Author's response to reviews

Title: Sleep duration of underserved minority children in a cross-sectional study

Authors:

William W Wong (wwong@bcm.edu)
Christina L Ortiz (tina.ortiz@houstontx.gov)
Debra Lathan (debra.lathan@houstontx.gov)
Louis A Moore (louis.moore@houstontx.gov)
Karen L Konzelmann (dkkontex@gmail.com)
Anne L Adolph (aadolph@bcm.edu)
E. O'Brian Smith (esmith@bcm.edu)
Nancy F Butte (nbutte@bcm.edu)

Version: 2 Date: 29 May 2013

Author's response to reviews: see over
May 29, 2013

Dr. Catherine Draper
Editor
BioMed Central

RE: MS 1651376446901367

Sleep duration of underserved minority children in a cross-sectional study

William W Wong, Christina L Ortiz, Debra Lathan, Louis A Moore, Karen L Konzelmann, Anne L Adolph, E. O'Brian Smith and Nancy F Butte

Dear Dr. Draper:

Thank you very much for the thoughtful comments of the reviewers and the opportunity to address the editorial and the reviewers’ comments.

Editorial comments

1. Please format the Authors' Contributions section of your manuscript according to the following guidelines (please use initials to refer to each author’s contribution).
   
   **Response:** This has been corrected in the revised manuscript.

2. Please also ensure that your revised manuscript conforms to the journal style (http://www.biomedcentral.com/info/ifora/medicine_journals).
   
   **Response:** The revised manuscript conforms to the journal style as illustrated in the example title page. All authors’ credentials have been removed from the title page. All affiliations are linked to each author by a numerical superscript. The corresponding author is identified with an asterisk. Author’s email address is listed and identified by the author’s initials on the title page. The text and sequence of headings and subheadings are in the format and order as specified by the journal.

Referee 1 comments:

1. I recommend that the authors seek clarity about the study objective. If the associations with SES, BMI, MVPA, and others factors are included, the study objective should reflect that and the discussion section should discuss each of these factors.

   **Response:** The last sentence under **Background** in the **Abstract** has been revised to indicate that the study measured the sleep duration of underserved minority children and its relationship with BMI, socioeconomic status (SES), gender, ethnicity and physical activity. In fact, the last sentence under **Background** in the original text already indicated that the study describes the sleep duration and the effects of BMI, SES, gender and ethnicity on sleep duration. Since we are also interested in exploring the potential relationship between physical activity and sleep duration, the sentence has been modified to include physical activity. To highlight the objective of the study, this sentence is formatted to be a new paragraph under **Background** in the revised manuscript. The **Discussion** section in the revised manuscript has been
expanded to discuss each of these factors.

2. The methods section is somewhat short of details: What was the objective of the Healthy Kids Houston Study? I would assume more than assessing sleep duration. Was this an intervention study? What is the rational of selecting the 14 communities? Why was the data collection spread out over two years? The methods section mentioned that a ‘single qualified technician’ determined sleep duration. I believe it is essential to provide the exact criteria that were used by this technician to determine sleep duration, so that other investigators can replicate the approach. More to this, were the sleep diaries kept by children and parents used as well? And used for validation?

**Response:** The objective of the Healthy Kids-Houston Study has been added under Study population in the revised manuscript. The Healthy Kids-Houston Study is a community-based after-school program to promote healthy lifestyle among minority children. Each program consists of three 6-week sessions, once in the fall, once in the spring and once at the end of the school year. A total of 14 communities were selected to make sure we have a representative sample of minority children living in the Greater Houston Metropolitan Area. The data collection was done over two years because we are limited by the physical capacity of the community centers and to make sure we have sufficient staff to properly implement the program and to ensure the safety of the children. These sentences have been added to the section under Study population in the revised manuscript.

The section on Sleep duration indicated that a log was kept by the children and parents to record the times and reasons for monitor removal as well as when the children went to bed and woke up. The section has been expanded with more details.

3. A concern that comes to mind is that sedentary time before sleep is counted as sleep time. Sedentary behavior is not a positive health behavior whereas sleep time is, so it seems essential to distinguish the two. Or should we value as sedentary behavior before sleep view as ‘positive behavior’? The National Sleep Foundation recommends ‘quiet time’ before sleep.

**Response:** As described under Sleep duration, any minutes scored as awake were removed from the sleep duration. This would exclude any sedentary activities before sleep. The same will apply to the “quiet time” as recommended by the National Sleep Foundation. However, the “quiet time” might have been counted as sleep time if consecutive zeros were recorded by accelerometry i.e. the child was totally motionless such as lying down and listening to music or watching TV/movie. The limitation has been added to the section on Sleep duration under Methods.

