EVEN MORE ASPECTS OF SLEEP:

ESSAYS EMPHASISING RESEARCH METHODOLOGY

Kevin Brewer

ISBN: 978-1-904542-50-6

This document is produced under two principles:

1. All work is sourced to the original authors. The images are all available in the public domain (most from http://commons.wikimedia.org/wiki/Main_Page). You are free to use this document, but, please, quote the source (Kevin Brewer 2009) and do not claim it as you own work.

2. Details of the author are included so that the level of expertise of the writer can be assessed. This compares to documents which are not named and it is not possible to tell if the writer has any knowledge about their subject.

Kevin Brewer BSocSc, MSc

An independent academic psychologist, based in England, who has written extensively on different areas of psychology with an emphasis on the critical stance towards traditional ideas.

Orsett Psychological Services,
PO Box 179,
Grays,
Essex
RM16 3EW
UK

orsettpsychologicalservices@phonecoop.coop

(http://kmbpsychology.jottit.com) or
(http://psyman.weebly.com)

CONTENTS

1. STUDYING SLEEP - QUESTIONNAIRE DESIGN

1.1. METHODS FOR STUDYING SLEEP

Sleep is "a private experience" (Yi et al 2006) which can be studied using objective and subjective methods. Each method has strengths and weaknesses (table 1.1).

METHOD	STRENGTHS	WEAKNESSES
Polysomnography (eg: EEG)	1. Physiological measures of sleep. 2. Does not depend on individual's opinion; eg: assessment of amount of sleep poor in insomniacs. 3. "Gold standard" for sleep structure (eg: stages). 4. Helps in assessing sleep problems. 5. Portable versions can be used in home environment.	1. Expensive and time-consuming. 2. Requires individual to sleep in special laboratory with lots of equipment. 3. Requires technically-trained staff to run equipment and interpret data. 4. Does not measure "natural sleep" well as artificial environment. 5. Even if used in home environment, number of sensors attached can affect bedtime, sleep latency, and sleep hours (Lauderdale et al 2006).
Actigraphy - portable equipment that measures activity and movement	1. Allows individual to continue normal life and sleep. 2. Measures sleep for longer periods, like weeks. 3. Measures sleep quality and quantity (Sadeh et al 1994).	1. Measures activity, and cannot distinguish between waking without movement and sleep (Menefee et al 2000). 2. Individual's sleep may be affected by wearing such devices. 3. Does not measure individual's own assessment of their sleep.

Self reported measures including questionnaires, and sleep diaries/logs (figure 1.1)	1. Measures subjective experience of sleep and sleep quality. 2. Diaries can be kept for very long periods. 3. Easily administered and inexpensive. 4. Can be used with large numbers of people. 5. Very flexible (eg: both qualitative and quantitative data in diaries). 6. Only measure for some aspects of sleep (eg: content of dreams), and cognitive information and psychological distress.	1. Subjective measures only. 2. Does not provide information about sleep structure. 3. Depends upon honesty and accuracy of recall of respondents (eg: underestimate number of awakenings and total sleep time; Hawkins and Shaw 1992). Self reported sleep duration is greater than actigraphic-determined measures (Quan 2006). 4. Issues related to questionnaire design like original sample, questions used, scoring system, and whether to have overall score or not. 5. Reliability and validity of questionnaires. 6. Sleep diaries dependent on motivation and discipline of individuals to keep them.

Table 1.1 - Strengths and weaknesses of three methods of studying sleep.

(Source: Hordaland; in public domain)

Figure 1.1 - Example of sleep diary.

1.2. SLEEP QUALITY SCALE

Yi et al (2006) developed the Sleep Quality Scale (SQS) to be an all-inclusive measure of sleep quality. The questionnaire design followed a number of typically steps.

STEP 1 - Define concept.

Before a questionnaire is designed, it is necessary to have a clear definition of the concept being studied. This is done by reviewing existing literature and interviewing individuals about their sleep.

The literature review identified the aspects of sleep quality as sleep initiation, sleep maintenance, depth of sleep, dreams, getting up after sleep, condition after sleep, effect on daily life, sleep amount, and satisfaction with sleep.

Fifty adults at a sleep laboratory in Seoul, Republic of Korea were interviewed for 30-60 minutes about their sleep. Questions asked included, "What do you think a good sleep is?" and "What do you think of a poor sleep?".

The interviews were transcribed, and potential items for the questionnaire were produced by content analysis.

STEP 2 - Design of preliminary scale.

The ideas from the content analysis were formalised into 75 statements. These statements were rated for relevancy (on an ordinal scale of 1-4) by six sleep experts. This is establishing content analysis, and only the most relevant items were kept. There were forty-six items at this stage.

STEP 3 - Pilot study.

Two pilot studies were performed with the preliminary questionnaire. One pilot study checked understanding of language and terms using five students.

The main pilot study collected data from forty-three adults who visited a sleep laboratory.

STEP 4 - Field test.

The first group of participants are given the final questionnaire, and they will be used to standardise the scores. 817 participants were used.

Part of this process involved establishing

reliability and validity [1]. There were two more separate samples for this process.

Sample 1 - 612 "community-dwelling" adults completed the SQS, and the Pittsburgh Sleep Quality Index (PSQI)(Buysse et al 1989). Concurrent validity is established by correlating the score on the SQS and a similar questionnaire (PSQI)($r = 0.72$; $p<0.0001$).

Construct validity is established by comparing the scores on the SQS between two groups expected to have different total scores (eg: insomniacs and non-insomniacs; total scores of 31.1 and 15.8 respectively) ("known group technique; Yi et al 2009).

Sample 2 - 110 university students completed the SQS twice with a two-week interval for test-retest reliability ($r = 0.81$; $p<0.0001$). Internal reliability was calculated using Cronbach's alpha.

STEP 5 - Final questionnaire.

The SQS has 28 items (statements)(box 1.1) with the response choices of "few" (1-3 times per month)(0), "sometimes" (1-2 times per week)(1), "often" (3-5 times per week)(2), and "almost always" (6-7 times per week)(3). The maximum score is 84, and a higher score means lower sleep quality.

Factor analysis identified six underlying factors of sleep quality:

- Restoration after sleep;
- Difficulty in falling asleep;
- Difficulty in getting up;
- Satisfaction with sleep;
- Difficulty in maintaining sleep;
- Daytime dysfunction.

STEP 6 - Use of questionnaire.

Further studies using the SQS with different samples will aid its validation, standardisation, and discrimination.

Yi et al (2009) compared forty sufferers of obstructive sleep apnea syndrome (OSAS) and thirty-seven controls for construct validity again (table 1.2). The participants were outpatients at the Korean University Ansan Hospital. These groups should have significantly

[1] Reliability is the consistency of the questionnaire, and validity is that it measures what it claims to measure.

different scores on the SQS.

	OSAS GROUP	CONTROL GROUP
NUMBER	40	37
MEAN AGE (yrs)	44.9	46.2
MALE/FEMALE	37/3 (92.5%/7.5%)	33/4 (89.2%/10.8%)
MEAN TOTAL SLEEP LENGTH (hrs)	6.68	6.38

Table 1.2 - Characteristics of the sample in Yi et al (2009).

This was the case with mean total scores of 27.3 for OSAS sufferers and 9.7 for controls. Four of the six underlying factors showed significant differences between the groups (table 1.3).

	OSAS GROUP	CONTROL GROUP
Daytime dysfunction (out of 36)	7.1	1.4
Restoration after sleep (12)	8.0	2.9
Difficulty in falling asleep (12)	0.9	0.6 *
Difficulty in getting up (9)	4.5	1.2
Satisfaction with sleep (9)	5.8	2.5
Difficulty in maintaining sleep (6)	1.2	1.1 *

(* Not significant; all others p<0.0001)

(After Yi et al 2009)

Table 1.3 - Scores on underlying factors of SQS.

Compared to the PSQI, the SQS is seen to have more items about restorative functions after sleep, difficulty in getting up, and daytime dysfunction due to poor sleep (Chartier-Kastler and Davidson 2007).

FACTOR - Daytime dysfunction

1. Difficulty in thinking due to poor sleep
2. Difficulty in concentrating due to poor sleep
3. Increase of mistakes due to poor sleep
4. Irritated feeling due to poor sleep
5. Decrease of interest in work or others due to poor sleep
6. Getting tired easily at work due to poor sleep
7. Sleepiness that interferes with daily life
8. Painful life due to poor sleep
9. Decrease of desire due to poor sleep
10. Increase of forgetfulness due to poor sleep
11. Headache due to poor sleep
12. Decrease of appetite due to poor sleep

FACTOR - Restoration after sleep *

13. Relief of fatigue after sleep
14. Regaining vigor after sleep
15. Clear-headed feeling after sleep
16. Refreshed feeling of body after sleep

FACTOR - Difficulty in falling asleep

17. Difficulty in getting back to sleep after nocturnal awakening
18. Never falling asleep after awakening during sleep
19. Difficulty in falling asleep
20. Tossing and turning sleeplessly

FACTOR - Difficulty in getting up

21. Wish for more sleep after getting up
22. Difficulty in getting up after sleep
23. Feeling unlikely to sleep after sleep

FACTOR - Satisfaction with sleep *

24. Satisfaction with sleep
25. Deep sleep
26. Enough sleep time

FACTOR - Difficulty in maintaining sleep

27. Waking up easily due to noise
28. Waking up during sleep

(* Scores of these items reversed)

(After Yi et al 2006)

Box 1.1 - Final statements used in SQS.

