Infant sleep disorders.

Their significance and

evidence based strategies for prevention.

A Randomised Control Trial

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Abstract

Sleep disorders in neonates and young children are common and are associated with negative consequences for children, parents and family units. Unresolved sleep problems may continue for years and be associated with behavioural disturbances, family disruption and impaired academic achievement.

Studies in the area have shown that behaviour modification techniques are effective in improving sleep performance and are superior to drug therapy. A variety of techniques, which focus primarily on modifying parental response to a crying infant, have been described. All behavioural techniques of proven benefit give some formal structure to the manner in which parents respond to a child's crying at times of sleep. Recent work has shown that these strategies can be effective in the first three months of life.

Sleep problems commonly present in primary care, and advice is received from a wide range of primary health care professionals. Parents report major inconsistencies in advice received from different professionals. No single, evidence based, protocol of advice holds a dominant position in Australian primary care.

This thesis has a number of sections. An initial investigative study confirmed the prevalence of sleep disorders in South Australian communities. It also confirmed the wide variety of resources used by parents and demonstrated a marked variation in levels of satisfaction with the advice received. The study identified a group of women who responded rapidly to their infants' crying. This behaviour pattern was correlated with more frequent sleep disturbances which were more persistent than for women who responded late.

Primary literature review identified several salient features about sleep.

- That blocks of sleep contain cyclical episodes of wakefulness. These episodes of waking are most frequent in the neonate, and decrease steadily throughout life.

- That the processes of achieving and maintaining sleep are, in part, dependent upon external environmental stimuli or ‘cues of sleep’.
- It is recognised that environmental cues of sleep may change and that the subject must ‘learn’ new cues.

The process of sleep initiation was, therefore, regarded by this study as a ‘learned skill’. As such, like all skills, it is performed less efficiently when the subject is fatigued.

The above findings and views were formulated into a philosophy of care which emphasised cues of sleep, which were parent independent, and the avoidance of fatigue in the child. A protocol of care was developed and formalised which taught parents about basic sleep structure and encouraged them to minimise contact with their children at times of sleep achievement and subsequent re -initiation within a block of sleep.

A principal aim of the study was to establish the efficacy of a behaviour modification technique minimising parental contact at the time of sleep initiation in neonates. This was tested by an RCT completed using the resources of the Adelaide Women's and Children's Hospital.

In the RCT families were recruited within two weeks of the birth of a child. The intervention group received a single 45 minute tutorial on infant sleep provided by a trained research nurse. The encounter occurred in a standard primary care type consultation. This visit was supported by written information consisting of a 50 page booklet. The control group received normal advice provided by their normal health care providers. Both groups completed sleep diaries at six weeks and twelve weeks of age. Robust randomisation and demographic data were used to confirm that both groups were comparable. A standardised instrument was used in both groups to assess parental well-being.

Analysis of sleep diaries from the RCT demonstrated improved sleep performance in children from the intervention group. A higher proportion of intervention infants achieved at least 15 hrs sleep per 24 hrs (61% v 28% $p<0.0001$). Infants in the intervention group achieved more sleep in a 24-hour cycle than controls. By 6 weeks of age, intervention infants slept on average 1.3 hours per day more than the controls (95% confidence interval 0.95 to 1.65, $p<0.0001$), and by 12 weeks they slept an average of 1.54 hours per day longer (CI 0.94 to 2.14, $p<0.0001$). Maximum sleep improvement occurred for female infants at 12 weeks being 2.08 hours per day (CI 1.22 to 2.93, $p<0.001$).

Recommendations from the study

- Behaviour modification is an effective technique to improve sleep performance in neonates
- Even a single consultation has a positive impact on sleep performance in the time period studied
- The technique described is suited to the primary care setting
- The intervention, as described, can be successfully implemented by a practice nurse

Disclaimer

This work contains no material accepted for the award of any other degree or diploma in any university or other tertiary institution. To the best of my knowledge and belief it contains no material previously published or written by another person, except where due reference has been made in the text.

Consent is given for this thesis, when deposited in the university library, to be available for loan and photocopying.

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Dr Brian Symon

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Date

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Chapter 1 Introduction, Aims and Hypothesis

1.1 Sleep

Sleep constitutes up to 30% of a person's life. While essential for the maintenance of life it is not fully understood. Disorders of sleep are common in families with young children. This thesis studied sleep problems in South Australia and their significance and reviewed the literature on sleep structure and interventions used to improve sleep performance. A protocol of care was designed and its efficacy and sustainability tested in neonates. It concludes with recommendations for the management of sleep in neonates.

1.2 Infant sleep

Sleep patterns in neonates, infants and young children vary considerably. [1 2] As many as 46% of children have sleep disturbances in the first few years of life. [3 4 5 6 7 8-10] The highest incidence occurs in children under the age of 2 years.[5]

1.3 Sleep disturbances

Not sleeping through the night, resisting going to bed, and atypical behaviour at awakening are collectively referred to as 'sleep disturbances'.[11] They constitute common, and sometimes serious, problems for many parents. [5 12-15] Consequences of even mild sleep disturbances can be significant for children, [16] parents [3] and families. [5 6 9 13]

1.4 Seeking advice

Families frequently desire advice, [17] and discuss what is considered normal for a particular age and what constitutes a problem. They seek advice on the management of sleep problems from a range of health professionals, including general practitioners.

1.5 Interventions available

Various techniques have been discussed in relation To modifying sleep patterns in infants and young children. Those showing the best and most persistent results involve behaviour modification. [2, 18-20] Given the widespread nature of the problem and the potential for severe consequences, a preventative strategy would be socially useful. In view of the number of services required, a short and cost effective intervention, suited to primary care, is required.

1.6 Aims of this study

- To review infant sleep in South Australia
- To test a behaviour modification program of improving sleep performance and avoiding sleep disturbance in neonates using a randomised control trial
- To test a model of care suitable for use in primary care
- To review the efficacy of using a nurse as the primary care provider
- To review the sustainability of any change in sleep performance
- To evaluate secondary effects on children, parents and family of a preventative approach to sleep disturbance.

1.7 Hypothesis

- That neonatal sleep can be improved by an intervention protocol begun in the first three weeks of life
- That improvement in infant sleep is maintained at three months of age
- That there are benefits for infants, parents and the family associated with improved infant sleep.

Chapter 2 Literature Review: Part 1

The Significance of Sleep (Why sleep?)

2.1 Introduction

Sleep is experienced by all individuals and approximately 30% of a human's life is spent asleep. Sleep deprivation is a negative event with a cumulative impact upon biological function. In experimental animals, total sleep deprivation (TSD) is fatal, [21] [22] and, in humans, TSD is associated with forgetfulness, paranoia, psychosis and hallucinations.[23] [24] As sleep represents such a significant part of our lives, and is essential for the maintenance of functional well being and life itself, its role should be clear. Paradoxically, this is not so. The significance of sleep, its precise role and the identification of the mechanisms which initiate and maintain sleep, continue to be areas of conjecture and study. This chapter will discuss current knowledge on the significance of sleep.

2.2 Sleep across species

Exploring the question of why we sleep has involved the study of many species. While it is not surprising that sleep varies between species and genera, the ubiquity of sleep in some form across the animal kingdom, and its obligatory status in higher species, underscores its importance. The essential nature of sleep is further demonstrated by the behavioural variations which have evolved to allow its continuance. These relate to sleeping posture, total length of normal sleeping hours and some unusual, and species specific, physiologies of sleep.[25] Its presence is obligatory for the maintenance of life in all avian and mammalian species.[25] These observations demonstrate an essential function or range of functions for sleep. This fundamental role across species should be easily identified. It is tantalising that its clear identification eludes researchers.

2.3 The functions of sleep

2.3.1 Introduction

The contribution which sleep makes to well-being has been extensively researched, and is represented by an increasing literature particularly in the last 50 years.[25] Despite this, many areas within the study of sleep remain obscure. What is clear is that sleep has multiple functions, at least some of which are essential for effective and maintained biological function. The hypothesised functions of sleep can be grouped into the following headings:

- Restorative
- Adaptive
- CNS learning and development
- Biological

2.3.2 Restorative

Historically, sleep has been regarded as a time of decreased activity, this view being the oldest presented in the literature.[25 26] The intuitive value of this hypothesis is the self evident restorative function of sleep, and the ever increasing need to sleep and 'rest' after increasing periods of sleeplessness.[26] Analysis shows this approach to be incomplete. Attempts to identify the precise nature of this restorative role have followed several lines of argument.

2.3.3 Protein synthesis

It has been proposed that one of the fundamental roles of periodic sleep is to allow 'growth' and the synthesis of biological components.[27-29] A proposal which has recently been studied is that there is increased protein synthesis during sleep. The majority of studies, however, show decreased protein synthesis during sleep unless protein availability is maintained by tube feeding. When specific proteins and hormones are studied, it is clear that some are tightly linked to sleep.[28 30]

2.3.4 Response to activity

The restorative model would suggest that increased bodily exercise would increase the need for 'repair and regeneration'. Most post exercise studies do not show increased post exercise sleep.[31] People who are fit and exercise regularly do not have increased sleep compared to less active controls. [25]

2.3.5 Body growth

The restorative hypothesis is supported by consistent observations that Growth Hormone (GH) is released during sleep and at no other times.[30] Secretion of GH has an obligatory association with the onset of NREM sleep. Once NREM sleep is achieved, the anterior pituitary secretes GH. While physical growth can be decreased in sleep disturbance, this does not appear to be related to GH deficiency as hormone levels are normal in some children with OSA. [32]

2.3.6 Restoration of the CNS

Evaluation of CNS restoration is complex. Multiple studies have used sleep deprivation to identify elements of the CNS which require 'restoration' through sleep. Total sleep deprivation in rats caused 100% mortality, without anatomical cause, in 10 to 30 days. [33] Experimentation with rats in states of extreme, and ultimately fatal, sleep deprivation, have not shown evidence of neuronal degeneration. [34] Synaptic function after sleep deprivation has been studied for multiple neurotransmitters with ambiguous results.[35]

More recent work has been reported to show irreversible organelle damage in some neurones following severe sleep deprivation. [36]

Intuitively, a restorative role in the CNS for sleep is attractive to the point of being self evident. At present, research has failed to identify either the biological damage of sleep deprivation or the biological improvements mediated by sleep.

2.3.7 Adaptive role of sleep

Theories of sleep function, with an adaptive or ecological element, tend to focus on energy conservation and predator avoidance.

2.3.8 Energy conservation

Mammals are homeothermic and expend considerable energy in thermoregulation. For poikilothermic creatures, the overall benefit of the low energy 'cost' of not providing thermoregulation compensates for the increased vulnerability of inactivity. For homeothermic mammals, increased independence from environmental conditions compensates for the high energy cost of thermo-regulation. Metabolic rates for homeothermic creatures can be 5-30 times higher than poikilothermic.[37]

During sleeping, energy expenditure can be decreased by 10%.[38] This saving may have a selective advantage in an environment where foraging for food entails risk. For a creature which is homeothermic and sleeps 8 hrs per day, the total energy saving could be in the range of 3.3%. Is an energy saving of 3.3% per day able to provide an adequate gain to establish selective advantage? Further weakening this argument is the clear success of homeothermic mammals.

2.3.9 Predator avoidance

The large majority of avian and mammalian species have a vision dominant CNS. Vision for both predator and prey is very movement sensitive. Being stationary while sleeping decreases the risk of being observed and targeted by a predator. No clear evidence exists to support or refute this hypothesis.

2.3.10 Circadian adaptation

Evolution on this planet requires mechanisms for coping with a day / night cycle. Sleep may have evolved to provide a management strategy for hours of darkness.

Melatonin is a mediator of dark adaptation. It is ubiquitous across almost all groups of organisms including protozoa, plants and all higher animals.[30] The evolutionary conservation of this molecule highlights the significance of light/dark adaptation. Could sleep have evolved as a mechanism of adapting activity and energy expenditure to periods of darkness? The argument is weakened by the conservation of sleep as an obligatory component of existence for creatures which are vision independent (bats) and day night independent (cetaceans).

2.3.11 CNS functions of learning, coordination and 'rest'

<u>Learning</u>

There is a commonly quoted correlation between sleep and learning. Multiple studies have replicated a negative impact of sleep deprivation on learning, attention span and intelligence. [16] Others have identified positive correlations between learning, particularly visual based skills, and good sleep. [39] Despite strong arguments in favour of this correlation, some data present inconsistencies. Drugs for depression, which abolish REM sleep, and rare brain lesions which abort REM sleep, have not been associated with impaired memory and learning.[40] The balance of opinion would appear to support that sleep is important in learning and memory consolidation, and that NREM sleep is the most important time of sleep during which this occurs.[41]

Coordination

Whereas some studies show only minor coordination impairment following sleep deprivation,[42] other studies have shown a clear correlation between sleep deprivation and impaired coordination.[43]

Rest from stimulus

While the sleeping brain may be considered to be disconnected from the environment, and in a 'resting state', even this is not absolute. Responses to external auditory signals can be observed by MRI in the sleeping state. These include active auditory processing and, if familiar names are uttered, language centres are activated as well. These findings demonstrate a continued ability to receive and process sensory data while asleep.[41] Similarly, a doctor on emergency call or a mother caring for an infant are readily woken from a deep sleep with appropriate auditory stimulus, indicating an incomplete disconnection from the environment.

Conclusion

Sleep again shows multiple paradoxical characteristics in the CNS. Available evidence on the functions of sleep contains multiple contradictions. While empirically we understand the impact of our own sleeplessness on CNS performance, identifying the biomechanical factors responsible remains elusive.

2.3.12 Molecular

Much research has been completed on the molecular and microbiological effects of sleep. While ultimately the identification of molecular behaviour at a neurotransmitter receptor site may provide a clear understanding of the unique functions of sleep, the field is too broad to be discussed in this thesis.

2.4 Conclusion

Having looked at the proposed restorative, adaptive and neurological hypotheses regarding the functions of sleep, much uncertainty remains. No single theory of the functions of sleep stands unchallenged. Although we have no problem, as individuals, comprehending the negative impact of sleep deprivation, and the positive contribution to our wellbeing of good sleep, scientific research has yet to define a clear bio-physiological model. Despite this ambiguity, some statements are unchallenged:

- Sleep is essential to life in higher animals
- Its functions are multiple, and relate to complex, homeostatic, neurological algorithms
- High quality sleep makes a contribution to effective individual and social functioning.

Chapter 3 Literature Review: Part 2

Sleep Structure (What occurs while asleep)

3.1 Introduction

Sleep has historically been viewed as a time of mental and physical inactivity. As mentioned, in chapters above, this is not an accurate view. The development of techniques to study sleep has shown that time spent asleep is, in fact, active in many ways. Sleep has a complex structure with multiple elements. Each element is now known to have unique functions. This section will discuss sleep structure and its development from the time of conception. The relevance to this thesis is in its exploration of the differences between foetal, neonatal and mature sleep. The first three months following birth are associated with fundamental changes in sleep structure. These changes are relevant to the time period under review. Sleep structure will be discussed under the following headings:

- Analysing sleep
- Elements of ‘normal’ sleep
- Foetal sleep
- Neonatal sleep
- Infant sleep

3.2 Analysing sleep

The scientific analysis of sleep is a relatively new science with a literature little more than 50 years old. Technological developments in the last quarter of the 20th Century have allowed increasingly sophisticated study. Multiple methods of studying and providing analysis of sleep have evolved, each with their individual advantages and disadvantages.

In this section the following methods of sleep analysis will be briefly discussed:

- Behavioural observation
- Polygraphy
- Time lapse video recording
- Actigraphic monitoring
- Mobility patterns

3.3 Behavioural observation

While the EEG is regarded as the 'reference standard' of sleep observation in mature sleep, behavioural observation is the standard in neonates.[25] The reason for a different point of reference is limited correlation between EEG patterns and observed behaviour in premature and newborn children. Direct observation readily separates the sleeping state from wakefulness, but the EEG does not. The electrical records generated by both active sleep and wakefulness may be so similar that the two states cannot be accurately identified and thus separated. For this reason, behavioural observation is the 'gold standard' in the earliest weeks of life.

Methods of behavioural observation vary but, in general, the child is observed by a trained researcher, and the waking or sleep state recorded at set periods of time or epochs. These vary in length, but are generally 10 – 30 seconds long, with the latter being the most common standard. Thus, in a standard sleep study, the researcher will record the state of waking or sleep every 30 seconds. This information may be linked to other recordings taken at the same time intervals. To describe and code both sleep and waking states in newborn infants, taxonomies have been developed.[44] The sleeping state is generally classified into one of the following states:

- drowsy
- active sleep (REM)
- transitional sleep (active sleep/quiet sleep transition)
- quiet sleep (NREM)

- sleep wake transition

Coding for different states of sleep is based upon direct observation of several variables as outlined in Table 1.

Sleep state	Respiration	REM's	Behaviour
Drowsy			Eyes closing, movement decreasing
Active Sleep (REM)	Irregular	Frequent. vertical movements (mature sleep REM's are largely horizontal)	Smiles, mouth movements, sighing, sobbing, limb movement, crying
Transitional Sleep	Mixed		Mixed
Quiet Sleep	Regular	Infrequent	May startle, brief limb movement, sucking. (The amount of movement decreases as NREM evolves)
Sleep Wake Transition			Eyes Opening

Table 1 Taxonomy of neonatal sleep states

Wakefulness is described as either:

- alert
- non alert
- fussing
- crying.

3.3.1 Limitations

Behavioural observation is time expensive, and is limited by the attention span of the observer. Scoring for sleeping/waking state every 30 seconds for multiple hours can be taxing. As a consequence of the above, the literature shows a limited number of studies and generally with small numbers of subjects.

3.3.2 Advantages

The main advantage of the technique is that, for the premature infant and neonates, there is no other method of evaluation which can confidently separate wakening from active sleep.

3.3.3 Polygraphic observation

The polygraph is a technique of sleep observation which relies upon multiple simultaneous recordings, generally of electronic signals. Multiple physiological variables can be measured and each study will choose those most relevant to its aims. The three standard elements of a polygraph include Electro-encephalogram (EEG), Electro-oculogram (EOG) and Electromyogram (EMG). Only the EEG will be discussed.

3.3.4 EEG

Multiple electrodes (channels), placed at various positions on the scalp, are used to gather electrical signals from the brain. The technique is unable to separate active sleep and wakefulness with accuracy under three months of age as the electrical signals are similar. Thus the EEG in particular, and the polygraph as a whole, are observational techniques of limited use in the first three months.

3.3.5 Other techniques

Many other techniques are available for observing sleep. These include Time Lapse Video Recording (TLVR), Actigraphic Monitoring and Mobility Monitoring. While each adds to the understanding of sleep, none are directly relevant to this thesis.

3.3.6 Conclusion

Multiple techniques exist for evaluating infant sleep. Each has strengths and weaknesses. For infants in the first three months of life, behavioural observation is the standard against which other assessments are compared. This RCT study used a behavioural observation technique. The observers were untrained parents who, while reporting on their child's behaviour, would not have been present at the cot side at all times.

3.4 Elements of normal mature sleep

3.4.1 Introduction

Sleep is an active state with complex architecture and functions. Despite extensive study, particularly in adults, the limits of our understanding are reflected in the difficulty which many authors have in even defining the sleeping state.[25 32 45] There are major differences between sleep in foetuses, neonates and adults. This section will discuss major sleep components which exist in fully developed or mature sleep.

3.4.2 Age

Age is the most important factor associated with changes in the basic elements of sleep. With the only exception of major neurological damage, age is more important than other physiological factors in predicting the character of total sleep time, complexity of sleep elements, length of sleep cycles and correlation with circadian rhythm. In this section the elements of mature or adult sleep will be discussed. Mature sleep patterns emerge by early teen years.

3.4.3 Total sleep hours

Through life there is a marked change in the amount of time spent asleep. At birth this may be 85% of the day, and in advanced age it may be as little as 25%.[46]

Figure 1 Total sleep per day through life

3.4.4 Sleep initiation

The process of achieving sleep is complex. Multiple neuropeptides, working in various structures of the brain, play a role.[47] Additional factors which are known to be involved include "fatigue", circadian rhythms and environmental cues or zietgrubers.[32] [48] The latter respond to alteration and can be trained.[32] This linking of environmental cues and sleep initiation begins at an early age. While the principal zeitgruber is light [32] many exist and can include social factors, noise / quiet cycles, temperature changes and parental contact.[32]

3.4.5 Sleep maintenance

While achieving sleep is complex, its maintenance is similarly complex and multi-factorial. No single site in the CNS assumes total responsibility for sleep maintenance. Multiple neurotransmitters, neuromodulators and sites are involved.[47] Similarly, fatigue, circadian rhythms and zietgrubers play a role.[32]

3.4.6 Dreaming

Although dreaming is generally associated with REM sleep, it can also occur in NREM sleep. Content of the dream states differ between REM and NREM sleep. In REM sleep the dreams, if recalled, tend to be more narrative, while if the subject is awoken in NREM sleep, there is more likely to be recall of an emotional state.

Whereas there may be a subjective perspective that dream states are either accelerated or delayed, in fact, events which are 'replayed' in the dream state occur at the same rate as when awake.

While an observer may be concerned that the time of dreaming is associated with anxiety in some form, it is likely that normal experiences are being 'replayed'.

The functions of dreaming are not proven but may play a role in the incorporation of short term into long term memory.[41]

3.4.7 REM Sleep

REM sleep was first described in 1953 by William Dement, a medical student working in a sleep laboratory at the University of Chicago. Initially heralded as a major breakthrough in sleep analysis, it has in fact been as perplexing as illuminating. Its functions and detailed control mechanisms continue to be hypothesised rather than proven. It is the time of sleeping where most dreaming occurs.[25 49] While REM sleep is the dominant state of sleep in the foetus, by birth it represents approximately 50% of all sleeping hours. It then falls to 20-25% by age 2 years, and its proportion of total sleep then declines very slowly through life. (Figure 2) .

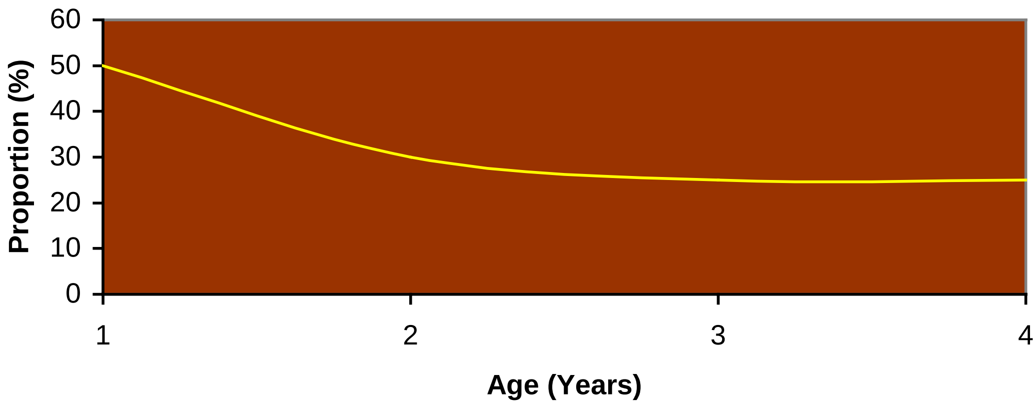

Figure 2 REM sleep as a proportion of all sleep in the first four years

<u>Control of REM sleep</u>

Control of REM sleep is driven principally by the dorso lateral pontine tegmentum in the pons. Neurons in this region generate signals which create the EEG signal, eye movement, myoclonus, and later in life, muscle atonia of REM sleep. Activation of REM sleep is achieved by Acetylcholine, GABA-ergic, cholinergic, glycinergic and glutamatergic neurons. Termination is achieved by noradrenergic and serotonergic neurons. The initiation and termination of REM sleep are controlled by complex homeostatic algorithms which are incompletely understood.

Physiology of REM sleep

Multiple physiological parameters have been associated with REM sleep.

CNS

There is an increased rate of neuronal firing compared to both NREM sleep and wakefulness.

Eye movements

Rapid eye movements are principally vertical in the neonate and become more horizontal by the time of full maturity of sleep which occurs in adolescence.

Skeletal muscle tone

Skeletal muscle tone is markedly relaxed in mature REM sleep. This is particularly so for head and neck muscles, and a state of semi-paralysis exists. Tone is decreased through the presence of a high level blockade which prevents electrical stimuli from entering the spinal column. The blockade is incomplete and muscles controlling respiration and eye movement respond to stimuli.

This is a major difference to neonatal sleep as will be discussed later.

Energy expenditure

Energy expenditure and oxygen consumption are increased in REM sleep compared to NREM.

Physiological observations

Blood Pressure is increased

Pulse Rate is irregular and increased

Respiration is irregular and increased

Temperature auto-regulation is altered and neither perspiration or shivering occur.

Awakening

Subjects awakening from REM sleep often report dreaming. Awakening from REM leaves the subject alert.

3.5 NREM sleep

NREM, or quiet sleep, is the largest component of mature sleep. Like REM sleep, its precise functions are incompletely understood but believed to be associated with the main restorative functions of sleep.[45]

3.5.1 Control of NREM sleep

Like all elements of sleep, NREM sleep has no single and dominant control mechanism. Major control systems occur in the basal forebrain systems.[25 32] Serotonin and Gamma-Amniobutyric Acid (GABA) are the principal neurotransmitters of NREM sleep.

