

REVIEW ARTICLE

Associations between tactile intimacy and sleep quality in healthy adults: A systematic review

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Summary

Prior research suggests that different types of touch can affect sleep, but whether there is a consistent association between tactile intimacy and sleep quality is unclear. Here, we report a pre-registered systematic review (International Prospective Register of Systematic Reviews [PROSPERO], CRD42020158683) of studies examining the association between tactile intimacy and sleep quality in healthy adults. The databases PsycINFO, PubMed, Web of Science, the Cochrane Central Register of Controlled Trials and EMBASE were searched on August 7, 2020. A total of 13 studies met the inclusion criteria and were synthesised qualitatively. Most commonly, articles researched sexual intimacy in relation to sleep quality, but some studies also investigated non-sexual affective touch and emotionally neutral touch. Some evidence for a connection between sexual function, sexual satisfaction and masturbation with sleep quality was found; however, no evidence for an association between sexual frequency or sexual positions and sleep was found. Interestingly, studies employing more subjective approaches were more likely to report an association between touch and sleep, potentially highlighting a discrepancy between self-reported and the objectively measurable association between touch and sleep.

KEYWORDS

affective touch, co-sleep, sexual behaviour, sleep in pairs

1 | INTRODUCTION

Sleep is not only a physiological necessity, but also a social activity shared by those who sleep together (Troxel, 2010). The interpersonal aspects of sleep have been increasingly researched in the recent past (Troxel, 2010; Troxel et al., 2007). One component of co-sleep that emerges consistently when couples are asked about their sleep habits is tactile intimacy (Hislop, 2007; Kirkman, 2010; Meadows et al., 2008; Venn, 2007). Here, tactile intimacy is used to refer to a range of attitudes and experiences including different types of touch

(e.g. interpersonal, affective, or self-touch), frequency of tactile experiences in one's life, and satisfaction with touch.

One type of tactile intimacy is affective touch. Affective touch is usually shared with another person and comes in a variety of forms such as hugging or sexual activity, both of which have been associated with physiological signifiers of relaxation (Brody, 2006, 2010; Brody & Preut, 2003; Costa & Brody, 2012; Grewen et al., 2003; Light et al., 2005). For example, experiencing a high frequency of partner hugs has been related to low blood pressure (BP) and heart rate (HR) in women (Grewen et al., 2003; Light et al., 2005). Such

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calming effects of touch might support the popular belief that affective touch facilitates sleep (Lastella et al., 2019). Yet, there are several gaps in our knowledge when it comes to studies directly investigating the relationship between affective touch and sleep (particularly for non-sexual touch like hugging).

In fact, most literature on the relationships between touch and sleep in adults has focussed on disorders surrounding sleep and sex, or the effects of abusive touch (Gallegos et al., 2019; Kajeepeeta et al., 2015; Schenck et al., 2007; Steine et al., 2012). Other wider literature reviews have examined the associations between relationship satisfaction, co-sleeping, and sleep quality (Troxel, 2010; Troxel et al., 2007). Interestingly, one review reported that individuals seem to sleep better alone, but prefer to co-sleep with their partner (Troxel, 2010); an inconsistency that has been highlighted repeatedly (Dittami et al., 2007; Hislop, 2007).

As human touch can be both calming and arousing (Van Anders et al., 2013; Jönsson et al., 2015), it might be involved in both the preference to co-sleep and sleep disruption caused by a partner. Research on the relationship between sexual activity and sleep has shown that a broad range of sleep-related disorders are associated with abnormal sexual behaviours (Schenck et al., 2007).

The evidence reviewed and classified by Schenck et al. (2007) consisted of case reports, interviews studies, surveys, textbook descriptions, and experimental evidence.

Further, research on the effects of past or present (sexual) abuse and interpersonal violence found that various symptoms of sleep disturbance, e.g. insomnia and nightmares, are more common among victims of interpersonal violence or sexual abuse than in control samples (Gallegos et al., 2019; Kajeepeeta et al., 2015; Steine et al., 2012). Such evidence mostly used cross-sectional designs, and childhood experiences were commonly assessed by retrospective measures (Gallegos et al., 2019; Kajeepeeta et al., 2015; Steine et al., 2012). Consequently, the available evidence is mostly correlational, and Kajeepeeta et al. (2015) noted that causal inferences are limited because some of the reviewed studies on adverse childhood experiences and sleep disturbances did not control for confounding factors.

While most work mentioned above focusses on touch between two people, it should be added that touch can also be experienced alone. There are reports of people experiencing a lack of touch in their lives, with some studies estimating that up to 60% of adults in the USA report a longing for touch, especially during the coronavirus disease 2019 (COVID-19) pandemic (Field et al., 2020). Some authors have linked lack of touch, and broader feelings of lack of affection, with a range of physical and mental health outcomes including higher levels of loneliness, depression, stress, mood and anxiety disorders, and secondary immune disorders (Floyd, 2014). In this regard, there is growing interest in the use of touch substitutes and self-touch as a self-care strategy to support relaxation. Yet, it is unclear how self-touch affects sleep.

One factor limiting our understanding of how tactile intimacy is associated with sleep is that to our knowledge, there is no

comprehensive synthesis of the evidence on tactile intimacy and sleep in healthy adults. Such a synthesis would (a) help to inform public health guidance concerning pre-sleep partnered touch and co-sleeping in general, and (b) identify knowledge gaps in the scientific understanding of the relationship between sleep and touch in healthy adults, therefore identifying open questions for future research.