1.3. REFERENCES

Buysse, D.J et al (1989) The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research Psychiatry Research 28, 193-213

Chartier-Kastler, E & Davidson, K (2007) Evaluation of quality of life and quality of sleep in clinical practice European Urology Supplements 6, 576-584

Hawkins, J & Shaw, P (1992) Self-reported sleep quality in college students: A repeated measures approach Sleep 15, 6, 545-546

Lauderdale, D.S et al (2006) Objectively measured sleep characteristics among early-middle-aged adults: The CARDIA study American Journal of Epidemiology 164, 1, 5-16

Menefee, L.A et al (2000) Sleep disturbance and non-malignant chronic pain: A comprehensive review of literature Pain Medicine 1, 156-172

Quan, S.F (2006) Invited commentary: How much do we really sleep? American Journal of Epidemiology 164, 1, 17-18

Sadeh, A et al (1994) Activity-based sleep-wake identification: An empirical test of methodological issues Sleep 17, 201-207

Yi, H et al (2006) Development of the Sleep Quality Scale Journal of Sleep Research 15, 309-316

Yi, H et al (2009) Validity and reliability of Sleep Quality Scale in subjects with obstructive sleep apnea syndrome Journal of Psychosomatic Research 66, 1, 85-88

2. USING PSYCHIATRIC DRUGS TO TREAT NARCOLEPSY

2.1. INTRODUCTION

Psychotropic or psychiatric drugs, developed to deal with traditional mental disorders, are used to treat sleep disorders. This article looks at the example of narcolepsy.

Table 2.1 weighs up the arguments for and against their use with narcoleptic patients.

ARGUMENTS FOR	ARGUMENTS AGAINST
1. Works on neurochemistry which is seen as cause of narcolepsy. 2. Effective in reducing symptoms. 3. Easy solution to problems which patients confident with. Narcoleptic individuals often desperate for solution and do not have time or motivation for long-term non-pharmacological solutions. 4. Short-term and immediate benefits. 5. Drugs tested on animals in experiments and clinical trials with humans before released to general population. So risks are minimal.	1. Common side-effects which seen as "price to pay" for treatment. Risk of severe and lethal side-effects. 2. Risks of tolerance, dependence, and rebound. 3. Cost of drugs. 4. Efficacy questioned by some studies, and some drugs not studied for sleep disorders. 5. Often non-pharmacological solutions are ignored or marginalised.

Table 2.1 - Arguments for and against the use of psychiatric drugs to treat narcolepsy.

Narcolepsy is a rare condition (1 in 2000 individuals) involving sudden sleep onset with cataplexy [2] and REM sleep abnormalities like sleep paralysis. There

[2] This is muscle weakness leading to knees buckling, jaw sagging, head dropping, and sometimes resulting in collapse. It is usually brought on by strong emotions. Full consciousness, however, is maintained during such an attack (Taheri and Mignot 2002).

is also excessive daytime sleepiness (Nishino and Mignot 1997).

2.2. AMPHETAMINE-LIKE STIMULANTS AND DAYTIME SLEEPINESS

The symptom of excessive daytime sleepiness can be treated with amphetamine-like stimulants (eg: methamphetamine, methylphenidate)(table 2.2). They work by increasing the amount of certain neurotransmitters in the brain, like dopamine, adrenaline, and noradrenaline (Nishino and Mignot 1997).

STIMULANT	COMMENTS
Methamphetamine	Most effective because stronger
Dextroamphetamine	Second most prescribed for narcolepsy in USA
Methylphenidate	Introduced in 1959 (Yoss and Daly 1959). Most prescribed for narcolepsy in USA. Short duration of action (3-4 hours)
Pemoline	Less side-effects, but less effective because milder
Mazindol	Weakest of amphetamine-like stimulants

Table 2.2 - Comparison of amphetamine-like stimulants (Nishino and Mignot 1997).

Amphetamine was first synthesised in 1927 by Alles (Nishino and Mignot 1997), and first used in 1935 with narcolepsy (Prinzmetal and Bloomberg 1935). Doyle and Daniels (1931) first proposed the use of stimulant drugs generally to reduce excessive daytime sleepiness in narcolepsy.

Mitler and Hajdukovic (1991) found that all amphetamine-like stimulants significantly reduced daytime sleepiness from the baseline in the multiple sleep latency test (MLST) [3] with methamphetamine and methylphenidate being the best. They produced improvements of over 60%, but none of the substances reduced daytime sleepiness to the level of healthy controls.

Amphetamines have common side-effects, including irritability, mood changes, headaches, palpitations,

[3] The MLST (Thorpy 1992) involves placing individuals in a quiet, dark room for 20-30 minutes at two-hour intervals over a 24-hour period. The participant is attached to an EEG machine. Sleep onset within five minutes during the day is defined as "pathological sleepiness".

One case of a 23-year-old builder with narcolepsy had a sleep onset time in the MLST of fifteen seconds, and immediate REM sleep (Zeman et al 2001).

tremors, excessive sweating, dry mouth, and insomnia. In rare cases, the build up of the substance can produce toxicity in the liver, and abnormal involuntary movements (eg: orofacial dyskinesia). Raised blood pressure is also another concern (Nishino and Mignot 1997). The view is taken by many doctors that common side-effects are a "price worth paying" for treatment. Thus "..a disabled narcoleptic patient might justifiably request the opportunity to experience maximum pharmacologically mediated reduction in sleepiness, and.. to then participate in a process of decision-making that balances side effect 'costs' against reduced disability 'benefits'" (Miller et al 1993).

Tolerance and dependence can occur as well as psychotic episodes in a minority of cases. Psychiatric complications occur in varying degrees (table 2.3).

PSYCHIATRIC COMPLICATION	FREQUENCY (%)	STUDY
Psychotic symptoms like hallucinations and delusions	1-2	Mitler et al (1994)
Depression *	46.5 (controls = 23.2)	Broughton and Ghanem (1976)
Suicidal thoughts *	18.6 (controls = 2.3)	Broughton and Ghanem (1976)

(* Not clear if caused by amphetamines and/or narcolepsy)

Table 2.3 - Examples of psychiatric complications from amphetamine-like stimulants in narcoleptic patients.

Methylphenidate is best known under the name "Ritalin", which is also commonly prescribed for ADHD (Attention Deficit Hyperactivity Disorder). Research on individuals who abused amphetamines have found changes to the brain, like fewer dopamine transporter proteins (Szalavitz 2005). Whether therapeutic use of the amphetamine substances has the same effects, particularly as the amount taken is much less. "The really tricky thing is back-extrapolating.. If you take 1000 grams and it produces brain damage, will 1 gram produce a thousandth of the amount of brain damage" (Frank Vocci reported in Szalavitz 2005 p38). The comparison of amphetamine abuse and amphetamine-based prescription drugs has limits (table 2.4).

AMPHETAMINE ABUSE	AMPHETAMINE-LIKE STIMULANTS BY PRESCRIPTION
• Higher doses • Smoking and injecting reach brain faster • Greater effect in novel situation • Animal based studies of effect	• Lower doses • Oral administration slower to brain • Research with rats shows benefits in reducing damage to brain cells • Applicability of animal studies to humans

Table 2.4 - Comparison of amphetamine abuse and amphetamine-like prescription drugs.

Miller et al's (1993) double-blind randomised clinical trial of methamphetamine ("Desoxyn") with narcolepsy is typical of that type of design. Double-blind means that neither the participants nor the doctors administering the drugs knew which condition was which. The reduces the effects of expectations.

Eight pairs of participants (one narcoleptic and one matched healthy control) each did all the conditions (baseline, high/low dose methamphetamine, and placebo) over 28 days (figure 2.1). The narcoleptic sample came from the Sleep Disorders Clinic population in La Jolla, California, and the controls were local volunteers.

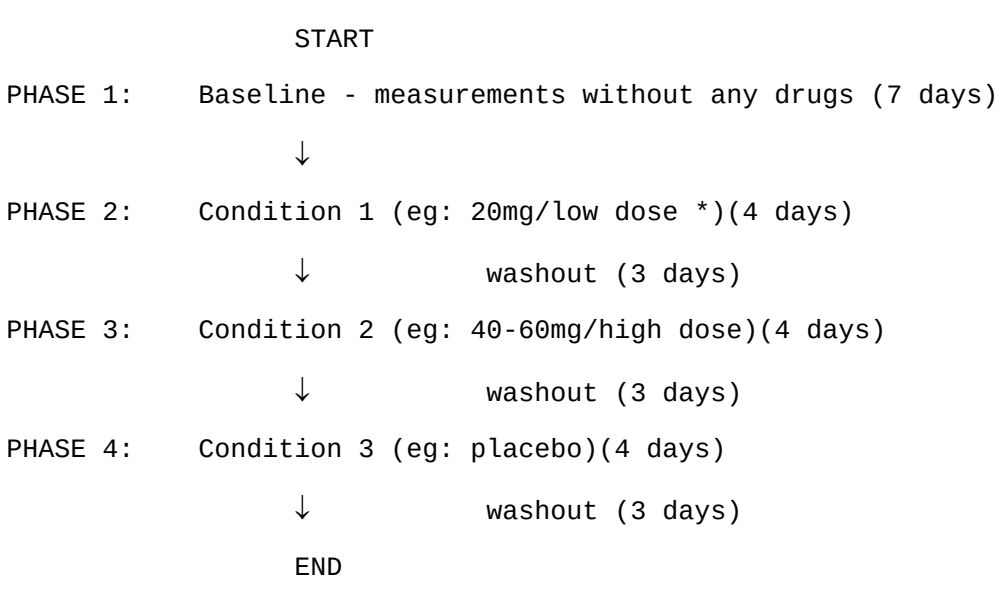

Figure 2.1 - Design of Miller et al's (1993) study.

Daytime sleepiness was measured by the MSLT, and performance on a computer-based driving task (Steer Clear driving simulator).

The mean MSLT score (how long to fall asleep) was 4.29 minutes for narcoleptics on the placebo and 4.53 minutes at baseline, and this increased to 9.27 minutes on the high dose of methamphetamine, compared to 10.35, 12.25, and 17.11 minutes respectively for controls.

The error rate on the driving task declined from 2.53% (placebo) to 0.33% (high dose) for narcoleptics and 0.22% and 0.16% respectively for controls.

Overall, high doses of methamphetamine allowed narcoleptic patients to function during the day similar to healthy controls.

This study has a number of limitations, many recognised by the researchers themselves (table 2.5).

Modafinil (a non-amphetamine-like stimulant) is also used for daytime sleepiness. It acts by blocking the release of the neurotransmitter GABA (Volans and Wiseman 2003).

