## PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (**http://bmjopen.bmj.com/site/about/resources/checklist.pdf**) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

## ARTICLE DETAILS

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| **TITLE (PROVISIONAL)** | Understanding the role of sleep in suicide risk: qualitative interview study |
| **AUTHORS** | Littlewood, Donna; Gooding, Patricia; Kyle, Simon; Pratt, Daniel; Peters, Sarah |

## VERSION 1 – REVIEW

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| **REVIEWER** | W Vaughn McCall<br>Department of Psychiatry and Health Behavior<br>Medical College of Georgia<br>Augusta University |
| **REVIEW RETURNED** | 24-Apr-2016 |

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| **GENERAL COMMENTS** | Kudos to the authors for being the first to provide a systematic qualitative review of why sleep problems are linked with suicidal ideation. The paper nearly meets its objectives, and mentions most but not all of its limitations.<br>Here is what would be required to address the deficiencies:<br>1. The paper acknowledges that nightmares are a significant source explaining the variance in predicting suicidal idealization. In the "Methods: study sample", the authors address this by including patients with nightmares, and reports of nightmares appeared in some of the quotes. However, in the end, the authors handled the questions of nightmares as simply another variation of sleep problems, and not as something district. Do the authors actually feel that nightmares are interchangeable with other sleep complaints? it would be useful to state either 'yes' or 'no', based upon what was learned in the data collection.<br>2. Scales are mis-labelled in Table 1. Beck Scale for Suicide Ideation; Pittsburgh Sleep Quality Index; etc.<br>3. It would be nice if Table 1 noted the proportion of respondents with sleep onset insomnia, versus sleep maintenance insomnia, versus nightmares, etc.<br>4. No need to report scale values in table 1 to 2 decimals (hundredths of a unit). This is false precision, especially in a small sample. Single decimals will do just fine.<br>5. Regarding the actual timing of suicide deaths.It is true that the Perlis reference claims that more suicide deaths per hour of wakefulness during the course of the night than during the day. However, Perlis' argument is based upon various assumptions regarding how many hours suicide victims are awake during the night - and these remain purely speculative. On the other hand, we have hard data regarding the actual times of suicide deaths, and it all points to infrequent suicides at night, and instead frequent suicide during the day, especially the morning. Please reconcile your Results and Conclusions with the following 4 citations: |

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| | (a) Houwelingen et al. J Aff Disorders 2001;66:215-223<br>(b) Erazo N. J Aff Disorders 2004;83:1-9<br>(c) Altamura C et al. J Aff Disorders 1999;53:77-85<br>(d) Preti A and Miotto P. J Aff Disorders 2001;65:253-261 |

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| **REVIEWER** | Jun Kohyama<br>Tokyo Bay Urayasu Ichikawa Medical Center, Urayasu, Japan |
| **REVIEW RETURNED** | 25-Apr-2016 |

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| **GENERAL COMMENTS** | This is a very interesting and important study. I really appreciate authors to fulfill this study. However, authors submitted this paper to B Medical J not to B psychological J. Please discuss neuronal mechanisms underlying the current result, although speculative such as the involvement of serotonin, oxytocin, prefrontal cortex, and amygdale etc. |

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| **REVIEWER** | Michael Nadorff and Shea Golding<br>Mississippi State University, United States |
| **REVIEW RETURNED** | 01-May-2016 |

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| **GENERAL COMMENTS** | The reviewed paper took a qualitative approach to investigate perceived relations between sleep and suicide among individuals meeting criteria for having had a major depressive episode and reporting suicidal thoughts/feelings/behaviors in the past year. The novelty of a qualitative approach and the effort to produce a diverse sampling of sleep issues (through maximum variation approach) are strengths of the study. This is also an important topic, as recent research by my lab and others, including recently this research team, have demonstrated the importance of sleep on suicidal behavior independent of other risk-factors. However, there are a few limitations that, if addressed, would improve the potential impact of the present study.<br><br>Major recommendations<br><br>1. I found the introduction to be a bit outdated and potentially misleading. The authors are missing more recent work by key authors in this field including Nadorff and Ribeiro (whose work isn't cited), and Bernert, and McCall whose older work is cited but not their more recent work. The authors cite a 2012 meta-analysis that insomnia symptoms are independently associated with suicidal behavior, but the literature has been very mixed on that point since 2012. This manuscript has the potential to greatly inform the literature by discussing these inconsistencies, hopefully adding some clarity through the qualitative data, and providing other authors with suggestions as to where the literature is lacking based upon the qualitative interviews and new avenues for future research. However, without a thorough, up-to-date literature review the article's potential is severely limited.<br><br>2. Related to the first point, I was disappointed that there wasn't more discussion of nightmares, particularly in the introduction. In the literature nightmares have consistently been shown to be independently associated with suicidal ideation, risk, attempts, and even death by suicide. It is quite likely the sleep disturbance that is most strongly associated with suicide risk. However, the word |