3.5.2 Stages of NREM sleep

While mature REM sleep has characteristic EEG signals, these are not divisible into multiple elements. In NREM sleep there are four consistent phases.

Stage 1

A state of drowsiness. The adult subject moves from the waking state, or an arousal, into Stage 1 NREM. Awareness is decreased and the eyes move slowly under closed eyelids. If awoken at this point they may deny sleep, but a lapse of recall of concurrent events confirms the ‘reality’ of sleep. Awakening from Stage 1 is rapid and not associated with disorientation.

Stage 2

Beyond three to four months, Stage 2 can be identified from the EEG through the existence of sleep spindles, and later again through K Complexes. In mature sleep, while the subject is readily awoken and may still be hesitant to accept the existence of sleep, there is again a lapse of awareness. The subject does not dream.

Stage 3

Stage 3 is a deeper state of sleep and, if awoken, the subject is temporarily disorientated. Wakening is more difficult compared to Stages 1 and 2. The EEG shows large slow delta waves which represent 20-50% of the EEG.

Stage 4

Stage 4 is a deep sleep from which awakening is difficult. The subject will only respond to important and context appropriate stimuli, e.g. a mother awakens to her crying child. Once awoken there is temporary confusion. Delta waves predominate and represent more than 50% of the EEG. Stages 3 and 4 are most frequently observed in the first 50% of a block or night of sleep.

3.5.3 Arousals

Repeated arousals occur within a block of sleep. Observed in all sleep studies, they occur three to six times per night.[32] They are a state of limited awareness even though the EEG is of the waking state. Recall of these events the following day is limited and their purpose is unknown. The universal existence of arousals, and the requirement to return to sleep, will be discussed in later chapters as a point of importance in understanding and managing infant sleep.

3.6 Foetal sleep

Studying sleep in the human foetus has been difficult for a range of technical and ethical reasons. Foetal sleep can only be recorded by trans-abdominal EEG. Such recordings may show electrical activity by 12 to 22 weeks.[50] At this age, the signal from the CNS is a continuous, low voltage, irregular pattern. It is homogenous and cannot be divided into different stages or elements. By 24 weeks, some degree of discontinuous activity is present and there is asynchrony between the hemispheres ('trace discontinu'). There is an absence of a detectable, electro-cortical reaction to stimuli. The EEG shows bursts of mixed frequency signals and long periods of quiescence. [51] The record does not allow separation into wake or sleep states. By 28 weeks, a 'trace alternant' signal with mixed electrical signals emerges. This pattern will become associated with quiet sleep.[44] By 30 weeks, discontinuous patterns have evolved to the point that quiet sleep and non quiet sleep can be recognised. Despite this development, the separation between the two states is incomplete. Certain elements of the EEG are "indeterminate". With increasing gestational age, the amount of indeterminate or transitional sleep decreases. At 30 weeks, about 67% of sleep time is indeterminate. Thus, by 30 weeks, the foetus has quiet sleep, active sleep, indeterminate sleep and wakefulness. As the foetus can only be studied by the EEG, and active sleep can not be differentiated from wake patterns, the record can only be coded for quiet sleep, active sleep and indeterminate sleep.

It is not until 36 weeks that the typical neonatal pattern emerges. By 40 weeks gestation, or term, the sleep record is generally divided into approximately 50-60 % active sleep and 40-50% quiet sleep. Of total sleep time about 40% will be indeterminate. Approximately 15% of total time is spent awake.

At the time of birth, the undisturbed foetus and then neonate experiences approximately 20.5 hours (85% of the day) of sleep and 3.5 hours (15%) of wakefulness.[25] These figures compare with published figures of 16.5 hours observed sleep in the fist few weeks of life.[45] In the baseline observational study reported in this thesis, the mean length of reported sleep at three months was 14 hours.

In conclusion, foetal EEG activity appears in the second half of pregnancy and evolves from a homogenous state at approximately 22 weeks to a pattern recognisable as neonatal by 36 weeks.

3.7 Neonatal sleep

3.7.1 Introduction

For the purposes of this thesis, the term neonate is used to discuss newborn infants from birth to approximately three months. This is longer than the standard definition of the first six weeks of extra-uterine life. This variation has been chosen to allow discussion of changes in sleep structure which occur in the first three months of life under one age group heading.

At birth, the elements of sleep are incompletely developed and the internal segregation of sleep elements is incomplete. Neonates show poor concordance of the EEG signal, physiological measures and behavioural patterns. There is limited correlation between electrical recordings and behavioural observations. In addition, only direct observation allows separation of active sleep and waking. Thus the evaluation of neonatal sleep is best performed by behavioural observation. Concordance of sleep measures increases rapidly in the first few months of life.

By six weeks, the key electrical marker of mature stage 2 NREM sleep, sleep spindles, have appeared and, by six months, all elements of mature sleep are present. Within this period of rapid evolution, major changes occur to the internal structure of sleep. The proportion of the day allocated to sleep; the proportions of sleep allocated to individual elements; the sequencing of sleep elements, and the body’s response to sleep, all change in major ways. The dramatic changes which are occurring in sleep in this six weeks raise the question as to whether this is a time when behaviour modification is appropriate or effective.

3.7.2 Circadian rhythms

At the time of birth, the linkage between sleep cycles and circadian rhythms has not been established. This develops rapidly and, by 6-8 weeks, there are temporal associations between sleep behaviour and day night cycles. There is a circadian rhythm to the secretion of melatonin and other hormones, including steroidal and growth hormone. The latter has an obligatory relationship to sleep and is only released in slow wave or NREM sleep and only then during NREM onset. The section of the hypothalamus which controls circadian rhythms plays a role in controlling body temperature and cortisol secretion.

3.7.3 Neonatal REM Sleep (active sleep)

From the time that a sleep state is first recognised in utero, active sleep and its precursors dominate the sleep record. By birth it is still the dominant element representing 50-60% of all sleep time. The proportion of time that it represents falls rapidly and, by 2 years of age, represents about 25% of sleep.

An additional characteristic of neonatal REM sleep is its position relative to wakefulness and NREM sleep. Whereas in mature sleep the subject passes from the waking state to the NREM sleep state, in the first three to six months of life, the infant passes directly from the waking state into REM sleep.

<u>Behaviour in neonatal REM sleep</u>

A range of physical events are characteristic of this phase.

<u>Eye movement.</u> The eyes are closed but both rapid and slow movements occur.

<u>Body movement</u>. Skeletal muscle movement exists. The presence of significant body movement in REM sleep is an important difference between neonatal and mature sleep. During the first year of life, a brain stem block, mediated by the pons, develops which prevents motor impulses passing from the brain stem into the spinal column. It is possible to hypothesise an evolutionary pressure for this. The negative consequences, for an adult, of being asleep and mobile are clear. For the neonatal human there are limited negative possibilities, as actual movement of the whole body is not possible. In addition,

the skeletal musculature is in a stage of rapid development where increased motor activity speeds antigravity strength. It is the presence of electrical signals from muscle movement

which prevents a separation of waking and active sleep states without direct observation.

Erectile tissue is turgid.

Vocalisation may occur. For parents this can be a deceptive event mimicking waking but, in fact, it is a normal occurrence within a period of sleep. Given that normal arousals occur approximately every 45 minutes, vocalisations at this point may be common in some infants.

Respiration is irregular.

Conclusion on neonatal REM sleep

While REM sleep in the neonate is given the same name as a somewhat similar component of mature sleep, it is different in several ways. The absence of body paralysis and atonia, its timing relative to other sleep elements and the proportion of total time asleep all represent significant differences. This structure evolves rapidly into a mature pattern and the first twelve weeks of life is a time of rapid change.

3.7.4 Neonatal NREM sleep (quiet sleep)

In the neonate, NREM sleep is fairly homogeneous on the EEG. It is not possible to identify the different stages of sleep which emerge in the first few months of life. By three months staging of NREM sleep is possible, and by six months all stages of mature NREM sleep can be identified. The other significant characteristic of NREM sleep in the neonate is that it is achieved via REM sleep.

It first appears in the foetus as a minor element of sleep. By the time of birth it represents about 50% of total sleep and, by age 2 years, it has reached 75%. It then slowly increases to 80-85% in advanced age. When first present in the foetus, its structure is largely homogenous. It evolves rapidly after birth and, by three months, has developed four recognisable stages. With further minor development these four stages are stable for life.

Like REM sleep, this state, when studied in the neonate, contains fundamental differences to the stage of mature sleep given the same name.

In the foetus, NREM sleep first appears as 'trace alternant' sleep at about 28 weeks. At 30 weeks, about 30% of all foetal time is quiet sleep and, at birth 40-50% of sleep is NREM. In mature sleep it represents about 75% of all sleep time.

Whereas in mature sleep the subject passes from the waking state to NREM sleep, in the first three months of life the neonate passes from the waking state into REM sleep and then into NREM.

A third and major difference between neonatal NREM sleep and mature sleep is the degree of differentiation which exists within its structure. At birth, the EEG shows little separation of NREM sleep elements. It is electrically a relatively homogenous state. Sleep spindles, which are the cardinal markers of stage 2 NREM sleep, appear by six weeks and, by six months, K complexes, delta waves and all four subdivisions of NREM sleep are recognisable.

Behaviour in neonatal NREM Sleep

While in this state there are a range of physical events:

- Eye movement. The eyes are closed and there is little physical movement. Eye movement is 'negative' on EOG.
- Body movement. Muscular movement is limited.
- Respiration is regular.
- Erectile tissue is flaccid.
- Vocalisation may occur.

Conclusion on neonatal NREM sleep

While NREM sleep in the neonate is again given the same name as a phase of mature sleep, which it will evolve into, in several ways it is different. Its timing relative to other sleep elements, the proportion of total time asleep it occupies, and the lack of identifiable subdivisions all represent significant differences. This structure evolves rapidly into a mature pattern, and the first twelve weeks is a time of rapid change.

3.7.5 Intermediate sleep

As might be expected at a time when sleep structure is changing rapidly from a neonatal to a mature pattern, there are periods where the sleeping state can not be identified. This time is referred to as intermediate sleep. The neonate's eyes are closed, and the criteria for active and quiet sleep co-exist. This is most frequently observed at times of sleep onset, when moving between sleep states, and upon awakening. About 2% of neonatal time is spent in intermediate sleep.

3.7.6 Sleep cycles

Sleep does not exist as a steady state and it is not continuous. A block of sleep contains cyclical awakenings followed by a rapid return to sleep. These events are referred to as sleep cycles. A single sleep cycle is the transition from arousal to sleep and back to the wakening state. [45] In the neonate, these are approximately 45 to 50 minutes long. By adolescence, they have extended to 90 minutes.[32]

3.7.7 Arousals

Sleep cycles always conclude in an arousal and are an essential element of sleep. Such events are universal and are identified by all methods of assessment. The level of arousal varies and may contain greater or lesser amounts of physical activity. While the length of arousals is reported to be stable across age, the frequency of occurrence increases in a linear fashion.[52] In the neonate, there are generally two to three arousals per "block of sleep", lasting from one to five minutes.[44 Page 13]

<u>Arousal types</u>

Arousals exist in two forms. Internal, or physiological arousals, which are part of normal sleep structure, and external or non physiological arousals. Various external factors can cause arousal and, if these occur in excessive frequency, can lead to a decrease in sleep quality. Combined loss of total sleep and increased numbers of non physiological arousals is particularly harmful.[53] In the context of this thesis, and the age group being studied, it is noted that by 8 months gestation the foetus has rest and activity cycles which are to a certain extent linked to maternal REM and NREM sleep cycles.[54] At the time of birth, arousals are occurring in response to internal physiological rhythms with a degree of linkage to maternal REM/NREM sleep cycles. Once the child is born, these two factors still exist and, in addition, the child must now learn to entrain sleep performance to additional external environmental cues. While the newborn is capable of adaptive behaviour which will allow linkage between external environmental cues and sleep performance, the sleep associations used are controlled by parental behaviour.

Behaviour on arousal

Upon arousal, the neonate will display a range of behaviours. These include opening of eyes, increased levels of body movement and various forms of vocalisation. Despite all of these events, the arousal is, in fact, an element of the block of sleep.

Neonates are divided into two groups based upon their behavioural response to arousal namely, self soothers and signallers.

Self Soothers

These infants undergo an arousal and return to sleep without external interaction. Vocalisations, if they occur, are minor. The return to sleep generally occurs within seconds to a few minutes.

Signallers

Upon arousal these neonates call out or 'signal'. In a behavioural sense, this signalling alerts the care provider and may result in an intervention. The return to sleep for a signaller occurs over a wide variation of times. There is often a major role played by parental response in determining this time. In the first month of life, 95% of neonates receive a parental response. By 12 months, 60-70% of infants are self soothing.[48] Signalling is amenable to behaviour modification and the majority of signallers can become self soothers. [55]

3.7.8 Neonatal wakefulness

In the time preceding birth, the foetus spends approximately 15% of the day, about 3.5 hours, in a state of wakefulness. Published tables on infant sleep suggest that, within the first week of life, the average newborn will spend approximately 16.5 hours awake and 7.5 asleep.[45] This represents a very rapid transition in less than seven days.

3.7.9 All sleep elements

The infant's day can be represented graphically in the following manner.

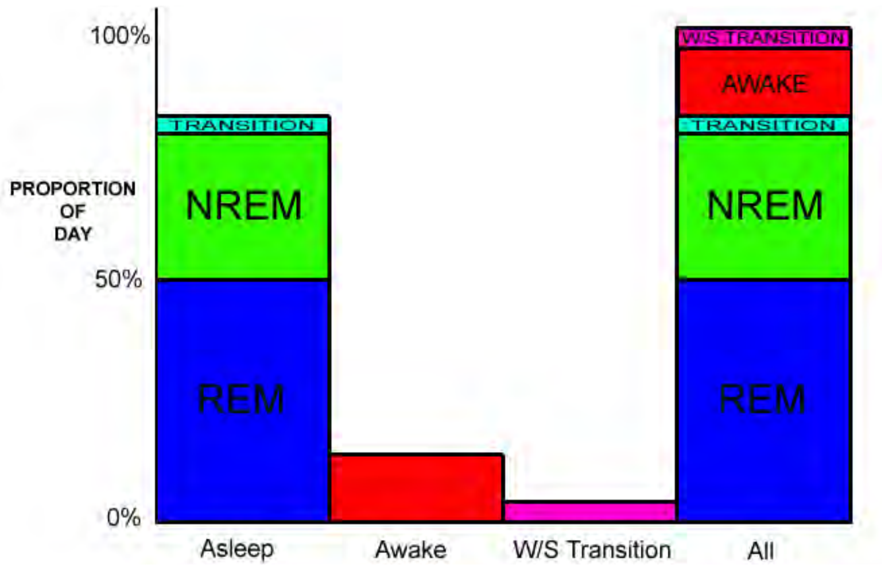

Figure 3 Neonatal activity pattern.

3.7.10 Conclusion on neonatal sleep

The foetus spends approximately 85% of the day in some form of sleep. Most newborns achieve approximately 70% of the day in a sleeping state. In the period of time which is the focus of this thesis, both REM and NREM sleep are different in many ways to that in mature sleep. While behavioural observation is able to code for wakefulness, active sleep and quiet sleep, examination of the EEG shows that the states are incompletely separated. Evolution of the neurological record into elements which correlate with behavioural observation occurs rapidly in the first three months. Subdivision of NREM sleep is occurring by three months.

3.8 Infant sleep

3.8.1 Introduction

For the purposes of this thesis, the term infant is used to describe a baby beyond 3 months of age.

By three to four months the EEG can be coded into all elements of a mature sleep pattern. REM sleep is well defined and has begun to decline as a proportion of the sleep record. NREM sleep has developed more complexity and has become the largest element of sleep.

Infant sleep will be discussed under the following headings;

- Circadian rhythm
- Sleep elements
- REM
- NREM
- Intermediate sleep
- Sleep cycles
- Arousals
- Wakening
- Conclusion

3.8.2 Circadian rhythm

By three months, sleep occurs with a circadian rhythm. The majority of total sleep and the longest individual sleep is nocturnal.[45] The melatonin system of sleep control is active. The supra-chiasmatic nucleus transfers information to the pineal gland with regard to a 'light off stimulus' and, in return, is influenced by melatonin released from the pineal. This control mechanism is now stable for life and, in the absence of external environmental cues, will generate a rhythm of sleep wake behaviour approximating 24 hours per day. It is controlled from the hypothalamus by cells within the supra-chiasmatic nucleus.

3.8.3 Sleep elements

Infant REM sleep

While the neonate moves directly into REM sleep, by three to four months the infant enters REM sleep from NREM, and not directly from the waking state.[44] The reasons for this change, and the source of its control, are unknown.

The proportion of sleep which is REM declines steadily and, by the age of two years, it represents only 20-25% of the total. (

Figure 2 pg 37.) The rate of decline is then slow and, even beyond the age of 70, REM sleep still represents 15-20% of all sleep.

Infant NREM sleep

It is in NREM sleep that major changes occur in the first three months, and then again in the next three months as a mature sleep pattern and structure in the EEG record evolves. After birth, the neonate shows a steadily increasing proportion of NREM relative to REM sleep. (

Figure 2 pg 37). This occurs in both a relative and an absolute sense. In a relative sense, at birth 40-50% of all sleep is NREM but, by age 2 years, this has increased to approximately 75%. In an absolute sense, the newborn sleeps approximately 8 hours per day in NREM and, by age 2 years, this has increased to almost 10 hours per day. While NREM is increasing in total sleep time it is also developing more complexity. From a reasonably homogenous state at birth, sleep spindles and K complexes emerge in the first few months and, by six months, all four elements of mature NREM sleep can be identified on the EEG. Infancy is the age of maximum NREM sleep ‘performance’. The deepest levels of NREM sleep, 3 and 4, are most abundant by 3-5 years of age. The amount of deep NREM sleep gradually declines thereafter. This decline can be detected in early adolescence and may, in fact, represent the earliest sign of CNS aging.

Intermediate Sleep

As in the neonate, at times of sleep onset, when moving between sleep states or upon awakening, the sleep state may be coded as intermediate sleep. Less than 2% of the sleep record is generally allocated to this.

3.8.4 Sleep cycles

Whereas several elements of sleep evolve rapidly, the length of sleep cycles changes slowly. At birth, they are about 45 minutes in length and will change slowly to achieve a mature sleep length of 90 minutes in early adolescence.

3.8.5 Arousals

Arousals, or partial awakenings at the end of each sleep cycle, continue from birth for the rest of life. The length of an arousal, which is from 15 secs to 3 minutes, does not change but frequency gradually increases.[52] The proportion of infants who can self settle from these arousals, as opposed to signalling, increases steadily.[5]

3.8.6 Wakening

Although arousals between sleep cycles remain stable in length, the length of awakenings between blocks of sleep increase slowly.[45] The neonate may spend 20-40 minutes awake at each awakening but this increases slowly and develops its own diurnal rhythm. Thus, by three months, for some infants, there may be no nocturnal awakenings.[5] However, the length and number of diurnal awakenings varies greatly between infants.[5]

3.8.7 Conclusion

Infancy and childhood, in some ways, represent the pinnacle of sleep achievement. It is in these years that sleep contains the most complexity and the highest proportion of deep sleep.

All elements of an adult EEG are present by six months. Full evolution of behaviours of sleep, including REM sleep atonia, have emerged by 12 months. The proportions of sleep which are allocated to REM and NREM continue to evolve through life but are largely complete by teenage years.

From the end of childhood, sleep begins to decline in both its complexity and depth. The amount of time spent asleep as opposed to awake continues its slow decline, spread over many years. The role and significance of these changes is unknown but, in particular, the decrease in deep NREM sleep may represent the earliest known indicator that the CNS has ‘peaked’ and has begun a slow decline.

3.9 Discussion

Despite intuitive and historical perspectives that time spent asleep is a time of quiet recuperation, it is in fact a period of complex activity.

The detailed structure of sleep can be studied in a number of ways. For the age group which is the focus of this study, behavioural observation is the most appropriate and was the technique used.

Normal sleep contains complex structures with several recognisable and consistent elements. While much is known on the timing, proportions and characteristics of these sleep elements, their precise functions are poorly understood.

The characteristics of foetal sleep are fundamentally different from mature sleep. At the time of birth, the neonate has a sleep structure in the process of evolving from the homogenous state of foetal sleep into more complex mature sleep patterns.

Despite fundamental differences between sleep at different ages, there are points of consistency. From approximately 30 weeks gestation and for the whole of life, sleep occurs in a cyclical fashion. Within blocks of sleep there are normal and appropriate episodes of arousal. In the age group being studied, there is a high level of consistency for arousals occurring at approximately 45 minute intervals.

At the time of birth, approximately 85% or 20.5 hours per day is spent asleep. Quoted figures of sleep performance in the first weeks of life suggest that 16.5 hours sleep per day is the mean length of sleep achieved. The initial study reported above shows even less sleep at three months, with 14 hours per day being reported. If we assume that the immediate pre-natal sleep length is ‘normal’, there is potentially a common experience of sleep deficit in the first weeks of life.

The information gained from this review has been utilised in developing elements of the behaviour modification program tested in the RCT.

Chapter 4 Literature Review: Part 3

Sleep Deprivation

4.1 Introduction

Sleep deprivation is widely discussed and, to some extent, universally experienced. There is a strong positive correlation between increasing sleep deprivation and impaired quality of human function. Impediments affect multiple body systems with the central nervous system (CNS) showing the greatest sensitivity. Within the CNS, higher level functions are affected first.[16 49 56] In the normal social context, and in scientific studies which achieve ethical approval, the effects of sleep deprivation show rapid reversibility upon a return to normal sleep structure.

In the context of this thesis, sleep deprivation of parents and neonates is common and has significant impact. This section will review some forms of sleep deprivation, its prevalence and impacts.

4.2 Forms of sleep deprivation

4.2.1 Complete sleep deprivation

Only in animal experiments can long term complete sleep deprivation be achieved. Continued total sleep deprivation in experimental animals is fatal.[33] Death is associated with a range of physiological disturbances including impaired thermoregulation, humoral and biochemical changes. At the structural level, extended sleep deprivation in rats is associated with degeneration of organelles in the central nervous system, possibly related to functional exhaustion and irreversible damage.[57] These findings underline again the vital functions that sleep plays and the potential significance of sleep deprivation.

4.2.2 Partial sleep deprivation

In human experience and studies which achieve ethical approval, only partial sleep deprivation is observed. These experiences may be short term, long term or variable. The latter version, most likely to be experienced by parents of neonates, is found to have the greatest impact upon CNS functioning.[58] Studies of industrial shift workers demonstrate that rotating night shifts have a higher negative impact upon total sleep than regular consistent night shifts.[59] In evaluating the impact of sleep deprivation, it has been reported that 17 hrs of enforced sleep loss produces a level of motor impairment greater than a level of alcohol consumption sufficient to exceed the legal driving limit.[43] In families caring for neonates there is a combination of both total hours of sleep deprivation and sleep fragmentation.

4.2.3 The prevalence of sleep deprivation

Australian studies report sleep problems with a frequency of 36-46%.[1] Similar frequencies are reported around the Western world.[13 5 60]

4.2.4 Precipitating factors

In families with young children, there are a number of factors which exist both independently and synergistically to create and maintain sleep disturbances.

<u>Anxiety and depression</u>

Anxiety and depression are common in young families.[6] There is a predictive correlation between depression and sleep disturbance.[3] Parents, particularly mothers, commonly report anxiety, a sense of failure and feelings of ‘stress’.[61] Anxiety impacts negatively upon sleep which impacts negatively upon mood. This combination may be self sustaining and a proportion of women diagnosed with post natal depression have sleep deprivation.[61]

Co-sleeping

This arrangement is possibly associated with disruption of sleep structure in a manner consistent with stress and impaired neurobehavioral development.[62] However, not only are some families intuitively practising co-sleeping, but certain authorities promote the practice. For example, the following quote comes from the La Leche League International, a prominent advocate of breast feeding.

"Studies have shown that co-sleeping with a breastfeeding infant promotes bonding, regulates the mother and baby's sleep patterns, plays a role in helping the mother to become more responsive to her baby's cues, and gives both the mother and baby needed rest."

As a major parent dependent cue of sleep achievement, co-sleeping might be expected to create and maintain sleep disturbance. A lower arousal threshold of co-sleeping infants has been reported. [62]

Airway problems

Snoring is a well studied form of disrupted sleep. Even mild snoring can be associated with impaired attention, lower memory and intelligence scores.[16] Both mothers and children can be affected by various levels of airway disturbance from snoring to obstructive sleep apnoea. While the literature indicates an increasing interest in studying this problem, little is yet known of the frequency. Clinical observation suggests that physical airway disorders are uncommon in neonates and infants. This would be consistent with a gradual increase in the frequency of obstructive sleep apnoea with increasing age.

Fatigue

Tiredness is common in society and particularly in mothers of young children. Many neonates present with a failure to achieve recommended total sleep per 24 hours. The literature generally identifies fatigue as being a consequence of poor sleep. This is consistent with lay experience.