Vignatelli et al (2005) stated the protocols for the studies on stimulant drugs generally with narcolepsy for the Cochrane Database [4]. This includes amphetamine-like stimulants (indirect-acting sympathomimetic drugs), direct-acting sympathomimetic drugs [5] (eg: phenylephrine hydrochloride), and other stimulants (eg: modafinil, caffeine). Clear criteria were set for inclusion of studies in the review (table 2.6).

[4] This is a database of systematic reviews of treatments (http://www.cochrane.org/index.htm).
[5] These are drugs that mimic the sympathetic nervous system (ie: stimulant the body).

LIMITATIONS RECOGNISED BY RESEARCHERS	OTHER LIMITATIONS
1. Washout period of 3 days may not have been long enough. 2. The four-day drug ingestion period may have been too short to achieve steady-state levels of methamphetamine. 3. Small sample. 4. Participants given drug once a day whereas optimal dosage may be twice a day as some participants reported effects wearing off in the afternoon. 5. Narcoleptics who did not take other medication were used for study.	1. Narcoleptics with other sleep disorders were excluded. 2. Narcoleptics and/or severe hypnagogic hallucinations were excluded. 3. Controls received lower doses of methamphetamine - 5mg (low) and 10mg (high) - for ethical reasons. 4. Healthy participants who volunteered to take amphetamines may not be typical of general population. 5. It was a repeated measures design, and the risk of practice effects existed for the driving task (ie: improvement by practice). The task involved 30 minutes of simulator driving to avoid obstacles. There is also the risk of other order effects - namely, fatigue and boredom. 6. The placebo capsules contained powdered sucrose which could have tasted different to the methamphetamine tablets. 7. Though the participants were blind to the drug or placebo, side-effects or not give a clue to the condition. Total side-effects reported by narcoleptics was one for placebo, and 19 (low) and 24 (high) for doses of methamphetamine. 8. Levels of daytime sleepiness were also clues to which condition.

Table 2.5 - Limitations of clinical trial by Miller et al (1993).

TYPE OF STUDIES Randomised controlled trials testing drug vs no treatment, placebo, or another stimulant for narcolepsy
TYPE OF PARTICIPANTS Adults: 18 years old and over.
EFFICACY • Assessed at less than 30 days • Assessed at more than 30 days
OUTCOME MEASURES 1. Elimination of excessive daytime sleepiness Objective measures; eg: >5 minutes on MSLT Subjective measures; eg: <11 points on Epworth Sleepiness Scale (ESS)(Johns 1998) 2. Elimination of cataplexy eg: subjective reporting of 50% or more reduction

Table 2.6 - Criteria for inclusion of studies in review.

2.3. ANTI-DEPRESSANTS AND CATAPLEXY

Cataplexy has been treated with anti-depressants, in particular tricyclic anti-depressants (TCA)(eg: imipramine). These "old" style anti-depressants have many side-effects, both common (eg: dry mouth, constipation, weight gain), and rare/severe (eg: heart problems, epileptic seizures, death)(table 2.7). TCAs also produce a rebound effect after abrupt interruption of dosage (Nishino and Mignot 1997).

TYPE OF ANTI-DEPRESSANT	STANDARD MORTALITY RATIO *
TRICYCLICS • Imipramine • Desipramine • Protriptyline • Clomipramine	 1.4 0 5 1.3
SELECTIVE SEROTONIN REUPTAKE INHIBITORS (SSRI) • Fluoxetine • Paroxetine	 0.3 *** 0.1 ***
OTHER • Viloxazine • Venlafaxine	 0 1.6 ****
MONOAMINE OXIDASE INHIBITORS (MAOI) ** • Phenelzine	 1.1

(* All prescriptions in England and Wales 1998-2000; Cheeta et al 2004. 1 = average, >1 = more observed deaths than expected, <1 = less observed deaths than expected)
(** Also prescribed for daytime sleepiness)(*** p<0.0001)(**** p<0.05)

Table 2.7 - Examples of anti-depressants prescribed for cataplexy, and risk of death.

In a review of studies for the Cochrane Database, Vignatelli et al (2008) found "scarce evidence that anti-depressants have a positive effect" on cataplexy "despite the clinical consensus" from case studies.

The following hypotheses were tested:

1. Anti-depressants are more effective than no treatment or placebo in reducing excessive daytime sleepiness;
2. Anti-depressants are more effective than no treatment or placebo in reducing cataplexy;
3. One class of anti-depressants (eg: TCI vs SSRI) is better than another;
4. One anti-depressant is better than another;
5. The beneficial effects exceed the side-effects.

The criteria for inclusion of studies were similar to those for stimulants outlined in table 2.6. Five studies with a total of 246 participants were included (table 2.8).

STUDY	FINDINGS
Schrader et al (1986)	Femoxetine (SSRI) vs placebo; significantly reduces cataplexy, but not excessive daytime sleepiness (N = 10)
Mitler et al (1990)	Viloxazine vs placebo; significantly reduces cataplexy and excessive daytime sleepiness (N = 56)
Schachter & Parks (1980)	Fluvoxamine (SSRI) vs clomipramine (TCA); no difference between them (N = 18)
Lammers et al (1991)	Ritanserin vs placebo; no effect (N = 28)
Mayer (2003)	Ritanserin vs placebo; no effect (N = 134)

Table 2.8 - Studies included in review by Vignatelli et al (2008).

In terms of the hypotheses, Vignatelli et al felt that there was no reliable evidence to make conclusions about them.

2.4. REFERENCES

Broughton, R & Ghanem, Q (1976) The impact of compound narcolepsy on the life of the patient. In Guilleninault, C et al (eds) Advances in Sleep Research Vol 3 New York: Spectrum

Cheeta, S et al (2004) Antidepressant-related deaths and antidepressant prescriptions in England and Wales British Journal of Psychiatry 184, 41-47

Doyle, j.B & Daniels, L.E (1931) Symptomatic treatment for narcolepsy Journal of the American Medical Association 96, 1370-1372

Johns, M (1998) Rethinking the assessment of sleepiness Sleep Medicine Reviews 2, 1, 3-15

Lammers, G.J et al (1991) Ritanserin, a 5-ht2 receptor blocker, as add-on treatment in narcolepsy Sleep 14, 130-132

Mayer, G (2003) Ritanserin improves sleep quality in narcolepsy Pharmacopsychiatry 36, 150-155

Miller, M.M et al (1993) Treatment of narcolepsy with methamphetamine Sleep 16, 4, 306-317

Mitler, M.M & Hajdukovic, R (1991) Relative efficacy of drugs for the treatment of sleepiness in narcolepsy Sleep 14, 218-220

Mitler, M.M et al (1990) Narcolepsy Journal of Clinical Neurophysiology 7, 93-118

Mitler, M.M et al (1994) Narcolepsy and its treatment with stimulants Sleep 17, 352-371

Nishino, S & Mignot, E (1997) Pharmacological aspects of human and canine narcolepsy Progress in Neurobiology 52, 27-78

Prinzmetal, M & Bloomberg, W (1935) The use of benzedrine for the treatment of narcolepsy Journal of the American Medical Association 105, 2051-2054

Schachter, M & Parks, J.D (1980) Fluvoxamine and clomipramine in the treatment of cataplexy Journal of Neurology, Neuroscience and Psychiatry 43, 171-174

Schrader, H et al (1986) The treatment of accessory symptoms in narcolepsy: A double-blind cross-over study - selective serotonin re-uptake inhibitor (femoxetine) versus placebo Acta Neurologica Scandinavica 74, 297-303

Szalavitz, M (2005) Demonhealer New Scientist 23/7, 37-39

Taheri, S & Mignot, E (2002) The genetics of sleep disorders Lancet Neurology 1, 242-250

Thorpy, M.J (1992) The clinical use of the multiple sleep latency test Sleep 15, 268-276

Vignatelli, L et al (2005) Stimulant drugs for narcolepsy in adults Cochrane Database of Systematic Reviews 4, Art.No. CD005503

Vignatelli, L et al (2008) Anti-depressant drugs for narcolepsy Cochrane Database of Systematic Reviews 1, Art.No. CD003724

Volans, G & Wiseman, H (2003) Drugs Handbook 2003 Basingstoke: Palgrave Macmillan

Yoss, R.E & Daly, D.D (1959) Treatment of narcolepsy with ritalin Neurology 9, 171-173

Zeman, A et al (2001) Narcolepsy mistaken for epilepsy British Medical Journal 322, 216-218

3. SLEEP IS ESSENTIAL OR IS IT?

3.1. INTRODUCTION

"What if sleep is not required but rather a kind of extreme indolence that animals indulge in when they have no more pressing needs, such as eating or reproducing?" (Cirelli and Tononi 2008). Thus it has been argued that sleep is not necessary.

Sleep is defined as a "rapidly reversible state of immobility and greatly reduced sensory responsiveness.. and that sleep is homeostatically regulated, namely that lost sleep is made up with an increased drive for sleep and a consequent 'sleep rebound'" (Siegel 2008 p208).

Siegel (2008) highlighted the importance of distinguishing sleep:

- Sleep is different to circadian (24 hour) changes in alertness;
- Sleep is different to hibernation and torpor states;
- Sleep is different to rest (without loss of consciousness).

3.2. ARGUMENTS OVER SLEEP AS ESSENTIAL

Cirelli and Tononi (2008) argued that the view that sleep is not essential is the "null hypothesis", which research aims to reject by showing that sleep is necessary. The strongest evidence would be a core function of sleep, which cannot be achieved in any other state of consciousness including restful waking, and this has not been established as of yet.

However, if sleep is not essential, then certain predictions can be made (Cirelli and Tononi 2008).

1. There will be species of animal that do not sleep at all.

The best way to establish if an animal is sleeping is by electrophysiological measures (eg: EEG recording of brainwaves). Where this is not possible behavioural signs (eg: immobility, lowered responsiveness) are sought. The behavioural sign of immobility is challenged by animals that sleep while moving (eg: "sleep swimming" in fish).