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| | nightmare does not even come up in the introduction. This is a missed opportunity in my opinion. People always ask me what is it about nightmares that leads one to suicide, and this study has the potential to really delve into answering that question. It is a very important question. I hope the authors take on the challenge of tackling it. They had a very nice paper on this in JCSM, which I was fortunate to write a commentary on, so they know some of my thoughts on this issue. I would love to hear more about their perspective of why this relation exists, especially if there are data from the qualitative study that can be used to back up their assertions. This would be very valuable to the literature, and to me as a researcher.<br><br>3. Although all participants had a history of depression and suicide the ranges suggest that some of the participants were indeed experiencing significant symptoms at the time of the interview, whereas others were not. Similarly, some reported relatively few current sleep symptoms. Were there differences between the participants based upon severity? Although I know it would greatly reduce the number of participants, it would be interesting to re-code the qualitative responses for just those with current severe suicidality, or severe sleep problems, to see if different factors emerge. It is possible that someone who has a history of these issues, but is not currently experiencing them, may have a very different report due to being removed from it for a period of time.<br><br>4. In the literature we see poor outcomes both with too much and too little sleep. As expected, participants' reports in this study appear to indicate this as well. Too little sleep at night presents individuals with time where suicidal behavior may occur with less intervention, but too much sleep may interfere with social activities and prevent behavioral activation. The authors may want to consider adding to this important area of the literature through commenting on differences they observed in those who slept too much vs. those who didn't sleep enough in order to help provide more information about why each is associated with increased suicide risk.<br><br>5. Although the participants have a history of depression and suicidal thoughts the ranges on the self-report measure makes me wonder whether this sample can really generalize to those who have clinically-significant sleep problems, or are really suicidal. Further discussion of this potential limitation would be welcome. I think it can be overcome by looking at those who are at clinical levels separately. This would greatly strengthen the study as some may be quick to dismiss the study as not being clinically-relevant due to the symptom ranges. Breaking the clinically-significant group out would go a long way toward increasing the clinical significance of this important work.<br><br>Minor recommendations<br><br>1. Table 1 could be improved upon by providing ranges for all measures. Currently, the SCI and AUDIT do not list possible ranges.<br><br>We are glad to see that you continue to work in this area of research, and we hope that you continue to do so. There is much to be done, and we think many lives can be saved by this line of research. |

## VERSION 1 – AUTHOR RESPONSE

Response to reviewer 1
Kudos to the authors for being the first to provide a systematic qualitative review of why sleep problems are linked with suicidal ideation. The paper nearly meets its objectives, and mentions most but not all of its limitations.

RESPONSE: Thank you for these positive and encouraging remarks.

Here is what would be required to address the deficiencies:
1. The paper acknowledges that nightmares are a significant source explaining the variance in predicting suicidal idealization. In the "Methods: study sample", the authors address this by including patients with nightmares, and reports of nightmares appeared in some of the quotes. However, in the end, the authors handled the questions of nightmares as simply another variation of sleep problems, and not as something district. Do the authors actually feel that nightmares are interchangeable with other sleep complaints? it would be useful to state either 'yes' or 'no', based upon what was learned in the data collection.

RESPONSE: Thank you. To answer your question, 'Do the authors actually feel that nightmares are interchangeable with other sleep complaints?' yes, pathways 1: being awake during the biological night, and pathways 2: failure to achieve 'good' sleep makes life harder, were reflected similarly across different sleep problems, as they related to core experiences of disturbed sleep. However, pathway 3: sleep provides an escape from waking life, seemed less common amongst those who experienced nightmares, and consequently reported fear of sleep which then made the idea of 'escaping to sleep' less attractive.
Therefore, we have updated the results (page 9, paragraph 3) and discussion (page 11, paragraph 3; page 12, paragraph 1) accordingly to reflect this.