The clinical work of the author suggests that this is an incomplete analysis. In observing infant behaviour, while poor sleep clearly results in fatigue, there is also a reverse relationship. With increasing levels of fatigue there is a decreased ability to achieve and maintain sleep. Fatigue sensitivity is observed in the consulting room to be inversely related to age. Thus, the younger the infant, the more fatigue sensitive they are. With increased fatigue there is a decrease in sleep performance for both sleep achievement and sleep maintenance. Thus, elevated levels of fatigue are clinically associated with increased sleep latency and decreased sleep efficiency. Other authors have commented on the child's susceptibility to fatigue. [63 64]

4.3 Effects of sleep deprivation

4.3.1 Impact upon the child

Effects of sleep deprivation upon an infant are difficult to study in a scientific fashion for ethical reasons. In addition there are no long term studies which show a link between sleep deprivation in infants and impact upon school age or later performance. Effects of sleep deprivation which are reported in older children are multiple but may include, hyperactivity,[65 45] behavioural problems, impaired school performance, reading disability [66] and increased rates of academic failure.[17] Long-term sleep disturbance in children has been associated with dyslexia.[66] Long term effects of sleep deprivation in the infant requires further study.

4.3.2 Impact upon the parent

The presence of persistent sleep disorders in a child can be associated with insecure attachment and a more ambivalent attitude to the child,[67] increased family stress, imperfect relationships in the home,[3 57 68] and maternal depression.[3 61] In particular, the development and maintenance of anxiety, depression and impaired self-esteem for the mother are commonly reported. [69] Postnatal depression is a condition of significance and "it is likely significant numbers of mothers being diagnosed as having postnatal depression are suffering the effects of chronic sleep deprivation". [61 3]

4.3.3 The central nervous system (CNS)

Effects upon the central nervous system are those which are most evident both in day to day experience and the research environment. Many specific elements of CNS functioning have been evaluated.

- Communication. These skills are decreased even after minor sleep loss. Changes include decreased word generation, focusing on limited semantic arguments, and decreased levels of appropriate intonation. [70]
- Memory. With minor sleep loss elements of memory are impaired. Temporal memory, the ability to recall recent events, is impaired initially. [49]
- Perception. In the days before ethicists, prolonged sleep deprivation studies of up to 10 days length have been reported. Consequences included disorientation, hallucinations and paranoia. [71]
- Neurocognitive functioning. More recent studies, using less dramatic sleep deprivation, display negative impact upon multiple CNS functions. Prefrontal cortex skills are severely impaired. [72] Mood is more affected than either cognitive or motor performance. Decision making is differentially impaired, with decisions based upon known rules less affected than others requiring innovation, [73] and even one night without sleep decreases vigilance and reaction times. [56]

- Motor coordination. Sleep deprivation has a well proven impact upon coordination skills. 17 hrs of sleep deprivation has been estimated to diminish motor coordination to an extent equivalent to blood alcohol of greater than 0.05%. [43]

4.3.4 Gene expression

A little known fact is an association between sleep and active expression of some genes. While for the large majority of genes, expression is not affected by variation in the sleep-wake state, there are exceptions. Being awake increases the expression of a number of genes associated with energy metabolism, neuro-transmitter vesicles, neurotransmitter transporters, plus neurotransmitter and hormone receptors. [27] The existence of a link between synapse, neurotransmitters and neurotransmitter receptors suggests a possible aetiology between sleep deprivation and impaired CNS function. The nature of this link has yet to be established.

4.3.5 Physiological functions

Multiple physiological functions are affected by sleep deprivation. Alterations in thermoregulation are readily demonstrated. Both increased and decreased body temperature have been reported.[33 74] There is a clear link between sleep performance and temperature homeostasis. Insomnia is associated with increased sympathetic activity including heart rate.[75] Multiple biochemical measures are affected by sleep performance including alterations in urinary urea, glucose, electrolytes and multiple hormone measurements.[76]

4.4 Reversibility

One of the characteristics of sleep deprivation is the ability of the body to recover. Even extended tests of sleep deprivation show rapid reversibility upon a return to adequate sleep. Recovery of the measurable impacts of sleep deprivation are usually reported after a single episode of sleep. Just as researchers still seek to identify the essential functions of sleep, so the mechanism of this rapid reversibility is unknown.

4.5 Conclusion

Sleep deprivation is common and there are a large number of identified consequences. Mechanisms of treating or preventing the problem are socially important. The key impacts of sleep deprivation are summarised in Table 2 pg 64.

Target	Impact
Children	Hyperactivity, behavioural disturbance. Reading disturbance, dyslexia, academic impairment,
Parents and the family unit	Impaired parental attachment, diminished self-esteem. Depression, anxiety and postnatal depression. Child abuse, sexual abuse, marital disharmony and separation.
CNS	Impairments to: Communication skills, memory, neuro cognitive functioning, and motor coordination.
Physiological function	Temperature homeostasis, pulse rate, respiration rate, sympathetic tone, para-sympathetic tone and multiple biochemical measures. Gene expression.

Table 2 Known associations of sleep deprivation.

Chapter 5 Literature Review: Part 4

Sleep Disturbance in Children

5.1 Discussion

The literature and the preliminary study of this thesis show that the sleep of infants and young children varies considerably.[4] However, not sleeping through the night, resisting going to bed and atypical behaviour at awakenings - problems collectively referred to as 'sleep disturbances',[11] constitute common, and sometimes serious, problems for many parents.[5 12-15] Parents frequently discuss what is considered normal for a particular age, what constitutes a problem, and seek advice on the management of sleep problems from health professionals, including general practitioners. Despite a lack of standardisation in studies reviewed to date, the literature is nevertheless consistent in showing the extent and seriousness of the problem, as well as the degree of concern it causes for parents.[5 6 9 13]

The frequency with which sleep disturbances are diagnosed relates to both the method of data collection and differing definitions of what constitutes a sleep disturbance. Commonly used markers found in the literature include :

- Problems of sleep achievement. Bedtime struggling which includes prolonged periods of time between the child being placed in bed and achieving sleep.
- Problems of sleep re-initiation. This includes recurrent signalling at times of night time waking.[5 11 13]

As many as 35% of children have sleep disturbances in the first few years of life with the highest incidence occurring in children under the age of 2 years.[4-10] Night signalling upon waking has been the most frequently investigated behaviour, although the criteria for considering this a problem have varied.[77] Multiple surveys show that 20% to 46% of

1 to 2 year olds wake on most nights.[3 15 78 79] As children grow older, most surveys, but not all, [80] show that the problem diminishes. Thus, while it must be a relief for parents to know the problem will eventually diminish or disappear, for many the problem will persist for long periods.[78] The problem of night time signalling is often compounded for many parents by the added difficulties of settling children for the night. One study found that 6% of 1 year olds and 12% of 2 year olds took more than 30 minutes to fall asleep at night.[81] Other studies show that 55% of 1 to 2 year olds have some night signalling and settling problems, with 29% reporting these difficulties at 3 years of age.[6 82 83]

Many sleep disturbances of young children are extremely persistent. Good longitudinal studies are few; however, one study, based on parental reports, found that 41% of children who had difficulty with sleeping at 8 months still had difficulties at 3 years.[6 84]Other studies illustrated that 40% of waking 8 year olds had experienced the problem since at least 3 years of age.[83 85]. To be classified as a night signaller, since most studies to date have relied on parental reports, a child must not only wake, but also attract the parent's attention to the fact that they are awake, usually by crying.[15] All infants wake intermittently at night, but those labelled as night signallers are those that cry on waking.

Negative effects are numerous and relate to the child, the parents and the family unit as a whole.[7 13 45 68] Many parents are unconcerned about their children's night waking and crying episodes, especially in young infants. However, when sleep disruptions and crying episodes persist, many parents become distressed, parental fatigue occurs and tolerance for night problems decreases. Long-term sleep disturbance has been associated with insecure attachment,[86] dyslexia,[7] hyperactivity,[45] behavioural problems,[12] impaired school performance and increased rates of academic failure.[17] Parental sleep deprivation can bring some parents to the point of abusing their children.[5 12 67] Other negative consequences include: imperfect relationships in the home, often resulting in marital disharmony,[5 67 87-89] ambivalent attitudes to the child,[67] and maternal depression..[3 6] Up to

28% of parents want help in relation to sleeping problems with their children[17] and up to 50% of parents may desire information,[5] but only a few actually receive the help that they need.[17] This may be because psychological services are scarce or helping agencies have become stigmatised.[15] By the time parents seek help, many have come to see themselves as inadequate, or failures, as parents.[15]

Factors claimed to be related to regular night awakening and crying episodes include prenatal factors, temperament, breast feeding,[90] physical illness, colic, familial distress, maternal depression,[6] parental attention, and poor sleep associations. [12 15 78 91]

Sleep associations refers to the fact that all individuals (including babies) learn to fall asleep with certain environmental cues.[45 65 82 84] The process of sleep initiation is repeated multiple times during the night at the conclusion of each physiological sleep cycle. In new born infants, sleep cycles approximate 45 minutes. Thus, a new born infant is awake and returns to sleep approximately every 45 minutes within a block of sleep. Adults have control over the conditions associated with falling asleep. Since these conditions are usually still present when waking during the night, return to sleep is generally prompt and not subject to recall the next day. [45]

It has been suggested that parents can contribute inadvertently to unwelcome night crying when they rock, hold, pat or feed their infants to sleep at bedtime.[10] Inappropriate management of sleep cues and behaviour patterns may initiate and maintain infant sleep disturbance.[92] That is, the child has not learnt to re-initiate sleep without the parent repeating similar conditions in which they originally went to sleep. Night crying may thus be conceptualised as the product of an interaction between parental behaviour and inborn child temperament.[45 78 82]

In clinical practice fatigue appears to be a positive correlate with poor sleep. While this observation is counter intuitive the literature offers support. The infants susceptibility to fatigue has been noted by other authors.[63 64]

Various techniques have been discussed in relation to modifying infants and young children's sleep patterns. Those showing the best and most persistent results involve behaviour modification,[2 93] using techniques such as programmed wakening,[93] systematic ignoring,[12] and graduated extinction.[15 85 94] Other approaches include supportive counselling for the parents, inpatient admission or various combinations of the above.[2 15] Although it has been shown that treatment can be effective, regular contact with health professionals over a number of weeks is normally required, with longer treatment needed for more entrenched sleep disturbance.[95] Prevention may be a better solution in the long term, given the widespread nature of the problem and the potential for severe consequences. In addition, a short and thus cheap intervention technique is required in view of the potential number of services required.[91]

Chapter 6 Literature review: Part 5

Interventions for the management of sleep disorders

6.1 Introduction

It has been argued above that sleep serves an essential purpose for the maintenance of normal body function. It has also been shown that sleep disorders are common and have a significant impact upon infant and parent well-being. In attempting to assist families with these problems, a range of strategies have been developed by health-care providers. These are discussed in this section.

6.2 Sleep interventions

Multiple interventions exist to assist with sleep disturbances. They may be used independently or in combination.

6.2.1 Drug therapy

The use of sedation to manage infant sleep problems is common,[2 60 96] the most frequent approach being the use of the phenothiazine containing antihistamines. This approach has significant problems. There is little evidence of long-term benefit,[2] the manufacturers of these drugs clearly recommend that they may not be used under the age of two years and there is some evidence for a positive correlation with sleep apnoea. [97] This follows the reporting of a possible correlation between phenothiazine antihistamines and sudden infant death syndrome. [97] While this work has not been replicated, most authorities do not recommend that this family of drugs be used either in the age group being discussed, or for the extended periods of time for which sleep disorders may exist.

6.2.2 Behaviour modification

Behaviour modification in the context of neonatal and infant sleep refers to changes in the parental response. Multiple variations exist and these will be discussed below.

6.2.3 Positive routine

In this technique bedtime is established at that time which the child naturally achieves sleep. That time is preceded by positive interaction between parents and child. Once a sleep routine is established, the timing of events is gradually moved to that time which the parents had originally intended. The major advantage of this technique is the avoidance of conflict between child and parents. It is particularly appropriate where the sleep problems relate to delays in sleep achievement. It is of little value for problems of sleep maintenance. [94]

6.2.4 Programmed awakening

In this technique, more appropriate for problems of sleep maintenance, the child is awoken through the night and resettled. The premise in this technique is that the child will awaken through the night and that the times of awakening have a degree of predictability. The parents have insight as to the times when the initial awakening occur. By anticipating this time by several minutes, the parents take additional responsibility. The child is resettled using minor interaction such as rewrapping. Over time, parental intervention is decreased and eventually ceased. As the child has ceased playing an ‘active’ role in awakening through the night the technique can assist in diminishing and ultimately avoiding recurrent, self initiated, night-time awakening.

6.2.5 Graduated extinction

Perhaps the most commonly utilised strategy in Australia and often referred to as controlled crying.[98] The technique relies upon a gradual removal of a parent from the sleep achievement and the sleep maintenance event. While the technique has proven efficacy,[94] it does involve the parents in listening to the child cry while they do not attend. Several different strategies are utilised by different authorities. The essential element of difference is the timing between the child's onset of crying and parental attendance occurring. This can vary from as little as one-minute up to 15 minutes. In addition, while some authorities recommend that the maximum time of crying be, for example, ten minutes, other authorities will continue to expand the time that the child is alone without limit until eventually the child has achieved sleep independently. While the methods above use parental contact as the strategy for sleep achievement, in this technique the physical presence of the parent is consistently diminished.

6.2.6 Systematic ignoring

In this technique the child is placed down in an appropriate manner and left by the parents until sleep is achieved.[12] While the technique has proven efficacy it relies upon the parents not responding to the child's cry, irrespective of the length, until sleep is achieved. It has been reported that this technique, which uses no parental cue of sleep achievement, can be superior to programmed awakening.[12]

6.2.7 Supportive counselling for the parents

Some researchers have attempted to solve sleep problems using an approach based upon informing parents about normal sleep structures and the range of interventions which can be chosen. This approach has proven to be superior to simply waiting for sleep problems to resolve spontaneously.[15 95]

6.2.8 Inpatient admission

On occasion, the sleep disorder and its impact upon the family is so severe that inpatient admission is required. Generally this approach focuses upon the management of anxiety or postnatal depression in the mother. It is seen as a crisis management strategy and has not been studied as a method of resolving the sleep problems.

6.2.9 Combination therapy

Various authors have combined elements of behaviour modification and parental information or counselling.[15]

6.3 Discussion

6.3.1 General efficacy of behaviour modification

Recent systematic review has suggested superiority for behaviour modification techniques as opposed to drugs therapy.[2] This review by Paul Ramchandani et al looked at all randomised controlled trials of interventions for problems of sleep initiation and sleep maintenance. This has been further supported by more recent RCT's in neonates.[99 100 101]

6.3.2 Drug Therapy

Drug therapy while widely used, [102] appears to have mainly short term benefit with limited ability to demonstrate maintenance of the improvement.[96 103] Parents report concerns about their children being on medication,[104] a finding confirmed by the author's clinical experience. It is concluded that while drugs may be helpful for short term management they have a limited role in resolving sleep problems

Most other interventions involve some form of psychological or behavioural approach. These can include programs of modifying behaviour guided by a therapist, self help booklets and parent intervention groups.[2] Some programs provide non directive education in the form of written material. For those studies which include behaviour modification, a wide range of techniques have been described. These include positive routines, graduated extinction, scheduled awakenings, extinction (systematic ignoring), modified extinction, plus educational booklets and a range of other sleep programs. Various forms of extinction, both with and without ongoing support, were successful.[12 94 105] Those which reviewed sustainability were able to demonstrate ongoing improvement at six weeks[12 94] and 12 weeks[106] following treatment. Techniques which included non directive education were of no benefit.

Current research supports the finding that a directive model of behaviour modification with an educational element, and where some form of extinction is advised, has proven efficacy and sustainability.

6.3.3 Cues of sleep achievement

The essential difference between various behaviour modification techniques relates to the amount of parental contact and its timing. It would appear that children can learn from an early age to achieve sleep either with parental support, independently, or with variable amounts of parental contact. Parents may become an element of the process of achieving sleep. They can become “cues” of sleep achievement or sleep maintenance or both. Published research and the author’s clinical experience suggest the superiority of techniques which allow the infant to develop independent skills of sleep achievement. The principal public source of advice to families with infants in South Australia suggests that infants can only ‘learn’ styles of sleep achievement after six months of age.[107]

6.4 Conclusion

The frequency with which sleep disorders occur, the negative impact they can have upon family life, and general teaching in the South Australian community that infants are unable to learn sleep cues under six months of age, led the author to investigate these issues. The following chapters relate to a preliminary investigation seeking to establish the frequency of sleep problems in South Australia, an RCT to investigate the efficacy of behaviour modification in neonates, and a follow-up on that study after five years.

Chapter 7 A Survey of Infant Sleep, and associated Family Well-Being

7.1 Abstract

A survey of sleeping in newborn infants in their first year of life was conducted in South Australia. Data was collected on parental demography, sleep variables, perceptions of family well-being, sources of information and the quality of the relationships within the family unit. The findings showed that strategies for sleep achievement, time of going to bed, time taken to achieve sleep and quality of sleep maintenance varied widely within the community. Women were divided into 'early responders', who attended to a crying child within 60 seconds, and 'late responders' who left a child to cry for an average of six minutes before responding. Early responders experienced more night waking and less total night sleep. This effect, while already present at three months, was maintained at 12 months of age.

While parents sought advice from multiple sources, medical practitioners, and in particular rural general practitioners, were the professional resource used most frequently. Advice from medical practitioners was more highly valued than any other source.

Equipping primary care medical officers with evidence based information on infant sleep was a recommendation from this survey.

7.2 Introduction

The frequency of sleep disorders in the primary care setting is variable.[1 2 5] In the sleep literature, Western cultures report sleep disorders in the first year of life with a frequency of approximately 30% - 46%. [1 2] In the primary care setting, parents frequently present requesting advice on the care of their newborn infant. At the time of this survey the author was a rural general practitioner. In caring for families with young infants and their sleep disorders, the author was struck by the frequency of the latter and the impact which persistent, disrupted sleep had upon family functioning. In planning the development of an intervention program, background information was required about sleeping in the community in which it would be utilised.

Funding was received from the Department of Health, Housing and Community Services (now Department of Health and Aging) to survey families in South Australia, with a focus on the experience of normal mothers and fathers. This chapter presents the survey which was designed, piloted and completed with a focus on families with children in their first year of life.

7.3 Aims

To review infant sleep in South Australia.

There were no hypothesis for this study.

7.4 Methodology

7.4.1 Design

The study was a structured interview.

7.4.2 Interview instrument

A questionnaire was designed 'de novo' to answer a series of specific research questions aimed at defining the issues associated with neonatal sleep. Assistance in this process was obtained from midwives working at the author's primary rural hospital. Once drafted, the instrument was piloted by the principal midwife assistant. This occurred through a small series of home visits with volunteer parents. The process identified a series of questions which were ambiguous to the interviewee. These questions were rewritten and the instrument retested. A second pilot confirmed that the wording was clear to both the parent being interviewed and the research nurse applying the instrument. Three research nurses were trained in the use of the instrument by the author. Training emphasised obtaining telephone consent to visit the subject's home, wording of questions that could be interpreted incorrectly and the correct method of coding required. Answers related to the child's present behaviour rather than previous.

Project nurses visited the family home and assisted the parent, usually the mother, in completing the questionnaire. Home visits occurred over a six month period in 1993. Scoring was a mixture of yes / no fields, numeric answers and avoided all free text. This technique avoided common problems of surveying such as lost forms, delayed returns and varied interpretation of questions.

Research nurses were recruited from each of three participating hospitals. The use of staff from each participating hospital allowed patients to be identified, provide consent, and to be visited at home without releasing identifying information to the author. This process allowed approval for the research to be granted by each organisation.

Data was entered into Epi-Info 6.0 by nursing and clerical staff, and checked for accuracy by the author. All data was visually checked for accuracy of data entry. A small number of data entry errors were identified and corrected.

Data analysis included ANOVA testing of means. Many survey questions asked subjects to select a single answer from a five point scale. Data from the five point scale was analysed to produce means. This mean value was then converted to a percentage of the best possible outcome.

Much of the analysis related to advice received and its value. Obtaining advice and finding it useful are connected but different variables. Combining scores for these two gave a numeric representation of the combined effect nominally entitled an estimate of 'social value'. If a source of advice was utilised 100% of the time and was useful 100% of the time, the 'social value' was 100% (1.0) X 100% (1.0) = 100% (1.0). If a resource was utilised 50% of the time and was useful 50% of the time, the social value score was 50% (0.5) X 50% (0.5) = 25% (0.25).

7.4.3 Subjects

Target populations

All patients from two rural towns who had delivered an infant in the preceding twelve months

Patients who had delivered an infant at the Queen Victoria Hospital in the preceding three months. The former two hospitals were sites of convenience. The Queen Victoria Hospital was deemed to be a reasonable representative of suburban populations as it was the largest obstetric service in Adelaide and additionally there were academic relationships in existence which allowed the project to obtain approval.

7.4.4 Inclusion criteria

Rural

- all deliveries at Meningie Hospital and Murray Bridge Hospital in the 12 months preceding the survey
- parents could be contacted by telephone
- parental home could be visited
- parents consented to be interviewed
- child had achieved 3, 6 or 12 months of age +/- one week

Suburban

- consecutive deliveries
- parents could be contacted by telephone
- parental home could be visited
- parents consented to be interviewed
- child had achieved 3 months of age +/- one week

7.4.5 Exclusion criteria

- family could not be telephoned
- family could not be physically visited
- mother was involved in alcohol or drug rehabilitation program
- child had a major health problem requiring specialist care as identified from the notes

7.4.6 Sample size

The rural sample was determined by the total number of deliveries in the time frame under review. The suburban sample was chosen to match the rural in total numbers. For technical reasons, the suburban sample was selected from consecutive deliveries where the child was approaching three months of age at the time of the survey. It was not possible to select children of multiple ages due to the administrative restrictions placed upon the research nurse by the hospital.

7.4.7 Measures

There were 61 items on the questionnaire and most had sub-elements. (See appendix V) The sections were designed to elucidate information about the following;

- Childs demography
- Mechanisms of feeding including amongst other details,
    - Bottle
    - Breast
    - Solids
- General and detailed information about sleep including amongst other details,
    - Bed time at night
    - Settling time
    - Length of sleep at night

    - Methods of sleep initiation
    - Day sleeps
    - Night time arousals
- Crying patterns
- General health
- Mothers demography
- Fathers demography
- Family
    - e.g. two parents three children
    - measures of family functioning
    - family support
- Parental attitudes to the child
- Sources of parenting advice and its value

7.5 Results

7.5.1 General

Of the 230 families surveyed 111 were suburban and 119 rural. Participation rates were high. Of 120 rural families approached one declined to participate (0.8%). Of 114 suburban families only three declined to participate (2.6%)

There was an average of two children per family. Suburban families were smaller having a mean 1.76 children compared to 2.33 in rural communities.

7.5.2 Mothers

The mothers had an average age of 28 years. Suburban mothers were on average a year younger with a mean of 27.5 years (28.6 years rural). Ninety six percent (96%) of women described themselves as Caucasian. While the average level of secondary education was year 11, there were 43% who had some form of extra training beyond secondary school. Twenty five percent (25%) had some employment. Of these women, 10% (2.5% of the total) were working full-time.

7.5.3 Fathers

Fathers had an average age of 30.6 yr and 96% described themselves as Caucasian. While the average level of secondary education was year 11, there were 50% who had some form of extra training beyond secondary school. 85.3% had some employment, and of these 92% (78% of the total) were working full-time. While suburban men had more education they were less likely to be employed, with slightly more than 16% being out of work compared to 13% of rural men ($p = 0.55$).

7.5.4 Family

The majority of families had two parents at home. Only 6.6% of families surveyed were single parent homes. Suburban families were more likely to be single parent (8% compared with 5%) ($p = 0.5$), and to have experienced separation in the last year (3.6% compared with 0.8%) ($p = 0.32$).

Almost 97% indicated that the family unit had been stable for the preceding 12 months. Approximately 25% of suburban respondents felt neutral or unhappy with their family life. Only 12% of rural respondents felt neutral or unhappy with family life.

Financially, rural families were on lower incomes with 62% having a total family income of less than $25K compared with 43% of suburban families. ($p < 0.001$)

7.5.5 Rurality

In comparing rural and suburban families differences were minor. All data collected which allowed comparison showed similar demographics. Where there were differences these were not significant. The only area which approached significance, with a p value of 0.09, suggested that rural families were happier. (Table 3 pg 82 (over two pages)).

	Suburban	**Rural**	**P value** $^{+}$
Total number of families	111	119	
Mothers age	27.5 yr	28.6 yr	
Fathers age	30.1 yr	31 yr	
Mothers mean level of secondary education	11.3 yr	11.0 yr	
Fathers mean level of secondary education	11.2 yr	10.7 yr	
Any additional training after secondary school			
-mother	42%	43.3%	
-father	53%	44.6%	0.24
Father employed	84%	87%	
Two parents at home	92%	95%	
Number of separations in the last year	4	1	0.16
Divorced	0	0	

Table 3 Demographic comparisons for rural and suburban families

(This table continues over page).

	Suburban	Rural	P value +
Happy * Maximum score 1 minimum score 5	1.83	1.5	
Calculated % of maximum happiness	79%	88%	0.09
Enjoying the baby Maximum score 1 minimum score 5	1.32	1.19	
Calculated % of maximum enjoyment	92%	95%	0.5

Table 3 Demographic comparisons for rural and suburban families (cont').

* This score was generated from the question; "Is the family group successful ?"

\+ data analysed using 2 x 2 tables Chi square and Fishers exact where #'s <5

7.5.6 Sources of parenting information

Mothers were asked to identify information sources which they utilised. Table 4 and Figure 4 summarise these results.