But despite disputed cases (table 3.1), "there is no

clear evidence of a species that does not sleep" (Cirelli and Tononi 2008).

SPECIES	SLEEP OR NOT?
Cockroach (eg: Tobler & Neuner-Jehle 1992)	YES - Lowered responsiveness; prolonged sleep deprivation leads to death (Stephenson et al 2007). NO - No increase in sleep time after short sleep deprivation.
Bullfrog (Hobson 1967)	YES - Periods of quiescence (quiet immobility). NO - No lowered responsiveness.
White-crowned sparrow (eg: Rattenborg et al 2004)	YES - Increased sleep time after sleep deprivation. NO - During migration little sleep but performance on memory test unaffected.

(After Cirelli and Tononi 2008)

Table 3.1 - Three examples of species where the existence of sleep is disputed.

2. Animals deprived of sleep will not compensate with more sleep later (known as rebound).

There are examples of species that do not increase sleep time after short sleep deprivation, like cockroaches, honeybees, and the fish, tilapia (Cirelli and Tononi 2008). Though lost sleep can be recovered by sleeping longer, it can also be recovered by sleeping more deeply (eg: slow-wave sleep, less awakenings).

Sleep rebound is tested by keeping animals awake for prolonged periods (eg: 10 days), usually with constant light, and then measuring sleep afterwards. But 15-20% of baseline sleep remains, even if the animals do not appear to rebound with longer sleep. In other words, no such study has kept animals wake for prolonged periods with absolutely no change to sleep afterwards (Cirelli and Tononi 2008).

3. There will be no harmful consequences to sleep deprivation.

Extreme sleep deprivation studies (eg: 2-4 weeks) have led to death in rats (Rechtschaffen and Bergmann 2002), for example, as in humans with the genetic disorder, Fatal Familial Insomnia. But death, in experimental studies, could be the result of stress rather than sleep deprivation.

Two consequences have been found in sleep deprivation studies with animals and humans (Cirelli and

Tononi 2008):

i) The intrusion of sleep into wakefulness in the form of "micro-sleep" episodes. The eyes are open, but EEG readings show brief moments of sleep. A mixed state of "sleepwake" ("dormiveglia") can develop.

ii) The decline in cognitive performance. This may be due to "sleepiness" (increased drive for sleep) or "tiredness" (brain cells need sleep).

Table 3.2 outlines the general conclusions about sleep in different species (Siegel 2008).

ORGANISMS	NUMBER OF SPECIES *	SLEEP
Humans	-	Yes.
Simple single cell	>400 000	No evidence, but circular rhythms of activity.
Insects	>700 000	Fruit flies show behaviour criteria for sleep. Simple nervous system of insects limits possibility of sleep.
Fish	>30 000	"Sleep-like states" and "sleep swimming" observed in small number of species studied.
Amphibians	>6000	Limited studies with contradictory evidence; eg: frogs. No REM sleep found.
Reptiles	>8000	Contradictory evidence over "REM sleep-like states" in limited studies.
Birds	>10 000	Both REM and NREM measured physiologically. During migration some birds experience sleep deprivation with no apparent affects or sleep rebound.
Land mammals	>4000	Systematic studies of domesticated species show REM and NREM sleep, but less studies of sleep in natural environment, part among migrating species. Some prey species are highly vulnerable and sleep would be highly maladaptive: "On the basis of the behavioural observations that have been conducted, we cannot say with confidence that all herbivores meet the standard criteria for sleep throughout their lifespan" (Siegel 2008 p211).
Marine mammals		Sleep swimming because not immobile, and unihemispheric sleep in dolphins. Challenges to definitions of sleep.

(* University of Michigan Museum of Zoology (2007) Animal Diversity website; http://animaldiversity.ummz.umich.edu; quoted in Siegel 2008).

Table 3.2 - Sleep in different organisms.

Siegel (2008) noted that fewer than fifty of about 60 000 vertebrate species have been tested fully for sleep. "Of those, some do not meet the criteria for sleep at any time of their lives and others appear able to greatly reduce or go without sleep for long periods of time" (p212).

But Cirelli and Tononi (2008) argued that the null hypothesis that sleep is not necessary can be rejected, and so sleep is essential. But if this is the case, what is the function of sleep? There are a number of possibilities:

- A universal function for all species based on the original evolution of a "proto-sleep state" in a common ancestor;
- A core function in relation to physiology which cannot be achieved outside of sleep (eg: at a cellular level);
- Different stages and types of sleep all work on the same function, for example, to benefit the brain;
- Different stages and types of sleep have different functions.

As to what is the function of sleep, there is no consensus, but, for Cirelli and Tononi (2008), "sleep is universal, tightly regulated, and cannot be eliminated without deleterious consequences".

But Siegel (2008) took a different view:

> It might well be more accurate to view sleep as a behaviour whose presence, quality, intensity and functions vary between species and across the lifespan. Different animals have used sleep to maximize energy savings by reducing body and brain energy consumption, increasing survival by seeking out a safe sleeping site, releasing hormones and conducting a variety of recuperative processes. Some species appear to be able to accomplish these processes during the waking state. This view contrasts with the idea that sleep is a universal state with the same underlying vital function in all species (p212).

3.3. REFERENCES

Cirelli, C & Tononi, G (2008) Is sleep essential? PLOS Biology 6, 8, e216

Hobson, J (1967) Electrographic correlates of behaviour in the frog with special reference to sleep Electroencephalography and Clinical Neurophysiology 22, 113-121

Rattenborg, N.C et al (2004) Migratory sleeplessness in the white-crowned sparrow (Zonotrichia leucophrys gambelii) PLOS Biology 2, e212

Rechtschaffen, A & Bergmann, B.M (2002) Sleep deprivation in the rat: An update of the 1989 paper Sleep 25, 18-24

Siegel, J.M (2008) Do all animals sleep? Trends in Neurosciences 31, 4, 208-213

Stephenson, R et al (2007) Prolonged deprivation of sleep-like rest states raises metabolic rate in Pacific beetle cockroach, Diploptera punctata (Eschscholtz) Journal of Experimental Biology 210, 2540-2547

Tobler, I.I & Neuner-Jehle, M (1992) 24 hour variation of vigilance in the cockroach Blaberus giganteus Journal of Sleep Research 1, 231-239

4. EXPERIENCING INSOMNIA: QUALITATIVE RESEARCH

4.1. INTRODUCTION

Little research on insomnia is qualitative research asking sufferers about their experiences and how they make sense of the reasons for not sleeping.

For example, Carey et al (2005) used focus groups to study the experiences of insomniacs. These are groups that discuss particular topics with some direction from the researcher.

The most important aspect of qualitative research is gaining an insider perspective of "the beliefs the patient holds about his illness, the personal and social meaning he attaches to his disorder, his expectations about what will happen to him.." (Kleinman et al 1978 p256 quoted in Henry et al 2008). Qualitative research into insomnia has advantages over quantitative methods (table 4.1)

1. Only way to study the meaning of the experience.
2. An insider's view of the experience.
3. Able to explore in more detail than with closed questions.
4. The interviewee can direct the interview, and highlight information overlooked by the researcher.
5. Quantitative methods are reducing a complex experience to simple statistical scores (reductionism).
6. Qualitative research places the studied behaviour in context of other behaviours.

Table 4.1 - Advantages of studying insomniacs with qualitative methods.

4.2. HENRY ET AL (2008)

Henry et al (2008) used semi-structured interviews with twenty-four insomniacs attending two sleep clinics in the USA. There were eight standard questions (table 4.2), but otherwise the interviewee could talk about what mattered to them in relation to their experiences of insomnia.

The interviews lasted between 45-90 minutes, and

were recorded for later transcription. Pseudonyms were given to each participant who had fully consented to take part. In terms of characteristics, nineteen interviewees were female, thirteen in total were married, and eight currently or had worked shifts.

1. What do you think has caused your problem? 2. Why do you think it started when it did? 3. What do you think your sickness does to you? 4. How severe is your sickness? Will it have a short or long course? 5. What kind of treatment do you think you should receive? 6. What are the most important results you hope to receive from this treatment? 7. What are the chief problems your sickness has caused for you? 8. What do you fear most about your sickness? (p718).

Table 4.2 - Standard questions used by Henry et al (2008).

The dominant theme from the interviews was work. This was shown when identified as a cause of insomnia, and the consequent effects of insomnia upon it. These are the main themes highlighted by the researchers:

1. Work as a precipitating or perpetuating factor for insomnia.

As the cause of insomnia (questions 1 and 2 in table 4.2), "my job", "just work" or "job anxiety" was mentioned by many interviewees (nearly two-thirds). For example, "Melanie" said: "I have no trouble falling asleep.. And then at 2.30 every morning, I just wake up all at once thinking about work" (p720).

Other problems were also linked to work; eg: "I'm depressed because I don't sleep and I hate my job" (female interviewee)(p719).

2. Work influences the timing and duration of sleep.

Those interviewees who had done or currently did shift-work linked that to their insomnia; eg: "Dan" (retired airline pilot) and "Dorothy" (retired nurse).

3. "Good" sleep, productivity, and therapy-seeking behaviour.

"Insomnia may be recognised by patients as a medical problem only when it begins to affect work" (Henry et al 2008 p721). Thus "good" sleep was linked to being productive at work; eg: "being able to wake up knowing that I can get up and go to work.. if going to work, to

feel sharp, not to feel groggy" ("Linda"; p721).

4. Productivity and the evaluation of treatment efficacy.

Any treatment for insomnia was evaluated in terms of the previous theme - it allowed "good" sleep and the individual was able to work productively.

5. Cognitive labour and the never-ending workplace.

"Cognitive labour" was used to describe the individual still thinking about work at home: "Angie, the 29-year-old bank teller, clarified that it was not the stress associated with the job, but its mental demands that often kept her awake at night" (p722).

While "Donna" admitted: "I lay there and think about the problems I dealt with that day and whether I dealt with them properly and what I did wrong and what I need to do to fix it" (p723).

