ARTICLE DETAILS

TITLE (PROVISIONAL)	Does access to neighborhood green space promote a healthy duration of sleep? Novel findings from 259,319 Australians
AUTHORS	Astell-Burt, Thomas; Feng, Xiaoqi; Kolt, Gregory

VERSION 1 - REVIEW

REVIEWER	Yingling Fan Assistant Professor of Urban Planning University of Minnesota USA No competing interest with the authors.
REVIEW RETURNED	30-May-2013

THE STUDY	The paper addresses an interesting topic—the relationship between neighborhood green spaces and sleep duration. The data is valid and the results are interesting. However, the paper in its current form has weaknesses. Below I provide comments on areas for improvement: • The measures of neighborhood green spaces in the paper are somewhat under-developed. Defining neighborhood green spaces requires two sub-definitions, including a neighborhood definition and a definition of green spaces. In this paper, the authors used 1-km buffers around CCD centroids to define neighborhoods and suggested that 1km is a reasonable walking distance from home. The authors need to provide relevant citations to support the statement that 1km is a reasonable walking distance in Australia. In the US literature which I am familiar with, 0.5 mile (800 meters) is the widely recognized walkable distance. I would further suggest the authors to use multiple neighborhood definitions because it is unknown whether the more immediate surroundings are more important factors of sleep duration than the walkable surroundings. I would also suggest the authors to use multiple definitions of green spaces. The authors excluded farmland meshblocks from their green space measure because meshblocks do not represent recreation spaces. Given the same rationale, the authors should have excluded all other green spaces that are not recreational, such as conservation areas. I think the author need to be careful about their selection of green spaces included in the study. Why are recreational green spaces important for sleep duration? The authors' hypothesis is that green spaces indirectly influence sleep duration through directly influencing physical activity and mental health. Given this hypothesis, the most appropriate way to measure green spaces in this study would be to find out the type of green spaces

	that are important for mental health and physical activity. The existing literature has found that non-recreational green spaces are important for mental health.
	• The statistical method the authors used for their analysis is inappropriate for their hypothesis testing. The key hypothesis the authors raised at the beginning of the paper is that physical activity and mental health serves as mediators between neighborhood green and sleep duration, i.e., neighborhood green has an indirect effect on sleep duration through its direct effect on physical activity and mental health. To test this hypothesis, the authors may consider more advanced statistical methods such as instrumental regression, path analysis, and structural equation modeling. Using multinomial logit regression will not be able to tease out the structural processes of which how neighborhood green operates indirect effects on sleep duration.
RESULTS & CONCLUSIONS	• The discussion section contains weak arguments which involve speculations. This critique is related to two critiques I mentioned earlier because without examining multiple neighborhood green measures and using appropriate statistical methods, it is difficult to derive meaning discussion. For example, simply showing that 80%+ neighborhood green contributes to low risk of low sleep duration will not provide meaning public policy implications because it is practically impossible to create an environment in which everybody live with 80%+ neighborhood green. It is important that the authors include multiple measures of green spaces (recreational vs nonrecreational, quality vs quantity) to tease out practical implications. In addition, the discussion on pages 9-10 about direct vs. indirect mechanisms through which neighborhood green influences sleep duration is at best speculations without implementation of appropriate and sophisticated statistical analyses.

| **REVIEWER** | Arlene Renalds, MSN,RN
Instructor
James Madison University
Harrisonburg, Virginia

I have no conflict of interests to report. |
| **REVIEW RETURNED** | 31-May-2013 |

| **THE STUDY** | 24 of the 44 references were greater than 5 years old. The studies were salient, but not current. |
| **GENERAL COMMENTS** | In light of my previous studies of the issue of green spaces, I think it is evidenced that this is a well conducted study. |

| **REVIEWER** | William C Sullivan
Professor, Landscape Architecture
University of Illinois at Urbana-Champaign

No competing Interests |
| **REVIEW RETURNED** | 01-Jun-2013 |

| **THE STUDY** | I don't think anything supplementary needs to be included in the manuscript. |

GENERAL COMMENTS	This is a fascinating article. My guess is that there are two pathways at work here. One through Restoration in the sense that S. Kaplan (1995) and Kaplan, Kaplan, and Ryan (1998) describes it -- that is, through attentional restoration and having a "clear head." The second pathway through a reduction in stress. This paper opens the door to new research that might have significant impacts for the health and wellbeing of millions of people who live in urban areas.