	Doctor	Hospital	CAYHS*	Relative	Friend
All families	66.5%	60.4%	72.2%	69.1%	53.5%
Suburban families	46.4%	57.3%	58.2%	78.2%	48.2%
Rural families	85%	63.3%	85%	60.8%	58.3%
p value (Suburban v's rural)	< 0.001	0.4	< 0.001	0.003	0.03

Table 4 Sources of advice

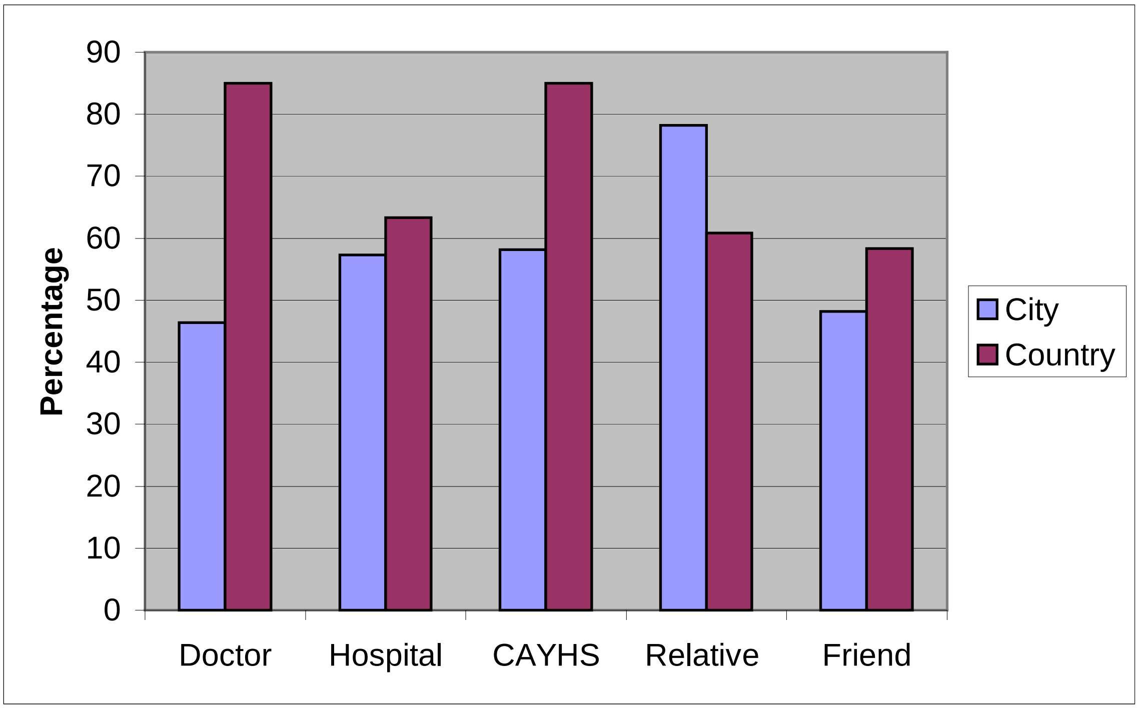

Figure 4 Sources of advice (suburban versus rural).

* Note. The abbreviation CAYHS refers to the principal public organisation supplying care to families with young children in South Australia. It's current title is "Child and Youth Health".

7.5.7 Value of advice received

The advice received by families was evaluated on a five point scale. A score of one (1) was useful advice most of the time, three was advice of neutral value, and five indicated that the advice was rarely useful. All scores were obtained at the time of interview.

	Doctor	Hospital	CYH	Relative	Friend
All families					
Value score (1 = highest score 5 = lowest score)	1.56	1.79	1.96	2.65	2.53
Percentage of maximum possible value of advice	86%	80%	76%	59%	62%

Table 5 Value of advice received (suburban versus rural)

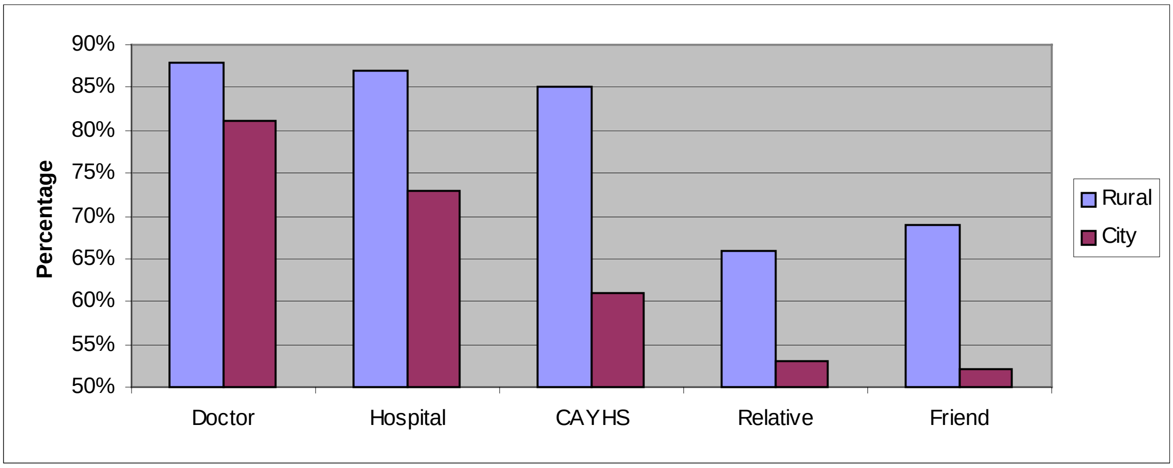

Figure 5 Value of advice received suburban versus rural as a % of best possible score.

A high proportion of families reported that doctors gave advice of good value. Rural doctors achieved the highest approval with an 88% rating. Suburban friends and relatives received the lowest ratings at 52% and 53% respectively.

The value of advice was also analysed by calculating a slightly different variable. A calculation was made of the proportion of respondents who felt that the advice received was of good value (score one or two), neutral (score three), or of poor value (score four or five).

The best advice appeared to come from general practitioners and other medical officers who had been consulted. Rural doctors received slightly higher approval ratings than their metropolitan colleagues.

	Good value	Neutral	Poor Value
City	66.7%	29.4%	3.9%
Country	80.4%	15.7%	3.9%
p value	0.001	0.03	N/A

Table 6 Percentage evaluation of advice from doctors

Hospitals were usually regarded as providing good advice, and again rural organisations predominated with a 77% approval rating. Suburban hospitals were reported as providing useful advice approximately half the time.

	Good value	Neutral	Poor value
City	50.8%	44.4%	4.8%
Country	77.0%	18.9%	4.1%
P value	< 0.001	< 0.001	N/A

Table 7 Percentage evaluation of advice from hospitals

Satisfaction with the state based organisation specialising in the area of child health (Child and Youth Health Services) was varied. While 72.5% of rural respondents reported that CYH advice was of high-value, suburban families reported 35.9% satisfaction. In fact, 64.1% or almost two in three suburban women reported that CYH provided advice of neutral or poor value.

	Good value	**Neutral**	**Poor Value**
City	35.9%	50.0%	14.1%
Country	72.5%	25.5%	2.0%
P value	< 0.001	< 0.001	< 0.001

Table 8 Value of CYH advice suburban versus rural

Advice from friends or relatives was poorly evaluated. A range of 66% to 77% of respondents found that advice from these sources was of poor value.

7.5.8 Social value score

As described above, combining scores on value of advice and the frequency with which the group was used for advice, was in turn used as an estimate of 'social value'. Performing this calculation for various sources of advice gave the following figures.

	Doctor	Hospital	CYH	Relative	Friend
All families					
Resource utilised	66.5%	60.4%	72.2%	69.1%	53.5%
Percentage of maximum possible value	86%	80%	76%	59%	62%
Social Value score	57.2%	48.3%	54.9%	40.8%	33.2%

Table 9 'Social value' of various sources of advice for all families

When reviewed for rural and suburban families a different picture emerged.

	Doctor	Hospital	CYH	Relative	Friend
Suburban families					
Resource utilised	46.4%	57.3%	58.2%	78.2%	48.2%
Percentage of maximum possible value	81.0%	73.0%	61.0%	53.0%	52.0%
Social Value score	37.6%	41.8%	35.5%	41.4%	25.1%

Table 10 'Social value' of various sources of advice for suburban families

	Doctor	Hospital	CYH	Relative	Friend
Rural families					
Resource utilised	85.0%	63.3%	85.0%	60.8%	58.3%
Percentage of maximum possible value	88.0%	87.0%	85.0%	66.0%	69.0%
Social Value score	74.8%	55.1%	72.3%	40.1%	40.2%

Table 11 'Social value' of various sources of advice for rural families.

Thus when estimating the 'social value' for all possible sources of information the following results arose. Best scores were given to rural doctors and lowest scores to suburban friends.

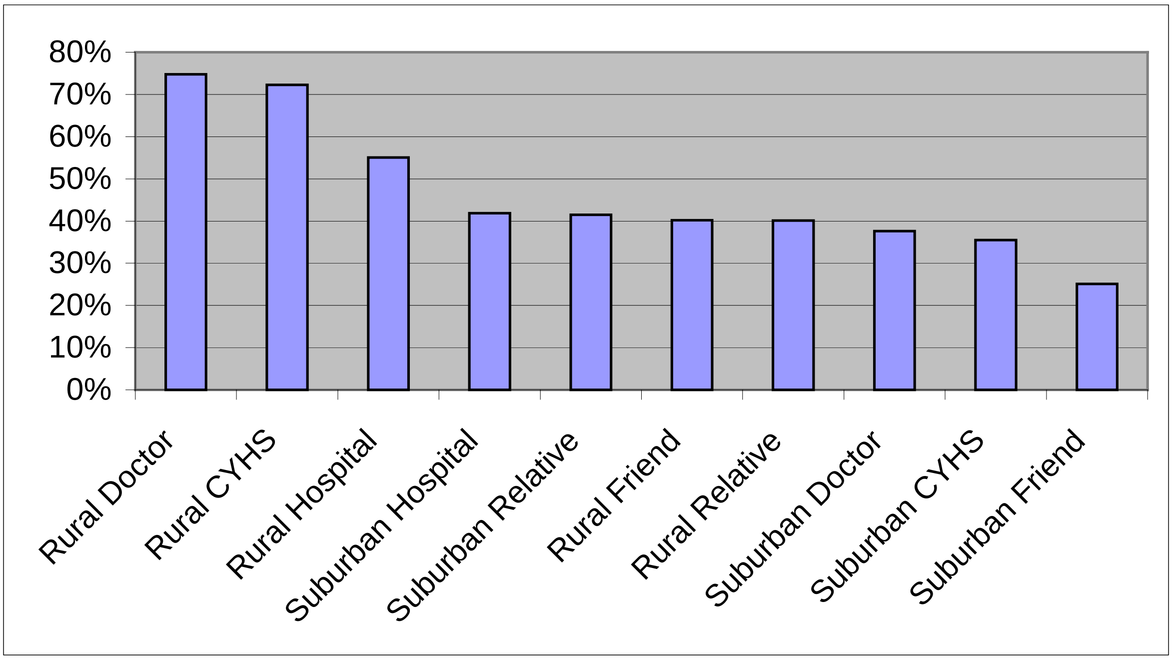

Figure 6 'Social value' scores of different sources of information for all families comparing rural and suburban resources

7.6 Sleep

7.6.1 Bed time.

The time at which children are put to bed varied greatly. Although data was collected on children at three, six and twelve months, only results for children at three months of age are presented below in order to allow reasonable comparison.

The mean time of the child's settling was almost 2100 hours. The SD was wide at 1.3 hours. A minority of infants (32.7%) were settling for their main night sleep at 10 pm or later.

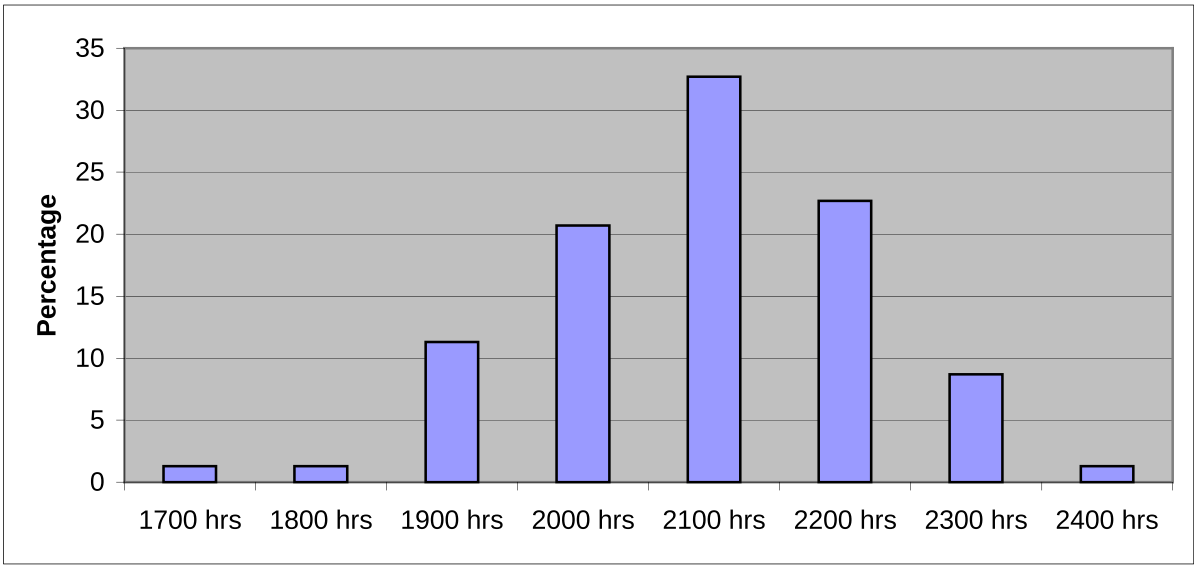

Figure 7 Bed time at age three months

Settling time	1700	1800	1900	2000	2100	2200	2300	2400
Percentage	1.3	1.3	11.3	20.7	32.7	22.7	8.7	1.3
Cumulative %	1.3	2.6	13.9	34.6	67.3	90	98.7	100

Table 12 Percentage of children in bed versus time at night

The total proportion of infants in bed increased steadily from 14% at 1900 hours to the large majority (90%) by 2200 hours.

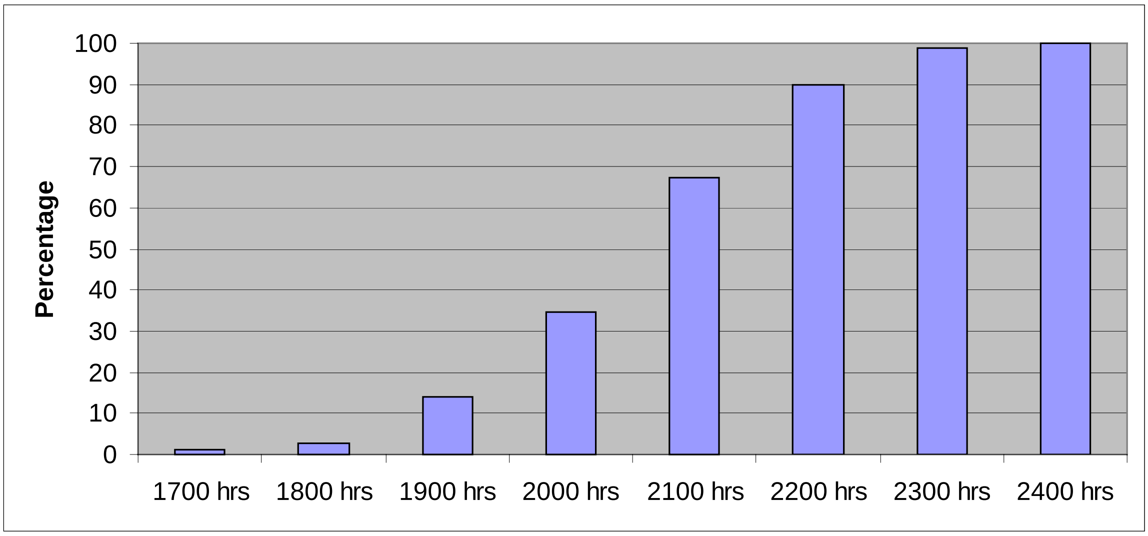

Figure 8 Cumulative totals of children in bed at age three months

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When comparing infants of different ages some significant variations emerged. Mean bed time at age three months was almost 2100 hours, six months 2000 hours and 12 months 1930 hours. In parallel with the mean bed time moving earlier in the evening, the standard deviation for bed time decreased. The large majority (98.7%) of parents regarded their children as having a regular bed time.

Age	Mean bed time	Standard deviation (SD) of bed time
Three months	8.54 PM	1.3 hours
Six months	8.06 PM	1.0 hours
Twelve months	7.36 PM	1.1 hours

Table 13 Mean bed time versus age

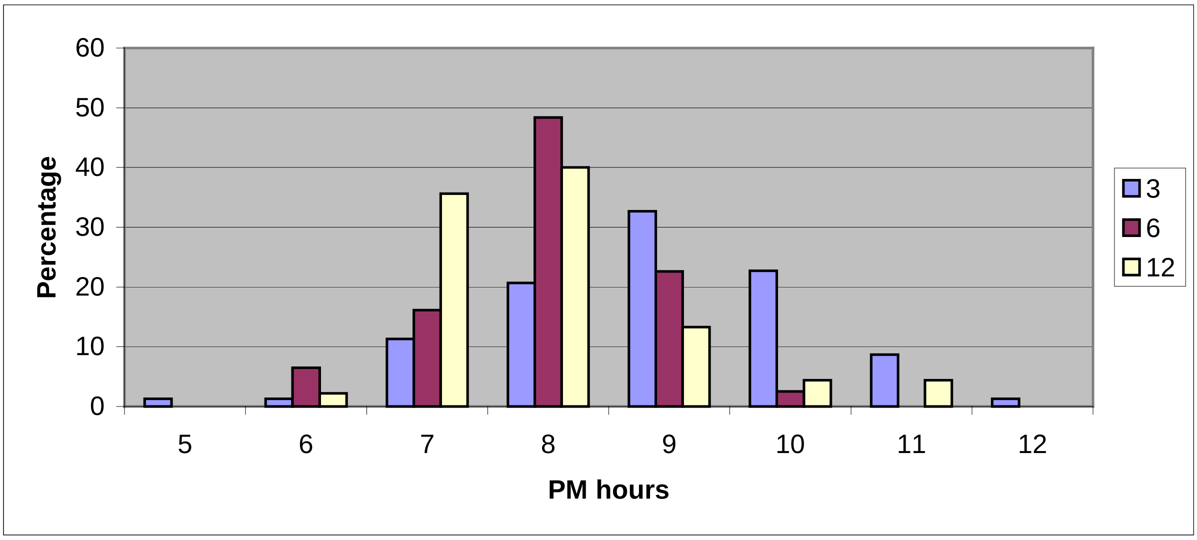


Figure 9. Bed time at night versus age in months

7.6.2 Settling time

The time taken to achieve sleep varied widely. At three months mean settling time was 10.3 minutes with a wide SD of 12.9 minutes. Results in the data table suggest a bimodal distribution of settling times (Table 14 pg 93). One subset of children (65.8%) achieved sleep in under 8 minutes (mean 3.6 min's). A second subset (34.2%) took more than 8 minutes (mean 23.3 min's). In comparing the two subsets, the latter group had a mean settling time more than 6 times that of the former.

Minutes	2	7	10	15	20	30	50	90
Percentage	44.3	21.5	2	19.5	0.7	8.1	3.4	0.7

Table 14 Settling time in minutes at age three months.

This bimodal character is still present when looking at all age groups and all children.

Minutes	.0-4	.5-9	.10-14	.15-19	.20-29	.30-39	>40	n’
n'	102	51	3	44	2	18	6	226
%	45.1%	22.6%	1.3%	19.5%	0.9%	8.0%	2.7%	100%

Table 15 Settling time in minutes for all children

7.6.3 Method of initiating sleep

Sleep achievement for infants at three months is a parent driven event. Comments from the research nurses showed that strategies of sleep achievement varied greatly, both within and between families. The strategy used could also change from night to night and even within a given night. Thus a given family could claim the use of multiple sleep achievement strategies.

Strategy	3 months	12 months
Fed while achieving sleep	89.5%	60.9%
Minimal handling	63.4%	69.6%
Held while achieving sleep	43.8%	21.7%
Bathed before bed	34.6%	54.3%
Rocked to sleep	24.8%	2%
Radio on	17.6%	4%
Light on	17.0%	19.6%
In bed with parents	2.6%	6.5%
Other method	0.7%	4.3%

Table 16 Sleep initiation strategies

7.6.4 Night sleep

Total night sleep

Mean total night sleep at age three months was 7.78 hours with a SD of 2.32 hrs. 31.4% of infants achieved 6 hours or less sleep per night. 41.2% of infants achieved 7.0 to 9.0 hours sleep. 27.5% achieved more than 10 hours sleep per night.

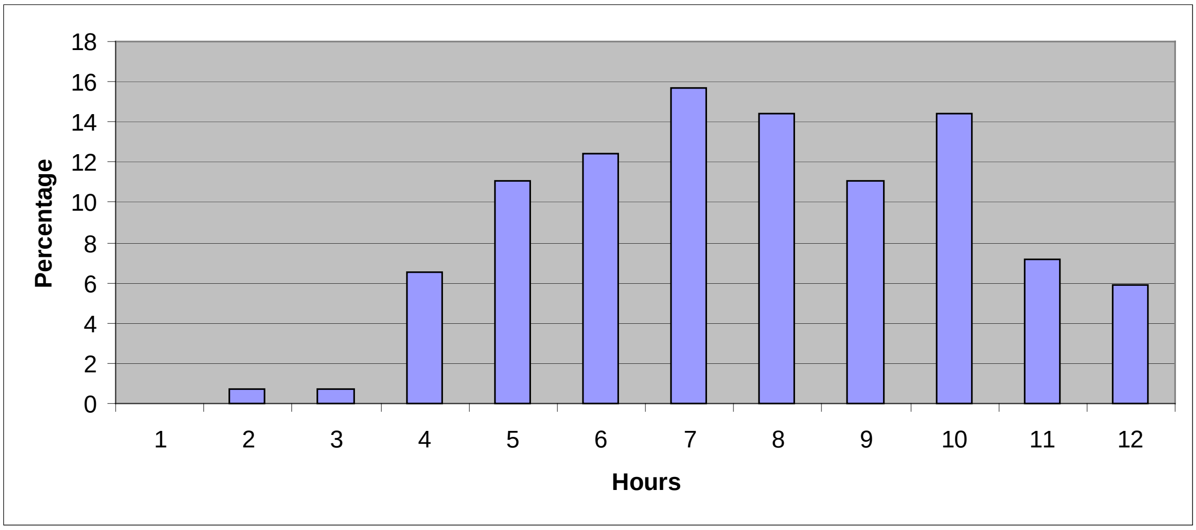


Figure 10 Total night sleep at age three months

Total hrs of night sleep	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Percentage										
3 mths	0.7	0.7	6.5	11.1	12.4	15.7	14.4	11.1	14.4	7.2	5.9
6 mths		3.2			6.5	6.5	12.9	22.6	19.4	6.5	22.6
12 mths		2.2				2.2		8.7	21.7	28.3	37

Table 17 Total night sleep. Percentages by age in months

Mean total night sleep increased from 7.78 hours at three months to 9.36 hours at six months and peaked at a mean of 10.7 hours at 12 months.

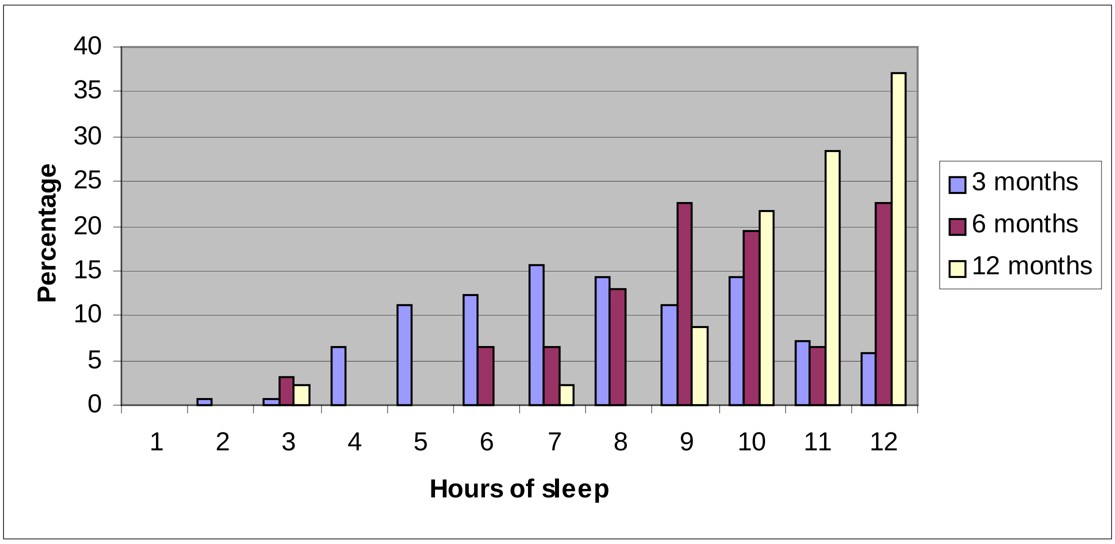


Figure 11 Total night sleep versus age in months

Longest night sleep

The mean longest night sleep at three months was 9.2 hours (SD 2.47 hours).