Henry et al (2008) concluded that the " centrality of 'work' in one's life, and its influence on subsequent self-diagnosis and treatment-seeking behaviour, remains salient. Not only do many describe the very nature of their disorder in terms of work, they often use work experiences to explain their symptoms, to structure their expectations of therapy, and to influence how they follow, or deviate from prescribed treatment plans" (p724).

4.3. REFERENCES

Carey, T et al (2005) Focusing on the experience of insomnia Behavioural Sleep Medicine 3, 2, 73-86

Henry, D et al (2008) Is sleep really for sissies? Understanding the role of work in insomnia in the US Social Science and Medicine 66, 715-726

Kleinman, A et al (1978) Clinical lessons from anthropologic and cross-cultural research Annals of Internal Medicine 88, 251-258

5. DO DOLPHINS SLEEP?

5.1. INTRODUCTION

Dolphins (figure 5.1) have to move continuously to survive. They must breathe every 30-60 seconds as this is not automatic and performed by the autonomic nervous system as in humans. So they do not have a period of immobility, which is one behaviour sign of sleep.

(Source: Arnaud 25; in public domain)

Figure 5.1 - Two dolphins.

But it was found that half the brain was asleep while the other half was awake. This is called "unihemispheric sleep" (Mukhametov et al 1977), and shows the slow wave brain pattern typical of full-brain (bilateral) sleep. This is an evolutionary solution to the need for sleep and the need to move continuously.

Siegel (2005) raised the note of doubt that these animals may not be sleeping. He pointed out that certain drugs produce slow-wave EEG readings in individuals clearly awake. On the other hand, dolphins may be sleeping more than observed because non-slow-wave EEG readings have been found in NREM sleep in rats (Bergmann et al 1987). This raises the problem in any sleep research of trying to correlate physiological measurements with behaviour in a definitive way, particularly among different species.

5.2. UNIHEMISPHERIC SLEEP

Is unihemispheric sleep the same as bilateral sleep? A number of criteria are used to measure the presence of sleep (Cirelli and Tononi 2008):

i) The sleeping brain is less responsive to stimuli than the waking brain.

This has been seen in the sleeping hemisphere in bottlenose and white-sided dolphins. Two trained dolphins were required to maintain continuous vigilance for five days. On the last night, one dolphin ignored the stimuli for four hours suggesting asleep (Ridgway et al 2006)(box 5.1).

ii) Eye closure.

Newborns sleep much longer than adult animals, and this has also been observed in young dolphins who engage in unihemispheric sleep while swimming with their eyes closed (Gnone et al 2006).

Gnone et al observed a male calf and mother during the first year of life at Genoa Aquarium, Italy. Sleeping behaviour as measured by no interest in the environment is shown by slow stereotyped circular swimming ("swim rest"), and "hanging behaviour" at the water surface with the blowhole above it. The newborn spent twelve hours a day in the "swim rest" only, and by one year old eight hours per day in "swim rest" and "hanging behaviour".

Sekiguchi et al (2006) monitored mother-newborn pairs for a period after birth at Kanogawa Sea World, Chiba, Japan. Point sampling at thirty-second intervals for 15 minute periods through underwater viewing windows and poolside, recorded eye closure and swimming behaviour. One eye closure was observed in both mother and neonate as well as both eyes closed for approximately one-third of the observation periods. Eye closure was more common underwater than at the surface (table 5.1).

	MOTHER	NEWBORN
AT SURFACE	58.8	12.1
UNDERWATER	100	91.7

(After Sekiguchi et al 2006)

Table 5.1 - Percentage of observation time during swim rest that right eye closed at one week after birth.

But Lyamin et al (2006) felt that the neonates' sleep behaviour is different to land mammals. The young dolphin during sleep surfaces to breathe every 10-40 seconds, opening both eyes, and then catches up mother who breathes less often. This shows brain activity not seen during sleep in land mammals.

iii) Sleep rebound.

This is the increase in sleep length after a period of sleep deprivation.

Oleksenko et al (1992) deprived bottle-nosed dolphins of sleep for periods ranging from 35-150 hours. EEG recordings showed increased sleep rebound in the affected hemisphere after deprivation was ended.

Bihemispheric sleep deprivation experiments were performed on six dolphins and unihemispheric deprivation on five. Measurements of brain activity were made using electrodes implanted in the parietal cortex under local anaesthesia. Sleep deprivation was maintained by slapping the water surface or by a weak electrical current to the flipper. The dolphins were aroused as soon as the EEG showed sleep brainwaves in either or both hemispheres.

Table 5.2 shows the results from one dolphin.

TYPE OF SLEEP DEPRIVATION	AMOUNT OF SLEEP DEPRIVATION (hrs)	AMOUNT OF EXTRA SLEEP IN RECOVERY PERIOD: RIGHT/LEFT HEMISPHERE (%)
Right hemisphere	48	75/5
Left hemisphere	53	>300/275
Both	35	150/200

(After Oleksenko et al 1992)

Table 5.2 - Example of results from one female dolphin ("83-1").

Dolphins do sleep, though it is different to other

mammals (ie: unihemispheric), and it challenges traditional measures of sleep (eg: periods of immobility).

Two adult bottlenose dolphins (WEN - male, and SAY - female) taught to detect target tones (one every 4-24 minutes) from usual tones. They were required to do this task for 120 hours continuously. Five sessions were performed (3 with WEN, 2 with SAY) at the Space and Naval Warfare Systems Center, San Diego, USA.

When the target tone was sounded, the dolphin had twenty seconds to press an underwater paddle, and be rewarded with a fish. Overall correct detection of target tone was high (out of approximately 500) - WEN: 97, 87, and 99%; SAY: 93 and 96%, and vigilance did not decline with sleep deprivation. But target response time was significantly slower during the night.

Eye closure was only observed once at night, and there was little sleep rebound after the experiment.

Box 5.1 - Details of Ridgway et al (2006).

5.3. REFERENCES

Bergmann, B.M et al (1987) NREM sleep with low-voltage EEG in the rat Sleep 10, 1-11

Cirelli, C & Tononi, G (2008) Is sleep essential? PLOS Biology 6, 8, e216

Gnone, G et al (2006) Sleep behaviour: Activity and sleep in dolphins Nature 441, E1--11

Lyamin, O.I et al (2006) Lyamin et al reply Nature 441, E11

Mukhametov, L.M et al (1977) Interhemispheric asymmetry of the electroencephalographic sleep patterns in dolphins Brain Research 134, 581-584

Oleksenko, A.I et al (1992) Unihemispheric sleep deprivation in bottlenose dolphins Journal of Sleep Research 1, 40-44

Ridgway, S et al (2006) Dolphin continuous auditory vigilance for five days Journal of Experimental Biology 209, 3621-3628

Sekiguchi, Y et al (2006) Sleep in continuously active dolphins Nature 441, E9-E10

Siegel, J.M (2005) Clues to the functions of mammalian sleep Nature 437, 1264-1271

6. ASKING BIG QUESTIONS ABOUT SLEEP

1. How much sleep do I need?

The answer will depend upon the individual. Sleep duration varies from person to person. The way to see if a person is sleep deprived is to test the level of daytime sleepiness.

In the mean sleep latency test (MLST), an individual is left in a darkened room for twenty minutes. How quickly they fall asleep is a measure of sleepiness. There are questionnaires which give examples of scenarios where an individual may fall asleep. For example, in an extreme case, sitting in a car waiting for traffic lights to change from red to green.

2. Do we need to sleep?

The answer seems to be yes. Most studies of long-term sleep deprivation have been with animals, like rats, and the applicability of such findings to humans is questionable. Rats kept awake for up to thirty days eventually die.

Humans who suffer from the genetic disorder, Fatal Familial Insomnia, also eventually die. But this may be due to the disorder rather than just sleep deprivation.

Sleep deprivation studies with humans lasting, say, fifty hours show concentration and attention problems, for example, as well as irritability, and physical lethargy. So to perform at our best we do need to sleep.

3. What do dreams mean?

The answer will depend upon the theory. Generally theories of the meaning of dreams vary between dreams as meaningful to dreams as meaningless. In the latter case, dreams are random images from a brain doing "mental housekeeping" during sleep. Any meaning is imposed by the dreamer.

Most other theories see dreams as having meaning. This includes hidden (or repressed) meanings as in psychoanalysis. Dreams can give clues to the worries the dreamer was ignoring, for example. Recent theories place less emphasis on the hidden meaning that needs interpreting, and more on the dream as a "letter to oneself". In a busy waking life, it may be the only time an individual is quiet during sleep.

7. STUDYING THE FREQUENCY OF NIGHTMARES ACCURATELY

Approximately 2-5% of the general population report regular nightmares (Lancee et al 2008). Nightmares are subjective experiences of sleep, and so physiological measures are not useful. The only way to measure them is to ask individuals to describe the experience.

The question is whether nightmares should be recorded immediately (prospective logs) or in retrospect (recalling past nightmares at a later date)(table 7.1).

PROSPECTIVE RECORDS	RETROSPECTIVE RECORDS
Both	
Advantage: Record frequency and distress	
Disadvantage: No independent verification of accuracy of information	
Advantage	
Less chance of forgetting	Easy to complete during the day
Disadvantage	
Issues related to recording information immediately (ie: middle of night)	Underestimate frequency

Table 7.1 - Prospective and retrospective recording of nightmares.

Lancee et al (2008) compared the different methods for recording nightmares among psychology students at Utrecht University in the Netherlands. Forty-nine, mainly female (93.9%), students used both methods.

- Prospective measure - Two-week nightmare diary/log recording information each morning: nightmare or not, woke up from nightmare, and intensity. After keeping the diary, participants were asked to estimate nightmare frequency for the period;

- Retrospective measure - A psychometric questionnaire (SLEEP-50; Spoormaker 2005) measuring nightmare frequency per month and in the last week.

There were significant differences in estimates of nightmare frequency between the two types of measures (table 7.2). The retrospective measure underestimated frequency compared to the prospective measure.

