



Title; Music brings joy, love and peace for persons needing to sleep, rest and refresh; a meta-analysis update.

Deborah Hilton

¹Deborah Hilton Statistics Online: <http://sites.google.com/site/deborahhilton/>

² ResearchGate: <https://www.researchgate.net/profile/Deborah-Hilton>

ORCID: <https://orcid.org/0000-0002-4667-7178>

*Corresponding Author

Deborah Hilton

*Email address deborah.hilton@gmail.com

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I. INTRODUCTION

The goal of a meta analysis maybe more so to understand the variability and pattern of the study's results thus understanding the question as opposed to consolidating identical studies on the topic [Borenstein et al., May 2021]. The purpose for the meta-analysis must be apparent and if studies are diverse then the random effects model can be utilised.

There is evidence that music is beneficial for a range of health conditions or situations. In fact, when the Cochrane Library is searched using the search word 'music', there were 70 Cochrane Reviews retrieved [Cochrane Library]. Various reviews mention music and report on whether or not it may alleviate preoperative anxiety (Bradt, Dileo & Shim., 2013), improve depressive symptoms and overall behavioural problems associated with dementia (van der Steen et al., 2025), whether it has beneficial effects on anxiety in persons with coronary heart disease such as those who have had a myocardial infarction (Bradt, Dileo, & Potvin., 2013) and effects for people who suffer depression (Aalbers et al., 2017). Music has also been shown to help people diagnosed with autism in terms of increased chance of global improvement (Geretsegger et al., 2022). Music interventions have also been used for people after acquired brain injury, stroke, and may prove beneficial for improving gait, upper extremity function, communication and quality of life (Magee et al., 2017). Also, there are reports that for people with substance use disorders music therapy may lead to moderate reductions in substance craving and can increase motivation for treatment/change (Ghetti et al., 2022). This is just a subset of the research.

A Cochrane review was published by Jespersen and colleagues in 2022, titled; 'Listening to music for insomnia in adults' [Jespersen et al., 2022]. Included in the review was 13 studies, of which eight studies were new to this update and this resulted in 1007 participants. The prerecorded music was listened to for 25 to 50 minutes, for a period of three days to three months. The Pittsburgh Sleep Quality Index [PSQI] scale was utilised to measure sleep quality and it ranges from 0 to 21 with higher scores indicating poorer sleep. At the end of the intervention, we found moderate-certainty evidence for improved sleep quality measured with PSQI in the music groups compared to no intervention or treatment as usual [TAU] (mean difference (MD) -2.79 , 95% confidence interval (CI) -3.86 to -1.72 ; 10 studies, 708 participants). The review findings provide evidence that in adults with symptoms of insomnia music maybe effective for improving subjective sleep quality.

This manuscript report enhances the results reported, by including four further randomised controlled trials in order to further refine and update the analysis and reassess the results [meta-analysis].



II. METHODOLOGY

The Pubmed MeSH (Medical Subject Headings) is the NLM controlled vocabulary thesaurus used for indexing articles for PubMed. A search was performed utilising the search string; ("Music"[Mesh]) AND "Sleep"[Mesh]. Article type; randomised controlled trial was selected which resulted in 25 manuscript retrievals. These were sorted in order from the most recent. Those abstracts published after 2022 (which is when the Cochrane Review was published), were reviewed and eight were published after that year.

The Comprehensive Meta-Analysis version 4.0.000 [<https://meta-analysis.com/>] was utilised to enter the data from the four studies identified that maybe suitable to add to the analysis, in order to combine and perform an update on the meta-analysis (Comprehensive Meta-Analysis, 2022). The effect direction was selected as negative. The random effects model was selected.

III. RESULTS

Four manuscripts identified reported outcomes one of which was the PSQI. These were in pregnant women who have pregnancy-related insomnia (Sanli et al., 2022; Hoegholt et al., 2025), depression-related insomnia (Lund et al., 2023), and on sleep quality associated with menopausal symptoms (Ugurlu et al., 2024). There was another one manuscript that assessed the effect of music on insomnia of college students but this has been subsequently retracted (retracted; Dos Santos et al., 2023).

Figure 1 shows the data entry table whereby the first ten studies shown are that which were reported in table 1.1 of the meta-analysis by Jespersen and colleagues [Jespersen et al., 2022]. The final four studies are those identified that are listed above, those that are added in this update.