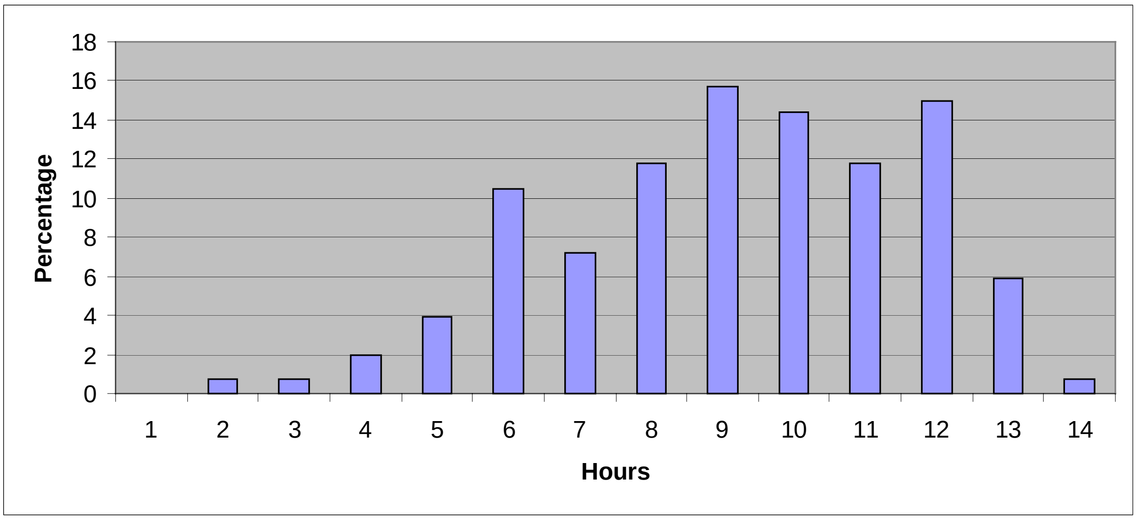


Figure 12 Longest night sleep at age three months

As age increased the longest night sleep increased. By six months it had increased by more than one hour to 10.2 hours, and at 12 months had increased by an additional hour to 11.2 hrs per night.

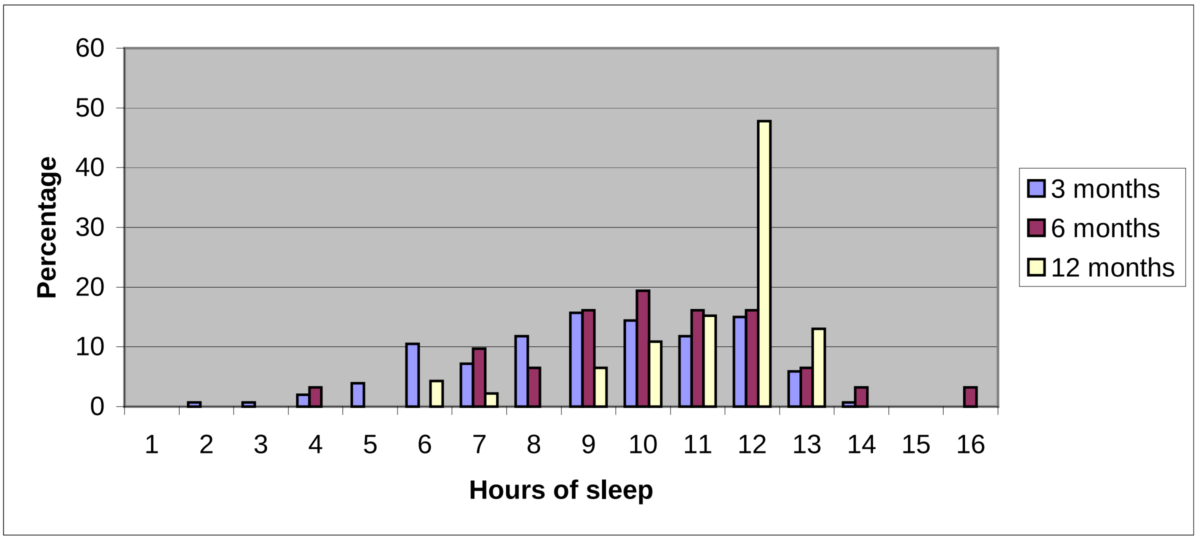


Figure 13 Longest night sleep versus age in months

Day Sleep

The mean number of day sleeps at three months was 2.89. The mean length of a day sleep was 2.14 hrs. Combining these numbers calculates a mean total day sleep of 6.18 hrs.

By six months the mean number of sleeping periods was 2.45. The mean length was 2.68 hours. Calculated mean total day sleep was 6.57 hours

By 12 months the mean number of day sleeps was 1.74. Their mean length was 2.53 hours. Calculated mean total day sleep was 4.4 hrs.

7.6.5 Crying time

Mothers were asked how long they would leave a child crying before attending. Mean crying time for all subjects was 3.6 min. The data appeared to be bimodal. A large minority of women (48.0%) indicated that they would respond to their child’s crying in two minutes or less. Mean crying time before responding in this group was one minute (SD 0.14 min’). For mothers willing to leave a child for more than two minutes, mean crying time allowed by the mother was 6.0 min’ (SD 3.5 min’).

Women who allowed a child to cry for more than two minutes (mean six minutes) are referred to in this thesis as ‘late responders’. Those who respond in two minutes or less (mean one minute) are referred to as ‘early responders’.

Time in min’s	0	1	2	3	4	8	13	18	21	n'
n'	1	108	1	2	76	32	5	2	2	229
%	0.4	47.2	0.4	0.9	33.2	14	2.2	0.9	0.9	100%
Cumulative %	0.4	47.6	48	48.9	82.1	96.1	98.3	99.2	100	
Reverse cumulative %	100	99.6	52.5	52.1	51.2	18	4	1.8	0.9	

Table 18 Time of crying in minutes before a parental response

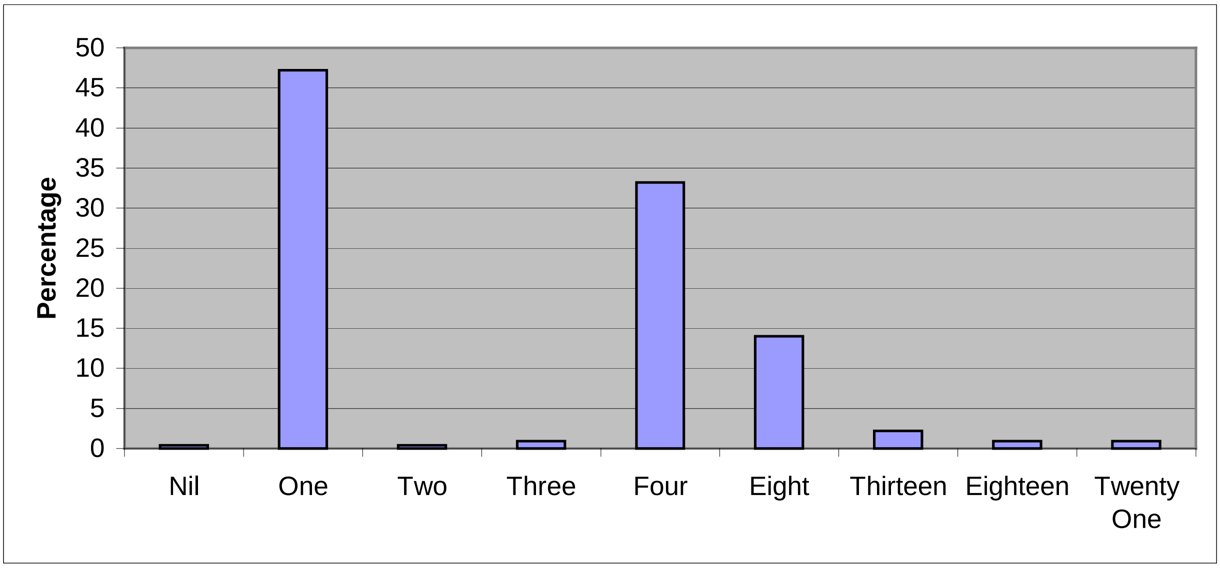


Figure 14 Acceptable crying time in minutes before a parental response

7.6.6 Night time events

<u>Waking overnight</u>

The frequency of night time wakening is relevant to family life. The table below reflects the total number of night awakenings at different age groups and for different parent groups.

	3 months	6 months	12 months
All subjects (230)			
Number of subjects	153	31	46
Mean no' of awakenings per night	1.36	1.03	1.07
'early responders' +			
Number of subjects	83	13	15
Mean no' of awakenings per night	1.46	1.48	1.53
'late responders' *			
Number of subjects	70	18	31
Mean no' of awakenings per night	1.24	0.67	0.84
Awakenings for 'late responders' as a percentage of awakenings for 'early responders'.	85%	67%	56%

Table 19 Night awakenings versus age for late and early responders

* 'late responders' allowed a child to cry for more than two minutes

\+ 'early responders' allowed a child to cry for two minutes or less.

Attending overnight

The number of times that a parent responded to the child overnight as opposed to being woken showed a mean of 1.36 at three months. Mean attendances for 'early responders' and 'late responders' are shown in Table 20. SD's are shown for 'early' and 'late responders'.

				Number of attendances									
	n'	**Mean**	**SD**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
All	(153)	1.36	1.57	32.7	30.7	20.3	12.4	0.7	0.7	0	0	2.0	0.7
Early	(83)	1.48	1.90	34.9	28.9	18.1	10.8	1.2	1.2	0	0	3.6	1.2
Late	(70)	1.21	1.03	30	32.9	22.9	14.3						

Table 20 Number of attendances overnight at age three months as percentages

	3 months	6 months	12 months
All subjects (230)			
Number of subjects	153	31	46
Mean no’ of attendances	1.36	1.00	1.07
Mean no’ of awakenings	1.36	1.03	1.07
‘Early responders’			
Number of subjects	83	13	15
Mean no’ of attendances	1.48	1.46	1.60
Mean no’ of awakenings	1.46	1.48	1.53
‘Late responders’			
Number of subjects	70	18	31
Mean no’ of attendances	1.21	0.67	0.81
Mean no’ of awakenings	1.24	0.67	0.84
Attendances by ‘late responders’ as a percentage of attendances for ‘early responders’	82%	46%	55%

Table 21 Number of attendances and awakenings overnight versus age.

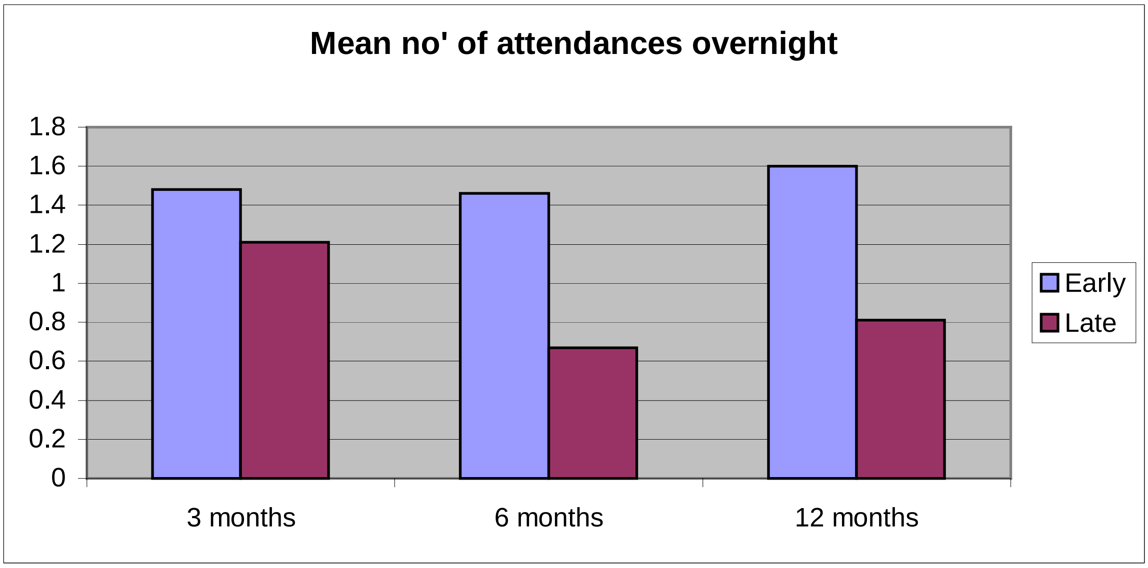


Figure 15 Mean number of attendances overnight versus age

7.6.7 Mothers’ perceptions

Mothers were asked to evaluate a range of questions about the quality of their child's sleeping. Responses for infants at three months were as follows.

Infants at three months of age (n = 153)		
	Y	N
Settles to sleep well	93.5%	6.5%
Sleeps through normal sounds	95.4%	4.6%
Is a light sleeper	17%	83%
Has a sleep problem	5.2%	94.8%

Table 22 Mothers’ perceptions of child's sleep

7.6.8 Satisfaction with family life

The mothers’ sense of family well being was evaluated. Mothers were asked to grade whether they felt that family life was successful on a five point scale:

- Happy = 1
- Reasonably happy = 2
- Neutral = 3
- Reasonably unhappy = 4
- Unhappy = 5

	Proportion scoring 1 or 2	Proportion scoring 3, 4 or 5	n
City	76.4%	23.6%	111
Rural	87.5%	12.5%	119
p value	0.02	0.03	

Table 23 Satisfaction scores for family life comparing rural and suburban families

7.7 Enjoying the baby

Mothers were asked to score whether they were enjoying their child. The scoring scale was;

Q. Enjoying the baby?

A. Yes / Most times / Sometimes / Rarely

As such low numbers of mothers reported a sleep problem numbers were too small to allow any meaningful analysis of whether the presence of a sleep problem had an association with enjoyment.

	Proportion of families reporting maximum score	Proportion of families reporting a positive result.	n
All families	78.2%	98.2%	230
Suburban	71.6%	98.2%	111
Rural	84.2%	98.2%	119
p value (Suburban v's rural)	< 0.001	N/A	

Table 24 Proportion of families reporting positive satisfaction score with the child

Families identified as early and late responders were analysed for their satisfaction both with the infant and with family life.

	All families	'early responders'	'late responders'
n	230	111	119
Happy family ? (Score on 5 point scale with 1 = max')	1.66	1.66	1.66
Percentage of maximum possible score	83.5%	83.5%	83.5%
Enjoying baby ? (Score on 5 point scale with 1 = max')	1.25	1.21	1.30
Percentage of maximum possible score	93.8%	94.8%	92.5%

Table 25 Parental satisfaction scores comparing 'early responders' and 'late responders'

7.8 Discussion

7.8.1 Sample

This survey studied families in South Australia from rural and suburban communities. There were differences in the two populations. Children of suburban families were exclusively aged three months as a result of restrictions placed upon the research nurse by the hospital releasing data. Rural families contained children aged three, six or twelve months. Apart from the age of their offspring, the patient inclusion criteria, contact methodology, interview instrument and method of interview were matched. They were similar in that they had delivered infants within the last three to twelve months and were caring for them at home. Children with disease requiring specialist care were excluded from survey in both samples.

Demographic data including age, education, employment and race supported that the two sample groups of parents were comparable.

The single exception was income, and this was more likely to represent rural / suburban differences rather than selection bias. In fact, as the suburban sample was selected from a public hospital facility, and the rural population included all deliveries, both public and private, it might be anticipated that selection bias might skew towards higher rural incomes. Despite this, rural incomes were lower.

7.8.2 Satisfaction scores

This survey did not include a formal instrument of parental wellbeing. The only estimation of parental stress was the use of satisfaction scores for family life and enjoyment of the infant.

There were significant differences between rural and suburban families. Significantly more rural respondents reported the highest possible score for their enjoyment of the baby. 84% compared to 72% ($p < 0.001$). Despite this, the level of satisfaction reported with the child was very high. 98% of all parents reporting positive attitudes to the parenting experience. Thus while rural families might report slightly higher levels of satisfaction, almost all parents reported that parenting was a positive experience.

Evaluation of family life again showed differences. 24% of suburban families and 12% of rural families ($p = 0.03$) reported feeling neutral or negative about family life.

7.8.3 Service providers

Families sought advice about children from multiple professional services and from their network of family and friends. Child and Youth Health Services (CYH) (originally Child, Adolescent and Family Health Services or CAFHS) as a specialist organisation with a focus on childcare predominated, but doctors and hospitals were frequently utilised. Family members and friends were also frequently consulted.

The quality of advice was evaluated on a 5 point scale. For the total pool of respondents the most useful source of advice was their doctor, followed then by hospital services, CYH, and finally, friends and relatives. The latter were graded as being the least useful source of information with 66% - 77% of respondents grading their advice as neutral or of poor value. Medical practitioners stood out as being the most useful source of advice about the issues of child care. This was particularly so for rural GPs with 80% of respondents grading their advice as being of good value. Hospitals were a useful source of information, but again with a rural predominance. While 50% of suburban women found hospital advice to be of good value, 77% of rural women were as appreciative of this service.

Specialised advice from CYH was unexpectedly poorly regarded. While almost 3 in 4 rural women found the advice to be of good value, for suburban women only 1 in 3 felt the same way. Discussion with women accessing this service indicated that the most frequent complaint was an inconsistency of advice given from a range of staff. This criticism was particularly levelled at the after hours telephone service.

The data was used to calculate an estimate of 'social value', which combined both the value of the advice received and the frequency with which families were able to access the advice. Even the best advice is of little social value if it cannot be or is not accessed. Using this score, all professional resources were valued more highly than friends and relatives. Rural advisors were highly valued and rural doctors most highly of all. Suburban doctors were not as highly graded on the social value score, but only because they were less often utilised even though the advice received was more highly valued than that from any other source. The data show a consistent theme that primary care providers, and in particular general practitioners, are the preferred vehicle for obtaining advice on childhood wellbeing in the first year of life.

7.8.4 Sleep problems

Sleep problems can be divided into issues of sleep achievement and sleep maintenance.

7.8.5 Sleep achievement

This study found large variations in the time of evening that children were settled for their main night sleep. While the mean bed time was almost 9 pm, there was a wide SD. 14% were in bed by 7 pm and more than a third by 8 pm. A small number of children (10%) had a bed time after 10pm. The most succinct summary on this issue is that bed time for infants varied widely.

The time taken to settle off to sleep, or sleep latency, also varied. While mean sleep latency was slightly more than 9.6 min' there was a SD of almost 11.5 min'. Despite the wide SD the mean sleep latency varied in a narrow band over all age groups . At three months it was 10.3 min', six months 7.3 min' and at 12 months 8.9 min's. Thus, the maximum difference in sleep latency was three minutes.

Further analysis showed that approximately two thirds of children (68%) settled in under ten minutes, with a mean settling time of less than four minutes (3.7 min'). One third of children (32%) took more than 10 minutes, with a mean settling time of 22 minutes. Thus, approximately one third of children surveyed had prolonged sleep achievement times, and in this group the mean settling time was more than six times longer. Graphical representation of this data suggested a bimodal population with two subgroups of children. There appeared to be one group of children who settled rapidly and another group with prolonged settling times.

7.8.6 Sleep maintenance

Waking overnight, while expected for neonates, is anticipated to decline as the child matures. This survey found that the majority of this improvement had occurred by 6 months with 1.03 mean awakenings per night as opposed to a mean 1.36 at three months. The number of awakenings at 12 months was similar but with a slight increase (1.07). (Figure 15 pg 103). This was consistent with other reports.[5] In fact, one author has described the awakenings at night as being so common that they should be regarded as normal.[5]

7.8.7 Parental response times

The response to a crying infant varied widely. Mothers surveyed felt that on average, they would wait 3 minutes before responding. Almost one half of women (48%) reported responding to their infant in two or less minutes with a mean response time of one minute. The remainder (52%) responded in three minutes or longer with a mean response time of six minutes. (**Table 18** page 98.)

The study identified a group of women who responded late (mean six minutes) and a second group who responded early (mean one minute) to their infant's crying.

This data reflected a clinical observation that some mothers respond almost at once to a crying infant ('early responders') and others wait for a slightly longer period ('late responders'). The appearance of a bimodal population and its correlation with clinical observation led to further analysis of these two groups.

A principal disruptor for families with young children is the number of waking episodes per night. An early response strategy was correlated with less satisfactory sleep outcomes. By three months of age parents who had a late response strategy were awoken overnight 82% as often as early respondents. By six months they were responding at 46% of the frequency, and at twelve months 55% as often. Thus, in this study, an early response strategy begun early in the infant's life was associated with double the frequency of night-time awakening at six and twelve months. In addition to parents being woken more often, sleep volumes for the children were less. The children of 'early responders' achieved on average one hour less sleep per night and their longest night sleep was one hour shorter. During the day they had shorter sleeps but more of them. Calculated total day sleep (number of sleep multiplied by average length) showed more day sleep for 'early responders'. Thus, the infant's sleep was less developed at night and there were more frequent, shorter sleeps in the day. This is a less mature pattern of sleep development. These differences in sleep performance emerged by three months but were still present at 12 months. This suggested either a reported consistency in the parents' strategy or a prolongation in the child's behaviour which is correlated with the initial parenting technique.

An early response to a child's crying was associated with more night awakenings and more frequent but shorter day sleeps. These impacts were persistent through the first year of life.

7.8.8 Settling techniques

Methods of initiating sleep were varied. While almost two thirds of parents felt that they used a technique of minimal handling, feeding, holding and rocking were commonly reported. When reviewed cumulatively, a large majority of parents used a settling technique which included physical contact with the child.

7.8.9 Night sleep

Once sleep was achieved the total amount of sleep varied widely. While the mean night sleep at three months was less than eight hours the SD was large (2.32 hours). Almost a third (31.4%) of children achieved less than six hours, and a quarter (27.5%) more than ten hours. Total night-time sleep increased to a mean of 9.4 hours at six months and 10.7 hours at twelve months.

The longest single night sleep achieved at three months was reported as being longer (9.2 hours) than total night sleep (7.78 hours). This inconsistency was created by some parents reporting 12, 13 or 14 hours as the longest night sleep which had been achieved while the previous question requested total sleep on an average night up to a maximum of twelve hrs. By six months, the longest night-time sleep was reported as 10.2 hrs and, at twelve months, 11.2 hrs.

In summary, bed time varied greatly as did the time taken to achieve sleep. Both total night sleep and the longest night sleep increased during the first year of life.

7.8.10 Day sleep

The mean number of day sleeps at three months was slightly less than three. They had a mean length of slightly more than two hours. On average, infants were achieving approximately 6.2 hours of day sleep at three months. This increased slightly to 6.6 hours at six months and had declined to approximately 4.5 hours at twelve months.

7.8.11 Total sleep

When combining night and day sleep, infants of this study were reported as sleeping approximately 14 hours per 24 hours at three months, 16 hours at six months and 15 hours at twelve months. This is different to published sleep volumes for infants in their first year in that the shortest total sleep occurred at three months compared to twelve months. Despite this, the sleep volumes are similar to published scales from large samples. [45] The variation from published tables is 1 to 1.7 hours. Babies in this study slept more at six and twelve months and less at three months.

7.8.12 General well being and happiness

Irrespective of the sleep data, the large majority of mothers reported that, in their opinion, their infants settled well (93.5%) and slept well once asleep (95%). For 'early responders' and 'late responders', there were only minor differences in happiness scores for family life and their ability to enjoy the child. The large majority of parents believed that their family life was happy and that they were enjoying caring for their child.

7.9 Study limitations

7.9.1 Sample bias

The major bias was sample selection for the suburban patients who were exclusively three months of age. This restriction was placed upon the study by the hospital contributing data and was unavoidable.

Families from the rural sample represented all children delivered in the timeframe under review and thus represented a total population survey. Families for the suburban sample represented those who met the selection criteria taken from labour ward records.

Deliveries were chosen so that families could be interviewed when children were three, six and twelve months of age. Families were chosen based upon the date of delivery and they were contacted in numerical sequence until sample size requirements were met. Analysis was completed separately for both rural and suburban populations to allow the identification of differences which could be attributed to selection bias. In addition a number of data elements have been analysed by age group to again allow recognition of this bias.

7.9.2 Data collection bias

Three separate surveyors were used. To minimise bias, a rigidly standardised survey instrument was utilised and all three surveyors were trained by the author.

7.9.3 Measurement validation

Another limitation is the presentation of ‘measures’ which have not been validated. The measure of ‘social value’ is believed to be unique to this study.

7.10 Conclusion

This initial survey identified a number of elements about infant sleep in a South Australian population which can be summarised as follows:

- A large proportion of parents used techniques of infant settling dependent upon parental contact
- The time of going to bed for infants in the first year of life was very variable
- Sleep latency was bimodal with some infants being more efficient than others
- Mothers responded to the crying infant in a bimodal manner. They could be regarded as ‘early responders’ or ‘late responders’

- Mothers with an early response strategy to infant crying experienced almost double the number of night awakenings at six and twelve months of age compared to ‘late responders’
- Children of parents who were ‘early responders’ had less total sleep at night, more and smaller day sleeps
- Doctors were the most highly valued source of information about infants.

As a consequence of these findings a strategy was developed which emphasised parents being encouraged to:

- function as ‘late responders’ to a baby’s crying
- to delay responding for an approximate minimum of five minutes
- utilise shorter periods of parent contact during the sleep achievement event.