MEASURE	AVERAGE NUMBER OF NIGHTMARES REPORTED	SIGNIFICANT DIFFERENCES
(a) Prospective: Sleep diary	2.0	(a) v (b) p = 0.04 (a) v (c) p <0.001 (a) v (d) p = 0.01
(b) Prospective: estimate of diary	1.9	(b) v (c) p = 0.01 (b) v (d) p = 0.06
(c) Retrospective: questionnaire per month	1.5	(c) v (d) ns
(d) Retrospective: questionnaire in last week	1.6	

Table 7.2 - Estimates of nightmare frequency per week based on method used.

REFERENCES

Lancee, J et al (2008) Measuring nightmare frequency: Retrospective questionnaires versus prospective logs Open Sleep Journal 1, 26-28

Spoormaker, V.I et al (2005) Initial validation of SLEEP-50 questionnaire Behavioural Sleep Medicine 3, 227-246

8. REM DEPRIVATION IN HUMANS: THE DISCOVERY OF REM REBOUND

Much research has concentrated upon the effects in humans of overall sleep deprivation. Dement (1960) was the first to study the effects of rapid eye movement (REM) sleep deprivation.

REM sleep had only been recently discovered (Aserinsky and Kleitman 1953), and its association with dreaming was established (Dement and Kleitman 1957) [6].

Dement (1960) reported the initial studies with eight young (23-32 year-old) males who were awakened immediately that their EEG recordings showed REM sleep. There is a distinctive pattern of electrical activity in the brain (brainwaves) that appears during REM sleep. The participants were "dream deprived" on between three ot seven nights each (total of 38 nights).

When awakened the participants were required to sit up and remain awake for a few minutes. On the first night of waking, when returning to sleep, the participants begun the sleep cycle again (eg: stage 1, stage 2 NREM sleep, deep sleep, then REM sleep), but on subsequent nights, they very quickly went to REM sleep. Thus the number of times awakened each night increased; eg: "R.G" awakened ten times on first night and twenty times on fifth night of REM deprivation.

When allowed to sleep normally on subsequent nights (recovery nights) the mean total dream time significantly [7] increased to 26.6% of total mean sleep time from 19.5% before the deprivation. The catching up on REM sleep after deprivation has been called "REM rebound" (Webb and Bonnett 1979).

Table 8.1 gives a summary of the results for each of the participants.

In terms of the effects of REM deprivation, the participants showed anxiety, irritability and difficulty in concentrating during the study. One participant was reported as developing "serious anxiety and agitation", and "W.G" withdrew from the study in "an apparent panic". Dement admitted that: "It is possible if the dream suppression were carried on long enough, a serious disruption of the personality would result" (p1707).

---

[6] It is now accepted that dreaming can occur in non-REM (NREM) sleep, and not all REM sleep involves dreaming (Solms 2000).

[7] Significant at $p<0.05$ level with a one-tailed Wilcoxin matched-pairs signed ranks test.

PARTICIPANT	BASELINE: REM SLEEP AS PERCENTAGE OF TOTAL SLEEP	NUMBER OF REM DEPRIVATION NIGHTS	FIRST RECOVERY NIGHT: REM SLEEP AS PERCENTAGE OF TOTAL SLEEP
WT	19.5	5	34.0
HS	18.8	7	34.2
NW	19.5	5	17.8 *
BM	18.6	5	26.3
RG	19.3	5	29.5
WD	20.8	4	29.0
SM	17.9	4	19.8 **
WG	20.8	3	withdrawn

(* Not significant; ** Second recovery night = 28.1%)

(After Dement 1960)

Table 8.1 - Summary of results for each participant.

REFERENCES

Aserinsky, E & Kleitman, N (1953) Regularly occurring periods of eye motility and concomitant phenomena during sleep Science 118, 273-274

Dement, W (1960) The effect of dream deprivation Science 131, 1705-1707

Dement, W & Kleitman, N (1957) The relation of eye movements during sleep to dream activity: An objective method for the study of dreaming Journal of Experimental Psychology 53, 5, 339-346

Solms, M (2000) Dreaming and REM sleep are controlled by different brain mechanisms Behavioural and Brain Sciences 23, 843-850

Webb, W.B & Bonnett, M.H (1979) Sleep and dreams. In Meyer, M.E (ed) Foundations of Contemporary Psychology New York: Oxford University Press

9. SLEEP AND RECREATIONAL DRUG USE

9.1. INTRODUCTION

Drugs work by changing the biochemistry of the brain, whether it is prescription medication for any medical condition, or recreational drugs.

The most commonly used recreational drugs are:

- Marijuana/cannabis - 42% of US teenagers have used it (National Institute on Drug Abuse 2006 quoted in Schierenbeck et al 2008), and 4.2 million American adults are classed as dependent (National Survey on Drug Use and Health 2006 quoted in Schierenbeck et al 2008).

- Cocaine - Tried by 9% of US teenagers (National Institute on Drug Abuse 2006 quoted in Schierenbeck et al 2008) with 1.7 million dependent US adults (National Survey on Drug Use and Health 2006 quoted in Schierenbeck et al 2008).

- Ecstasy - 7% of US teenagers have tried it (National Institute on Drug Abuse 2006 quoted in Schierenbeck et al 2008).

9.2. MARIJUANA/CANNABIS

Cannabis has complex effects upon the brain which can produce drowsiness and ease in getting to sleep or have arousing effects. REM sleep decreases as does stage 3 NREM sleep, while stage 4 NREM sleep decreases (Schierenbeck et al 2008).

Schierenbeck et al (2008) found sixteen studies using objective sleep measures. But the samples were often small, and the amount and route of administration of cannabis varied between studies. Also the amount of usual cannabis use was an issue as heavy users may have had withdrawal effects during the study.

Cannabis withdrawal produces increased REM sleep reported subjectively as "strange dreams", and less total slow-wave sleep (Schierenbeck et al 2008).

9.3. COCAINE

Cocaine is stimulant that increases the amount of the neurotransmitter, dopamine, in the brain, and produces an effect on sleep similar to amphetamines. Namely, trouble sleeping - longer sleep latency and reduced total sleep time - and suppression of REM sleep (Schierenbeck et al 2008).

Cocaine withdrawal produces other changes to sleep. Total sleep time is reduced to mirror chronic insomnia, but REM sleep increases as a percentage of total sleep (Schierenbeck et al 2008).

Schierenbeck et al (2008) found eight controlled polysomnography studies of cocaine withdrawal. Three of them simulated a cocaine binge on the first night with administration of the drug, and then followed with three nights, say, of abstinence. Such studies need to take place in a clinic or hospital where the health of the patient can be monitored, and requires full consent from the patients as there are ethical issues about simulating cocaine use and withdrawal. Most of the studies only used small numbers of participants (eg: three).

9.4. ECSTASY

Ecstasy (MDMA; 3,4-methylenedioxymethamphetamine) increases the amount of serotonin and dopamine in the brain. It is amphetamine-based as the name suggests, and thus a stimulant. Sleep is suppressed.

Studies of heavy, regular users have found varying results. For example, McCann et al (2007) found that stage 2 NREM sleep was reduced while stage 1 NREM sleep was increased in the context of reduced total sleep time. However, Ricaurte and McCann (2001) found that sleep efficiency and slow-wave sleep increased.

These studies did not have a baseline measure of sleep patterns before the drug use, and so any sleep differences compared to a control group may have been due to pre-existing differences (Scierenbeck et al 2008).

9.5. REFERENCES

McCann, U.D et al (2007) The effect of catecholamine depletion by alpha-methyl-para-tyrosine on measures of cognitive performance and sleep in abstinent MDMA users Neuropsychopharmacology 32, 1695-1706

Ricaurte, G.A & McCann, U.D (2001) Experimental studies on 3,4-methylenedioxymethamphetamine (MDMA. "ecstasy") and its potential to damage brain serotonin neurons Neurotoxicity Research 3, 1, 85-99

Schierenbeck, T et al (2008) Effect of illicit recreational drugs upon sleep: Cocaine, ecstasy and marijuana Sleep Medicine Reviews 12, 381-389

10. TREATING INSOMNIA

10.1. BENZODIAZEPINES

Insomnia, in any form, may affect 30-40% of the general population in a year (Wagner and Wagner 2000). It involves difficulty falling asleep, or frequent wakings, or or early morning waking, or a combination of them.

Transient insomnia lasts 2-3 nights, for example, and is due to specific stressors, like jet lag or shift work changes. Short-term insomnia, up to three weeks, is a long version of this type. Chronic insomnia is long-term and may be due to an underlying medical condition (Wagner and Wagner 2000).

Insomnia has been treated with medication. A type of tranquillizers (or anti-anxiety drugs) called benzodiazepines (BDZ)(table 10.1) [8] "have long been considered the cornerstone of pharmacologic therapy for insomnia" (Wagner and Wagner 2000).

- Estazolam
- Flunitrazepam
- Flurazepam
- Loprazolam
- Lormetazepam
- Midazolam
- Nitrazepam
- Quazepam
- Temazepam
- Triazolam

Table 10.1 - Commonly used BDZs (Wagner and Wagner 2000).

The use and effectiveness of a medication can be assessed in a number of ways:

- Population surveys - These surveys ask individuals about their use of the medication and whether they feel

[8] One of the best known names is "Valium" which a brand name for diazepam, one of the BDZs. Also "Mogadon" (nitrazepam) and "Librium" (chlordiazepoxide) are well known (Green 1996).

it works. This method gives the subjective view from the sufferer.

- Case studies - These are small-scale studies of individuals given the medication with few experimental controls like randomisation or a placebo group.

- Open trials - These are clinical trials of the medication for a period, like twelve months, but both the patient and the doctor know what medication is being given. Thus there is a risk of expectancy effects.

- Randomised clinical trials - This method is the most rigorous for establishing the efficacy of a medication. It involves randomly placing a participant in a medication group or a placebo group, but which is hidden from the sufferer and the doctor (double-blind procedure). The two groups are treated the same in order to avoid extraneous variables.

- Systematic reviews - This method combines previous findings to find an overall pattern.

- Meta-analysis - Statistical re-analysis of other studies to find overall effects.