4. Further, counting sedentary behavior as sleep time would mean that the ‘true’ sleep time is even shorter – and thus the public health problem bigger. I encourage the authors to discuss this issue in dept.

**Response:** The discussion section has been expanded to address this concern.

5. GEE is an appropriate statistical approach to analyze the associations of the various factors with sleep duration. However, as participants were recruited as 14 centers, clustering of observations within centers should be considered as well.

**Response:** The generalized linear models were repeated with the inclusion of the community centers in the model. The Statistical Procedures in the revised manuscript has been changed to reflect that the generalized linear models to test the
effects of gender, age group, race/ethnicity, obesity status and SES on sleep duration has been done with and without inclusion of community centers in the model. We also indicated that the GEE was done with adjustment for age, gender, race/ethnicity, obesity status and community center. The Results section also has been revised to indicate that the inclusion of community center in the analysis did not change the effects of gender, age, race/ethnicity, obesity status and SES on sleep duration. The difference in sleep duration between weekdays and weekend as reported in Figure 2E also remain unchanged with inclusion of age, gender, race/ethnicity, obesity status and community center in the generalized estimating equations model.

6. The vertical axes of Figure 1 needs to be clarified. Also, does the figure present ‘child averages’, or ‘night averages’? Please clarify.

   Response: The title of the vertical axis for Figure 1 has been changed to Number of children. The histogram in Figure 1 represents the sleep duration per day for the children in a given interval. This last sentence has been added to the legend of the figure.

7. One may wonder why it is important to study the effect of SES in a study that was targeting underserved subjects – subjects of low SES.

   Response: For completeness, we included SES in the analysis. However, we also indicated in the Discussion that the lack of association between SES and sleep duration is anticipated probably because of the very small number of children (n = 33) under the high SES category. We also stated in the Results section that excluding SES in the analysis did not affect the effects of race/ethnicity, obesity status and gender/age on sleep duration.

8. The last paragraph on page 7 comes ‘out of the blue’. Why MVPA? Why not other quantities of physical and sedentary activity? Where these regression analyses adjusted?

   Response: The objective to examine the relationship between physical activity and sleep duration has been included under Background of the revised Abstract and under Background in the text of the revised manuscript. Under Methods, the subheading for Moderate-Vigorous Physical Activity (MVPA) has been changed to Physical activity so that we can include sedentary and light physical activities in the analysis. The Statistical procedures section has been modified to indicate that the same generalized linear models procedure with adjustment for age, gender, race/ethnicity, obesity status and center has been used to examine the relationship between sleep duration and physical activity. The Results section has been revised to indicate no relationship was detected between MVPA and sleep duration but a significant negative relationship was reported between sleep duration and sedentary/light physical activities.

9. The authors could seek a bit more depth in their Discussion section. This section has parts that are redundant with the introduction, and seems to focus on comparisons of devices that measure sleep duration. In light of the fact that the paper is submitted to BMC Public Health, the reader may appreciate a discussion that has more focus on public health matters. For example: We know that sleep duration among children has declined steadily over the past decades and that currently a substantial proportion is not meeting sleep recommendations. How does this proportion relate to the proportion among underserved minority children? I encourage the authors to add this
and to discuss this difference.

Response: Since many readers might not fully appreciate the accuracy of a hip-worn accelerometer such as Actical for the measurement of sleep duration in a large number of children, we feel that the first paragraph in the Discussion is needed. We appreciate the comment of the reviewer. We have expanded the Discussion section to relate the proportion of children not meeting the sleep recommendation to the proportion among underserved minority children and its potential implication.

10. Further: Could this difference account for the difference in BMI seen in the general population and in underserved minorities? What is causing the difference? Where are the solutions? Are there any messages for public health practitioners arising from this study?

Response: As shown in the most recent publication on the prevalence of obesity among U.S. children and adolescents (Ogden CL et al. Prevalence of obesity and trends in body mass index among US children and adolescents, 1990-2010. JAMA 2012, 307: 483-90), the prevalence of overweight and obesity remained significantly higher among minority children when compared to white children. Among the white children, approximately 25% were considered overweight and between 6% and 15% were considered obese depending on their ages. A recent study measured the sleep duration on 308 children using wrist accelerometry for a period of one week showed that these children slept an average of 8 h/d (Spruyt K et al. Sleep duration, sleep regularity, body weight, and metabolic homeostasis in school-aged children. Pediatrics 2011, 127: e345-52). The authors also reported that the obese children were found to sleep less than the normal weight children. Since the majority of the children (71.4%) in the study were white, one can speculate that children living in the United States, regardless of race/ethnicity, might not be meeting the National Sleep Foundation recommendation of 10-11 h/d. However, the cross-section data would not allow us to comment on whether the shortage of sleep can account for the difference in BMI as reported between white and the minority populations. The Discussion section has been expanded to talk about the potential solutions and potential public health messages as we responded to comments #4 and #7 of the second reviewer.