Addition to Results (page 9, paragraph 3):-
However, it is possible that the 'escape of sleep' may seem less attractive to those who fear sleep as a consequence of experiencing distressing nightmares. One participant spoke of the conflict between the desire to escape from her thoughts, but the reluctance of going to sleep due to the fear of experiencing more distressing nightmares.
"[on why sleep is important to her] it takes me away from my thoughts, but I get a lot of nightmares so sometimes I don't wanna sleep like, I have a fear of falling asleep. Like I lie there and I think urgh, especially if I've had a nightmare the night before and its played on my mind all day, then I'll be like I don't want to sleep." (ID8, female)

Addition to Discussion, Principal findings (page 11, paragraph 3):-
Furthermore, data from the current study suggested that nightmares may trigger fear of sleep, which then made the 'escape of sleep' seem less attractive. Consequently, without the escape of 'good sleep,' perceptions of entrapment, and suicidal thoughts and behaviours may escalate. Indeed, results from a recent cross-sectional study with individuals who had experienced trauma, indicated that the relationship between nightmares and suicidal behaviour operated indirectly via defeat, entrapment and hopelessness (Littlewood et al., 2016). Taken together, these findings lay the groundwork for future studies to investigate the extent to which the role of entrapment in explaining suicidal pathways varies as a function of the specific type of sleep problem experienced.

Addition to Discussion, Future research (page 12, paragraph 1):-
Sixth, to what extent does fear of sleep moderate the role of entrapment in the relationship between sleep problems and suicide.

2. Scales are mis-labelled in Table 1. Beck Scale for Suicide Ideation; Pittsburgh Sleep Quality Index;

etc.

RESPONSE: We are grateful to the reviewer for highlighting these typo's, which have been amended accordingly. (page 5)

3. It would be nice if Table 1 noted the proportion of respondents with sleep onset insomnia, versus sleep maintenance insomnia, versus nightmares, etc.

RESPONSE: Thank you for this suggestion. We have added this information into the results section (page 5, paragraph 1, lines 8 and 12):-
At the time of the interviews, 13 participants reported current symptoms consistent with the threshold criteria for Diagnostic and Statistical Manual of Mental Disorders V Insomnia Disorder, as indicated by the Sleep Condition Indicator. Of these 13, three met quantitative criteria for sleep onset insomnia (SCI items 1) and nine met quantitative criteria for both sleep onset and maintenance insomnia (SCI items 1 and 2).25 Furthermore, current sleep quality for the majority of the sample was poor, based on scores from the Pittsburgh Sleep Quality Inventory26 (n = 15; 83%). In addition, eight participants reported difficulty sleeping due to bad dreams at least once per week in the month prior to interview.

4. No need to report scale values in table 1 to 2 decimals (hundredths of a unit). This is false precision, especially in a small sample. Single decimals will do just fine.

RESPONSE: We are grateful to the reviewer for highlighting this, and have amended decimals as suggested. (page 5)

5. Regarding the actual timing of suicide deaths .It is true that the Perlis reference claims that more suicide deaths per hour of wakefulness during the course of the night than during the day. However, Perlis' argument is based upon various assumptions regarding how many hours suicide victims are awake during the night - and these remain purely speculative. On the other hand, we have hard data regarding the actual times of suicide deaths, and it all points to infrequent suicides at night, and instead frequent suicide during the day, especially the morning. Please reconcile your Results and Conclusions with the following 4 citations:
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(c) Altamura C et al. J Aff Disorders 1999;53:77-85
(d) Preti A and Miotto P. J Aff Disorders 2001;65:253-261

RESPONSE: Thank you. We have amended the text to reflect this in the discussion (page 10, paragraph 8):-
Indeed, this is consistent with a large literature which suggests that social isolation, and lack of social support are associated with mental illnesses, and suicidal thoughts and behaviours. 32-36 Studies examining temporal patterning of suicide across the 24 hour day consistently indicate that suicides are more frequent during daytime hours (Houwelingen et al., 2001; Erazo, 2004; Altamura et al., 1999; Preti & Miotto, 2001). However, recent work by Perlis and colleagues, suggests that when adjusting for the proportion of the population awake at different times of the day, then relative risk of suicide is greater during the night.31

Response to reviewer 2
This is a very interesting and important study. I really appreciate authors to fulfill this study. However, authors submitted this paper to B Medical J not to B psychological J. Please discuss neuronal mechanisms underlying the current result, although speculative such as the involvement of serotonin, oxytocin, prefrontal cortex, and amygdale etc.

RESPONSE: Thank you for these positive and encouraging remarks.
We agree. Whilst a full account of potential biological mechanisms would be outwith the scope and aims of this paper, we have amended the further research section of the discussion and make reference to a review paper that contemplates the contribution of such mechanisms. (page 12, paragraph 1):-
Finally, whilst outwith the scope of this qualitative study, further research should also consider the possible role of biological mechanisms in understanding the sleep-suicide relationship (McCall & Black, 2013). For instance, based on interrelations between suicide, serotonin and sleep regulation it has been suggested that a reduction in sleep may lead to or potentiate underlying serotonergic dysfunction, which in turn may contribute to suicidal thoughts and behaviours via impaired decision making and reduced cognitive control of emotion (McCall & Black, 2013).

