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Sleep quality and the menstrual cycle

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ABSTRACT

Objective: This study aimed to assess the temporal relationship of subjective sleep quality to menstrual cycle phase in a community (non help-seeking) sample of adult women over six months. Previous work has produced contradictory results and often used student samples.

Participants/Methods: Patients/Methods: This was a cohort study, using daily electronic data collection in the Greater Toronto Area, Ontario, Canada; 76 women aged 18–42 years recruited by random digit telephone dialing, recorded mood, sleep quality, and other health variables on a daily basis for 24 weeks. **Results:** Using linear mixed models, we assessed the relationship between subjective sleep quality and three menstrual cycle phases (menses, premenstrual and midcycle) over 395 cycles. Premenstrual sleep quality was poorer than during the rest of the cycle, with a mean difference of 1.32 between premenstrual and midcycle reference phase, on a 1–100 quality scale (higher score denotes poorer quality). This difference held when the independent variables of daily exercise and physical health were added to the model; it became non-significant when perceived stress and later, social support were also added to the model.

Conclusions: Sleep quality in adult non-help seeking women is statistically poorer in the premenstruum but the size of the difference is of little clinical significance and was no longer statistically significant with inclusion of the potentially confounding variables, perceived stress and social support.

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1. Introduction

Women report more sleep disturbance than men [1,2]; the consensus on this finding was summarized in a meta-analysis, in which a female to male risk ratio for insomnia of 1.41 [95% confidence interval: 1.28–1.55] was reported [3]. This is curious, given that there are a number of studies reporting that women have either better objective sleep parameters [4,5] or no clear-cut differences from men in sleep architecture when assessed with objective methods such as polysomnography [6,7]. The discrepancy between subjective and objective sleep information has long been reported and reasons for it considered [8–11]. The higher prevalence of depression and anxiety

is relevant to experiences of poor sleep [1,8,12,13]. Whenever a gendered medical phenomenon is discovered, a search is made to link the finding to female reproductive hormones; so it is with sleep. Driver, Baker and colleagues have been working on the links between women's objective and subjective sleep and the menstrual cycle for some years. In a 2008 review, they reported small changes in objective sleep measures during the menstrual cycle and examined a handful of papers showing poorer subjective sleep premenstrually and during menstruation [14]. Table 1 documents the studies we identified which address subjective sleep quality and a menstrual cycle phase variable; we have indexed the study characteristics. Of thirteen studies reviewed, nine showed some association with a menstrual cycle phase, although which phase was not consistent. In two studies, the phase was combined perimenstrual (premenstrual plus menses days); in two, women slept both worse and better premenstrually and in one, sleep was poorer in the follicular (non premenstrual) part of the cycle.

Several sociodemographic variables have also been associated with poor sleep and many of these afflict women more than men. In the three UK National Psychiatric Morbidity Surveys, in addition to female gender, factors such as increased age, lower educational attainment, depression, unemployment, economic

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Table 1Published studies of subjective sleep quality and menstrual cycle (MC) phase in normal ^a adult women, listed chronologically.

