A systematic review and meta-analysis of wind farm noise effects on sleep using validated objective and subjective sleep assessments

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This meta-analysis suggests that wind farm noise does not significantly impact objective sleep onset latency, total sleep time, wake after sleep onset or sleep efficiency.

INTRODUCTION

- Little is known about the potential impacts of wind farm noise (WFN) on sleep.
- Previous research is limited to small scale cross-sectional studies reporting largely anecdotal impacts on sleep using inconsistent sleep metrics.
- We comprehensively reviewed findings from studies evaluating the impact of WFN using more widely accepted and validated objective and subjective sleep measurements.

METHODS

- Search terms included “wind farm noise”, “wind turbine noise”, “wind turbine sound”, “wind turbine noise exposure” AND “sleep”.
- Inclusion criteria:
  - Original articles, English, >year 2000.
  - Used either PSG, Actigraphy, or psychometrically validated subjective sleep assessment tools (e.g., Insomnia Severity Index, Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale, Sleep Wake Diary).
- Uniform outcomes based on average weighted mean differences of retrieved studies were meta-analysed.

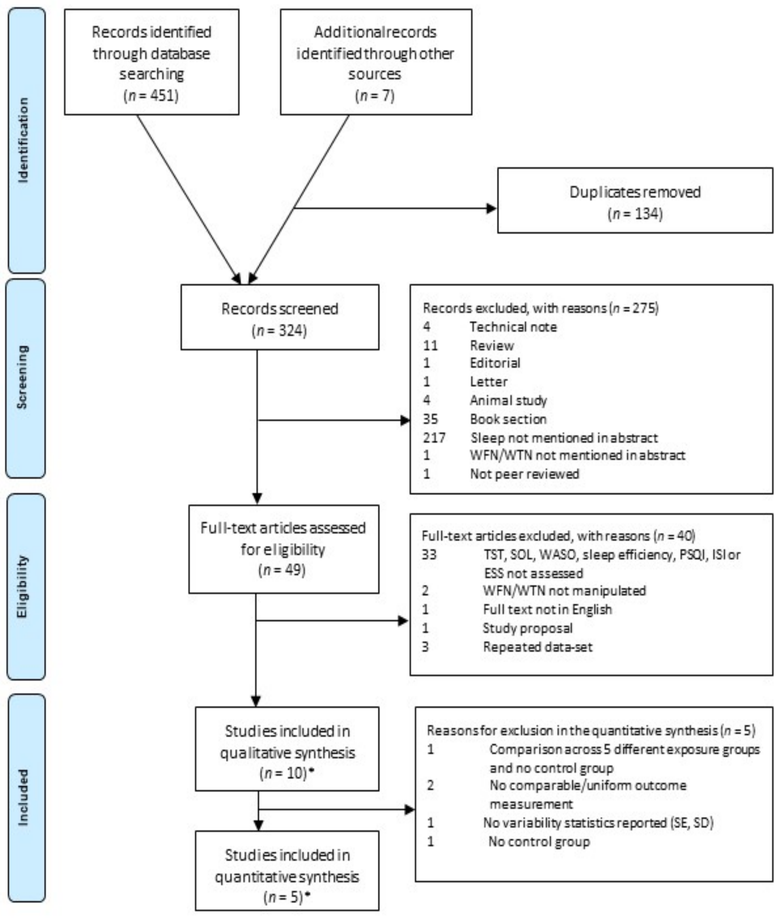

Figure 1. PRISMA flow diagram showing the process for inclusion. *Note.* *1 additional study was included in the qualitative and quantitative synthesis, as one study conducted and analysed two separate pilot studies, so these were treated independently.