Evidence for the efficacy of a treatment comes from, in order, meta-analysis of randomised placebo-controlled studies, single randomised clinical trials, treatment studies without placebo controls, case series studies, quasi-experimental studies, and consensus reports from experts (Riemann and Perlis 2009).

One example of a study of medication is Kramer et al (1993), who looked at 150 cases of polysomnographically chronic insomniacs with no other sleep disorder who were treated with medication only. Many studies are not as strict in their selection criteria. Nearly two-thirds (61.3%) of patients were rated as improved due to the medication. The main medications were BDZs and sedative anti-depressants (eg: doxepin).

Other studies have shown that medication and behavioural treatment together are more effective (eg: 72% of sufferers improved after six months; Dashevsky and Kramer 1998).

BDZs have side-effects that include tolerance, dependency, withdrawal symptoms, rebound insomnia, and "hangover effects" (Kramer 2000). Sleep architecture (the amount of different stages of sleep) is also altered by suppressing stages 3 and 4 sleep (deep/slow-wave sleep), and changing REM sleep (Wagner and Wagner 2000).

Hangover effects include memory problems, and accidents through psychomotor impairments (ability to control limbs and movements) the following day after use. Memory is affected most in terms of laying down new memories. But both these problems can occur in untreated insomniacs (Kramer 2000).

Dependence has always been the greatest concern about BDZs with long-term use after it was realised that it occurred in the 1960s. For example, 1.1% of the British population were estimated to be dependent on BDZs (Dunbar et al 1989).

Attempting to stop BDZs after long-term use can lead to relapse (return of insomnia symptoms), rebound (worse insomnia symptoms than before the medication began), or withdrawal (including insomnia and anxiety)(Kramer 2000).

These concerns have led to negative attitudes towards the long-term use of BDZs both by medical and lay people. But Kramer (2000) argued that if they work, particularly in an environment of limited successful treatments for chronic insomnia, then the benefits may outweigh the risks.

"Non-classical" BDZs (eg: zolpidem, zopiclone, zaleplon) have been developed in recent years because of the negative view of BDZs. There are a number of studies that show these new drugs to be as effective if not more so than BDZs. Table 10.2 summarises some of the comparison studies (Wagner and Wagner 2000).

COMPARISON	NUMBER OF STUDIES (AND PARTICIPANTS)	GENERAL CONCLUSIONS
Zolpidem vs triazolam	4 (677)	Both equal for total sleep length, reducing sleep latency and nocturnal awakenings, and both better than placebo
Zopiclone vs triazolam	5 (1750)	Zopiclone better or equal to triazolam, and both better than placebo
Zopiclone vs temazepam	2 (97)	Zopiclone better or equal to temazepam, and both better than placebo
Zaleplon vs triazolam	3 (215)	Zaleplon better than triazolam on many indicators, but both better than placebo
Zaleplon vs zolpidem	3 (1721)	Both better than placebo. Some differences in withdrawal and rebound symptoms (eg: no rebound with zaleplon)

(After Wagner and Wagner 2000)

Table 10.2 - Comparison of particular non-BDZs and BDZs with insomnia.

Overall, zaleplon reduces sleep latency, but does not improve total sleep time or number of nocturnal awakenings. Zopiclone and zolpidem show improvements on all three aspects of insomnia (Wagner and Wagner 2000).

10.2. META-ANALYSIS

Meta-analysis summarises other methods of research by statistically reanalysing them, and producing an overall score of difference or "effect size" (Wood 2000)

Meta-analysis is based on the comparison of group means using the "d" statistic. The "d" statistic is expressed in standard deviation units, which is assuming a normal distribution of behaviour.

Technically, Campbell (1996) defined "d" as the mean of group A divided by the standard deviation of A minus the mean of group B divided by the standard deviation of B. While Glass et al (1981) used the mean of experimental group minus mean of control group, then divided by standard deviation of control group.

Effect sizes of 0.2 are seen as minor, 0.5 as medium, and 0.8 or more as large (Riemann and Perlis 2009).

Smith and Egger (1998) pointed out three problems with the use of meta-analysis:

i) Whether to include unpublished data or not. Another problem is that studies finding no significant differences are not published (known as the "file-drawer problem").

ii) What choice of outcome measures to use.

iii) Definitions of terms in each study may vary. "Each study gets exactly one 'vote' no matter how well done it is. Thus, a study using a large sample that is well controlled has the same weight as a study using a smaller sample that is more poorly controlled" (Rosenhan and Seligman 1995).

Sharpe (1997) listed two more problems in the form of:

a) "Apples and Oranges" - Meta-analysis can sometimes attempt to average different phenomena. It is important to include only studies of the same thing.

b) "Garbage in-Garbage out" - Including methodologically poor quality studies can obscure the results from good quality studies.

The studies included in meta-analyses of treatments for insomnia usually measure sleep latency (SL), number of awakenings (NOA), total sleep time (TST), sleep efficiency (SE%), and overall subjective ratings of sleep quality (SQ). Short-term (or acute) studies range from 1-4 weeks, and long-term studies can last up to six months (Riemann and Perlis 2009).

Riemann and Perlis (2009) found four meta-analyses of "benzodiazepine receptor agonists" (BZRAs)(BDZs and newer "Z-drugs") for the treatment of insomnia. Though the evidence was not entirely consistent, all these drugs produce short-term benefits, but there was insufficient data about long-term benefits.

10.3. NON-PHARMACOLOGICAL TREATMENTS

Non-pharmacological treatments include psychological and behavioural treatments, self-help strategies, and alternative therapies.

The main psychological and behavioural treatments used with insomnia are:

- Stimulus control - going to bed only when sleepy and getting out of bed at same time each morning;
- Sleep restriction - restricting time in bed to estimated average amount of sleep;
- Sleep hygiene - education about behaviours that affect sleep (eg: caffeine late at night);
- Paradoxical intention - explicitly trying to stay awake when in bed.

Riemann and Perlis (2009) reported five meta-analyses of psychological and behavioural techniques for insomnia (table 10.3). All the studies found considerable benefits from these treatments with the strength of effect varying between treatments (eg: sleep hygiene vs relaxation).

But the meta-analyses were repeated analyses of existing data rather than evaluations using different data. Furthermore, most of the studies included in the meta-analyses were not randomised placebo-controlled studies.

Morin et al (2006) concluded that five psychological and behavioural treatments had empirical support - stimulus control therapy, relaxation, paradoxical intention, sleep restriction, and combined cognitive-behavioural therapy (CBT).

META-ANALYSIS	NUMBER OF STUDIES INCLUDED	DETAILS	FINDINGS FOR SLEEP LATENCY
Morin et al (1994)	59	Studies between 1974-1993	minus 27.7 mins (43.1% reduction) (treatment) vs minus 8 mins (12.6%) placebo
Murtagh & Greenwood (1995)	66	Studies between 1973-1993	minus 24 mins (39.5%) for treatment groups
Pellesen et al (1998)	13	Studies between 1966-1998; elderly insomniacs (>60 yrs)	Significant benefits from treatment
Montgomery & Dennis (2004)	6	Studies between 1966-2022; elderly (>60 yrs)	Mean reduction 3 mins for treatment
Irwin et al (2006)	23	Studies between 1966-2004;	Significant effects for

Table 10.3 - Five meta-analyses of psychological and behavioural treatments for insomnia found by Riemann and Perlis (2009).

In terms of the comparison between pharmacological and non-pharmacological treatments, Riemann and Perlis (2009) found five large-scale studies and one meta-analysis. For example, McClusky et al (1998) compared triazolam and behavioural strategies over four weeks and at a nine-week follow-up. The medication produced short-term benefits, while the behavioural strategies maintained the benefits in the long-term.

Overall, the studies showed that behavioural treatments are better in the longer term. It should be noted that behavioural treatments do have side-effects like partial sleep deprivation with the sleep restriction technique.

Table 10.4 lists the effect sizes found in different meta-analyses quoted in Riemann and Perlis (2009).

10.3.1. Self-Help Techniques

van Straten and Cuijpers (2009) performed a meta-analysis on studies of self-help treatments for insomnia. These are "standardised psychological treatments which can be worked through independently by the patients themselves in their own homes" (p62). They include written, audio, video or Internet materials.

STUDY	EFFECT SIZE (d) FOR IMPROVEMENTS IN SLEEP LATENCY *
Nowell et al (1997)	0.56 BZRAs vs placebo
Morin et al (1994)	Overall 0.8 (behavioural treatments: pre vs post-treatment) Combined behavioural treatments 1.05 Sleep restriction 0.98 Bio-feedback 1.00 Relaxation (cognitive techniques) 1.20
Murtagh & Greenwood (1995)	Overall 0.87 (behavioural treatments: pre vs post-treatment) Combined behavioural treatments 1.00 Stimulus control 1.16 Relaxation (cognitive techniques) 0.93
Pallesen et al (1998)	Short-term 0.41 Long-term 0.64 (behavioural treatments: pre vs post-treatment)
Irwin et al (2006)	0.50 (behavioural treatments: pre vs post-treatment)
Smith et al (2002)	Pharmacological 0.45 CBT 1.05 (pre vs post-treatment)

(* 0.2 = minor, 0.5 = medium, 0.8+ = large)

Table 10.4 - Examples of effect sizes (d) for sleep latency from different meta-analyses.

The authors used four basic criteria for inclusion of studies, which produced ten randomised trials:

- Random allocation of participants to condition by independent party;
- Concealment of random allocation process from participants;
- Assessors of outcomes blind to participants' treatment or not;
- Complete follow-up.

The main purpose of the first three measures is to remove expectancy effects by participants and researchers.

The effect size (d) was calculated by subtracting the post-test average score of the control group from the average post-test score of the experimental group and dividing by pooled standard deviations of both groups. Thus an effect size of 1.0 shows that the mean of the experimental group is one standard deviation larger than the mean of the control group.

In the study of a self-help technique, it is not possible to have a placebo group, so a waiting list group is used as the control.

van Straten and Cuijpers found significant improvements for the self-help techniques compared to waiting lists for sleep efficiency (d = 0.42), sleep latency (d = 0.29), and sleep quality (d = 0.33), but not total sleep time. But all the studies were based upon sleep diaries and not independently verified data.