Here, we report a systematic literature review addressing the question of how tactile intimacy and sleep are associated in healthy adults. We focus on healthy participants because prior work has reviewed only the relation between sexual behaviour and sleep in pathological (Schenck et al., 2007) or abused (Gallegos et al., 2019; Kajeepeeta et al., 2015; Steine et al., 2012) samples. In contrast, the association between touch and sleep in healthy adults has been neglected, even though pre-sleep touch and touch during sleep is also likely to occur in people that show healthy sleep patterns (Hislop, 2007; Kirkman, 2010; Meadows et al., 2008; National Sleep Foundation, 2005; Venn, 2007). We furthermore excluded research on violent or abusive touch, as we wanted to understand more about the links between sleep and touch outside of the context of abuse, which has been researched extensively before (Gallegos et al., 2019; Kajeepeeta et al., 2015; Steine et al., 2012).

2 | METHODS

2.1 | Search strategy

Five databases were searched on August 07, 2020: PsycINFO (EBSCO), PubMed (National Center for Biotechnology Information [NCBI]), Web of Science (Clarivate Analytics), the Cochrane Central Register of Controlled Trials (Wiley) and EMBASE (Ovid). The following terms and their variations were used: sleep, nap, dream, lucid, co-sleep, co-sleeping, couple sleep, touch, sexual, intimacy, and tickling. The search strategies were finalised with a subject librarian and customised per database (Appendix S1). All text fields were searched for keywords; no filters were used. Moreover, reference lists of eligible articles and previous review articles were scanned to identify additional suitable articles. This review was pre-registered on the International Prospective Register of Systematic Reviews (PROSPERO, CRD42020158683) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklists are presented in Appendices S4 and S5.

2.2 | Eligibility criteria

Inclusion criteria were:

1. Articles were published in a peer-reviewed scientific journal, written in English, and presented original findings (Gallace & Spence, 2010; Pengo et al., 2018; Miner & Kryger, 2017).

- To ensure that our findings do not reflect age-related changes in touch perception and sleep behaviour (21–23), samples had to be composed of adults aged ≥ 18 and ≤ 65 years.
- Participants were healthy, i.e. not selected for health problems or pathological behaviour.
- The article investigated adult human touch, including self-touch and interpersonal touch. Non-human touch (e.g. acupuncture, where the observed effect is caused by needles), adult-child touch and violent or abusive touch were excluded.
- The article investigated sleep quality or at least one of the following components of sleep quality: sleep initiation, sleep maintenance or sleep quantity (Kline, 2013).
- Articles named at least one touch-related keyword and one sleep-related keyword in the title. Keywords were based on a list of terms developed during search strategy piloting (Appendix S2). This rule was implemented to focus on articles specific to touch and sleep.
- In the abstract and full-text screening stages, the reviewers agreed that the article examined touch and sleep. When questionnaires were used, this condition could be met if at least one item focussed on touch prevalence, type, or experience directly. Studies using touch as an intervention had to describe the touch administered. For interview studies, descriptions of touch had to be part of the analysed content.

Piloting revealed that few studies explicitly focussed on adult touch and sleep; hence, touch prevalence, type, or experience were

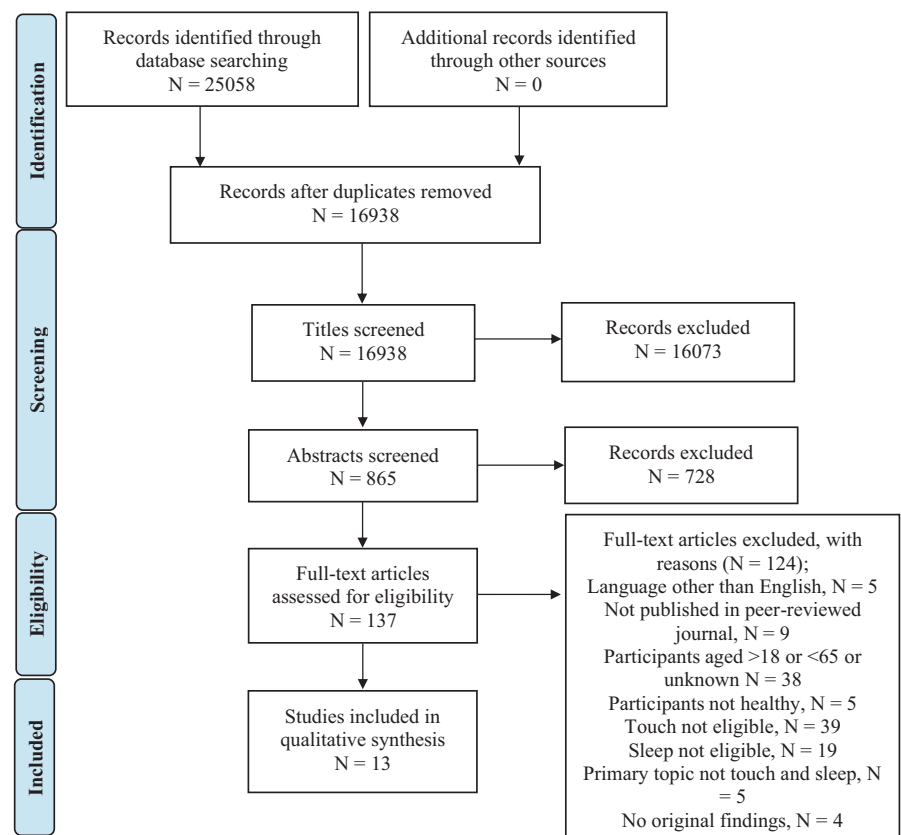
included. If articles did not report sufficient details to determine whether inclusion criteria were met, study authors were contacted, this was the case with some articles that did not report the age range of participants. If the details were not provided after three contact attempts, the article was excluded (Alleva et al., 2015). Details about the contacted authors are reported in Appendix S3.