Referee 2:

Major comments

1. Subject selection: This was a convenient and purposive sampling of underserved minority children, which has limitation of its own. There was no detail description on the response rate. A pertinent issue is how representative this group of underserved minority children will be. Any comparison of their SES and physical status with the general population in the Texas area and/or the country? The lack of a control group also posed a question to the conclusion – was the sleep deprivation specific to this group of disadvantageous children or to all children? Was it the SES (economically deprived) or the minority ethnicity (cultural and ethnicity) issues that matter? In other words, the authors have not been able to inform the readers on whether this group of deprived minority children being more vulnerable to sleep deprivation.

Response: The Healthy Kids-Houston program was promoted as a community-based after-school program to promote a healthy lifestyle among minority children. Since
the program was implemented in community centers operated by the City of Houston, the program was opened to all children regardless of weight status or race/ethnicity as long as they met the age limit and had no physical or medical limitations to physical activities. The program was promoted through elementary schools in close proximity to the community centers to minimize transportation issues. Parent orientations and program registrations were held after school either at the schools or at the community centers. Although we had almost a 100% response rate from the parents who attended the parent orientations, we could not provide the actual response rate because many families expressed interest but our program was in conflict with the schedules of many other after-school programs which were available to the children.

In an earlier study, we documented the prevalence of childhood obesity among 5,264 students with diverse ethnic and socioeconomic backgrounds in the Houston Independent School District (HISD) (Wong WW et al. Prevalence of overweight in a multiethnic pediatric population. J Children’s Health 2003, 1: 477-87). Our results were similar to those reported from schools across Texas (Hoelscher DM et al. Measuring the prevalence of overweight in Texas school children. Am J Public Health 2004, 94: 1002-8). The results from both studies also were similar to those reported across the country (Ogden CL et al. Prevalence of obesity and trends in body mass index among US children and adolescents, 1990-2010. JAMA 2012, 307: 483-90). Therefore, the physical status of our minority children residing in Houston, Texas is anticipated to be similar to the minority populations in Texas and across the country. With majority of the minority populations residing in the major metropolitan areas across the country, we can only speculate that the SES of the minority populations residing in Houston, Texas are representative of the population across Texas or across the country.

We are aware the lack of a control group is a limitation of our cross-sectional study and will be mentioned in our Discussion. With the lack of objective measure of sleep duration among minority children in the literature, our results represented the first report on the sleep duration among minority children using an objective instrument over a 7-day period. Although our results showed that obese children slept less than normal-weight children, the majority of the children (98%), including those with normal body weight, were not meeting the National Sleep Foundation recommendation of 10-11 h/d of sleep. In a recent study using wrist accelerometry to measure sleep duration (Spruyt K et al. Sleep duration, sleep regularity, body weight, and metabolic homeostasis in school-aged children. Pediatrics 2011, 127: e345-52), white children also did not meet the sleep recommendation. Therefore, we can only speculate that sleep deprivation might be a general trend across all ethnic groups. This comment has been included in the revised Discussion.

2. SES status: as the majority of children came from the socioeconomic deprived group, it will not be surprising that SES was not a significant factor related to sleep duration and obesity.

Response: Agreed. Please see our response to comment #7 under Referee 1.

3. Sleep measurement: the use of Actical is a major strength of the study. Any age and gender differences between black and Hispanic children that may account for differences in their sleep duration? Did the authors also look at the daytime naps that
some of the minority children may keep the siesta culture?

**Response:** The generalized linear models analysis including all 2-way and 3-way interactions revealed a significant interaction between gender and age. No significant 3-way interactions were detected among gender, age and race/ethnicity. As shown in Figure 2A, the older girls slept less than the younger children. Figure 2B showed that the Hispanic children also slept more than the black children. Therefore, age, gender and race/ethnicity affected the sleep duration.

We did not look at the daytime naps among our children because daytime naps are uncommon among children between 9 and 12 years of age. In a study involving 4,470 Chinese children with an average age of 9.2 ± 1.8 y (Zhang et al. Roles of parental sleep/wake patterns, socioeconomic status, and daytime activities in the sleep/wake patterns of children. J Pediatr 2010, 156: 606-12), only approximately 6% of children took naps. Therefore, it is not likely that daytime naps among our underserved minority children will compensate for their short sleep duration. This comment is now part of the Discussion.