Reference location	Sample & Method, number of MCs & MC phases studied	Findings on sleep quality	Conclusion: Pos or Neg
1 Patkai et al. 1974 [15] Stockholm Sweden	N = 6, convenience sample, aged 22–35. Daily records on work days only. 2 MCs, 4 MC phases	Sleep quality was poorest & sleep duration longest in premenstrual phase ($p < 0.01$) Old, small study.	Pos. Sleep worse premenst.
2 Halbreich et al. 1982 [16] New York USA	N = 154, 2 convenience samples, aged 20–53. Retrospective summary 1 MC phase (premenst)	'Bipolar' sleep item, sleep both increased & decreased premenst (in 25% of women I)	Pos. Both directions premenst.
3 Stewart 1989 [17] Toronto Canada	N = 100, well women clinic patients, aged 29.6 ± 7.1 yrs, 34% OC users Retrospective summary, 1 MC phase (premenst)	25% recalled sleeping more & 10% sleeping less premenst.	Pos. Both directions premenst.
4 Laessle et al. 1990 [18] Munich Germany	N = 30, 24.4 ± 2.5 yrs healthy students, no OC users. Daily diary for sleep quality & stress, hormonal assays. 1 MC, 5 MC phases	No MC effect for sleep duration or quality. Sleep quality worse if ↑ interpersonal stress (in premenstrual phase only)	Neg. Sleep worse with stress
5 Chaturvedi et al. 1993 [19] Bangalore India	n = 112 Indian college students aged 17–22. Retrospective summary 1 MC phase (premenst)	50% recalled negative sleep change premenst. (mean 2.6 ± 3.5 out of 10).	Pos. Sleep worse premenst.
6 Driver et al. 1996 [20] Zurich Switzerland	N = 9 healthy students aged 20–30, regular menstrual cycles, daily sleep log, PSG alternate nights for one month 1MC, ?2 MC phases	No MC phase diffs in sleep quality, or objective sleep measures (total sleep time, sleep & REM latencies, or slow wave sleep)	Neg. No sleep-MC phase association
7 Manber & Bootzin 1997 [21] Arizona USA	N = 32 univ. admin staff, aged 38.7 ± 5.3 , ^b had PMS. Sleep diaries 2x daily Mid follicular vs late luteal means compared. 2 MCs, 2 MC phases	↓sleep efficiency & quality, & ↑ sleep onset latency in the luteal phase. No diffs in sleep duration	Pos. Sleep worse premenst
8 Cited in Driver et al. 2008 [14] National Survey USA	National Sleep Foundation telephone survey 1998 n = 514 (Not able to be checked)	70% retrospectively stated their sleep was disturbed by premenst & menstrual physical symptoms	Pos. Sleep worse premenst AND during menses
9 Baker & Driver 2004 [22] Witwater-srand, South Africa	N = 26, mean age 21, (18–31yrs) healthy university students, no medication, no OCs. Daily sleep diaries, Ovulation date assessed by urinary hormones 1 MC, 5 MC phases	Subjective sleep quality ↓ premenst & during menses cf midfollicular & early luteal phases. No diffs in sleep continuity. Premens and menses not separated	Pos: ↓sleep quality premenst AND during menses
10 Brown et al. 2008 [23] Hawaii USA	N = 89 healthy students, non OC users daily diaries. Salivary hormone assay. 1–3MCs, 5 MC phases	Sleep quality poorer premenst but no sleep duration x MC phase diffs. No diffs in sleep quality by sexual activity.	Pos. ↓sleep quality premenst.
11 Guillermo et al. 2010 [24] Las Vegas USA	N = 40 healthy students, 20 OC users, salivary hormone assay, questionnaires 1MC, 3 MC phases	Sleep disturbances ↑ follicular. No midcycle-luteal diffs. No diffs between OC vs non-OC users	Pos: sleep worse in early follicular phase
12 Stanicic & Jokic-Begic 2010 [25] Zagreb Croatia	N = 51 convenience healthy sample 26.7 ± 7 yrs, diaries 3xdaily for 4 premenst days & 4 follicular days (8–11). 2MC, 2 MC phases	'Sleep deprivation' not diff between two phases	Neg.
13 Hachul et al. 2013 [26] San Paulo Brazil	N = 126, gen pop sample, each studied on one day (126 follicular, 69 luteal phase and 102 OC users) MC coding: NA	No difference ins sleep quality between 3 groups (nb: different women in each group)	Neg.

^a i.e. not perimenopausal, elderly or with premenstrual tension/syndrome/dysphoric disorder.^b PMS using Rubinow and Roy-Byrne 1984 criteria.

LEGEND: DNA = does not apply, MC = menstrual cycle, neg = no menstrual cycle phase association with sleep quality, OC = oral contraceptives, premenst = premenstrual(ly), PSG = polysomnography, pos = reports a menstrual cycle phase association with sleep quality.

inactivity, and widowed, divorced, or separated status were all linked to poor sleep [2]. Similarly, in Hong Kong, female gender, psychiatric disturbance, older age, unemployment-low socioeconomic status, alcohol, medication, and for women only, marital status and a noisy sleep environment predicted insomnia [27].

Several researchers have implicated the complexity of women's social and paid work lives [5,28–32]. Walseben has suggested that the different context of women's lives compared to men (eg, sleep being disrupted by children's needs or caregiver responsibilities to the wider family) may need to be implicated when analyzing women's sleep quality data. The type of paid employment women undertake is part of the social context; there are a small number of studies, mostly from Scandinavia, linking sleep quality directly to job characteristics [29,33–36]. Social support has also been implicated in sleep quality [29,37].

Several reviews of gender and sleep or women and sleep have been published in recent years; these have tended to focus on objective sleep studies, polysomnography or actigraphy, as these are where the greater amount of data can be found [4,38–44]. These

reviews agree that there are frequent methodological problems with the published sleep studies (small number of projects, small sample sizes, inconsistent ways of subdividing the menstrual cycle into its component phases and using only one or two cycles, which does not deal with the well-recognized intercycle variability). These are common problems also found in menstrual cycle research methodology in general [45,46].

Exercise has been thought to be helpful in promoting good quality sleep since biblical times [47] cited by Youngstedt and colleagues [48]. A recent mini-review outlined likely physiological links between exercise, both acute and 'chronic', and sleep [49]. The current evidence on associations between sleep quality and exercise/physical activity is contradictory, with some studies reporting a positive link [31,50,51] and others not [48]. The 2013 annual poll by the National Sleep Foundation, the independent, non-profit, sleep education, research and advocacy US organization, examined the sleep-exercise association; this found a dose relationship between sleep quality (four levels) and exercise (also four levels) [52]. Youngstedt and colleagues have suggested that epidemiological studies are more

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