2.3 | Procedure

Titles, abstracts, and full texts were screened by two independent reviewers (AD and either RP, JB or NB) in consecutive stages (PRISMA flow diagram is shown in Figure 1). Disagreements were settled by discussion and inter-rater reliability was established by using Cohen's kappa statistic. At the title and abstract screening stages, inter-rater agreement was fair with $\kappa = 0.324$, $p < 0.001$; and $\kappa = 0.311$, $p < 0.001$, respectively. At the full-text screening stage, agreement was substantial with $\kappa = 0.664$, $p < 0.001$. Note that in the full-text screening stage, seven articles were reviewed exclusively by AD because they could only be accessed as hard copies in the British Library, and because of COVID-19 restrictions during the time of screening it was not feasible to send two of the authors to the British Library.

Data extracted included article author(s), participant gender and age range, year of publication, country, sample size, aim of the study, methods, and primary outcomes. Also note that after search completion, it was decided that dream outcomes should

FIGURE 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram. From: Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G.; The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLOS Medicine, 6(6), e1000097. 10.1371/journal.pmed1000097. For more information, visit www.prisma-statement.org



be reviewed separately from sleep quality outcomes to avoid reviewing widely different sleep outcomes; hence, dream-related articles were not reported here. Included studies were synthesised qualitatively, this decision was made due to the heterogeneity of eligible articles.

2.4 | Quality assessment

For quality assessment, we used the QualSyst tool developed by Kmet et al. (2004). This tool was chosen because it allows the assessment of studies that use a variety of methods. It consists of two separate checklists, one for quantitative and one for qualitative studies. Articles are judged on whether they meet each criterion, with the options “yes” = 2, “partial” = 1, “no” = 0 and “not applicable (N/A)”. A summary score is calculated per paper by summing the results attained on each item and dividing the sum by the total possible sum. Items that are judged N/A are subtracted from the total possible sum, higher scores indicate better article quality (i.e. total possible sum = 28 - [number of N/A × 2]). Summary score: total sum/total possible sum). Two reviewers performed screening (AD and either NB or JB), disagreements were resolved by discussion. Again, inter-rater agreement was examined by calculation of Cohen's Kappa. Kappa was significant and ranged from 0.408 to 0.691 for most papers, with the exception of Dittami et al. (2007), $\kappa = 0.194$, $p = 0.222$, and Kirkman (2010), $\kappa = -0.111$, $p = 0.681$.

3 | RESULTS

A total of 25,058 articles were retrieved. Details on inclusion criteria were missing for two articles, these were excluded. After duplicate removal and screening, 13 articles met the inclusion criteria; details are presented in Figure 1. Overall, quality assessment scores ranged from 0.61 (Khastar et al., 2020) to 0.95 (Pallesen et al., 2020), with higher scores indicating better quality. Scores per item are presented in Tables 1 and 2 for quantitative and qualitative articles, respectively.

3.1 | Study sampling

Study information are summarised in Table 3. Sampling methods were diverse and included snowballing techniques and recruitment in community hubs (Hislop, 2007; Ogunbajo et al., 2020), clinical centres (Afsahri et al., 2018; Khastar et al., 2020; Nozoe et al., 2014), university (Junker et al., 2016), or on social networks (Kirkman, 2010). One study drew a sample from a population registry (Pallesen et al., 2020), and one study used Amazon's Mechanical Turk (Seehuus & Pigeon, 2018). Four articles (Brissette et al., 1985; Costa et al., 2017; Cutler et al., 2005; Dittami et al., 2007) did not explain the sampling strategy.

3.2 | Sleep measurements

Most articles included some subjective method for assessing sleep quality (Afsahri et al., 2018; Costa et al., 2017; Dittami et al., 2007; Hislop, 2007; Junker et al., 2016; Khastar et al., 2020; Kirkman, 2010; Nozoe et al., 2014; Ogunbajo et al., 2020; Pallesen et al., 2020). Of these, eight articles used questionnaires (Afsahri et al., 2018; Costa et al., 2017; Junker et al., 2016; Khastar et al., 2020; Nozoe et al., 2014; Ogunbajo et al., 2020; Pallesen et al., 2020; Seehuus & Pigeon, 2018). Of these, most articles used the Pittsburgh Sleep Quality Index (PSQI; Afsahri et al., 2018; Costa et al., 2017; Khastar et al., 2020; Nozoe et al., 2014; Ogunbajo et al., 2020; Seehuus & Pigeon, 2018), which measures seven different components of sleep quality: subjective sleep quality itself, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction (Buysse et al., 1989). Other sleep questionnaires used were the Insomnia Severity Index (ISI), which measures insomnia symptoms (Bastien et al., 2001) and was used by two of the reviewed articles (Afsahri et al., 2018; Seehuus & Pigeon, 2018) and the Epworth Sleepiness Scale (ESS; Johns, 1991), which measures daytime sleepiness and was used by one of the reviewed papers (Afsahri et al., 2018). Lastly, one article (Pallesen et al., 2020) used the relatively new Bergen Insomnia Scale (Pallesen, 2008), which measures insomnia symptoms and one article (Junker et al., 2016) used a self-developed questionnaire to measure sleep onset positions.