VERSION 1 – AUTHOR RESPONSE

Reviewer: Yingling Fan
Assistant Professor of Urban Planning
University of Minnesota
USA

No competing interest with the authors.

The paper addresses an interesting topic—the relationship between neighborhood green spaces and sleep duration. The data is valid and the results are interesting. However, the paper in its current form has weaknesses. Below I provide comments on areas for improvement:

• The measures of neighborhood green spaces in the paper are somewhat under-developed.

Defining neighborhood green spaces requires two sub-definitions, including a neighborhood definition and a definition of green spaces. In this paper, the authors used 1-km buffers around CCD centroids to define neighborhoods and suggested that 1km is a reasonable walking distance from home. The authors need to provide relevant citations to support the statement that 1km is a reasonable walking distance in Australia. In the US literature which I am familiar with, 0.5 mile (800 meters) is the widely recognized walkable distance. I would further suggest the authors to use multiple neighborhood definitions because it is unknown whether the more immediate surroundings are more important factors of sleep duration than the walkable surroundings.

I would also suggest the authors to use multiple definitions of green spaces. The authors excluded farmland meshblocks from their green space measure because meshblocks do not represent recreation spaces. Given the same rationale, the authors should have excluded all other green spaces that are not recreational, such as conservation areas. I think the author need to be careful about their selection of green spaces included in the study. Why are recreational green spaces important for sleep duration? The authors' hypothesis is that green spaces indirectly influence sleep duration through directly influencing physical activity and mental health. Given this hypothesis, the most appropriate way to measure green spaces in this study would be to find out the type of green spaces that are important for mental health and physical activity. The existing literature has found that non-recreational green spaces are important for mental health.

Authors: Buffers of 1 kilometre radius were based upon definitions used in previous work in the Netherlands and recently published work in Australia. We have amended the Methods section to reflect this. We agree that different types of green space may have different impacts on health outcomes, including sleep duration. Unfortunately, the data available lacked sufficient detail to conduct such analyses. We already reflected on this in the last sentence of the Discussion section but have taken the opportunity to add further information to emphasise the point, including a citation of the referee's paper that explored the issue of green space type.

• The statistical method the authors used for their analysis is inappropriate for their hypothesis testing.

The key hypothesis the authors raised at the beginning of the paper is that physical activity and mental health serves as mediators between neighborhood green and sleep duration, i.e., neighborhood green has an indirect effect on sleep duration through its direct effect on physical activity and mental health. To test this hypothesis, the authors may consider more advanced statistical methods such as instrumental regression, path analysis, and structural equation modeling. Using multinomial logit regression will not be able to tease out the structural processes of which how neighborhood green operates indirect effects on sleep duration.

Authors: Controls for mental health and physical activity had a negligible impact on the association between green space and sleep duration. Had there been a more substantive impact, we would have sought more sophisticated methods to explore the structural processes in more depth, but this was not the case.

• The discussion section contains weak arguments which involve speculations. This critique is related to two critiques I mentioned earlier because without examining multiple neighborhood green measures and using appropriate statistical methods, it is difficult to derive meaning discussion. For example, simply showing that 80%+ neighborhood green contributes to low risk of low sleep duration will not provide meaning public policy implications because it is practically impossible to create an environment in which everybody live with 80%+ neighborhood green. It is important that the authors include multiple measures of green spaces (recreational vs nonrecreational, quality vs quantity) to tease out practical implications. In addition, the discussion on pages 9-10 about direct vs. indirect mechanisms through which neighborhood green influences sleep duration is at best speculations without implementation of appropriate and sophisticated statistical analyses.