This strategy was to be provided in a primary care type model and its efficacy evaluated through an RCT.

Chapter 8 The Randomised Control Trial

The Effects of a Behaviour Modification Protocol in Neonates.

8.1 Introduction

Sleep disturbance in infants is a common problem encountered in primary care. Its frequency across Western cultures and consequent impacts upon measures of personal and family well-being are widely reported, as discussed in preceding chapters. A pilot study carried out in South Australia demonstrated the frequency of sleep disturbance and identified a group of parents whose behaviour was associated with more frequent and more persistent sleep disorders.

A review of the literature indicated that behaviour modification techniques were associated with the best long-term improvements in sleep performance. [2]

Reviewing present knowledge of sleep identified the cyclical structure of blocks of sleep.

The fact that behaviour modification was effective in modifying sleep performance suggested that external cues played a role in sleep achievement and sleep maintenance. In addition, these cues of sleep could be modified and the subject could learn a new style of sleep achievement. Combining various elements of this knowledge resulted in a protocol of advice to parents containing the following six elements:

- A block of sleep contains multiple sleep cycles
- Sleep achievement is in part cue dependent
- Cues of sleep are learned, can be changed and then relearned
- Sleep achievement is usefully regarded as a learned skill
- Fatigue interferes with the learned skill of sleep achievement
- Cues of sleep achievement which are parent independent are the most successful.

Several elements of this protocol had been identified by other authors in developing a range of behaviour modification programs. Recently research has begun to show the efficacy of these techniques in the first three months of life using multiple visit protocols. [99]. In South Australia, the principal organisation advising the public indicates that behaviour modification is not felt to be effective in infants less than six months of age. [107]

It was decided to test the efficacy of a single visit behaviour modification protocol in neonates, using a RCT, and to review the persistence of any changes in sleep performance by short-term follow-up.

8.2 Aims

A trial was designed with the following aims:

- To test a behaviour modification program aimed at improving sleep performance and avoiding sleep disturbance in neonates, using a randomised control trial
- To test a model of care suitable for use in primary care
- To review the efficacy of using a nurse as the primary care provider.
- This study was conducted to evaluate the effects of a single tutorial provided to parents of normal neonates. Efficacy was determined by measuring subsequent levels of sleep achievement.

8.3 Hypothesis

- That neonatal sleep can be significantly improved by an intervention protocol begun in the first three weeks of life
- That improvement in infant sleep is maintained at three months of age
- That there are benefits for infants, parents and the family associated with improved infant sleep.

8.4 Methods

8.4.1 Ethics

The study was approved by the Human Ethics Committee at the Adelaide Women's and Children's Hospital.

8.4.2 Study population

A sample size of at least 130 per group was determined, based on the number of subjects required to detect a predicted effect.[108] The primary calculation was founded upon the ability to detect a 30% increase in the proportion of intervention infants achieving 15 hours sleep per night compared to controls. The sample size was calculated to be able to produce a p value of 0.05 with a power of 90%.

Families were recruited through the 'notifications of birth' section in the *'The Advertiser'* - the principal daily newspaper in South Australia.

8.4.3 Inclusion criteria included

- delivery between 36 and 42 weeks gestation
- English speaking mother
- telephone in the home
- the mother intending to provide full time care for her infant for at least the first twelve weeks.

8.4.4 Enrolment

- families were identified firstly from the newspaper
- a telephone number was found in the local telephone book
- one thousand and one (1001) families were contacted. They were informed of callers name, that the Adelaide Women's and Children's Hospital was the site of

this research and that it had a focus on infant sleep. They were offered an opportunity to participate in a study

- those who accepted were posted a consent form
- upon receipt of the signed consent form the family was enrolled in the study and randomised
- controls received an information sheet, sleep diaries and explanatory documents by post
- intervention subjects made an appointment to meet the nurse at the Adelaide Women's and Children's Hospital.

8.4.5 Procedures and dependent measures

Written informed consent was obtained.

Measurements of infant behaviour were obtained at six weeks and twelve weeks post birth. The instrument was a sleep diary. Such instruments have been validated for measuring infant behaviour. [109] [110] For this study, the instrument was a 24 hour “sleep diary” which allowed every 10 minute period of the day to be scored for the child being asleep, awake, feeding or crying. Recording began on the first day after the child turned either six or twelve weeks of age. (Appendix V).

Infant weight was used as a proxy measure of infant well-being.

Parental well-being was evaluated using the CES-D depression questionnaire, a validated instrument for depression. [111] [112] The questionnaire contains 20 questions which relate to a sense of well-being. Both mothers and fathers were requested to complete the questionnaire upon finalising the second sleep diary at the end of the 13th week of life. (Appendix V).

8.4.6 The control group (C)

Parents in the control group received normal care from their regular health practitioners. They participated in sleep diary record keeping of their infant at both six weeks and again at twelve weeks post birth.

8.4.7 The intervention group (I)

Parents visited a trained research nurse at the Adelaide Women's and Children's Hospital, when their baby was about 2 to 3 weeks of age. The visit was usually approximately 45 minutes long. An initial assessment was carried out which included bare weighing the infant, to review adequate weight gain. Infants were also reviewed for general well being. Specific advice, given in the form of a tutorial, was customised to individual family circumstances, but the consistent aims of the program were to:

- Ensure that sleep modification was only attempted on well babies
- Ensure that the baby was growing satisfactorily to avoid any attempt at sleep modification in children who were hungry
- Maximise night time sleep as early as possible
- Return the mother to a full night of sleep as early as possible after her child's birth
- Achieve a workable day time routine for the mother.

Tutoring emphasised an understanding of sleep in infants. The following information was included:

- Infant sleep is cyclical with repeated episodes of arousal within a block of sleep
- Environmental factors, or ‘cues of sleep’, influence transitions to sleep
- Sleep achievement is usefully regarded as a 'learned' skill
- Fatigue interferes with the performance of learned skills (in this setting - the skill of sleep achievement). Neonates are very susceptible to fatigue. Tearfulness in a well-fed neonate may reflect fatigue rather than pain

- Cues of sleep, which are parent independent, are the most useful for developing 'independent sleep skills'. Parents were encouraged to minimise handling at the time of sleep achievement.

The parental behaviour recommended focused on:

- Allowing an infant to be in a “parent independent” position at the time of achieving sleep, at the beginning of a “block” of sleep.
- Regarding initial crying at the time of sleep initiation as being due to tiredness and best handled by a minimal parental response.
- Leaving an infant to settle to sleep for a minimum of five minutes before responding; this time interval to be extended by five minutes for each additional return visit to the child.

Each family was given a booklet written by the author of the thesis [113] that reinforced the above points. (Appendix IV) In addition, families were offered telephone support if problems arose.

8.4.8 Randomisation

Subjects entering the study were randomised using a blocking randomisation technique.

<u>Blocking randomisation</u>

A statistician created a randomisation scale which randomised into blocks of eight. Thus, while each consenting subject was allocated to control or intervention randomly after each eight subjects there would be an equal number in each study group. Equal numbers existed in the control and intervention groups after 8, 16, 24, 32 etc randomisations.

<u>Blind</u>

Allocation to controls or intervention was carried out by a person whose single role in the study was the management of randomisation. The research nurse was not responsible for or involved in the allocation of the subjects to either study group. She clearly knew that the subjects seen by her were in the treatment group.

8.4.9 Statistical analysis

Each sleep diary was dual entered into Epi Info Version 6.04 word-processing, database and statistics computing package.[114]

Statistical analysis was conducted at six weeks and twelve weeks separately. In addition data were pooled and analysed.

Each period of analysis contained seven or 14 repeated measurements per individual, one for each 24 hour period in the week/s of interest. To avoid over-sampling bias the data was reviewed using repeated measures analysis with generalised estimating equations (GEE) in SAS. [115 116]

8.5 General Results

8.5.1 Participation

One thousand and one (1001) families were contacted by phone. They were informed of callers name, that the Adelaide Women's and Children's Hospital was the site of this research and that it had a focus on infant sleep. Of these 346 (34.6%) initially agreed to participate and were randomised into controls (C) 175 and interventions (I) 171. Of these 346 families 11 later made direct contact to withdraw from the study although one family still returned data. Larger numbers made no further contact with the study and did not respond to material posted to their homes.

Over the data collection period;

- 269 (78% of 346) families returned data (C 133 / I 136)
- 253 (73% of 346) families returned data at six weeks (C 121 / I 132)
- 216 (61% of 346) families returned data at twelve weeks (C 107 / I 109)
- 200 (58% of 346) families returned data at six and twelve weeks (C 97 / I 103)

8.5.2 Data volume

All families which agreed to participate represented 4844 potential days of records. Each day consisted of a 24-hour block of time for one subject. In total, 3,246 (67% of potential) days were recorded and returned. For those 269 families which actually returned data, 3,246 (86% of a possible 3766) days were received.

Few parents had difficulty completing the diaries, with none having to be discarded because of data entry errors by the parents.

There were a slightly higher number of days for females recorded (1653) compared with males (1593) which reflected that 51% of records were from female infants.

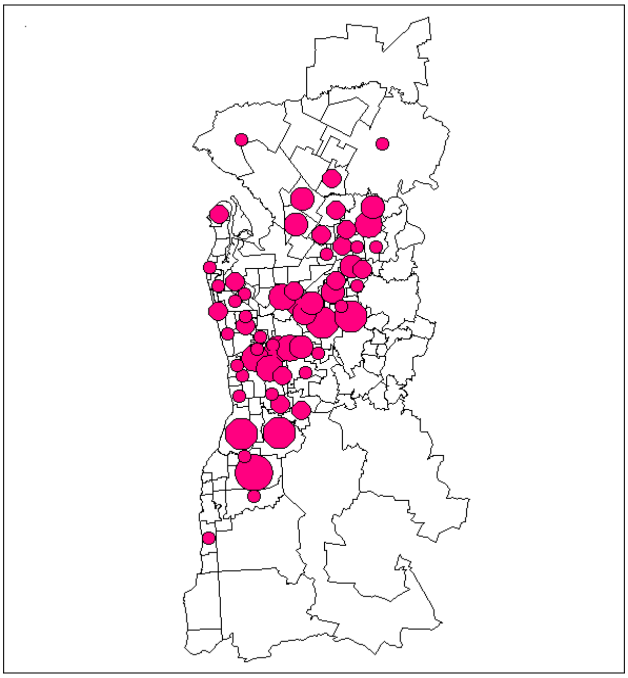
A slightly higher number of days were recorded during the first data collection period at six weeks (1749) compared with twelve weeks of age (1497). This reflected both incomplete sleep records returned and a drop out rate of 19% between the two time frames.

8.5.3 Demography

Postcode information demonstrated a comparable spread of subjects across the city's socio-economic areas. Responses were graphed by postcode in such a manner that a larger circle represents a higher number of subjects. (**Figure 16** Page 125).

More importantly postcode information was reviewed using the Socio-economic Index for Australia (SEIFA) developed by the Australian Bureau of Statistics.[117] This scale identifies socio-economic status through postcode. There was no socio-economic misbalance between the groups.

Controls.



Interventions

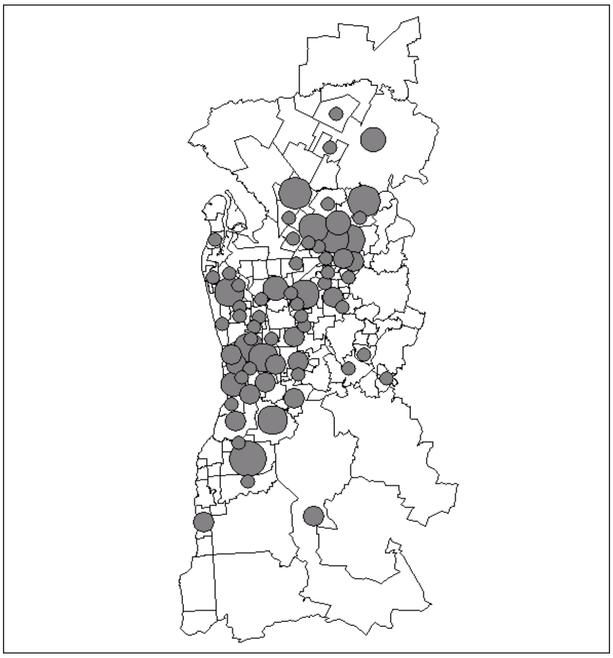


Figure 16 Controls and interventions by postcode

Data on race and ethnicity, marital status and age of parents, social class, position in family of neonate or other demographics are unknown. This data was not collected to increase the likelihood of participation.[118]

Sex of neonate.

There was no statistical difference between the numbers of male and female neonates, in either group, at either the six or twelve week time frames.

		Controls		**Intervention**		**Both**	
		No	**%**	**No**	**%**	**No**	**%**
6 Weeks	**Female**	59	48.8%	70	53%	129	51%
	Male	62	51.2%	62	47%	124	49%
			100%		100%		100%
	Total No.	121	47.8%	132	52.2%	253	100%
12 Weeks	**Female**	53	49.5%	57	52.3%	110	50.9%
	Male	54	50.5%	52	47.7%	106	49.1%
			100%		100%		100%
	Total No	107	49.5%	109	50.5%	216	100%

Table 26: Proportion of male and female children in the control and intervention groups at six and twelve weeks

8.6 Sleep results.

Data analysis

Primary data processing used ANOVA in Epi Info.[119] Where the existence of repeated measures made this technique inappropriate, generalised equalising equations (GEE) were used.[115] This later technique avoids artificial amplification of measures of significance through repeated sampling.

8.6.1 Total hours of sleep in a 24-hour period

At six weeks, total sleep per 24 hours was significantly increased in the intervention group compared to controls. A mean improvement of 1.3 hours per day or 9.1 hours per week was reported ($p < 0.001$). All lower confidence intervals exceed 0, supporting the significance of the intervention.

		95% Confidence Limits		p-value
	Increased sleep	Lower	Upper	
All	1.30 hrs	0.95	1.65	<.001
Male	1.66 hrs	1.22	2.10	<.001
Female	0.94 hrs	0.41	1.47	<.001

Table 27 Increased sleep per 24 hours at six weeks by sex of child

At twelve weeks, total sleep per 24 hours was significantly increased in the intervention group. A mean improvement of 1.54 hours per day or 10.78 hours per week was reported ($p < 0.001$) when comparing the two groups at the same age. All lower confidence intervals exceed zero.

		95% Confidence Limits		p-value
	Increased sleep	**Lower**	**Upper**	
All	1.54 hrs	0.94	2.14	<.001
Male	0.98 hrs	0.15	1.81	0.021
Female	2.08 hrs	1.22	2.93	<.001

Table 28 Increased sleep per 24 hours at twelve weeks by sex of child

The next figure represents total sleep reported for all infants at both ages.

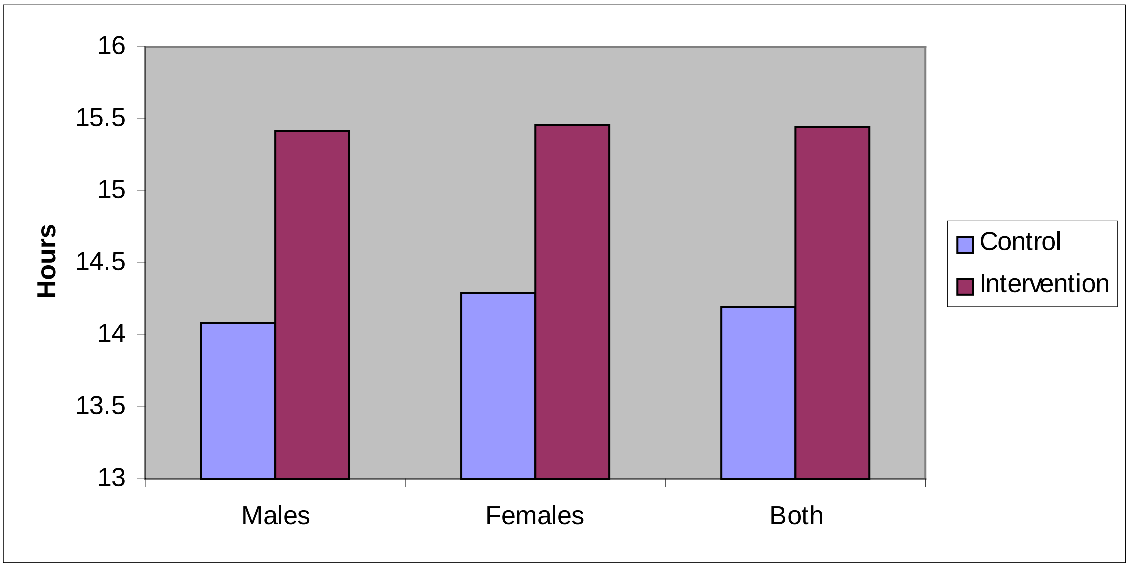


Figure 17 Total sleep per 24 hrs for all records by sex of child

The maximum improvement occurred for females at twelve weeks with an increase of 2.08 hours per day or 14.56 hours per week ($p < 0.001$). Minimum improvement occurred for males at twelve weeks with an increase of 0.98 hours per day or 6.86 hours per week ($p = 0.021$).

8.6.2 Frequency of achieving 15 hrs sleep per 24 hrs

The two study groups were compared for the frequency of achieving 15 hours total sleep per 24 hours. At the time of original study design this had been regarded as a key measure. Sample sizes were selected to provide an ability to detect a 30 percent improvement in the number of infants achieving 15 hrs sleep per day with the power of 90%.

A highly significant result was observed with 61% of the intervention group achieving at least 15 hours mean daily sleep, compared with 28% of controls ($p<0.0001$). (Figure 18).

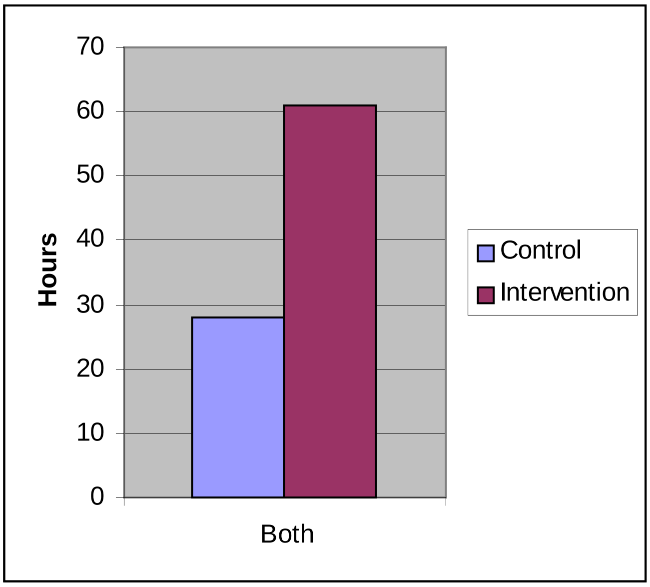


Figure 18 Percentage of infants achieving 15 hrs sleep per 24 hours by group

8.6.3 Further analysis of total sleep per 24 hours

All records were analysed for the total number of hours sleep achieved per 24 hours. The data was then divided into groups representing increasing volumes of total sleep. Groupings existed for 0-8, >8-10, >10-12 etc in two hour blocks. The number of sleep records in each block was tabulated. This data was graphed to demonstrate the number of sleep diary records reporting a given number of hours sleep. **Figure 19** represents time periods from > 8 hours to >22 hours per day. Only four records showed infants who slept for 8 hrs or less per day. These were all controls.

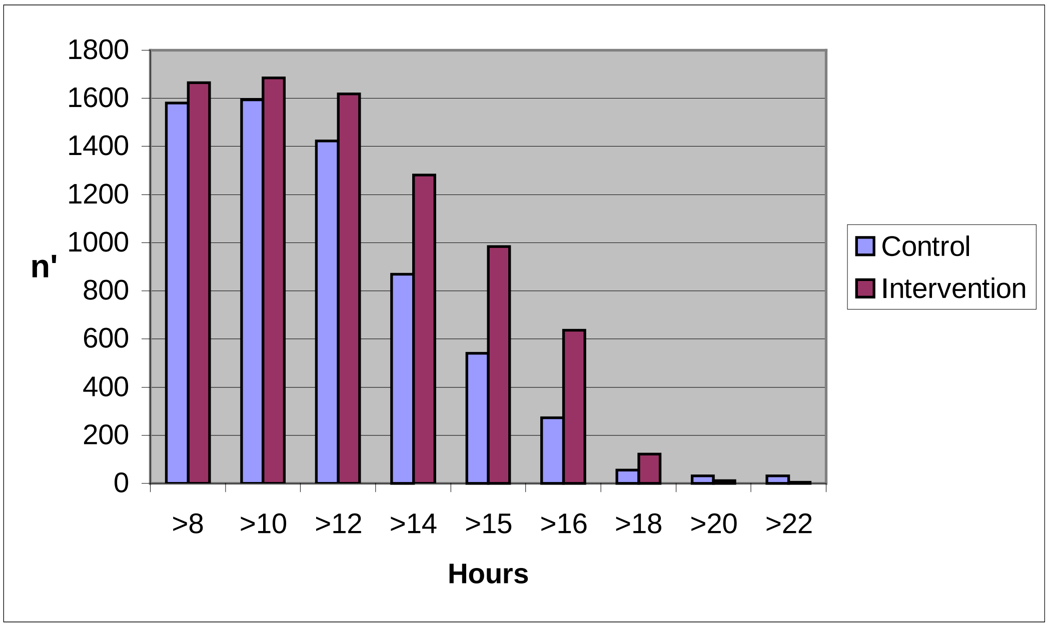


Figure 19 Number of sleep records reporting hours of sleep per day by group.

Records were reviewed for the proportion which achieved increasing sleep targets. As the amount of sleep per day increased, the number of intervention records achieving this target, expressed as a percentage of all records achieving this target, increased steadily.

In the figure which follows, and which represents variations in the proportions of a record set which achieved increased volumes of sleep, very small numbers of records exist at each end of the table and have not been graphed. Controls are overly represented in this small number of records.

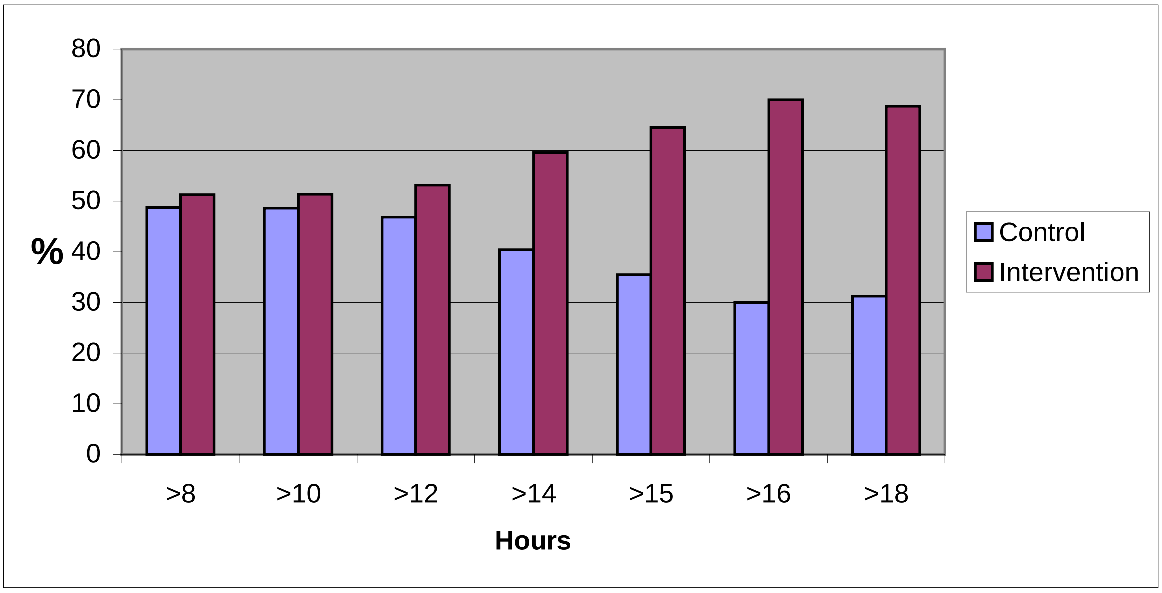


Figure 20 Proportions of records achieving increasing total sleep by group

The data was reviewed to identify the number of records in nominated time intervals. Thus, records were divided into those achieving 8 – 10 hrs, 10.1 – 12 hrs etc. When presented graphically, there is a right shift in the median for intervention records. (Figure 21 page 132).