Two articles used sleep logs (Dittami et al., 2007; Hislop, 2007), and two articles conducted in-depth interviews with participants (Hislop, 2007; Kirkman, 2010). One study conducted a full polysomnography (Brissette et al., 1985), one study measured electroencephalography (EEG), electro-oculography (EOG) and electromyography (EMG) to assess sleep latency (Cutler et al., 2005) and one study used actigraphy (Dittami et al., 2007).

3.3 | Relationship between tactile intimacy and sleep

Below, results are summarised according to the various types of tactile intimacy reviewed, most of which are sexual. Note that the erotic valence of touch is continuous (Van Anders et al., 2013; Bendas et al., 2017; Herbenick et al., 2019; Jönsson et al., 2015); hence, it can be challenging to distinguish between sexual and non-sexual touch. However, as the distinctions were mostly clear in the papers reviewed here, we refer to affective touch that is not explicitly sexual as “non-sexual affective touch”.

3.3.1 | Sexual intimacy

In the included articles, several different sexual variables were investigated, which need to be disambiguated. The investigated variables include sexual function, sexual satisfaction and sexual quality of life (QoL), sexual self-efficacy, and sexual position.

TABLE 1 Quality assessment scores for quantitative articles for each quality assessment criterion

Criteria	Afsahri et al., 2018	Brissette et al., 1985	Costa et al., 2017	Cutler et al., 2005	Dittami et al., 2007	Junker et al., 2016	Khastar et al., 2020	Nozoe et al., 2014	Ogunbajo et al., 2020	Pallesen et al., 2020	Seehuus & Pigeon, 2018
1. Question/objective sufficiently described?	1	2	2	2	2	2	1	2	1	2	2
2. Study design evident and appropriate?	2	2	2	1	2	2	0	2	2	2	2
3. Method of subject/comparison group selection or source of information/input variables described and appropriate?	1	1	1	1	1	1	1	1	1	2	1
4. Subject (and comparison group, if applicable) characteristics sufficiently described?	2	2	2	2	2	2	2	2	2	2	2
5. If interventional and random allocation was possible, was it described?	N/A	1	N/A	1	N/A	N/A	2	N/A	N/A	N/A	N/A
6. If interventional and blinding of investigators was possible, was it reported?	N/A	0	N/A	N/A	N/A	N/A	0	0	N/A	N/A	N/A
7. If interventional and blinding of subjects was possible, was it reported?	N/A	N/A	N/A	2	N/A	N/A	0	N/A	N/A	N/A	N/A
8. Outcome and (if applicable) exposure measure(s) well defined and robust to measurement/misclassification bias? Means of assessment reported?	2	2	2	2	1	2	2	2	1	2	2
9. Sample size appropriate?	2	0	2	1	1	2	2	1	2	2	2
10. Analytic methods described/justified and appropriate?	1	1	1	2	2	1	2	1	1	2	1
11. Some estimate of variance is reported for the main results?	1	1	0	1	1	1	2	1	2	1	2
12. Controlled for confounding?	1	2	1	1	1	1	1	2	0	2	1
13. Results reported in sufficient detail?	2	1	1	2	1	1	1	1	2	2	2
14. Conclusions supported by the results?	2	2	2	2	1	2	1	2	2	2	2
Summary score (total sum/total possible sum)	0.77	0.65	0.73	0.77	0.68	0.77	0.61	0.71	0.73	0.95	0.86

Items could be scored as “yes” = 2, “partial” = 1, “no” = 0, or “not applicable” = N/A.

TABLE 2 Quality assessment scores for qualitative articles for each quality assessment criterion.

Criteria	Hislop, 2007	Kirkman, 2010
1. Question/objective sufficiently described?	2	2
2. Study design evident and appropriate?	2	1
3. Context for the study clear	2	2
4. Connection to a theoretical framework/wider body of knowledge?	1	1
5. Sampling strategy described, relevant and justified?	2	1
6. Data collection methods clearly described and systematic?	1	1
7. Data analysis clearly described and systematic?	0	2
8. Use of verification procedure(s) to establish credibility?	0	0
9. Conclusions supported by the results?	2	2
10. Reflexivity of the account	1	2
Summary score (total sum/total possible sum)	0.65	0.7

Items could be scored as “yes” = 2, “partial” = 1, or “no” = 0.

Sexual function describes the absence of problems with the different stages of sexual activity. In women, sexual function describes desire and subjective arousal, vaginal lubrication, experience of orgasm, satisfaction with the sexual experience, and pain during and following vaginal penetration (Rosen et al., 2000). In men, sexual function pertains to desire, penile erection, sexual satisfaction, experience of orgasm, and ejaculation (Rosen et al., 1997). Sexual satisfaction is thus a component of sexual function, it is thought to describe the subjective degree of pleasure and intimacy experienced (Pascoal et al., 2014).

Sexual QoL is a term used to describe the impact of sexual function on physical, social, emotional, and psychological wellbeing (Symonds et al., 2005). Sexual self-efficacy describes the belief that one is able to make decisions about ones' own sexual behaviour, therefore describing one's agency over own sexual life (Assarzadeh et al., 2019). Lastly and somewhat less abstract, one of the included studies investigated sexual position, which describes how people engage in sexual activity. Below, results with respect to these variables are reviewed.