Thorndike et al (2008) described an Internet self-help programme called "Sleep Healthy Using The Internet" (SHUTi)(http://www.shuti.net). Users keep a sleep diary online while advised and guided through different programmes like sleep hygiene (eg: bedroom temperature and lighting; caffeine and alcohol intake)(table 10.5).

• Sleep restriction and stimulus control techniques • Sleep hygiene • Cognitive restructuring (challenges "thinking errors" about sleep) • Relapse prevention

Table 10.5 - Core features of SHUTi.

Thorndike et al studied 21 users of SHUTi with the "Intervention Utility Questionnaire for SHUTi" (UQ) and "Internet Impact Questionnaire for SHUTi" (IQ). The UQ has sixteen items about the usability like ease and convenience to use, and the IQ is a 14-item measure of perceived effectiveness of SHUTi.

The majority of the participants found SHUTi usable, and 95% believed it was effective in improving their sleep.

10.3.2. Alternative Therapies

Systematic reviews are more common here. They do not re-analyse the data as in meta-analyses, but they report the patterns from a number of studies systematically (table 10.6).

SYSTEMATIC OR LITERATURE REVIEW	META-ANALYSIS
• Qualitative • Selected coverage • Individual studies either statistically significant or not	• Quantitative • Comprehensive coverage • Overall magnitude of change possible to calculate

Table 10.6 - Systematic review vs meta-analysis.

Huang et al (2009) included thirty studies in their systematic review of the use of acupuncture with

insomnia.

The vast majority of studies (93%) showed benefits. But the rigour of these studies was questioned. Only three studies were double-blinded, and five had sham acupuncture control conditions. While three studies had objectively (physiological) measures of sleep improvements. There was also differences in acupoints used, as well as the number of sessions (ranging from 1 to 60).

Some researchers view insomnia as "a disorder of inappropriate arousal" (Bonnet and Arand 1995) and not as a sleep disorder. So it can be treated by techniques that reduce the level of arousal through relaxation. One technique for doing this is yoga.

The Yoga Biomedical Trust (1983; quoted in Pietroni 1991) claimed that 82% of 542 cases self-reported improvement of their insomnia with yoga.

10.3.2.1 Khalsa (2004)

In a more structured study, Khalsa (2004) [9] investigated the effectiveness of yoga with twenty individuals (18 women, two men) with chronic insomnia (greater than six months duration, and longer than 30 minutes to fall asleep). Daily sleep-wake diaries were kept for a two-week baseline and then the 8-week treatment phase (45 minutes of yoga before bedtime). The diary entries included total sleep time, sleep onset latency, number of awakenings, and waking time.

Analysis of the completed diaries found significant improvements from the baseline to the end of the treatment in:

- Total sleep time - from 5.4 hours (baseline) to 6.0 hours (increase of 12.2%);
- Sleep quality - mean rating of 2.7 (out of five) to 3.0;
- Sleep efficiency (amount of time in bed and how much time asleep) - 68% to 76% (more time asleep);
- Sleep onset latency (time to fall asleep) - reduced by 15.2 minutes (30.1%) on average.

Overall, the participants benefited from the yoga in

[9] This was the only study that could be found using the words "yoga" and "insomnia" in the title of articles in the following databases: CENTRAL (Cochrane Central Register), MEDLINE, PsycINFO, CINAHL, and Google Scholar (Vignatelli et al 2008)(search on 11/7/09).

improving aspects of their sleep. But, as the author admitted, this was only a preliminary and uncontrolled study with a number of limitations.

1. Self-selection of participants with positive attitude and expectations about yoga.

2. High drop-out of participants over ten weeks of study. Forty individuals gave informed consent, then six withdrew before the baseline. Thirteen participants withdrew during the treatment phase, and one person did not correctly fill out the sleep-wake diary. This left 20 participants who completed the study.

3. Disproportionately more women than men (90%).

4. The influence of the researcher (eg: expectations) as the study not blind.

5. The short-term nature of the study is vulnerable to the unrepresentativeness of the data. This is a problem of sampling a short period of time. How representative is that time to the overall picture? In other words, the insomnia may have improved, not because of the treatment, but because it was a good period in the sufferers' lives. Ideally, the study should be longer or sample different periods in a year, say.

6. The results did not take into account the drop-out rate, and thus "the improvements observed may be relatively inflated" (Khalsa 2004 p275).

7. The participants were not homogeneous in terms of characteristics; eg: length of insomnia ranged from 0.6 to 43.6 years; ages ranged from 30 to 64 years.

8. Extraneous variables like one participants was taking medication for insomnia during the study. Thirteen participants had undergone other training to manage the insomnia, and ten had unsuccessfully tried medication in the past. Participants with prior experience of yoga and meditation were not excluded.

9. No independent verification of information in sleep-wake diaries nor that the participants performed the yoga as instructed every day.

10. Compliance with yoga was checked with an in-person interview one week after yoga training, and with fifteen-minute telephone calls every two weeks for the remainder of the study.

11. The study included individuals with primary insomnia (as is usual in these types of studies) and secondary

insomnia (due to another condition). Two participants reported depression, three mild or moderate anxiety, and two had restless legs syndrome.

12. Ten participants performed the exercises for 30-minute sessions and ten for 45-minute sessions because it was decided to extend the time of exercises after the first ten participants. However, analysis showed no significant differences between the two groups, and the data were combined.

13. The manifestation of the insomnia varied between participants. Based on the sleep-wake diaries, six participants had maintenance insomnia (frequent wakings), one participant had onset insomnia (problems falling asleep), and the remainder had a combination of both.

10.4. REFERENCES

Bonnet, M.H & Arand, D.L (1995) 24-hour metabolic rate in insomniacs and matched normal sleepers Sleep 18, 581-588

Campbell, A (1996) Sex differences and social behaviour in children and adults. In Hatcher, D (ed) Proceedings of the 1996 ATP Conference Leicester: Association for the Teaching of Psychology

Dashevsky, B & Kramer, M (1998) Behavioural treatment of chronic insomnia in psychiatrically ill patients Journal of Clinical Psychiatry 59, 693-699

Dunbar, G.C et al (1989) Patterns of benzodiazepine use in Great Britain as measured by a population survey British Journal of Psychiatry 155, 836-841

Glass, G et al (1981) Meta-Analysis in Social Research Beverly Hills, CA: Sage

Green, S (1996) Drugs and psychological disorders Psychology Review November, 25-8

Huang, W et al (2009) A systematic review of the effects of acupuncture in treating insomnia Sleep Medicine Reviews 13, 73-104

Irwin, M.R et al (2006) Comparative meta-analysis of behavioural interventions for insomnia and their efficacy in middle-aged adults and in older adults 55+ years of age Health Psychology 25, 3-14

Khalsa, S.B.S (2004) Treatment of chronic insomnia with yoga: A preliminary study with sleep-wake diaries Applied Psychophysiology and Biofeedback 29, 4, 269-278

Kramer, M (2000) Hypnotic medication in the treatment of chronic insomnia: Non nocere! Doesn't anyone care? Sleep Medicine Reviews 4, 6, 529-541

Kramer, M et al (1993) The effectiveness of sleeping medication in chronic insomnia: A clinical case series Sleep Research 22, 219

McCluskey, H.Y et al (1991) Efficacy of behavioural versus triazolam treatment in persistent sleep-onset insomnia American Journal of Psychiatry 148, 121-126

Montgomery, P & Dennis, J (2004) A systematic review of non-pharmacological therapies for sleep problmes in later life Sleep Medicine

Reviews 8, 47-62

Morin, C.M et al (1994) Non-pharmacological interventions for insomnia: A meta-analysis of treatment efficacy American Journal of Psychiatry 151, 1172-1180

Morin, C.M et al (2006) Psychological and behavioural treatment of insomnia: update to the recent evidence Sleep 29, 1398-1414

Murtagh, D.R & Greenwood, K.M (1995) Identifying effective psychological treatments for insomnia: A meta-analysis Journal of Consulting and Clinical Psychology 63, 79-89

Nowell, P.D et al (1997) Benzodiazepines and zolpiddem for chronic insomnia: A meta-analysis of treatment efficacy Journal of the American Medical Association 278, 2170-2172

Pallesen, S et al (1998) Non-pharmacological interventions for insomnia in older adults: A meta-analysis of treatment efficacy Psychotherapy 35, 472-481

Pietroni, P.C (1991) Reader's Digest Family Guide to Alternative Medicine London: Reader's Digest

Riemann, D & Perlis, M.L (2009) The treatments of chronic insomnia: A review of benzodiazepine receptor agonists and psychological and behavioural therapies Sleep Medicine Reviews 13, 205-214

Rosenhan, D.L & Seligman, M.E.P (1995) Abnormal Psychology (3rd ed) New York: Norton

Sharpe, D (1997) Of apples and oranges, file drawers and garbage: Why validity issues in meta-analysis will not go away Clinical Psychology Review 17, 881-901

Smith, G.D & Egger, M (1998) Meta-analysis: Unresolved issues and future developments British Medical Journal 17/1, 221-225

Smith, M.T et al (2002) Comparative meta-analysis of pharmacotherapy and behavioural therapy for persistent insomnia American Journal of Psychiatry 159, 5-11

Thorndike, F.P et al (2008) Development and perceived utility and impact of an Internet intervention for insomnia E-Journal of Applied Psychology 4, 2, 32-42

van Straten, A & Cuijpers, P (2009) Slef-help therapy for insomnia: A meta-analysis Sleep Medicine Reviews 13, 61-71

Vignatelli, L et al (2008) Anti-depressant drugs for narcolepsy Cochrane Database of Systematic Reviews 1, Art.No.CD003724

Wagner, J & Wagner, M.L (2000) Non-benzodiazepines for the treatment of insomnia Sleep Medicine Reviews 4, 6, 551-581

Wood, P (2000) Meta-analysis. IN Breakwell, G.M et al (eds) Research Methods in Psychology (2nd ed) London: Sage