Authors: With respect, this was an exploratory study and not one with the intention of generating immediate policy recommendations. As outlined in the Introduction, the issue of whether the amount of local green space is associated with sleep duration has not been previously explored. That this association remained significant for people with 80%+ green space after controls for individual and other neighbourhood characteristics is still an important finding with respect to enhancing knowledge on how place and health are connected. That this is the first article to do this necessitates further research and inevitably involves some speculation on what could be done and how, though we do not think that any conjecture present is to the extent that the referee seems to imply. As for the issue of green space type and (possibly) more sophisticated methodologies, these have already been covered in our responses to the referee's earlier comments.

Reviewer: Arlene Renalds, MSN,RN
Instructor
James Madison University
Harrisonburg, Virginia

I have no conflict of interests to report.

24 of the 44 references were greater than 5 years old. The studies were salient, but not current.

In light of my previous studies of the issue of green spaces, I think it is evidenced that this is a well conducted study.

Authors: Thank you for your review and support.

Reviewer: William C Sullivan
Professor, Landscape Architecture
University of Illinois at Urbana-Champaign
http://willsull.net
I have not competing interests.

This is a fascinating article. My guess is that there are two pathways at work here. One through Restoration in the sense that S. Kaplan (1995) and Kaplan, Kaplan, and Ryan (1998) describes it -- that is, through attentional restoration and having a "clear head." The second pathway through a reduction in stress. This paper opens the door to new research that might have significant impacts for the health and wellbeing of millions of people who live in urban areas.

Authors: Thank you for your enthusiasm for our paper.

VERSION 2 – REVIEW

REVIEWER	Yingling Fan Assistant Professor of Urban Planning University of Minnesota USA
REVIEW RETURNED	01-Jul-2013

THE STUDY	The authors response to the statistical method concern I had earlier is not convincing at all. " Controls for mental health and physical activity had a negligible impact on the association between green space and sleep duration." An alternative explanation for the negligible impact could be that sleep duration mediates the relationship between neighborhood green and mental health/physical activity. The relationship between mental health/physical activity and sleep duration can certainly be bidirectional. I suggest the authors to careful think about the alternative explanations of their empirical findings and try to add information and/or analyses to rule out some of the explanations as much as possible.

VERSION 2 – AUTHOR RESPONSE

Reviewer: Yingling Fan
Assistant Professor of Urban Planning
University of Minnesota
USA

The authors response to the statistical method concern I had earlier is not convincing at all. " Controls for mental health and physical activity had a negligible impact on the association between green space and sleep duration." An alternative explanation for the negligible impact could be that sleep duration mediates the relationship between neighborhood green and mental health/physical activity. The relationship between mental health/physical activity and sleep duration can certainly be bidirectional. I suggest the authors to careful think about the alternative explanations of their empirical findings and try to add information and/or analyses to rule out some of the explanations as much as

possible.

Authors: We agree that confounding is an important issue, particularly with the cross-sectional data to which we are restricted. We can assure you that we have thought carefully about this issue and have sought to revise the manuscript accordingly.

The most serious threat, in our opinion, is the unmeasured phenomena of traffic density and associated noise pollution, which we commented on in the Discussion section of the original and revised manuscripts. More green space may proxy lower levels of traffic and noise pollution, which could potentially aid a healthier duration of sleep.

We have added in this second revision that it may be possible that people who are more predisposed to a healthier duration of sleep select into greener neighborhoods, but that this is a hypothesis that can only be addressed satisfactorily with longitudinal data.

As for the possibility that sleep duration mediates the relationship between neighborhood green space and mental health or physical activity, and by definition, other health outcomes such as the incidence of cardiovascular disease, we agree that this is a thought-provoking hypothesis but it is not directly relevant to this paper as sleep duration is conceptualized as the outcome of interest, not as a mediator. Nevertheless, we have commented on the possibility of sleep duration as a mediator of the relationship between green space and other health outcomes in the Discussion section as we feel that this is an important avenue for future research.