Nights with sexual contact were found to reduce subjective negative judgments of co-sleeping in women, while actigraphic recordings did not show a difference between nights with and without sexual contact (Dittami et al., 2007). Dittami et al. (2007) found that men experienced a decrease in sleep efficiency following sexual contact. In contrast, Pallesen et al. (2020) found that sexual activity was judged to improve sleep quality in a questionnaire study of men and women, where men reported this effect to be stronger than women.

The relationship between sexual frequency and sleep quality was assessed by two articles that found no statistically significant association between sexual frequency and sleep quality (Costa et al., 2017; Ogunbajo et al., 2020). Ogunbajo et al. further investigated the relationship between anal sexual positions and sleep quality and reported no significant association of usual sexual position with sleep quality (Ogunbajo et al., 2020).

Regarding the association between sexual function and sleep measurements, Afsahri et al. (2018) reported a positive correlation between sexual function and sleep quality, and a negative correlation between sexual function, sleepiness, and insomnia. Seehuus and Pigeon (2018) also reported a negative correlation between sexual function and insomnia, and two studies found no significant correlation between sexual function and sleep quality (Nozoe et al., 2014; Seehuus & Pigeon, 2018).

One article found a significant correlation between sexual satisfaction and sleep quality in women only (Costa et al., 2017). Correspondingly, two studies reported a negative correlation between sexual satisfaction and insomnia (Afsahri et al., 2018; Seehuus & Pigeon, 2018) in women (but note that Afsahri et al. (2018) tested women exclusively). Furthermore, negative correlations between sexual satisfaction, sleep problems and sleepiness were found (Afsahri et al., 2018). Additionally, Khastar et al. (2020) investigated how sexual QoL, sexual self-efficacy and sleep quality would be influenced by sleep hygiene and sexual function information sessions and found a slight improvement in all measures.

Summarised, there seems to be some converging evidence on an association between sexual satisfaction and sleep quality especially in women, and no evidence for an association between either sexual frequency or sexual position and sleep quality. The evidence on other sexual variables and sleep quality is ambivalent.

3.3.2 | Masturbation

Neither an experimental study, nor an article correlating subjective sleep quality and masturbation frequency found an association between masturbation and sleep quality (Brissette et al., 1985; Costa et al., 2017). However, in Pallesen et al. (2020), masturbation was judged to have a positive effect on sleep quality except for masturbation without orgasm, which men judged to delay sleep onset and impair sleep quality. Masturbation was the only self-touch researched in association with sleep.

3.3.3 | Non-sexual affective touch

Junker et al. (2016) researched the amount of physical contact of couple's sleep onset positions. The most common position to fall asleep in was spooning, whereas falling asleep without touch was uncommon (Junker et al., 2016). The topic of non-sexual affective touch was additionally addressed by participants of the two qualitative studies reviewed here (Hislop, 2007; Kirkman, 2010). Cuddling seems to be common just before sleep and serves a function of intimacy building; however, some participants reported withdrawing to their side of the bed at sleep onset (Hislop, 2007). Furthermore, especially women seem to value physical intimacy beyond sex prior to sleep onset (Kirkman, 2010).

3.3.4 | Other types of touch

One study investigated the relationship between cranial manipulation and nap latency and duration (Cutler et al., 2005). It was found that sleep latency was significantly decreased after compression of the fourth ventricle compared to sham-touch and no-touch conditions. Interestingly, the percentage of time spent asleep in each 30-min trial was significantly higher during compression and sham-touch conditions compared to no-touch conditions (Cutler et al., 2005). The topic of non-affective, functional touch also came up in the interview studies, where participants reported partner nudging, pushing, or kicking, e.g. to correct partner snoring (Hislop, 2007; Kirkman, 2010). Note that we originally expected to review articles on affective touch and sleep. To increase comprehensiveness of the review, we applied a broad search strategy resulting in retrieval of the article investigating cranial manipulation (Cutler et al., 2005). However, because this type of functional touch was not the focus of the present review, we refrain from discussing these findings in the discussion.

4 | DISCUSSION

We conducted a systematic literature review with a broad search strategy on the relationship between tactile intimacy and sleep quality in healthy adults aged 18–65 years. Even though we expected research on tactile intimacy and sleep in healthy adults to be limited, this approach was chosen following the recommendations of Munn et al. (2018) that systematic reviews are appropriate when informing areas for future research.

The search returned 13 eligible studies, using a variety of research designs. Most of the included studies investigated sexual variables in relationship to sleep quality. Evidence for associations between sexual variables and sleep was mixed. Most prominently, three studies suggested a relationship between sexual satisfaction and sleep quality or insomnia severity (Afsahri et al., 2018; Costa et al., 2017; Seehuus & Pigeon, 2018). No study explicitly researched the relationship between non-sexual affective touch and sleep, but the topic was brought up by respondents of the two included

interview studies (Hislop, 2007; Kirkman, 2010). Below, the findings are discussed in detail.

4.1 | Sexual touch and sleep

Evidence for a relationship between sexual variables and sleep was mixed, and some of the inconsistent findings might be clarified by examining the degree of subjective judgment employed across measurement tools. When asked for a direct judgment, participants responded that sex and masturbation have positive effects on sleep (Pallesen et al., 2020). Likewise, when asked to keep a sleep diary, participants reported better sleep after sex (Dittami et al., 2007).