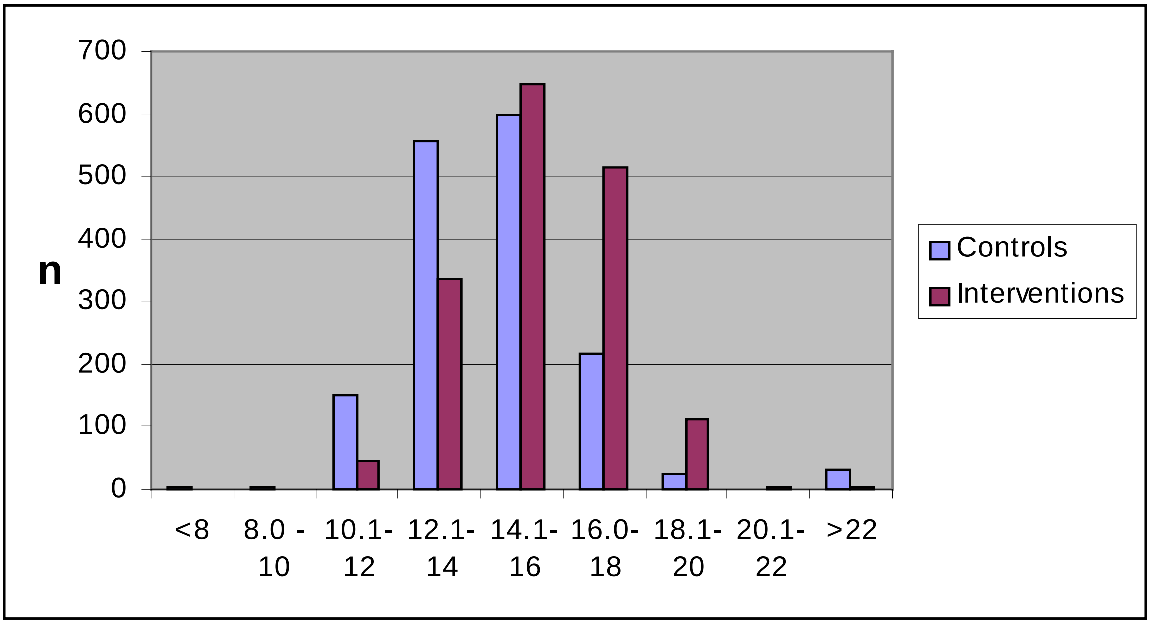


Figure 21 Number of sleep records v's increasing hours of sleep by group

Hours of sleep	<8	8.0 - 10	10.1-12	12.1-14	14.1-16	16.0-18	18.1-20	20.1-22	>22
Controls	4	3	150	555	597	217	24	1	30
Interventions	0	1	46	336	646	515	111	5	5

Table 29 Number of sleep records for increasing hours of sleep by group

When these data are converted to proportions, the intervention records are even more clearly represented on the right of the graph. The exception lies with a small number of records for children who were in the control group demonstrating more than 22 hours of sleep per day.

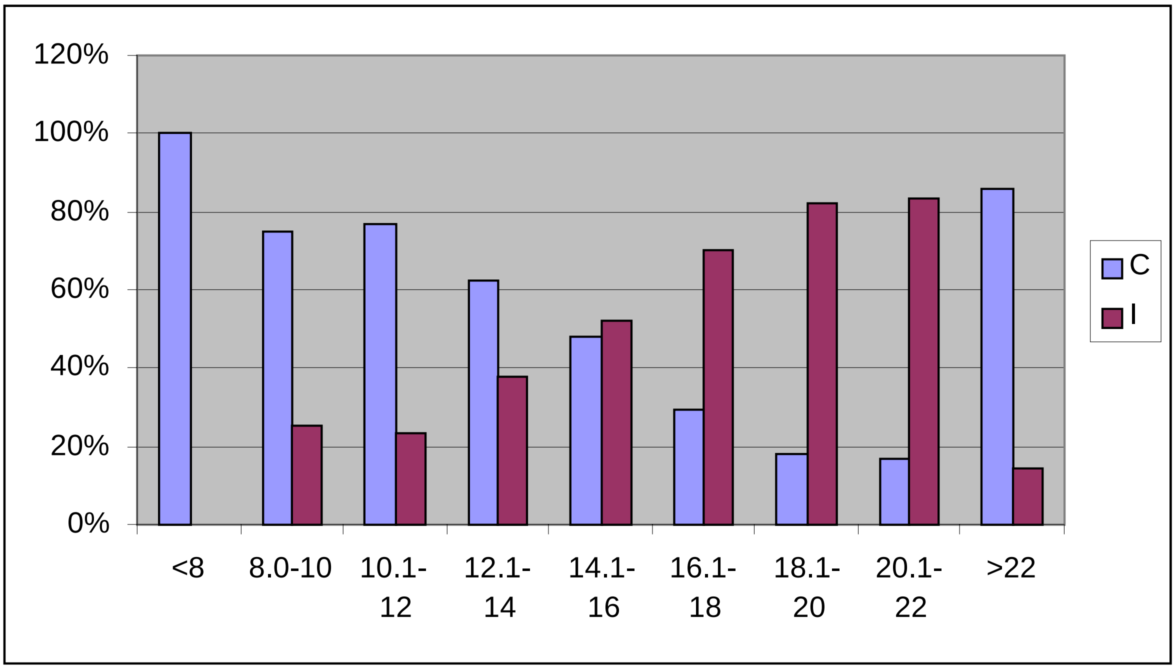


Figure 22 Proportions of records reporting increasing hours of sleep achievement by group

Hours of sleep	<8	8.0-10	10.1-12	12.1-14	14.1-16	16.1-18	18.1-20	20.1-22	>22
Controls	100%	75%	77%	62%	48%	30%	18%	17%	86%
Interventions	0%	25%	23%	38%	52%	70%	82%	83%	14%

Table 30 Proportions of records reporting increasing hours of sleep achievement by group

8.6.4 Increased hours of night sleep

In this study, night was defined as the twelve hours between 6 pm and 6 am. At six weeks, total night sleep was significantly increased in the intervention group compared to controls. A mean improvement of 0.5 hours or 3.5 hours per week was reported ($p < 0.001$). All lower confidence intervals exceed 0, supporting the significance of the intervention. (Table 31 page 134).

		Six weeks			
			95% Confidence Limits		p-value
		Increased sleep	Lower	Upper	
Total night sleep	All	0.5 hrs	0.32	0.69	<.001
	Male	0.72 hrs	0.47	0.98	<.001
	Female	0.3 hrs	0.04	0.56	0.025

Table 31 Increased hours of night sleep at six weeks by sex of child

At twelve weeks, total night sleep was significantly increased for pooled data. A mean improvement of 0.54 hours or 3.78 hours per week was reported (p = 0.003). For pooled data, all lower confidence intervals exceed 0, supporting the significance of the intervention. (**Table 32**). For males, the improvement of 0.42 hours per night was not significant and the 95% confidence limits include zero.

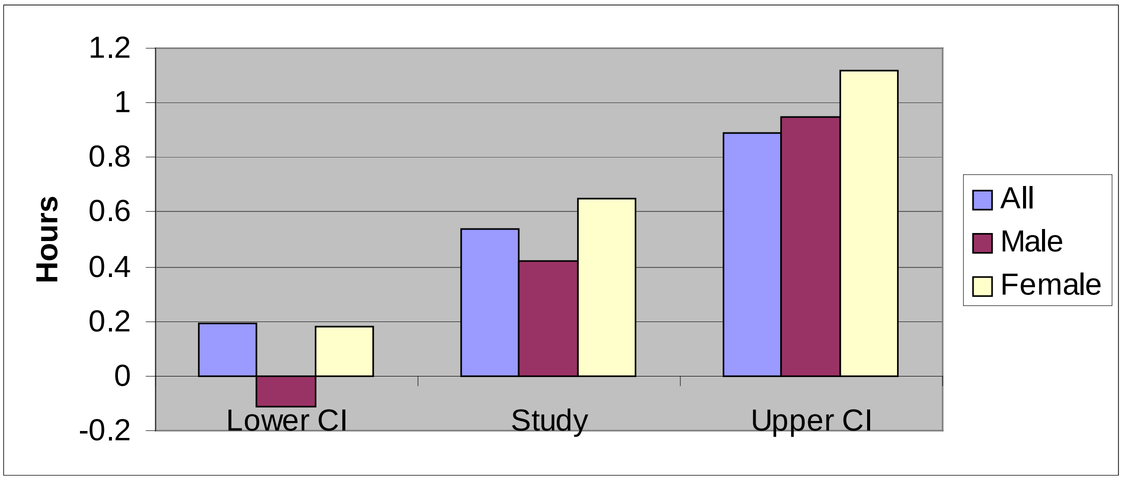


Figure 23 Increased hours of night sleep at twelve weeks by sex of child

		Twelve weeks			
			95% Confidence Limits		p-value
		Increased sleep	Lower	Upper	
Total night sleep	**All**	0.54 hrs	0.19	0.89	0.003
	Male	0.42 hrs	- 0.11	0.95	0.117
	Female	0.65 hrs	0.18	1.12	0.006

Table 32 Increased hours of night sleep at twelve weeks by sex of child

The figure below represents the number of hours of sleep at night reported, at six weeks and twelve weeks, for controls and interventions. In addition, it graphs the reported improvement in total night-time sleep per week.

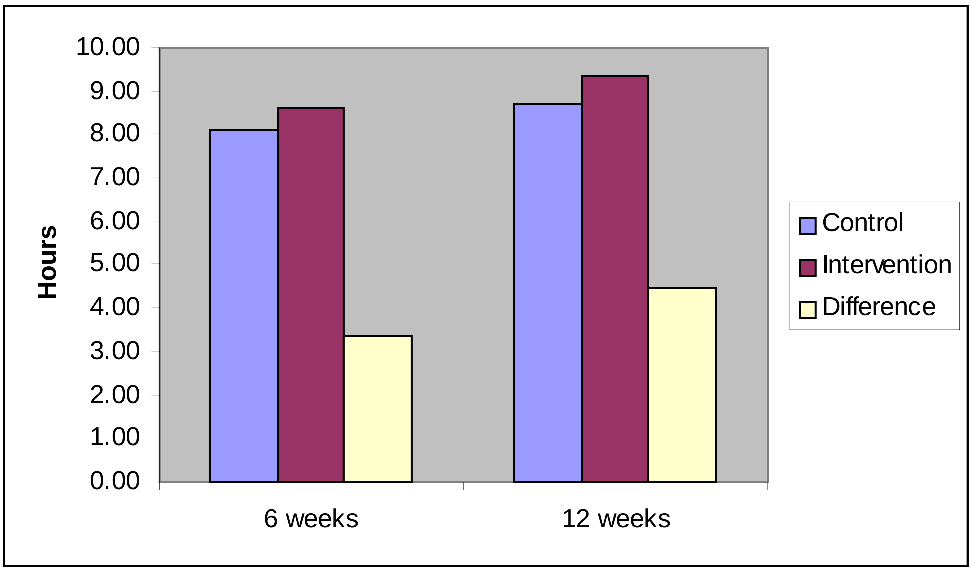


Figure 24 Total sleep per night at 6 and 12 weeks by group and cumulative weekly improvement

8.6.5 Eight hours of night sleep

In clinical practice, the achievement of eight hours sleep per night is an important milestone for parents. The number of neonates achieving more than eight hours sleep per night was calculated. Intervention reports showed 1309 of 1669 (78.4%) sleep cycles achieving 8.1 or more hours of night sleep. Control reports showed 975 of 1585 (61.5%) sleep cycles achieving 8.1 or more hours of night sleep. This represents a highly significant increase of 16.9% ($p < 0.0001$) in the number of nights where children achieved 8.1 or more hours of sleep for the intervention group. (Figure 25 page 137).

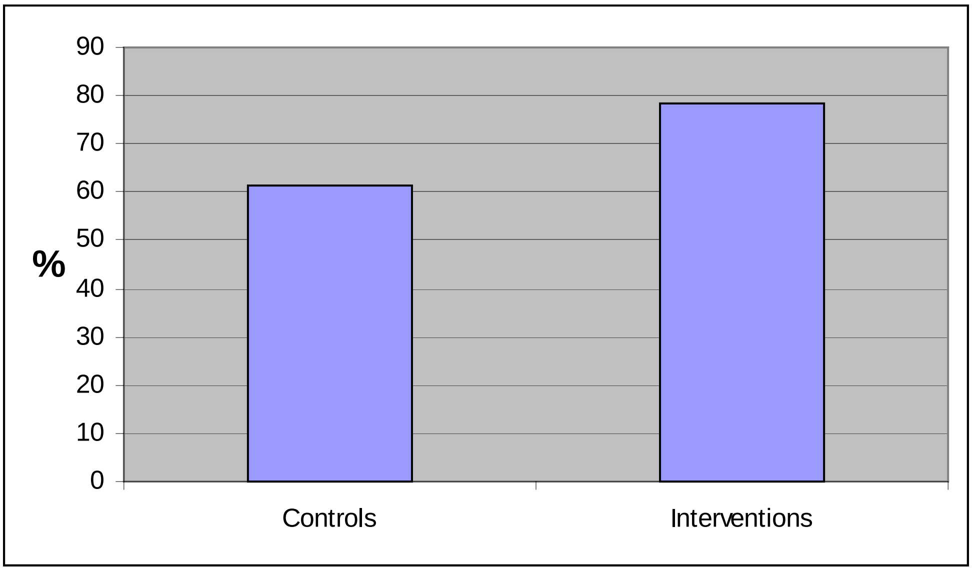


Figure 25 Percentage of all records achieving eight hours of night sleep

8.6.6 Longest night sleep

The length of the longest uninterrupted sleep period at night was calculated.

Repeated measures analysis, using generalised estimating equations, showed 'a day effect' over the week of observation at six weeks ($p<0.068$) i.e. there were increases in the length of the longest uninterrupted night sleep with each additional night. Thus, by the final night of the seven periods of record keeping, the longest night sleep was prolonged for both interventions and controls compared to the first day.

In addition, the rate of improvement was increasing more rapidly for interventions. An intervention baby sleeps on average 0.05 hours more than controls each 24 hours as the week progresses (95% CI 0.00 to 0.1).

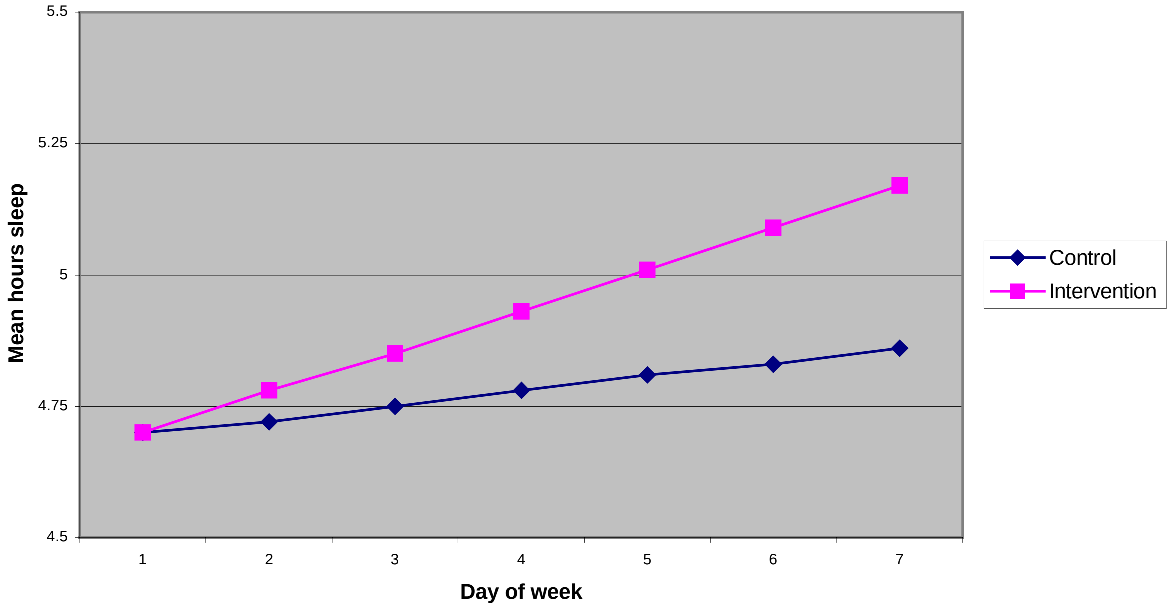


Figure 26 Day by day changes in the longest night sleep at six weeks by group

Despite this ‘day effect’, differences in the mean length of the longest night sleep were not significant at six weeks ($p = 0.77$).

By twelve weeks, the rate of change per 24 hours was not significant. Thus there was no ‘day effect’ detectable in the 7 reporting periods. There was a significant increase of 0.78 hours in the mean longest night sleep for interventions ($p<0.003$).

		Six weeks			
			95% Confidence Limits		p-value
		LNS	Lower	Upper	
Increased sleep	All	0.15 hrs	- 0.11	0.42	0.261
	Male	0.26 hrs	- 0.14	0.65	0.203
	Female	0.01 hrs	- 0.32	0.34	0.940

Table 33 Increase in the longest night sleep (LNS) at six weeks by sex of child

The longest night sleep at twelve weeks did show significant improvement. Mean improvement was 1.07 hours (p = 0.003). 95% confidence intervals do not include zero for pooled data.

Male infants at twelve weeks show a significant improvement in the longest night sleep (p = 0.049) while the lower 95 % confidence limits includes zero.

		Twelve weeks			
			95% Confidence Limits		p-value
		LNS	Lower	Upper	
Increased sleep	All	0.65 hrs	0.23	1.07	0.003
	Male	0.59 hrs	0.00	1.17	0.049
	Female	0.67 hrs	0.10	1.24	0.021

Table 34 Increase in the longest night sleep (LNS) at twelve weeks by sex of child

8.6.7 Total day sleep

In this study day was defined as the twelve hours between 6 am and 6 pm.

At six weeks, total day sleep was significantly increased. A mean improvement of 0.81 hours or 5.67 hours per week was reported ($p < 0.001$). Lower confidence intervals exceed zero, supporting the significance of the intervention. (Table 35 page 139). Both male and female intervention group infants achieved significantly more sleep during the day than the control group infants. At six weeks, male intervention infants were sleeping on average 57 minutes longer per day, or 6.65 hours per week, than controls ($p<0.001$). Female intervention subjects achieved 39.6 minutes more sleep per day or 4.62 hours per week than controls ($p<0.001$). (Table 35 page 139).

		Six weeks			
			95% Confidence Limits		p-value
		TDS	**Lower**	**Upper**	
Increased sleep	**All**	0.81 hrs	0.56	1.07	< 0.001
	Male	0.95 hrs	0.63	1.28	< 0.001
	Female	0.66 hrs	0.29	1.04	< 0.001

Table 35 Increase in total day sleep (TDS) at six weeks by sex of child

At twelve weeks, the intervention group was again recording significantly more total daytime sleep than the control group. Female intervention infants achieved 59 minutes per day or almost 7 hours a week more sleep than controls ($p<0.001$). Male intervention infants achieved 24.6 minutes per day or 2.87 hours a week more sleep during the day than the control group ($p <0.048$).

		Twelve weeks			
			95% Confidence Limits		p-value
		TDS	Lower	Upper	
Increased sleep	All	0.71 hrs	0.39	1.03	< 0.001
	Male	0.41 hrs	0.00	0.82	0.048
	Female	0.98 hrs	0.5	1.46	< 0.001

Table 36 Increase in total day sleep (TDS) at twelve weeks by sex of child

8.6.8 Longest day sleep

The longest day time sleep was recorded. Repeated measures analysis showed a trend towards longer day sleeps but did not demonstrate statistical significance at six weeks ($p = 0.073$) or twelve weeks ($p = 0.179$). Improvement in the length of the longest day sleep varied between two and eleven minutes.

8.6.9 Total crying

No significant differences were recorded for mean crying times over a 24 hour time period. At six weeks, interventions showed an increased crying time of 3.6 minutes per 24 hours ($p = 0.5$). At twelve weeks, interventions showed a decreased crying time of 1.2 minutes per 24 hours ($p = 0.833$). These results were consistent at both six and twelve week recording periods for both male and female neonates. Actual crying time differences were minor. (Table 37 page 141).

		Six weeks			
			95% Confidence Limits		p-value
		TCT	Lower	Upper	
Increased crying	All	0.07 hrs	- 0.15	0.24	0.65
	Male	0.07 hrs	- 0.21	0.34	0.635
	Female	0.07 hrs	- 0.17	0.32	0.226

Table 37 Total crying time (TCT) per 24 hours at six weeks by sex of child

		Twelve weeks			
			95% Confidence Limits		p-value
		TCT	Lower	Upper	
Increased crying	All	0.17 hrs	- 0.05	0.39	0.133
	Male	- 0.02 hrs	- 0.25	0.23	0.940
	Female	- 0.02 hrs	- 0.19	0.16	0.842

Table 38 Total crying time (TCT) per 24 hours at twelve weeks by sex of child

8.6.10 Mean bare weight

Bare weight was recorded for the control and intervention group neonates at both six and twelve weeks. Male infants were heavier than their female counterparts. At six weeks, males had a mean weight of 250 gram more than females (p=0.0008). At twelve weeks, males had a mean weight of 401 gram more (p=0.0003). There were no significant weight differences for males or females between intervention and control groups at six or twelve-weeks.

8.6.11 Parental well-being

Parental well-being was estimated using the CES-D depression scale. On this scale, an increasing number indicates the increasing possibility of clinical depression. Scores of 10 to 16 are reported, in the literature, to be associated with increasing levels of depression. Above 16 the scores are strongly correlated with other tests for depression. In this study parents' scores were not diagnostic of depression.

There were no significant differences between scores for mothers associated with the intervention (p = 0.96).

There were no significant differences between scores for partners associated with the intervention (p = 0.53).

There was a difference between men and women which was significant but this was not related to the intervention (p = 0.009). (Table 39 page 143).

	Mood scores		
	Controls	**Interventions**	**p value**
Mother	8.0	8.0	0.96
Both partners	7.1	7.3	0.70
Partner	5.8	6.5	0.53
Difference between mother and partner	2.2	1.5	0.009

Table 39 Mood scores for mothers and their partners by group

8.7 Discussion

The results indicate that the program of care trialled in this study has a significant and positive impact upon infant sleep. Improvement appeared by six weeks and was maintained at twelve weeks.

8.7.1 Participation

The efficacy of the technique of telephone contact was quite practical. Approximately 1/3 (34.6%) of those contacted agreed to participate and of these only 22% failed to return signed consent and data. A sample size of 260 had been calculated as necessary to detect the anticipated effect, and this target was easily achieved in the study period of six months.

8.7.2 Data volume

The sleep diary was initially regarded as complex and demanding.   Each 24 hours was divided into 10 minute intervals (144 cells). For each cell 4 different behaviours could be coded (576 choices). This was repeated for 7 days (4032 choices) and for 200 families who presented reports at six and twelve weeks. A total of 14 days recording for 24 hrs per day (8064 choices) was required. Despite this complexity, 86% of potential data was collected from those that participated. Parents had little or no trouble in completing the sleep diary. No diaries at all needed to be discarded because of detectable data entry errors. Parents' commitment to the study was high, perhaps reflecting their interest in the topic and in their newborn child.

8.7.3 Randomisation

The methodology of block randomisation using a dedicated staff member is known to be robust. As a consequence, there was equal representation of socio-economic quartiles.

8.7.4 Total sleep

The intervention protocol resulted in statistically significant improvements in total sleep. In addition to achieving high levels of statistical significance, the improved sleep was of practical significance. At six weeks, total sleep per 24 hours was increased by 1.3 hours per day representing 9.1 hours per week. In a lay sense, this represents an additional night of sleep per week for a parent. At twelve weeks, total sleep per 24 hours was increased further to 1.54 hours per day representing 10.8 hours per week. Again, this volume of sleep would be expected to be clinically significant for parents. Boys achieved more improvement than girls at six weeks with an additional 11.6 hrs per week compared to controls. Girls achieved far more improvement than boys at twelve weeks with an additional 14.6 hours per week compared to controls. In South Australia, it is commonly quoted by those who provide infant support services that behaviour modification before six months is neither appropriate or effective.[107] This study demonstrates the newborn's ability to respond to behaviour modification techniques in the first weeks of life, with a practical improvement in sleep volumes relevant to family life.

Continuity of improvement is important. Little would be gained if an improvement present at six weeks were absent at follow-up. In this study, improvement was maintained and increased. This was particularly true for female infants where sleep improvement doubled from almost one hour at six weeks, to above two hours at twelve weeks. For males, an improvement at six weeks was still present at twelve weeks but had diminished. Thus, intervention boys were still sleeping approximately one hour per day more than controls, but this was a smaller improvement than had been achieved at six weeks. An explanation for this decrease is not clear from the study, nurse reports or parent comments. In the clinical setting, this reversal in boys at three months appears to be related to hunger. Boys are heavier and grow with higher weight gain velocity. Clinical experience suggests that, by three months, a proportion of fully milk fed boys are ‘outgrowing’ their milk supply and respond by increasing the total number of feeds per 24 hours. Even with this relative reversal, the boys are still achieving significantly improved sleep, compared to controls, at six and twelve weeks.

The greater improvement in sleep for males compared to females at six weeks was unexpected and the reasons for this are unclear.

8.7.5 Frequency of achieving 15 hours sleep

In designing the research proposal, a principal aim of the project had been to achieve and detect a 30% improvement in the proportions of infants achieving 15 hours of sleep per 24 hours. The observed impact was stronger than anticipated with slightly more than double the number of intervention infants (61%) achieving this target compared to controls (28%) ($p < 0.0001$). The target of 15 hours sleep per 24 hours is relevant to infant care as it is at the lower limit of descriptions in the literature of normal sleep volume per 24 hours at this age.

8.7.6 Total hours of sleep per 24 hrs

All analyses of total sleep showed a positive effect in intervention children. Groupings for children achieving greater than 8, 10, 12 through to 18 hours of sleep all showed higher numbers of intervention children. A small number of cases achieved greater than 20 and 22 hours of sleep. In those two categories, control children were overly represented. It would be unusual for children to sleep for more than 20 hours per day, and even more unusual to sleep more than 22 hours per day. For the latter children, this leaves less than two hours per day for approximately six feeds, bath, changing and parental contact. While all of these records showed consistency of record keeping, the possibility of a consistent recording error must be considered. Controls are overly represented here and, if there is a data recording error, parental fatigue may be a contributing cause. As the data is technically correct on examination of the sleep diaries they have been retained in analysis.

