*. 2014;35(1):11–17.
9. Owens JA, Belon K, Moss P. Impact of delaying school start time on adolescent sleep, mood, and behavior. *Arch Pediatr Adolesc Med*. 2010;164(7):608–614.
10. Danner F, Phillips B. Adolescent sleep, school start times, and teen motor vehicle crashes. *J Clin Sleep Med*. 2008;4(6):533–535.
11. McKeever PM, Clark L. Delayed high school start times later than 8:30am and impact on graduation rates and attendance rates. *Sleep Health*. 2017;3(2):119–125.
12. Thacher PV, Onyper SV. Longitudinal outcomes of start time delay on sleep, behavior, and achievement in high school. *Sleep*. 2016;39(2):271–281.
13. Perez-Lloret S, Videla AJ, Richaudeau A, et al. A multi-step pathway connecting short sleep duration to daytime somnolence, reduced attention, and poor academic performance: an exploratory cross-sectional study in teenagers. *J Clin Sleep Med*. 2013;9(5):469–473.
14. Lufi D, Tzischinsky O, Hadar S. Delaying school starting time by one hour: some effects on attention levels in adolescents. *J Clin Sleep Med*. 2011;7(2):137–143.
15. Urrila AS, Artiges E, Massicotte J, et al. Sleep habits, academic performance, and the adolescent brain structure. *Sci Rep*. 2017;7:41678.
16. Groeger JA. Youthfulness, inexperience, and sleep loss: the problems young drivers face and those they pose for us. *Inj Prev*. 2006;12(suppl 1):i19–24.
17. Owens J, Adolescent Sleep Working Group Committee on Adolescence. Insufficient sleep in adolescents and young adults: an update on causes and consequences. *Pediatrics*. 2014;134(3):e921-32.

18. Vorona RD, Szklo-Coxe M, Wu A, Dubik M, Zhao Y, Ware JC. Dissimilar teen crash rates in two neighboring southeastern Virginia cities with different high school start times. *J Clin Sleep Med*. 2011;7(2):145–151.
19. Vorona RD, Szklo-Coxe M, Lamichhane R, Ware JC, McNallen A, Leszczyszyn D. Adolescent crash rates and school start times in two central Virginia counties, 2009-2011: a follow-up study to a southeastern Virginia study, 2007-2008. *J Clin Sleep Med*. 2014;10(11):1169–1177.
20. Wheaton AG, Olsen EO, Miller GF, Croft JB. Sleep duration and injury-related risk behaviors among high school students–United States, 2007-2013. *MMWR Morb Mortal Wkly Rep*. 2016;65(13):337–341.
21. Meininger JC, Gallagher MR, Eissa MA, Nguyen TQ, Chan W. Sleep duration and its association with ambulatory blood pressure in a school-based, diverse sample of adolescents. *Am J Hypertens*. 2014;27(7):948–955.
22. Chaput JP, Dutil C. Lack of sleep as a contributor to obesity in adolescents: impacts on eating and activity behaviors. *Int J Behav Nutr Phys Act*. 2016;13(1):103.
23. Kelly NR, Shomaker LB, Radin RM, et al. Associations of sleep duration and quality with disinhibited eating behaviors in adolescent girls at-risk for type 2 diabetes. *Eat Behav*. 2016;22:149–155.
24. Krueger PM, Reither EN, Peppard PE, Burger AE, Hale L. Cumulative exposure to short sleep and body mass outcomes: a prospective study. *J Sleep Res*. 2015;24(6):629–638.
25. Winsler A, Deutsch A, Vorona RD, Payne PA, Szklo-Coxe M. Sleepless in Fairfax: the difference one more hour of sleep can make for teen hopelessness, suicidal ideation, and substance use. *J Youth Adolesc*. 2015;44(2):362–378.
26. McKnight-Eily LR, Eaton DK, Lowry R, Croft JB, Presley-Cantrell L, Perry GS. Relationships between hours of sleep and health-risk behaviors in US adolescent students. *Prev Med*. 2011;53(4–5):271–273.