Seehuus and Pigeon (2018) observed that sexual function correlated with the ISI but not the PSQI and hypothesised that the differences in findings might be due to the differences between measures: the ISI assesses the affective evaluation of sleep, whereas the PSQI assesses more objective sleep parameters (Seehuus & Pigeon, 2018). A comparable effect occurs for sex measures, e.g. some evidence related sexual satisfaction to sleep quality, insomnia, and sleepiness in women (Afsahri et al., 2018; Costa et al., 2017; Seehuus & Pigeon, 2018). Of these, Seehuus and Pigeon (2018) also reported an association between sexual satisfaction and insomnia severity, but not between sexual satisfaction and sleep quality as measured by the PSQI, in men. This is notable because sexual satisfaction is a subjective and affective subcomponent of sexual function.

The above findings are in concordance with recent findings indicating that respondents judge sexual activity and masturbation with orgasm to improve sleep quality and sleep onset (Lastella et al., 2019). Similarly, when asked who falls asleep first after sex, men judge their sleep latency after sex as shorter relative to nights without sex (Kruger & Hughes, 2011).

Contrarily, when using objective measures of sleep such as actigraphy or polysomnography or assessing more objective parameters of sex such as sexual frequency or sexual position, no consistent effects of sex or masturbation were recorded (Brisette et al., 1985; Costa et al., 2017; Dittami et al., 2007; Ogunbajo et al., 2020).

Summarised, the articles presented here might provide preliminary evidence for the hypothesis that sexual activity is perceived to be associated with sleep quality. This subjective evaluation might be lost when using measurements that focus on objective aspects of sex and sleep exclusively. It is noteworthy that the researched aspects of sexuality rarely focussed on the touch itself. Instead, studies investigated various aspects of sexual health (e.g. sexual function, satisfaction, and frequency). Caution is therefore required in linking specific behaviours directly with the effects of sexual touch alone.

4.2 | Non-sexual touch and sleep

The present review aimed to assess all types of touch and sleep (excluding violent and abusive touch), but non-sexual affective touch

TABLE 3 Summary of reviewed articles

Reference, Country	Participant age, years	Participant numbers and sex (% female)	Method	Study objective
Afsahri et al. (2018), Iran	between 18–45	227 (100)	CS	Evaluate the relationship between sleep quality and sexual function in women of reproductive age
Brissette et al. (1985), Canada	21–35	10 (50)	RCT, WS	Measure the effects of masturbation on sleep latency and sleep structure in men and women
Costa et al. (2017), Portugal	18–57	275 (62)	CS	Measure association between subjective sleep quality, sexual frequency and desire and unstimulated sexual arousal
Cutler et al. (2005), USA	22–35	20 (40)	RCT, WS	Assess whether compression of the fourth ventricle is associated with altered sleep latency and muscle sympathetic nerve activity
Dittami et al. (2007), Austria	21–31	20 (50)	quasi-experimental	Assess effects of sleeping together or separately and engaging in sexual activity or not on sleep efficiency and quality for men and women
Hislop (2007), UK	20–59	40 couples, i.e. 80 participants in total (50)	interview	Exploring the tensions between a participants' own sleep needs with those of their partner.
Junker et al. (2016), Germany	19–31	90 (86)	CS	Test whether intimacy of sleep onset position was related to relationship quality and duration
Khastar et al. (2020), Iran	22–50	120 (100)	RCT, BS	Investigate impact of sleep quality on sexual QoL among female shift workers
Kirkman (2010), New Zealand	45–65	20, not reported	interview	Explore how being in a relationship influences quantity and quality of sleep in same-sex couples.
Nozoe et al. (2014), Brazil	31–53	40 (100)	CS	Test association between sexual function and sleep quality in caregiving mothers of children with Duchenne muscular dystrophy versus mothers with healthy children
Ogunbajo et al. (2020), Nigeria, USA	18–60	406 (0)	CS	Assess prevalence of poor sleep health, sexual risk behaviour and other health related outcomes in Nigerian gay, bisexual, and other men who have sex with men.
Pallesen et al. (2020), Norway	18–55	1,080 (56)	CS	Assess how sexual activity is perceived to influence sleep quality and latency
Seehuus and Pigeon (2018), USA	18–65	656 (49)	CS	Assess the relationships between sleep and sex in a representative sample

Study designs: BS, between subjects; CS, cross-sectional study; RCT, randomised controlled trial; WS, within-subjects. Touch measurements: FSFI, Female Sexual Function Index; IIEF, International Index Of Erectile Function; LiSat, Life Satisfaction; SQOL, Sexual Quality Of Life – female. Sleep measurements: EEG, electroencephalography; EOG, electro-oculography; EMG, electromyography; ESS, Epworth Sleepiness Scale; HR, heart rate; ISI, Insomnia Severity Index; PSQI, Pittsburgh Sleep Quality Index.