Figure 2 shows the meta-analysis results while Figure 3 is a high-resolution plot.

The random effects pooled statistic was; -2.266 [-3.123 to -1.408]. This includes 14 studies and resulted in 1012 subjects.

The report in Comprehensive Meta-Analysis version 4.0.000 states that the random-effects model was employed for the analysis. The studies in the analysis are assumed to be a random sample from a universe of possible studies, and this analysis hence makes inference to that cosmos.

As previously stated, the mean effect size is -2.266 with a 95% confidence interval of -3.123 to -1.408. The mean effect size in the universe of comparable studies could fall anywhere in this interval.

The Z-value tests the null hypothesis that the mean effect size is zero. The Z-value is -5.176 with $p < 0.000$. Using a criterion alpha of 0.050, we reject the null hypothesis and conclude that in the universe of populations comparable to those in the analysis, the mean effect size is not precisely zero.

The results with the addition of four studies is a slightly lesser effect of music overall as compared to the previous meta-analysis but only marginally.



IV. DISCUSSION

In healthcare, most meta analyses of interventions are limited to randomized trials given they are the method of evaluation most recognised [Borenstein et al, 2021]. In the book titled; 'Common Mistakes in Meta-Analysis and how to avoid them' it explains well the understanding of meta-analysis results and interpretation [Borenstein., 2024]. If there is a statistically significant difference between groups, we can conclude the intervention group has performed more favourably than the control group. It should also be acknowledged that this finding may in fact be due to a confound. We must also acknowledge that findings such as those observed with any treatment effect or intervention, could be considered observational or observed effects and not necessarily causal effects.

A systematic review of the use of honey as a wound dressing concluded that while there is low assurance concluding that honey is a useful treatment for superficial wounds or burns, there is biological plausibility (Moore et al., 2001). If one is to consider biological plausibility as it relates to music, then physiological parameters may give indication of biological plausibility. The Bonny Method of Guided Imagery and Music (GIM) centres on music and consciousness for personal growth and change (McKinney and Honig., 2017). The researchers examined randomized and nonrandomized controlled trials and repeated measures designs that reported psychological or physiological outcomes (systolic and diastolic blood pressure, beta-endorphin, cortisol, and pain) related to health.

An observed effect, as opposed to causal maybe debatable, in addition to confounds needing consideration. When sleep and music are considered, other factors that may be envisaged or considered that may affect outcomes could include; pillow quality, pillow quantity, lighting, other noise, temperature, humidity, disruptions or other factors that may confound the result.

If I was to vote count, there would be 10 studies that were statistically significant and 4 that were not. When meta-analysis is performed it is possible to vote count [Borenstein et al., Chapter 28, 2009]. The number of studies that are statistically significant and those that are not statistically significant are tallied or counted, in order to make a comparison yet this methodology is flawed.

Meta analysis allows us to ascertain the relevant question of what is the effect magnitude and whether or not there is consistency in effect across studies. Borenstein and colleagues [Borenstein et al., Chapter 43, 2009] state that mixing fruit namely whether it be apples and oranges or if I state another example, it could be purchasing clothing from a designer store as opposed to op shop bargains then comparing items purchased makes the comparison awkward. In addition, Borenstein and colleagues state rubbish input into the analysis results in rubbish output, missing or ignoring research studies or performing the meta-analysis task inadequately can be meta-analysis criticisms [Borenstein et al., Chapter 43, 2009]. For this reason, some have suggested a narrative review maybe better. Readers who want a comprehensive understanding of the key difference between a meta analysis and a narrative review can read further on this topic [Borenstein et al., 2021].

Another term used is an umbrella review and while the main focus of this research was not per say music, but nursing interventions that aimed to improve inpatients' sleep in intensive and non-intensive care units, the results did state that environmental changes were reported as beneficial but inconclusive and in fact music, along with acupuncture, earplugs and eye masks, generally were positive [Bellen et al., 2022].