27. Shochat T, Cohen-Zion M, Tzischinsky O. Functional consequences of inadequate sleep in adolescents: a systematic review. *Sleep Med Rev*. 2014;18(1):75–87.
28. Owens JA, Dearth-Wesley T, Lewin D, Gioia G, Whitaker RC. Self-regulation and sleep duration, sleepiness, and chronotype in adolescents. *Pediatrics*. 2016;138(6).
29. Iglowstein I, Jenni OG, Molinari L, Largo RH. Sleep duration from infancy to adolescence: reference values and generational trends. *Pediatrics*. 2003;111(2):302–307.
30. Carskadon MA, Wolfson AR, Acebo C, Tzischinsky O, Seifer R. Adolescent sleep patterns, circadian timing, and sleepiness at a transition to early school days. *Sleep*. 1998;21(8):871–881.
31. Fredriksen K, Rhodes J, Reddy R, Way N. Sleepless in Chicago: tracking the effects of adolescent sleep loss during the middle school years. *Child Dev*. 2004;75(1):84–95.
32. Thorleifsdottir B, Bjornsson JK, Benediktsdottir B, Gislason T, Kristbjarnarson H. Sleep and sleep habits from childhood to young adulthood over a 10-year period. *J Psychosom Res*. 2002;53(1):529–537.
33. Carskadon MA, Acebo C. Regulation of sleepiness in adolescents: update, insights, and speculation. *Sleep*. 2002;25(6):606–614.
34. Jenni OG, Achermann P, Carskadon MA. Homeostatic sleep regulation in adolescents. *Sleep*. 2005;28(11):1446–1454.
35. Eaton DK, McKnight-Eily LR, Lowry R, Perry GS, Presley-Cantrell L, Croft JB. Prevalence of insufficient, borderline, and optimal hours of sleep among high school students—United States, 2007. *J Adolesc Health*. 2010;46(4):399–401.
36. American Medical Association. Insufficient sleep in adolescents. https://policysearch.ama-assn.org/policyfinder/detail/school%20start%20time?uri=%2FAMADoc%2FHOD.xml-0-5024.xml; 2016. [H-60,930].
37. Adolescent Sleep Working Group Committee on Adolescence and Council on School Health. School start times for adolescents. *Pediatrics*. 2014;134(3):642–649.
38. Watson NF, Martin JL, Wise MS, et al. Delaying middle school and high school start times promotes student health and performance: an American Academy of Sleep Medicine position statement. *J Clin Sleep Med*. 2017;13(4):623–625.
39. Schott P. Forum speakers call for later start times at GHS. *Greenwich Time* October 13, 2015. http://www.greenwichtime.com/news/article/Forum-speakers-call-for-later-start-times-at-GHS-6569477.php, Accessed date: 18 August 2017.
40. Anne Arundel to host forums on school start, dismissal times. *WBAL-TV* January 13, 2016. http://www.wbaltv.com/news/anne-arundel-to-host-forums-on-school-start-dismissal-times/37412248, Accessed date: 18 August 2017.
41. Liverpool Central School District. Results of a student survey. https://sites.google.com/a/liverpool.k12.ny.us/start-with-sleep/student-surveys; 2014, Accessed date: 18 August 2017.
42. San Ramon Valley High School. SRVHS challenge success survey. http://www.srvhs.net/resources/SRVHS%20Challenge%20Success%20Student%20Survey.pdf, Accessed date: 18 August 2017.
43. Cherry Creek School District. School start times. http://www.cherrycreekschools.org/EducationalLeadership/SchoolStartTimes/Pages/default.aspx, Accessed date: 18 August 2017.
44. Defranco T. Tri-town surveys says kids need more sleep, later start to school. *Wicked Local Boxford* September 23, 2016. http://boxford.wickedlocal.com/news/20160923/tri-towns-survey-says-kids-need-more-sleep-later-start-to-school, Accessed date: 18 August 2017.