Touch measure/ intervention	Sleep measure/ intervention	Main findings regarding touch and sleep
FSFI	PSQI, ISI, ESS	Sexual function is negatively related to problems with sleep quality, insomnia, and sleepiness.
Intervention: 3 nights in sleep lab, participants masturbated with or without orgasm or read. Measurement: orgasm recorded by anal EMG, HR, respiratory rate, and button press at start and end.	Polysomnography	No effect of masturbation with or without orgasm on any sleep measure
Sexual satisfaction item from LiSat scale, frequency of penile-vaginal intercourse, noncoital sex and masturbation in the past month	PSQI	Sexual frequency does not correlate with sleep quality, but sexual satisfaction correlates with sleep quality in women.
Intervention: compression of the fourth ventricle, sham touch, no touch control	Sleep latency by EEG, EOG, EMG	Sleep latency is shorter after compression of fourth ventricle compared to sham touch and no touch control.
Intervention: couples were asked to sleep together for at least 10 nights and separate for 10 nights, sleep was monitored over 28 nights in total. Measurement: occurrence of sexual contact reported	Sleep-wake pattern by actigraphs; sleep and wake quality, -times, dreams by sleep log	In women, sleep efficiency decreases when co-sleeping with partner, with or without sexual contact. In men, sleep efficiency decreases when co-sleeping following sexual contact. In women, subjective sleep reports decrease after co-sleeping without sex, but not after co-sleeping with sex. In men, subjective sleep reports improve after co-sleeping with or without sex.
In-depth interviews with couples and separate interviews with each partner, audio diaries		Bedsharing offers couples opportunities for sexual and physical closeness. There is a societal expectation to sleep together despite disadvantages in terms of comfort.
Self-developed questionnaire depicting different sleep onset positions, participants indicated preferred position and frequency of positions.		Spooning is the most frequent sleep onset position in young couples.
SQOL-F, sexual self-efficacy questionnaire	Intervention: 3 weekly 90–120-min sessions informing about sleep hygiene. Measurement: PSQI	Sleep quality, sexual self-efficacy and sexual QoL improve in sleep hygiene intervention group compared to control.
In-depth interviews, conducted by homosexual interviewer with same sex as participant		Women in same-sex couples expect to share the bed with their partner to symbolise intimacy and commitment. Sexual activity is more important to male couples, whereas female couples talk about intimacy more.
FSFI	PSQI	Mothers of children with Duchenne muscular dystrophy score lower on FSFI and report lower sleep quality than control women. However, the measures of sleep quality and sexual function are not significantly associated.
Usual position during anal sex, frequency of receptive and insertive anal sex in past 30 days, condom use at last anal sex	Items of PSQI concerning sleep duration and sleep-related problems	Reporting condom use during last sexual contact is related to lower odds of having sleep problems. Usual sexual position and sexual frequency are not associated with sleep quality.
Self-developed questions about the effects of sexual activity with or without orgasm and masturbation with or without orgasm on sleep latency and sleep quality	One item on habitual sleep onset, Bergen insomnia scale, self-developed questions about the effects of sexual activity with or without orgasm and masturbation with or without orgasm on sleep latency and sleep quality	Sex with orgasm is perceived to have a positive effect on sleep latency and sleep quality. Sex without orgasm is perceived to have an impairing effect on sleep by men. Masturbation with orgasm is perceived to have a positive effect on sleep. Masturbation without orgasm is perceived to have a negative effect on sleep by men.
FSFI, IIEF	PSQI, ISI	Significant correlation between insomnia severity and sexual function, even if taking the shared variability with depressive and anxious symptoms and stress into account.

was surprisingly under-researched in relation to sleep (Hislop, 2007; Junker et al., 2016; Kirkman, 2010). In the included qualitative studies, touch was conceptualised as warming, comforting, and intimacy building (Hislop, 2007; Kirkman, 2010). These interpretations are consistent with articles assessing the calming effects of affective touch more broadly (e.g., Brody, 2010; Jakubiak & Feeney, 2017; Morrison, 2016). However, the absence of literature on the topic of affective touch and sleep is notable, considering that touch was repeatedly mentioned when participants were asked to talk freely about their partnered sleep experiences (Hislop, 2007; Kirkman, 2010).

We were also surprised not to retrieve articles on massage and sleep that fulfilled the inclusion criteria. The lack of eligible articles on this topic was because research on massage and sleep has focussed primarily on patient populations or infants (Field et al., 2005; Hu et al., 2015; Li et al., 2014; Samuel et al., 2020). Exploring the links between massage and sleep in a non-clinical, adult population remains an important area of further research.

Summarised, the evidence reviewed here indicates that non-sexual touch has calming effects; however, further research is needed before conclusions on the direct link between non-sexual touch and sleep can be drawn.

4.3 | Gender differences

Men seem to attribute a larger positive effect of sex or masturbation on sleep than women, especially when orgasm is reached (Kruger & Hughes, 2011; Lastella et al., 2019; Pallesen et al., 2020). The relationship between sexual satisfaction and sleep quality was found primarily in women (Afsahri et al., 2018 who tested women exclusively; Costa et al., 2017; Seehuus & Pigeon, 2018). Dittami et al. (2007) reported that women's subjective sleep quality improved after sexual contact, which might provide support for the assumption that sexual satisfaction and subjective sleep quality are associated in women. However, as sexual activity was not further defined or investigated (Dittami et al., 2007) such hypotheses remain speculative.

The idea that sexual satisfaction and subjective sleep quality are associated in women might be consistent with the inference that co-sleeping is perceived as a sign of relationship intimacy, especially by women (Kirkman, 2010). More generally, it has been argued that co-sleeping and pre-sleep touch might be perceived as socially desirable (Junker et al., 2016; Kirkman, 2010). Summarised, evidence for the association between tactile intimacy and sleep differs slightly across genders.