4. Weekday-weekend differences: It is a global trend that children would compress the weekday sleep and attempted to compensate it during weekend. It was shown by Wing et al (The Effect of Weekend and Holiday Sleep Compensation on Childhood Overweight and Obesity. Pediatrics 2009; 124:e994-e1000.) that weekend compensation may ameliorate the sleep deprivation related overweight/obesity. Did the authors note the effect of weekend compensation in this current study?

**Response:** In a cross-sectional study of 5,159 Chinese children with an average age of 9.3 ± 1.8 y, children who slept more during the weekend had lower risk of overweight and obesity (Wing et al. The effect of weekend and holiday sleep compensation on childhood overweight and obesity. Pediatrics 2009, 124: e994-e1000). The sleep data were collected using a 54-item sleep questionnaire and the anthropometric data were based on parent reports. When weekend sleep compensation was included in the generalized linear models, we found no compensation effect on BMI z-scores or obesity status (p ≥ 0.18). The much larger sample size in the study of Chinese children might increase the power to detect the effect of sleep compensation on obesity risk. It is also possible that there is a significant race/ethnicity difference in sleep compensation between Chinese children and Hispanic and black children. To evaluate the potential compensation effect, a much large sleep study among underserved minority children is needed. However, if the sleep compensation result reported among the Chinese children is true, the result indirectly suggested that longer sleep duration might be appropriate. This comment is now part of the Discussion.

5. Age and gender effect: the older girls slept shorter than similar age boys. Any measurement and correlation with the pubertal status?

**Response:** We did not evaluate the pubertal status of our children. Therefore, we cannot comment on the correlation between sleep duration and sexual maturation.

6. Obesity and sleep measurement: it was interesting that there was a high proportion of overweight/obese children in this study. As the determination of the overweight/obesity status was referring to the normative references, was the normative references standardized for minority group? In addition, did the authors also measure other comorbid sleep symptoms including Obstructive sleep apnea and
insomnia, which were commonly present in obese and deprived children respectively.

**Response:** With regard to the comment on the high proportion of overweight/obesity children in the study, please refer to the second paragraph of our response to comment #1 above.

The determination of the overweight/obesity status was based on the universal accepted criteria employed in the national surveys based on BMI percentile (overweight: BMI ≥ 85th percentile but <95th percentile; obese: BMI ≥ 95th percentile) as described under the section on **Weight and height**. We are not aware of any normative references for minority children.

We agreed that other comorbid sleep symptoms are more common among obese and deprived children, however, we did not have the resources to collect any medical history on the children. Therefore, we do not have the information to share with the readers in the paper.

7. Inadequate sleep: any reasons to explain the lack of sleep in this group of minority children? Recent studies suggested a web of factors including school start time, parental and SES influences that may predict sleep duration of children (Zhang et al. Roles of parental sleep/wake patterns, socio-economic status and daytime activities in the sleep/wake patterns of children. Journal of Pediatrics 2010; 156:606-612.) as well as the solid evidences of delay school start time in ameliorating the sleep deprivation (Owens et al. Impact of delaying school start time on adolescent sleep, mood, and behavior. Arch Pediatr Adolesc Med. 2010 Jul;164(7):608-14.)

**Response:** In a study carried out in Hong Kong, leisure extracurricular activities and later school start time were found to length sleep time among school-aged children (Zhang et al. Roles of parental sleep/wake patterns, socioeconomic status, and daytime activities in the sleep/wake patterns of children. J Pediatr 2010, 156: 606-12). However, high socioeconomic status, media use and homework were found to shorten sleep time. In a separate study among adolescents (Owen et al. Impact of delaying school start time on adolescent sleep, mood, and behavior. Arch Pediatr Adolesc Med 2010, 164: 608-14), by delaying school start time by 30 minutes led to an increase in sleep time by 45 minutes; more satisfaction with sleep; improved motivation; reduced sleepiness, fatigue and depressed mood; and improved class attendance. Both studies again suggested that longer sleep duration might have many beneficial effects including reducing the risk of obesity. The beneficial effects by delaying school start time are very interesting and need to be confirmed, particularly among underserved minority children. With schools pushing for better academic outcomes, children are given more homework. If the negative effect of homework on sleep time is real, schools need to balance school hours and homework load. With the ready accessibility of television, computer, and other digital devices to most families, programs to promote a healthy lifestyle by reducing screen and video game time are needed because media use was found to shorten sleep time. This comment is now part of the Discussion.

**Minor comments**

8. Discussions: there was an over-elaboration on the differences among different objective sleep measurements in the discussion.

**Response:** Please refer to our response to comment #9 under Referee 1.
We hope our responses have adequately addressed the comments of the reviewers and look forward to a favorable response from the Editor.

Sincerely yours,

William W. Wong, Ph.D.