45. Falleta G. EG survey will show effects of later start time. *East Greenwich Pendulum* December 12, 2015. http://www.ricentral.com/east_greenwich_pendulum/news/local_news/eg-survey-will-show-effects-of-later-start-times/article_8b33595c-9e9c-11e5-ad74-3b54966379c2.html, Accessed date: 18 August 2017.
46. Barnett DE. Healthy Youth Survey shows kids not getting enough sleep. *The Issaquah Press* November 18, 2015. http://www.issaquahpress.com/2015/11/18/to-the-editor-healthy-youth-survey-shows-kids-not-getting-enough-sleep/, Accessed date: 18 August 2017.
47. Schott P. Parents upset about school start time survey. *Greenwich Time* May 30, 2015. http://www.greenwichtime.com/local/article/Parents-upset-about-school-start-time-survey-6296655.php, Accessed date: 18 August 2017.
48. Pegher K. Task force survey supports changing school start times. *Annapolis Capital* December 10, 2014. http://www.capitalgazette.com/news/schools/ph-ac-cn-task-force-survey-1210-20141210,0,2040712.story#sthash.Ex5WqBh6.dpuf, Accessed date: 18 August 2017.
49. Dunietz GL, Matos-Moreno A, Singer DC, Davis MM, O'Brien LM, Chervin RD. Later school start times: what informs parent support or opposition? *J Clin Sleep Med*. 2017;13(7):889–897.
50. Morgenthaler TI, Hashmi S, Croft JB, Dort L, Heald JL, Mullington J. High school start times and the impact on high school students: what we know, and what we hope to learn. *J Clin Sleep Med*. 2016;12(12):1681–1689.
51. Marx R, Tanner-Smith EE, Davison CM, et al. Later school start times for supporting the education, health, and well-being of high school students. *Cochrane Database Syst Rev*. 2017;7:CD009467.
52. Wheaton AG, Chapman DP, Croft JB. School start times, sleep, behavioral, health, and academic outcomes: a review of the literature. *J Sch Health*. 2016;86(5):363–381.
53. Start school later. About us. http://www.startschoollater.net/about-us.html, Accessed date: 7 August 2017.
54. Merikangas K, Avenevoli S, Costello J, Koretz D, Kessler RC. National comorbidity survey replication adolescent supplement (NCS-A): I. Background and measures. *J Am Acad Child Adolesc Psychiatry*. 2009;48(4):367–369.
55. Stanford Graduate School of Education. School surveys. http://www.challengesuccess.org/schools/school-surveys, Accessed date: 1 April 2017.
56. Kandel DB, Davies M. Epidemiology of depressive mood in adolescents: an empirical study. *Arch Gen Psychiatry*. 1982;39(10):1205–1212.
57. Carskadon MA, Vieira C, Acebo C. Association between puberty and delayed phase preference. *Sleep*. 1993;16(3):258–262.
58. School Sleep Habits Survey. Sleep for science: sleep research lab. http://www.sleepforscience.org/contentmgr/showdetails.php/id/93, Accessed date: 28 May 2017.
59. Centers for Disease Control and Prevention. Youth risk behavior surveillance system (YRBSS) overview. https://www.cdc.gov/healthyyouth/data/yrbs/overview.htm; 2016, Accessed date: 25 May 2017.
60. Centers for Disease Control and Prevention. YRBSS frequently asked questions. https://www.cdc.gov/healthyyouth/data/yrbs/faq.htm, Accessed date: 23 August 2017.
61. Centers for Disease Control and Prevention, Brener ND, Kann L, et al. Methodology of the Youth Risk Behavior Surveillance System—2013. *MMWR Recomm Rep*. 2013;62(RR-1):1–20.
62. Centers for Disease Control and Prevention. National Youth Risk Behavior Survey. https://www.cdc.gov/healthyyouth/data/yrbs/pdf/2017/2017_yrbs_national_hs_questionnaire.pdf; 2017, Accessed date: 23 August 2017.
63. Wheaton AG, Ferro GA, Croft JB. School start times for middle school and high school students—United States, 2011-12 school year. *MMWR Morb Mortal Wkly Rep*. 2015;64(30):809–813.