4.4 | The association between tactile intimacy and sleep

As stated above, the calming effects of affective touch (Floyd et al., 2009; Grewen et al., 2003; Light et al., 2005; Morrison, 2016;

Tricoli et al., 2017) and sexual activity (Brody, 2006, 2010; Costa & Brody, 2012) might contribute to the perception that tactile intimacy and sleep are associated. One closely related recurring theory is that stress has a shared effect on sexual behaviour as well as sleep (Afsahri et al., 2018; Nozoe et al., 2014; Seehuus & Pigeon, 2018). There is abundant evidence regarding the effects of stress on sleep (Kalmbach et al., 2018; Kim & Dimsdale, 2007) and some evidence concerning its effects on sexual behaviour (Abedi et al., 2015; Hamilton & Julian, 2014; Randall & Bodenmann, 2009). This theory might be supported by those studies that found no direct correlation between sexual variables and sleep quality but found impaired sexual functioning or altered sexual risk behaviour in those who also experience worse sleep quality (Afsahri et al., 2018; Nozoe et al., 2014; Ogunbajo et al., 2020; Seehuus & Pigeon, 2018). Nonetheless, note that Seehuus and Pigeon (2018) found a significant correlation between sexual function and insomnia severity even after controlling for the shared effect of anxiety and depression. Still, it seems plausible that stress explains at least some of the shared variability between sexual behaviour and sleep.

4.5 | Limitations and future directions

The present review has some limitations. Firstly, it is hard to draw definite conclusions regarding the association of tactile intimacy and sleep because of the small number of articles on the topic. Given that tactile intimacy is a highly prevalent behaviour that occurs before sleep, this lack of empirical research is surprising. Our present study is a call for more systematic work exploring relationships between touch and sleep in healthy adults.

The articles included here focussed mostly on sexual touch, including masturbation. As we originally planned to conduct a review on all types of adult touch (with the exclusion of violent and abusive touch), the heavy focus on sexual variables was surprising. More research is needed to understand the inconsistency between the subjective judgment of the effect of sexual activity on sleep and objective findings on this topic. This is especially important considering that the present review was conducted in healthy adults exclusively: without comprehensive evidence on the association between sexual touch and sleep in healthy adults, we are unlikely to understand their connections in disorders surrounding sleep and sex.

It is also worth considering affective non-sexual touch separately, as this form of touch is researched even less widely in association with sleep. This is noteworthy as this form of touch is probably common given the frequency of bedsharing amongst adults (National Sleep Foundation, 2005). Furthermore, partnered co-sleep facilitates nocturnal affective touch (Hislop, 2007; Kirkman, 2010).

It is also noteworthy that the evidence on self-touch before sleep was scarce and focussed on masturbation (Brisette et al., 1985; Costa et al., 2017; Pallesen et al., 2020). Self-touch (e.g. gently stroking one's own arm) is thought to alleviate symptoms stemming from touch deprivation and including sleep disturbance (Field et al., 2020). Therefore, research on the relationship between more diverse types

of self-touch and sleep quality is desirable. As affective touch is thought to have relaxing effects (e.g. Brody, 2006, 2010; Brody & Preut, 2003; Costa & Brody, 2012; Grewen et al., 2003; Light et al., 2005), such research could be particularly helpful for clinical groups with sleep problems.

A further point to note is that most articles reviewed here used cross-sectional self-report measures. Future research could benefit from applying more diverse methods, such as sleep diary approaches as used by Dittami et al. (2007) or experimental procedures as used by Brisette et al. (1985), as well as collecting longitudinal data. Such a diversity of approaches is especially important because findings reported by subjective measures of sleep quality do not always correspond to findings made with objective measures, as noted in the paragraph on sexual touch and sleep. Lastly, we focussed on an early/middle aged adult sample (aged 18–65 years), as touch perception and sleep quality changes with age (Cascio et al., 2019; Miner & Kryger, 2017; Pengo et al., 2018). Future articles might help to disentangle the relationship between touch and sleep throughout early development and in older age.

5 | CONCLUSION

We conducted an exhaustive systematic literature review of studies examining the association of tactile intimacy and sleep quality in healthy adults. Most of the reviewed studies researched sexual intimacy, even though non-sexual touch repeatedly emerged in interview studies on sleep in couples. The evidence reviewed here suggests that there is a general perception that sexual touch enhances sleep. This subjective judgment stays largely unconfirmed by studies examining objective aspects of touch and sleep.

Possible reasons for the perceived association between touch and sleep include the stress-buffering effects of touch and the shared influence of stress on sexual behaviour and sleep. It became clear that in healthy adults, touch in relation to sleep is widely understudied, even though it is likely that many partnered adults in Western society engage in some form of touch before sleep. As affective touch has been linked to relaxation (e.g., Brody, 2006, 2010; Brody & Preut, 2003; Costa & Brody, 2012; Grewen et al., 2003; Light et al., 2005), further research on pre-sleep touch is required, as this could potentially inform behavioural advice for patients with sleep-related problems. Hence, we strongly encourage future research to investigate various types of touch and sleep.

CONFLICT OF INTEREST

MJB is supported by the Economic and Social Research Council (ESRC, grant no. ES/R007527/1) and the Wellcome Collection. AG is an advisor for a project originally partially sponsored by Johnson's Baby. She has written two books (*Nodding Off*, Bloomsbury Sigma, 2018; *The Sleepy Pebble*, Flying Eye Books, 2019) and is working on a further project with Lawrence King Publishing. She is a regular contributor to BBC Focus magazine and has contributed to numerous other outlets (such as *The Conversation* and *The Guardian*). She has

been interviewed by magazines and commercial websites. She has provided a paid talk for business and is occasionally sent trial products from commercial companies (e.g. blue light blocking glasses). She has received grant funding for her research from several bodies. The other authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

The study was designed by AD, RP, AG, and MB. The literature review was conducted by AD, RP, JB, and NB. All authors contributed to the manuscript.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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