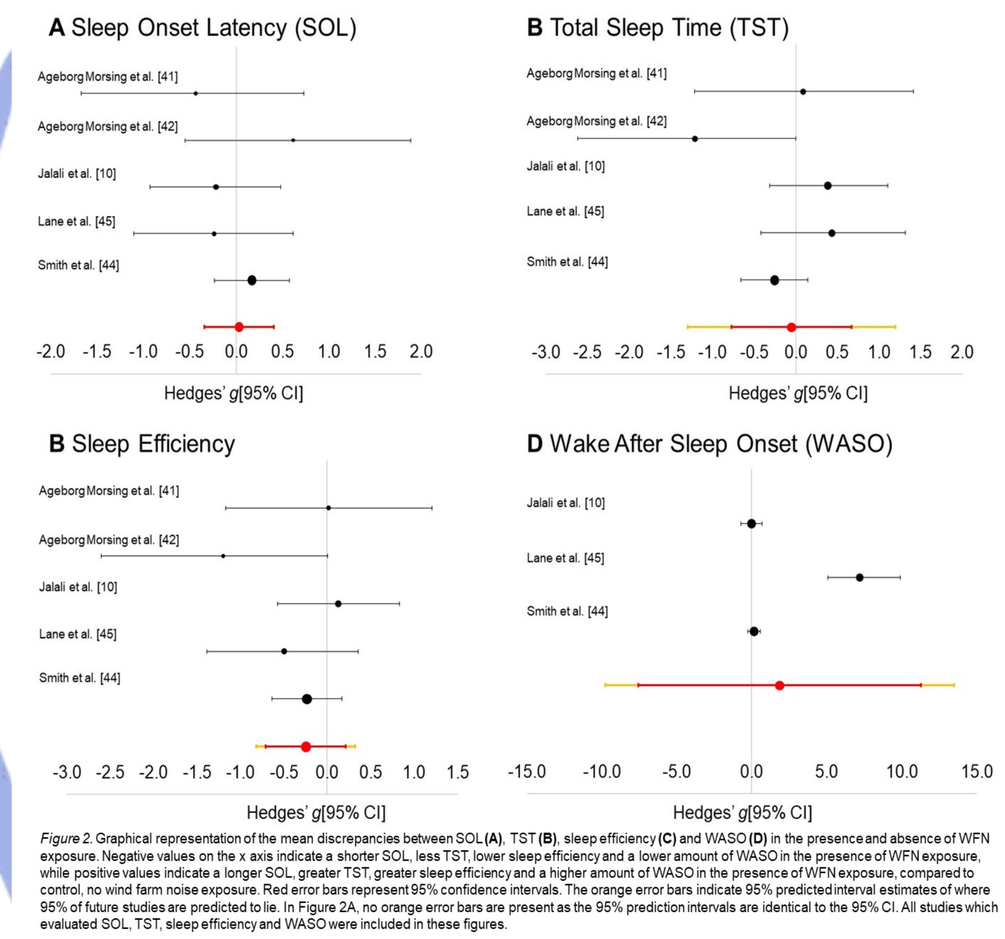

Figure 2. Graphical representation of the mean discrepancies between SOL **(A)**, TST **(B)**, sleep efficiency **(C)** and WASO **(D)** in the presence and absence of WFN exposure. Negative values on the x axis indicate a shorter SOL, less TST, lower sleep efficiency and a lower amount of WASO in the presence of WFN exposure, while positive values indicate a longer SOL, greater TST, greater sleep efficiency and a higher amount of WASO in the presence of WFN exposure, compared to control, no wind farm noise exposure. Red error bars represent 95% confidence intervals. The orange error bars indicate 95% predicted interval estimates of where 95% of future studies are predicted to lie. In Figure 2A, no orange error bars are present as the 95% prediction intervals are identical to the 95% CI. All studies which evaluated SOL, TST, sleep efficiency and WASO were included in these figures.

RESULTS

- Ten studies were eligible for review and five studies reported comparable sleep outcomes which were thus meta-analysed. These included sleep onset latency (SOL), total sleep time (TST), wake after sleep onset (WASO) and sleep efficiency.
- Meta-analyses (*Hedges' g*[95% CI] revealed no significant differences in objective SOL (0.03[-0.34 to 0.41]), WASO (1.86[-7.54 to 11.27]), TST (0.05[-0.77 to 0.67]) or sleep efficiency (-0.25[-0.71 to 0.22]) in the presence versus absence of WFN (all p>0.05).
- Few studies used psychometrically validated subjective measures of sleep.
- Subjective sleep estimates were not meta-analysed due to measurement disparity.
- Available data support that insomnia symptom severity, sleep quality and daytime sleepiness are impacted by WFN exposure compared to no WFN exposure.
- Sleep diary parameters (self reported SOL, TST, WASO and sleep efficiency) show less consistent findings.

DISCUSSION

- Cautious interpretation remains warranted given variable sleep measurement methodologies, WFN interventions and limited sample sizes.
- Well controlled experimental studies using ecologically valid WFN exposure, objective and psychometrically validated subjective sleep assessment tools are needed to provide more conclusive evidence regarding the impact of WFN on sleep.

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INSPIRING ACHIEVEMENT

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