Response to reviewer 3.
The novelty of a qualitative approach and the effort to produce a diverse sampling of sleep issues (through maximum variation approach) are strengths of the study. This is also an important topic, as recent research by my lab and others, including recently this research team, have demonstrated the importance of sleep on suicidal behavior independent of other risk-factors.

RESPONSE: Thank you for these positive and encouraging remarks.

Major recommendations
1. I found the introduction to be a bit outdated and potentially misleading. The authors are missing more recent work by key authors in this field including Nadorff and Ribeiro (whose work isn't cited), and Bernert, and McCall whose older work is cited but not their more recent work. The authors cite a 2012 meta-analysis that insomnia symptoms are independently associated with suicidal behavior, but the literature has been very mixed on that point since 2012. This manuscript has the potential to greatly inform the literature by discussing these inconsistencies, hopefully adding some clarity through the qualitative data, and providing other authors with suggestions as to where the literature is lacking based upon the qualitative interviews and new avenues for future research. However, without a thorough, up-to-date literature review the article's potential is severely limited.

RESPONSE: Thank you for your direction on this. We initially decided to include a concise introduction, however on reflection we agree with your comments and have expanded the introduction as suggested (page 3, paragraph 1):-
However, it is noteworthy that more recent evidence investigating the association between insomnia and suicidality has produced mixed results (Nadorff, Fiske, Sperry, Petts & Gregg, 2013; Nadorff, Nazem & Fiske, 2011; Nadorff, Anesti, Nazem, Harris & Winer, 2013). The linkage between nightmares and suicide appears somewhat clearer, with consistent reports of a direct relationship between nightmares and suicidal thoughts and behaviours, independent of psychopathology and comorbid insomnia (Nadorff, Nazem & Fiske, 2011; Golding, Nadorff, Winer & Ward, 2015; Littlewood, Gooding, Panagioti & Kyle, 2016). Nightmares have also been shown to mediate the relationship between insomnia and suicidal ideation (McCall et al., 2013). This suggests that there may be specific differences in the mechanisms which account for the nightmares/suicide relationship, in comparison to the insomnia/suicide relationship. However, it also remains possible that core mechanisms underpin more generic features of sleep problems, such as sleep discontinuity, altered sleep architecture and poor sleep quality. For instance, a large longitudinal case-control cohort study found that poor sleep quality predicted an increased risk of suicide, across a 10-year period (Bernert et al., 2014). In addition, recent research has indicated that a state of hyperarousal, which may be common to both insomnia and nightmares, interacted with a person's sense of fearlessness about death to predict suicidal behaviours (Ribeiro et al., 2014).

2. Related to the first point, I was disappointed that there wasn't more discussion of nightmares,

particularly in the introduction. In the literature nightmares have consistently been shown to be independently associated with suicidal ideation, risk, attempts, and even death by suicide. It is quite likely the sleep disturbance that is most strongly associated with suicide risk. However, the word nightmare does not even come up in the introduction. This is a missed opportunity in my opinion. People always ask me what is it about nightmares that leads one to suicide, and this study has the potential to really delve into answering that question. It is a very important question. I hope the authors take on the challenge of tackling it. They had a very nice paper on this in JCSM, which I was fortunate to write a commentary on, so they know some of my thoughts on this issue. I would love to hear more about their perspective of why this relation exists, especially if there are data from the qualitative study that can be used to back up their assertions. This would be very valuable to the literature, and to me as a researcher.

RESPONSE: Thank you; we agree and have amended the introduction to reflect this, as outlined in the response to the first comment. In addition, and also in response to Reviewer 1, we have revised the results and discussion to reflect areas where the pathways may differ based on type of sleep problem, with specific reference to nightmares. See response to Reviewer 1, comment 1.

3. Although all participants had a history of depression and suicide the ranges suggest that some of the participants were indeed experiencing significant symptoms at the time of the interview, whereas others were not. Similarly, some reported relatively few current sleep symptoms. Were there differences between the participants based upon severity? Although I know it would greatly reduce the number of participants, it would be interesting to re-code the qualitative responses for just those with current severe suicidality, or severe sleep problems, to see if different factors emerge. It is possible that someone who has a history of these issues, but is not currently experiencing them, may have a very different report due to being removed from it for a period of time.