64. Fairfax County VA. Fairfax County Youth Survey. http://www.fairfaxcounty.gov/demogrph/youthpdf.htm; 2017, Accessed date: 25 May 2017.
65. Fairfax County VA. Fairfax County Youth Survey FAQs. http://www.fairfaxcounty.gov/demogrph/youth_survey_faq.htm, Accessed date: 19 August 2017.
66. Fairfax County VA. Youth survey of 8th, 10th, and 12th grade students. http://www.fairfaxcounty.gov/demogrph/youth_survey/pdfs/sy2016_17_fairfax_county_survey_instrument.pdf; 2016, Accessed date: 22 August 2017.
67. Thellman KE, Dmitrieva J, Miller A, Harsh JR, LeBourgeois MK. Sleep timing is associated with self-reported dietary patterns in 9- to 15-year-olds. *Sleep Health*. 2017;3(4):269–275.
68. Park S, Lee Y, Lee JH. Association between energy drink intake, sleep, stress, and suicidality in Korean adolescents: energy drink use in isolation or in combination with junk food consumption. *Nutr J*. 2016;15(1):87.
69. Owens JA, Mindell J, Baylor A. Effect of energy drink and caffeinated beverage consumption on sleep, mood, and performance in children and adolescents. *Nutr Rev*. 2014;72(suppl 1):65–71.
70. Centers for Disease Control and Prevention. Energy drink consumption and its association with sleep problems among U.S. service members on a combat deployment—Afghanistan, 2010. *MMWR Morb Mortal Wkly Rep*. 2012;61(44):895–898.
71. Faris MAE, Jahrami H, Al-Hilali MM, et al. Energy drink consumption is associated with reduced sleep quality among college students: a cross-sectional study. *Nutr Diet*. 2017;74(3):268–274.
72. Cella D, Yount S, Rothrock N, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS): progress of an NIH roadmap cooperative group during its first two years. *Med Care*. 2007;45(5 Suppl 1):S3–S11.
73. Meltzer LJ, Avis KT, Biggs S, Reynolds AC, Crabtree VM, Bevans KB. The Children's Report of Sleep Patterns (CRSP): a self-report measure of sleep for school-aged children. *J Clin Sleep Med*. 2013;9(3):235–245.
74. Bevans KB, Riley AW, Forrest CB. Development of the healthy pathways child-report scales. *Qual Life Res*. 2010;19(8):1195–1214.
75. Youth Risk Behavior Surveillance System (YRBSS). A Guide to Conducting Your Own Youth Risk Behavior Survey; 2014.

76. Spilsbury JC, Drotar D, Rosen CL, Redline S. The Cleveland Adolescent Sleepiness Questionnaire: a new measure to assess excessive daytime sleepiness in adolescents. *J Clin Sleep Med*. 2007;3(6):603–612.
77. Drake C, Nickel C, Burduvali E, Roth T, Jefferson C, Pietro B. The Pediatric Daytime Sleepiness Scale (PDSS): sleep habits and school outcomes in middle-school children. *Sleep*. 2003;26(4):455–458.
78. LeBourgeois MK, Giannotti F, Cortesi F, Wolfson AR, Harsh J. The relationship between reported sleep quality and sleep hygiene in Italian and American adolescents. *Pediatrics*. 2005;115(1 Suppl):257–265.
79. Monitoring the future. http://www.monitoringthefuture.org/; 2017, Accessed date: 30 July 2017.
80. Morgenthaler T, Alessi C, Friedman L, et al. Practice parameters for the use of actigraphy in the assessment of sleep and sleep disorders: an update for 2007. *Sleep*. 2007;30(4):519–529.
81. Wolfson AR, Carskadon MA, Acebo C, et al. Evidence for the validity of a sleep habits survey for adolescents. *Sleep*. 2003;26(2):213–216.
82. Wahlstrom K. Changing times: findings from the first longitudinal study of later high school start times. *NASSP Bull*. 2002;86(833):3–21