Evidence is important, yet hearsay or personal reflections also hold weight and substantiate likelihood. My mother [first and middle name Joy Love] is a classical music pianist having completed many formal practical performance and theoretical examinations including that from the Australian Music Examinations Board and the Trinity College. One classical music performance that I have archived that she performed beautifully and to absolute perfection without a note out of place is; *Chopin's Valse (Waltz) in A flat, op.69, no.1 (opus 69, number 1)*. A Chopin autographed copy of this classical music is now at the National Library (Biblioteka Narodowa) of Poland in Warsaw, while another autographed version of the piece is at the Conservatoire de Paris, yet considered to be a less refined version. I hope Joy Love has an autographed copy kept for me that I can treasure as I certainly consider listening to her play Chopin is both entertaining & serene. Irrespective of evidence, I consider music to an extent promotes rest, sleep and calm and has healing potential if you have opportunity to listen to music such as this



when it is performed so precisely, beautifully and melodically.

V. CONCLUSION

Meta-analysis has an important role in understanding outcomes in this case being the effect of music on sleep as measured by the PSQI. Narrative reviews, umbrella and scoping reviews also provide useful reflections on topics and complement meta-analytical statistical analysis. Personal reflections regarding music choice and the benefits which may or may not include facilitating sleep and calm, are individual. This maybe a private individual journey regardless of whether you listen to church chorales, hymns, pop, classical, chamber, operatic, concert, instrumental, rap, heavy metal, upbeat, jazz or country western music.

Various famous quotes on music that also incorporate an element of statistics or maths include;

“Music is the pleasure the human soul experiences from counting without being aware that it is counting.” — German mathematician and philosopher Gottfried Wilhelm von Leibniz (1646-1716) who co-discovered calculus.

“Mathematics is on the artistic side a creation of new rhythms, orders, designs, harmonies, and on the knowledge side, is a systematic study of various rhythms, orders, designs and harmonies.” — William L. Schaaff, author and mathematics education professor.

“Music and math together satisfied a sort of abstract ‘appetite’, a desire that was partly intellectual, partly aesthetic, partly emotional, partly, even, physical.” –music critic/composer Edward Rothstein. (p. xv of his 1995 book *Emblems of Mind: The Inner Life of Music and Mathematics*).

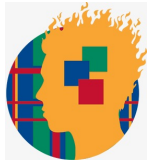


Figure 1. Data entry table – the effect of music on sleep as measured by the PSQI.

Study name	Pittsburgh Sleep Quality Index [PSQI] Mean	Pittsburgh Sleep Quality Index [PSQI] Std-Dev	Pittsburgh Sleep Quality Index [PSQI] Sample size	Pittsburgh Sleep Quality Index [PSQI] Mean	Pittsburgh Sleep Quality Index [PSQI] Std-Dev	Pittsburgh Sleep Quality Index [PSQI] Sample size	Effect direction	Std diff in means	Std Err	Variance	Hedges's g	Std Err	Variance	Difference in means	Std Err	Variance
1 Amiri, 2019	2.370	4.800	15	4.800	1.370	15	Negative	-0.688	0.376	0.141	-0.670	0.366	0.134	-2.430	1.289	1.661
2 Burai, 2020	5.400	3.100	74	6.700	3.650	69	Negative	-0.385	0.169	0.029	-0.383	0.168	0.028	-1.300	0.565	0.319
3 Hamat, 2008	3.270	1.800	35	5.900	2.193	29	Negative	-1.324	0.277	0.077	-1.307	0.274	0.075	-2.630	0.499	0.249
4 Jespersen, 2019	8.700	3.800	18	11.200	3.000	15	Negative	-0.722	0.361	0.130	-0.705	0.352	0.124	-2.500	1.210	1.465
5 Kulich, 2003	5.800	3.200	32	8.100	3.400	33	Negative	-0.636	0.256	0.065	-0.688	0.252	0.064	-2.300	0.819	0.672
6 Lai, 2005	7.130	3.190	30	10.070	2.750	30	Negative	-0.987	0.273	0.075	-0.974	0.270	0.073	-2.940	0.763	0.531
7 Liu, 2016	6.670	2.950	61	7.850	3.600	60	Negative	-0.353	0.183	0.034	-0.357	0.182	0.033	-1.180	0.598	0.357
8 Momemasab, 2018	6.000	3.450	33	14.220	4.720	35	Negative	-1.979	0.296	0.088	-1.957	0.293	0.086	-8.220	1.008	1.015
9 Shum, 2014	5.900	2.400	28	9.500	2.600	32	Negative	-1.435	0.290	0.084	-1.416	0.286	0.082	-3.600	0.649	0.422
10 Wang, 2016	7.280	3.390	32	8.720	3.700	32	Negative	-0.406	0.253	0.064	-0.401	0.249	0.062	-1.440	0.887	0.787
11 Hoegholt, 2025	8.400	2.700	31	8.200	2.750	40	Negative	-0.073	0.239	0.057	-0.073	0.237	0.056	-0.200	0.653	0.426
12 Lund, 2023	12.500	4.000	51	12.800	4.000	51	Negative	-0.075	0.198	0.039	-0.074	0.197	0.039	-0.300	0.732	0.627
13 Ugunlu, 2024	6.230	2.580	30	8.160	2.550	31	Negative	-0.752	0.265	0.070	-0.743	0.262	0.068	-1.930	0.657	0.431
14 Sanli, 2022	4.400	3.191	35	6.228	3.135	35	Negative	-0.578	0.244	0.060	-0.572	0.241	0.058	-1.828	0.756	0.572
15																
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Figure 2. Meta analysis results – the effect of music on sleep as measured by the PSQI.