RESPONSE: Thank you. We agree that these are very important points. However, the current study is intended to capture core processes across sleep problems. Therefore, we decided to purposively recruit to ensure a heterogeneous sample to access maximum variance in participants views. Hence we sampled across the key variables you reference (current versus past mental illness, experience of suicide attempts versus suicidal ideation). With a qualitative design such as this it is not possible to conduct sub-analyses and draw any meaningful conclusions. We agree however that this is an interesting idea that could be explored within further empirical investigation, and have extended the discussion to reflect this (page 11, paragraph 4):-
First, although it is considered a strength that this conceptual model was developed from a purposive, maximum variation sample, findings should be complemented with empirical investigation to determine the extent to which these pathways extend to other mental illness, different levels of depression-severity and across different duration and severity of sleep problems.

We have also amended the results section to clarify proportion of the sample experiencing a current major depressive episode as follows (page 5, paragraph 1):-
Most participants (n = 16; 89%) had experienced multiple major depressive episodes during their lifetime, and ten participants were experiencing a current major depressive episode.

4. In the literature we see poor outcomes both with too much and too little sleep. As expected, participants' reports in this study appear to indicate this as well. Too little sleep at night presents individuals with time where suicidal behavior may occur with less intervention, but too much sleep may interfere with social activities and prevent behavioral activation. The authors may want to consider adding to this important area of the literature through commenting on differences they observed in those who slept too much vs. those who didn't sleep enough in order to help provide more information about why each is associated with increased suicide risk.

RESPONSE: Thank you. We have highlighted the consequences of having too little sleep versus too much sleep on suicidal ideation, especially with respect to the implications of sleeping too little at night (page 10, paragraph 8) and the daytime consequences of disturbed sleep in relation to inactivity and associated negative thinking (page 11, paragraph 2).

We agree that comparing sleep/suicide mechanisms in people who sleep too much and too little would be interesting. Our goal in the current study was to investigate core processes across sleep problems and the study designed to achieve this. The numbers are not sufficiently large to undertake sub-analyses. This is something that could be undertaken in a subsequent study specifically designed to test for these group differences and we have included this point in the Discussion section (page 12, paragraph 1):-
Furthermore, whilst the goal of the current study was to investigate core processes across different types of sleep problems, future empirical work is required to determine whether the proposed conceptual model extends to explain the relationship between suicide and specific types of sleep problems (e.g., nightmares, insomnia, hypersomnia).

5. Although the participants have a history of depression and suicidal thoughts the ranges on the self-report measure makes me wonder whether this sample can really generalize to those who have clinically-significant sleep problems, or are really suicidal. Further discussion of this potential limitation would be welcome. I think it can be overcome by looking at those who are at clinical levels separately. This would greatly strengthen the study as some may be quick to dismiss the study as not being clinically-relevant due to the symptom ranges. Breaking the clinically-significant group out would go a long way toward increasing the clinical significance of this important work.

RESPONSE: Thank you. To clarify, whilst current suicidality and sleep symptoms ranged across participants, interview questions were specifically focused on the times the individual was feeling at their worst in terms of their suicidal thoughts or making suicide attempts. Therefore, to perform sub-analyses based on this could be misleading and uninformative.
We agree the extent to which the conceptual model translates to different clinical populations and specific types of sleep problems is important. Given the aim of this study, we think this will be best addressed by future investigation and have amended the discussion to reflect this (page 11, paragraph 4):-
First, although it is considered a strength that this conceptual model was developed from a purposive, maximum variation sample, findings should be complemented with empirical investigation to determine the extent to which these pathways extend to other mental illness, different levels of depression-severity and across different duration and severity of sleep problems.

Minor recommendations
1. Table 1 could be improved upon by providing ranges for all measures. Currently, the SCI and AUDIT do not list possible ranges.

RESPONSE: We are grateful to the reviewer for highlighting this, and have amended accordingly. (page 5).

**VERSION 2 - REVIEW**

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| **REVIEWER** | W Vaughn McCall<br>Medical College of Georgia; Augusta University<br>Augusta, Georgia USA |
| **REVIEW RETURNED** | 04-Jun-2016 |

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| **GENERAL COMMENTS** | The paper is improved. I have no more comments |

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| **REVIEWER** | Jun Kohyama<br>Tokyo bay Urayasu Ichikawa medical center |
| **REVIEW RETURNED** | 18-Jun-2016 |

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| **GENERAL COMMENTS** | I really appreciate this work. |

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| **REVIEWER** | Michael Nadorff and Shea Golding<br>Mississippi State University |
| **REVIEW RETURNED** | 21-Jun-2016 |

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| **GENERAL COMMENTS** | The authors have done a thorough job responding to reviews and I feel that it has greatly strengthened the paper. I believe the paper will add to the literature and publication is justified. |