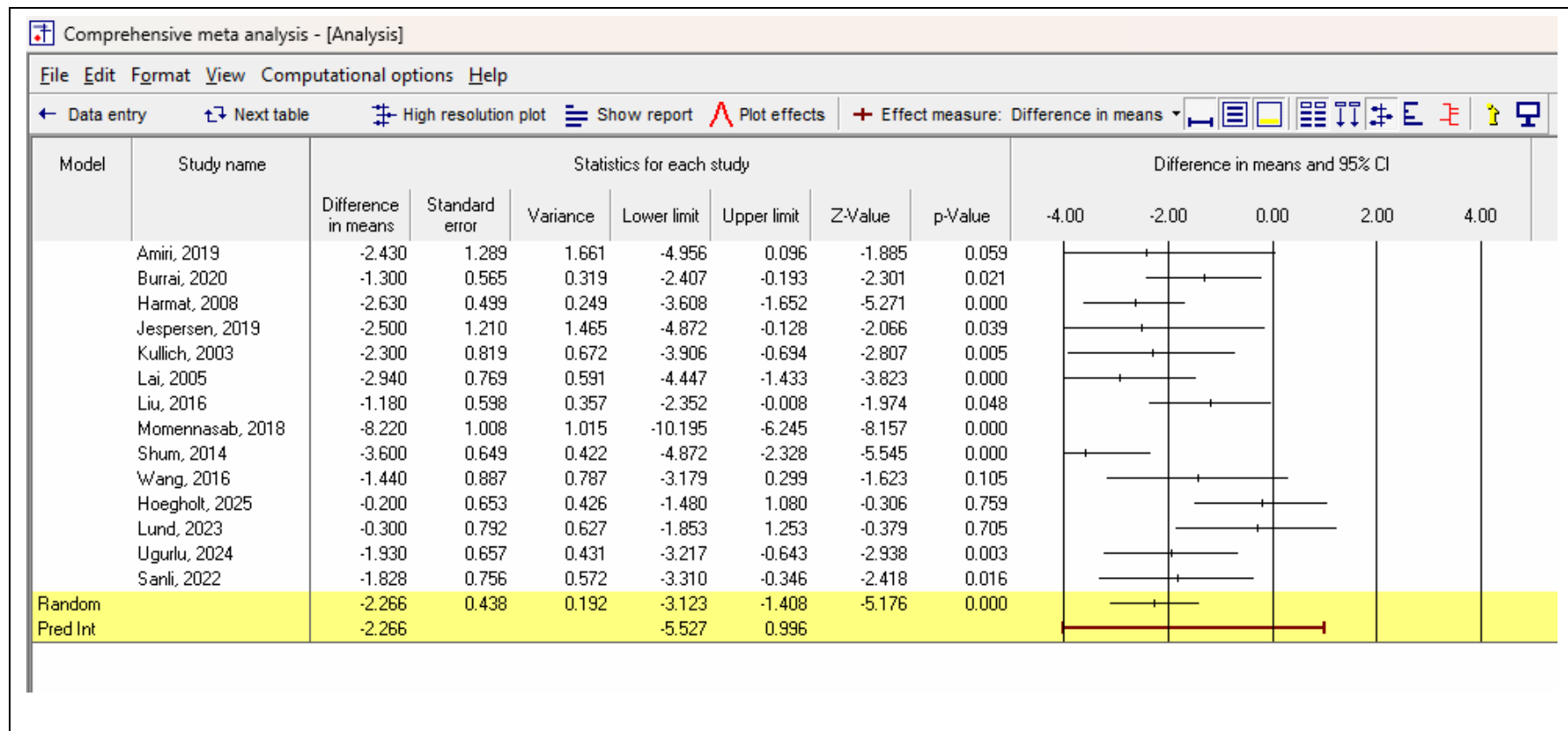
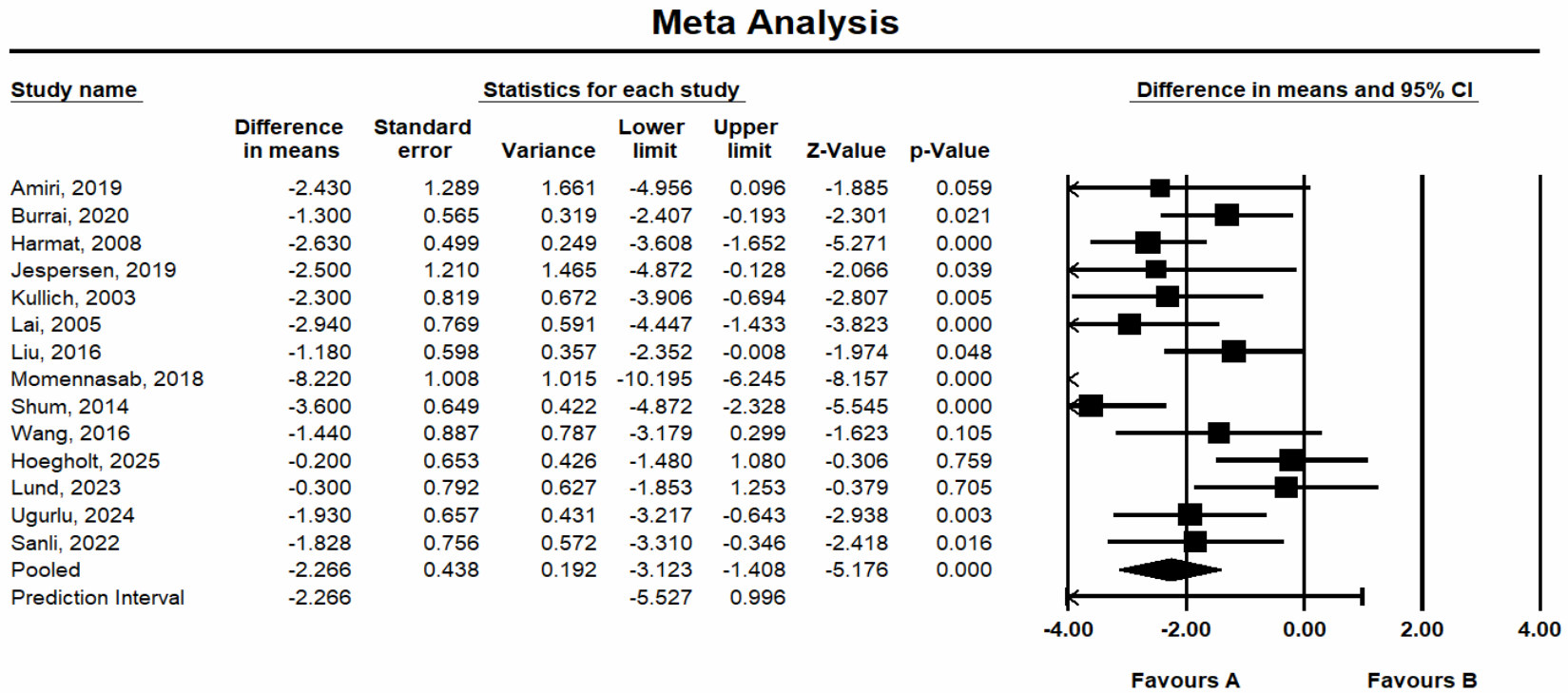




Figure 3. High resolution plot.



Meta Analysis



Picture 1. Piano photograph





Picture 2. A musical wind up piano





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