When looking at the proportion of records showing a given amount of total sleep e.g. < 8 hrs, > 8.1 - 10.0 hrs, 10.1 - 12.0 hrs etc, intervention children are overly represented in those time periods which represent improved sleep. For all records achieving greater than 8 hours of total sleep, 51% were interventions and this percentage increased steadily until 70% of records reporting more than 16 hours sleep per day were from the intervention group. When looking at records for particular periods of sleep e.g. 8-10 hours, 10.1-12 hours etc, graphical representation clearly reflects the increased mean for interventions, 15.45 hours per day compared to 14.19 hours for controls. In time periods of less than 14 hours sleep per day, controls predominate.

The impact of the intervention is most clearly demonstrated when proportions are displayed. For infants sleeping less than 8 hours per day 100% are controls, at 14-18 hours 48% are controls and at 20-22hours 17% are controls. A consistent theme occurs for all time periods showing a steadily increased proportion of records being from the intervention group as hours of sleep achievement increased.

A small number of possibly aberrant records exist in the group beyond 22 hours sleep.

Thus, in all detailed analyses, intervention infants experienced superior sleep.

8.7.7 Total night sleep

The improvement in total sleep was distributed over both night and daylight sleep. Improvement at night was greater at twelve weeks (4.5 hours) than at six weeks (3.4 hours) reflecting the development of circadian rhythms with increasing age.

Of particular significance to parents is the achievement of eight hours sleep at night. Almost 17% more intervention records reflected 8.1 hours or more night sleep (78.4% compared to 61.5%).

Interestingly, six week records showed no significant increase in the longest single sleep even though total sleep was longer. However, there was a day effect during a period of recording. With each additional day, both study groups showed increased length of longest night sleep. This improvement would be consistent with maturation of infant sleep in the child's seventh week of life. Intervention infants were improving the length of the longest night sleep slightly faster than controls.

By twelve weeks, the longest night sleep had become significantly longer for interventions. This reflects consistency with the clinical observation of longer night sleeps by three months of age and maintained efficacy for the intervention.

8.7.8 Total day sleep

Increased total sleep received a contribution from day-time sleep as well. At six weeks, this was 5.67 hours or 62% of a total 9.1 hours of improved sleep. At twelve weeks, 4.97hrs or 46% of the 10.78 hrs improvement is occurring during the day. Again, this reflects both general sleep improvement associated with intervention children and increasing maturity at three months with a higher proportion of sleep at night.

8.7.9 Crying

There is much debate in South Australia about the wisdom and appropriateness of leaving a child to cry.[107] Interestingly, there was no practical or statistical increase in crying in the intervention children. The maximum difference was slightly more than 4.2 minutes per day. By twelve weeks there was essentially no difference with intervention children crying 1.2 minutes per day less than controls. If it is argued that leaving a child to cry can have emotional consequence, in this study, by twelve weeks, there is no increased crying to debate.

8.7.10 Weight gain

While males were heavier than females there was no significant difference in weight or weight gain between the two study groups.

8.8 Review of hypothesis

8.8.1 That neonatal sleep can be significantly improved by an intervention protocol begun in the first three weeks of life

Statistical analysis supports this hypothesis. Significant improvements in sleep performance occurred by six weeks of age. Improvements which were observed included increased total hours of sleep per 24 hours, total hours of sleep at night, longest sleep at night and total hours of sleep in daylight. The overall improvement was in excess of one additional night's sleep per week.

8.8.2 That improvement in infant sleep is maintained at three months of age.

Statistical analysis supports this hypothesis. Significant improvements in sleep were maintained at three months of age. Improvements included increased total hours of sleep per 24 hours, total hours of sleep at night, longest sleep at night and total hours of sleep in daylight. The total volume of sleep improvement was in excess of one additional night's sleep per week.

8.8.3 Improvements in secondary measures

That there are benefits for infants, parents and family associated with improved infant sleep.

Infants

Additional benefits for the infant can only be indirectly measured. Two parameters were reviewed, being weight gain and crying time. There were no differences between controls and interventions for either of these measures.

Parents

Parental psychological well-being was evaluated using a validated instrument for depression. There were no differences between controls and interventions for this measure. Partners of mothers had lower depression scores. This would be consistent with the predominant role played by mothers in caring for children, their broken sleep in the first three months of life, and the positive correlation between sleep deprivation and depression. Despite this, maternal depression scores did not reach levels consistent with even minor depression.

8.9 Patient acceptability

The study design did not seek information from families on their evaluation of the intervention and the method by which it was delivered. Only indirect measures could be used. Families were asked to keep detailed sleep diaries for two periods of seven days; every 10 minute period for seven days required data to be entered. During the design stage, this was seen as an impediment to the study's success. However, 86% of all possible records were returned. The fact that no sleep diaries were rejected as a consequence of data recording errors, and the very high rate of return, may represent an indirect measure of patient acceptance. In addition, it is noted that the research nurse was unknown to the family participating in the study. Generally, the existence of a relationship between researcher and subject would be expected to increase acceptability, as is the case of parents consulting their general practitioner in the context of family primary care.

8.10 Internal validity

The extent to which the study results can be applied to the cohort can be reduced by several factors.

Sample bias

Subjects were selected from advertisements placed in the notification of birth section of the city's daily newspaper. Apart from the name of the child and the parents no information was available to influence the selection process of subjects. There was no mechanism for self-selection into the study.

Maturation bias was not possible as both controls and interventions were at the same age at commencement of the study.

Testing bias

The testing instrument was identical for both groups.

Randomisation bias

The study's randomisation was robust. The research assistant had only passive interaction with the randomisation process. A second person was allocated exclusive responsibility for informing the research assistant of the group status of all subjects. Randomisation was only undertaken after initial contact, verbal approval to participate, and upon receipt of informed consent. A randomised blocking technique assured that equal numbers of subjects were allocated to each group in blocks of eight. Checking the randomisation by socio-economic status confirmed equal allocation to both groups of all four recognised socio-economic quartiles.

8.11 Efficacy

Analysis of the data supports that the intervention was effective in increasing sleep performance in newborn children and high levels of statistical significance were achieved. In addition, as the improvement amounted to multiple hours of additional sleep per week, this would be of practical assistance to the families. These results compared highly favourable to other studies which had shown improvement but not to the same degree.[99]

8.12 Sustainability

8.12.1 Sleep performance at twelve weeks

Pooled data showed an increase of more than nine hours sleep per week by six weeks of age, associated with the intervention. At twelve weeks, this improvement was maintained and increased with 10.8 hours of additional sleep per week.

8.13 Secondary outcomes

The literature consistently reports associations between impaired sleep and the incidence of anxiety and depression. Some authors hypothesise that the incidence of postnatal depression, which can reach as high as 15%, may, in part, be related to sleep deprivation. [3] A strategy which improved infant sleep and, by inference, sleep of the child's parents would be expected to be associated with improvements in measures of parental well-being. Such a positive correlation has been reported by other authors.

8.14 Instruments of testing parent and infant well being

In the RCT, the instrument for evaluating parental well-being was the CES-D depression score, a recognised instrument for this psychological parameter. Infant well-being was evaluated indirectly, using weight and crying time

8.14.1 Parental well-being

The RCT was unable to elicit improvement in parental well-being as a consequence of the intervention. Such a finding is inconsistent with other reported studies. It was suspected that the chosen instrument was too insensitive. In addition, the intervention, while showing significance in a statistical sense, may not have been large enough in a practical sense to have an impact upon family life. While this cannot be completely discounted, the existence of up to more than 10 hours additional sleep per week would intuitively be associated with some alterations in parent well being.

The CES-D instrument has, in retrospect, been shown to be insensitive in this setting.

8.14.2 Childhood well-being

While the measures of infant well-being utilised in the RCT are limited, it is difficult to propose a measure or instrument appropriate to the setting.

<u>Weight</u>

While the intervention children were being left for longer periods of time and were achieving both more hours of sleep and longer sleeps, this did not impact negatively upon feeding as estimated by weight gain. Both interventions and controls had equal weight gain at twelve weeks.

Crying

While the parents of intervention children were being encouraged to leave their children for longer periods of time to achieve and maintain sleep, even in the presence of significant tearfulness, this did not translate into increased volumes of crying. This is significant in a field where it may be regarded as controversial to advise parents to leave children to cry themselves to sleep. Analysis indicates that, despite the advice, children did not experience more crying than those receiving normal care.

8.15 Limitations of the study

A range of factors may limit confidence in the data and its analysis. These will be discussed individually.

8.15.1 Subject selection

Subjects for this study were identified from '*The Advertiser*'. The parents had made a decision to publicly advertise the birth of their child in Adelaide's only daily newspaper. This technique fails to identify infants whose birth is not advertised. While this might be expected to limit the study of families in low socio-economic status, there was no difference in socio-economic post codes as reflected by the Socio-economic Index for Australia of the ABS. This is consistent with the fact that advertising a birth in '*The Advertiser*' would not be seen as a financial barrier for many families. Four lines of text to announce a child's birth during a weekday costs $20 (Quote from '*The Advertiser*' 6th February 2002).

The study also had a selection bias towards families confident in English. Advertising requires reading skills and thus families unable to read English could be expected to be less well represented. In addition, one of the selection criteria for inclusion was proficiency in English, thus excluding families from cultural groups where English was not spoken. The 1996 Census reported that 84.5% of residents speak only English at home. Of the 15% who speak another language at home, 12% speak English well. Only 3% of the population are not proficient in English. [120]

While appropriate numbers were enrolled in the study these represented only 35% of those contacted. It is not possible to verify their demography as no data was collected.

8.15.2 Observational bias

The recording of infant behaviour was made by parents. They were not specifically trained in the skills of record keeping beyond the instructions given to all parents. The recording of ‘sleep’, as detected by this technique, includes some episodes of ‘quiet wakefulness’. Thus total sleeping hours will be over-represented, by this study, compared to studies where a trained observer is present at the cot side and is able to accurately report on episodes of quiet wakefulness. The randomisation protocol protects against this bias affecting analytical comparisons between the two groups.

8.15.3 Intervention

The researchers were concerned that the strategy used was limited to a short tutorial supported by a booklet written in common English. This intervention might have been inadequate to generate a response. In addition, the intervention lacked a protocol for follow up which was known from clinical work to weaken the effect. In addition, all other published work utilised interventions with multiple consultations. The fact that such a positive result was obtained with both practical and statistical significance was reassuring.

8.15.4 External validity

<u>Factors reducing external validity</u>

The extent to which the study results can be applied to the general population can be reduced by several factors.

<u>Selection bias</u>

The one concern about the selection strategy was that the subjects only became eligible for selection by placing an advertisement in the newspaper which announced the birth of a child. This could potentially discriminate against a lower socio-economic group as they might not be able to afford the advertisement. Protecting against this bias was the low cost of placing an advertisement. Analysis of the socio-economic quartiles showed an appropriate spread across the community suggesting that the methodology did not lead to inappropriate subject selection.

<u>Treatment bias</u>

Treatments which are restricted to specific environments such as hospitals, universities, or other unusual sites may limit the ability to generalise results to the general population. In this study, the practical intervention occurs in the subjects' homes.

Another form of treatment bias occurs where the treatment personnel are uniquely effective or forceful and thus not representative of other potential care providers. A particularly enthusiastic or articulate proponent may provide care which cannot be replicated in the general community. In this study, the author was excluded and a trained care provider, working successfully in a public hospital, but without any prior experience in the field, made all contact with the families.

Avoiding treatment bias was further enhanced by deleting the impact of an ongoing relationship between the intervention families and the care provider. The research nurse made contact via telephone and then the family were seen for the single tutorial. The family then returned to their normal care providers thus omitting the potential to modify their behaviour through a desire to achieve approval from the researcher.

Selection treatment interaction bias

An interaction or treatment strategy which requires particular skills or characteristics may introduce bias. This was controlled through robust randomisation.

8.15.5 Factors improving external validity

External validity may be improved by certain strategies.

Sample model

The population to which we wish to generalise results is the entire population of families which contain children. The study used that population as the source of its sample, thus increasing the ability to generalise.

Sample size

Increasing sample size increases the statistical probability that the analyses found within the sample groups are applicable to the general population. The study used a sample size which was large by international standards. For the RCT, the original calculation of sample size aimed to detect a proposed outcome with a power of 90%. The highly significant p values produced by the analysis, the small confidence intervals, and the frequency with which the confidence intervals did not include zero reinforce that the sample size was adequate in the study.

8.15.6 Alternative strategies for managing sleep problems in neonates

While current research suggests that behaviour modification is the most appropriate form of treatment for infant sleep disorders, there are multiple variations. This study focused upon a particular form of behaviour modification. Other forms of treatment may have been equally or even more successful.

8.15.7 Limited impact on measures of well being

The study failed to show an alteration in psychological well-being of the parents. This is inconsistent with other studies and may relate to an insensitive instrument, too small an improvement in sleep to be practically significant to the parents, too small a sample size, or measuring emotional well-being too early after the intervention. While published research has shown improved scores for parental depression following improved infant sleep, it was not possible to claim such improvement from this intervention. The frequency with which parents seek advice for this problem, the volume of the research literature, the frequency with which it is discussed socially all indicate the significance of persistent sleep disturbance. In expanding this work, further research would be required to identify secondary measures affected and appropriate instruments for detecting such changes.

8.16 Conclusion

The intervention has a highly significant impact upon improving sleep in neonates. This is particularly effective in achieving more than 15 hours sleep per 24 hours. Improvement is present by six weeks of age. The improved sleep is achieved without any impact upon crying time or weight gain.

Chapter 9 Conclusion

This study originated in the clinical observation of both the significance and prevalence of sleep disorders in families with young children. The resulting academic process was completed in several connected elements.

- A review of sleep problems in both rural and suburban South Australia
- A literature review of the area
- The completion of an RCT of a behaviour modification strategy in neonates anticipated to improve sleep performance in the first three months of life.

9.1 To review sleep problems in neonates and infants in South Australia

This initial survey study reviewed sleep in a cohort of families within the first year of the child's life. Families who participated were drawn from suburban Adelaide and three small to medium sized rural towns.

There were several findings of interest.

- Settling times for infants (sleep latency) varied widely and the data suggested a bimodal distribution with some infants settling readily and others taking prolonged periods for sleep achievement.
- Strategies for sleep achievement varied but the clear majority included some element of parental care.
- Parental responsiveness to a crying infant appeared to be bimodal with one group of women responding in the first minute (early responders), and a second group who would, on average wait six minutes before responding (late responders). An early response of the mother correlated with increased frequency of night-time awakening at six and twelve months. The children of early responders experienced almost double the frequency of night-time wakening and had both less total night sleep and a longest single night sleep that was shorter. The consequences of responding early to a child appears to persist at least through the first year of life.

- For mothers who were seeking advice about their children, doctors were the most highly valued source. Doctors working in primary care were regarded as a superior source of advice to all other organisations and social groups.

Utilising the initial study, and a literature review of evidence based strategies, a protocol of care was developed. This protocol, which had a large educative content, in addition to behaviour modification advice, included the following core elements:

- Human sleep is a cyclical process with multiple arousals within a block of sleep
- The achievement of sleep and its maintenance is in part dependent upon external environmental cues
- Cues of sleep can be learned, altered and relearned
- Sleep is usefully regarded as functioning as a learned skill
- Fatigue interferes with the efficient performance of sleep achievement and sleep maintenance which both function as learned skills
- Parents are encouraged to function as ‘late responders’ with short periods of contact during sleep achievement events.

This advice was generally consistent with recent published literature but not with current practices as advised by the major organisations working in the area of child health. There were unique elements of the protocol, in particular the concept that sleep functions as a ‘learned skill’ impaired by fatigue, which is not articulated in the literature.

9.2 Literature review

Reading the relevant sleep literature demonstrated a number of points of interest.

- The significance of sleep is not completely understood, as yet, but adequate sleep achievement is essential for a wide range of biological functions.
- Sleep structure is complex but universally contains repeated episodes of arousal followed by a return to sleep
- Sleep deprivation has negative consequences of significance upon children, parents and the family unit
- Throughout Western cultures, infant and neonatal sleep disturbance is common with frequencies of 20-46% quoted in multiple studies
- A wide range of interventional and preventative techniques have been studied but those using behaviour modification have shown the highest efficacy.

Using the principal findings of the baseline study and techniques recommended by the literature, a protocol of care was developed. This was articulated in a booklet addressing infant sleep issues. In addition, a tutorial for parents with young children was developed which was supported by the written material. The study presented this model of care to a randomised controlled trial.

9.3 To test a behaviour modification technique of avoiding sleep disturbance in neonates using a randomised control trial

Analysis of data from that RCT has shown that the intervention was associated with significant improvements in all sleep variables measured. In particular, the following findings can be reported:

- Higher proportions of infants achieved 15 hours sleep per 24 hours
- Higher proportions of infants achieved 8 hours of night sleep
- Increased total hours of sleep per 24 hours
- Increased total night sleep
- Increased length of longest night sleep
- Increased total day time sleep.

These improvements achieved both statistical and practical values without negative consequences upon infant crying or weight gain.

Despite these improvements, there were no detectable improvements in scores of maternal depression using the instrument chosen.

9.4 Applicability in the target age group

Recent RCT's, including this study, support the efficacy of behaviour modification in the first three months of life. This study has shown the highest level of efficacy reported in the peer reviewed literature. Despite this evidence, behaviour modification in neonates is either rarely recommended or actively discouraged by those working in the field. Organisations such as Child and Youth Health Services in South Australia discourage its use until after six months. [107] There are two criticisms;

- that neonates are unable to learn using behaviour modification techniques
- that there is the potential for emotional damage.

The former assertion is disproven by this study, which shows practical and statistically significant improvement in sleep performance. The latter has not been tested in this study, as no instrument of emotional well-being is known for a twelve week old neonate. The proxy measure of crying shows no difference between study groups.

9.5 Implications for primary care

The sleep problems described present in many settings including, tertiary care centres, secondary hospitals, primary care practices and specialist organisations. The initial survey demonstrated that primary care general practitioners were the most valued source of information. Extensive experience in the area has demonstrated that these families initially present in primary care. To be of practical benefit to the community, the protocol thus needs to be applicable to the primary care setting.

The intervention design included three elements relevant to primary care;

- the provision of a single face-to-face tutorial from a trained research nurse
- the provision of written material supporting information given by the nurse
- the availability of telephone support if the family were to request it.

These will be discussed individually.

9.5.1 Face-to-face tutorial

The primary intervention was a single tutorial with the child and at least one but preferably two parents. The time for the tutorial was approximately 45 minutes. Such an intervention is possible in the primary care setting. It is not limited by time-of-day, equipment, sophistication of the environment or any specific technical problem apart from the availability of parents and care provider. If necessary, the tutorial could be given in the absence of the child. Of interest in this RCT was the single intervention. The most comparable studies have used multiple consultations and repeated family contact.

Using a nurse as the primary care provider

A registered nurse with paediatric experience was recruited to provide the patient intervention. The training program contained three elements.

- Observation with the author

The research nurse attended a meeting with the author and received several hours experience with unselected and undifferentiated patients in primary care where the presenting problem was a disorder of infant sleep. The patients were not specifically neonates. Such training is similar to the experience of medical students attending primary care in their senior years for advanced apprenticeship type teaching. Training time was less than eight hours.

- Observation by the author

Once the research nurse had become confident in the style of care required she was observed assuming the role of care provider. Patients were selected from the age group appropriate for the study. Following each case, she was tutored in alterations which were appropriate. When she had achieved a level of proficiency, she was authorised to commence active interventions, as part of the study. Training time was less than four hours.

- Reading

The written material, which was to be distributed to the patients, was used as the principal source of reading for the research assistant. This totalled 50 pages and required approximately two hours of reading.

- Conclusion

This study involved an intervention, which was provided exclusively by a registered nurse. Less than 20 hours of training was required. While the intervention achieved high levels of efficacy, further experience and training of the research nurse might be assumed to increase the impact.

Sleep deprivation in parents and sleep disorders in young children are common. In a health care environment, with shortages of general practitioner consulting time in many geographical areas of Australia, provision of care by nursing staff, who are readily trained and can be supported, would appear to be an appropriate model of care.

9.5.2 Written material

In this study, extensive written material was presented to the families. This document contained additional information consistent with the content of the tutorial. Other authors have tested the use of written material in this environment with positive results.[106] Once again, the provision of written material was consistent with the primary care paradigm. It is common practice for general practitioners to supplement the consultation with written material.

9.5.3 Telephone support

While telephone support was offered it was rarely utilised. Despite this, it is again an element of care used by primary care physicians. In the context of recommending a strategy for primary care, the experience of the study that families were unlikely to abuse the privilege of having telephone contact, increases its attraction as a support mechanism.

9.5.4 Conclusion

All elements of this intervention can be provided in the primary care environment. Analysis has shown its efficacy. As the study design supports strong external validity, it could continue to be provided in the primary care environment. Patient acceptance of the intervention, as discussed elsewhere, would be expected to be further enhanced by delivery in primary care where the family had a long-term relationship with the care provider.

9.6 Summary

The protocol as described is a successful intervention

- Behaviour modification is an effective technique to improve sleep performance in neonates
- The technique described is suited to implementation in the primary-care setting.

Bibliography

1. Hiscock H, Wake M. Randomised controlled trial of behavioural infant sleep intervention to improve infant sleep and maternal mood. *BMJ* 2002(324):1062.

2. Ramchandani P, Wiggs L, Webb V, Stores G. A systematic review of treatments for settling problems and night waking in young children. *BMJ* 2000;320(7229):209-13.

3. Hiscock H, Wake M. Infant Sleep Problems and Postnatal Depression: A Community-Based Study. *Pediatrics* 2001;107(6):1317-1322.

4. Wooding AR, Boyd J, Geddis DC. Sleep patterns of New Zealand infants during the first 12 months of life. *Journal of Pediatric Child Health* 1990;26:85-88.

5. Armstrong KL, Quinn RA, Dadds MR. The sleep patterns of normal children. *Med J Aust* 1994(161):202-206.

6. Zuckerman B, Stevenson J, Bailey V. Sleep problems in early childhood: Continuities, predictive factors, and behavioural correlates. *Pediatrics* 1987;80(5):664-671.

7. Anders TF. Night waking in infants during the first year of life. *Pediatrics* 1979(57):860-864.

8. Bernal JF. Night waking in infants during the first 14 months. *Developmental Medicine and Child Neurology* 1973(15):760-768.

9. Illingworth RS. Sleep problems in the first three years. *British Medical Journal* 1951:722-728.

10. Johnson MC. Infant and toddler sleep. A telephone survey of parents in one community. *Developmental and Behavioural Pediatrics* 1991;12(2):108-114.

11. France KG, Blampied NM, Wilkinson P. Treatment of infant sleep disturbance by Trimeprazine in combination with extinction. *Developmental and Behavioural Pediatrics* 1991;12(5):308-314.

12. Rickert VI, Johnson CM. Reducing nocturnal awakenings and crying episodes in infants and young children. A comparison between scheduled awakenings and systematic ignoring. *Pediatrics* 1988;81:203-211.

13. Ferber R. Sleep, sleeplessness, and sleep disruptions in infants and young children. *Annals of Clinical Research* 1985(17):227-234.

14. Jimmerson KR. Maternal, Environmental and Temperamental characteristics of toddlers with, and toddlers without, sleep problems. *Journal of Pediatric Health Care* 1991;5(2):71-77.

15. Scott G, Richards MPM. Night waking in infants: Effects of providing advice and support for parents. *Journal of Child Psychology and Psychiatry, 31:4; 551-567.* 1990;31(4):551-567.

16. Blunden S, Lushington K, Kennedy D, Martin J, Dawson D. Behavior and neurocognitive performance in children aged 5-10 years who snore, compared to controls. *J Clin Exp Neuropsychol* 2000;22(5):554-68.

17. Kahn A, Van de Merckt C, Rebuffat E, Mozin MJ, Sottiaux M, Blum D, et al. Sleep problems in healthy preadolescents. *Pediatrics* 1989;84(3):542-546.

18. Leeson R, Barbour J, Romaniuk D, Warr R. Management of sleep problems in a residential unit: Child, Adolescent & Family Health Service, SA., 1991.

19. Anders T, Eiben L. Pediatric sleep disorders: a review of the past 10 years. *J Am Acad Child Adolesc Psychiatry* 1997;36(1):9-20.

20. Pinilla T, Birch L. Help me make it through the night: behavioral entrainment of breast-fed infants' sleep patterns. *Pediatrics* 1993;91(2):436-44.

21. Everson C, Bergmann B, Rechtschaffen A. Sleep deprivation in the rat: III. Total sleep deprivation. *Sleep* 1989;12(1):13-21.

22. Rechtschaffen A, Gilliland M, Bergmann B, Winter J. Physiological correlates of prolonged sleep deprivation in rats. *Science* 1983;221(4606):182-4.

23. Jones C, Griffiths R, Humphris G. Disturbed memory and amnesia related to intensive care. *Memory* 2000;8(2):79-94.

24. Babkoff H, Sing H, Thorne D, Genser S, Hegge F. Perceptual distortions and hallucinations reported during the course of sleep deprivation. *Percept Mot Skills* 1989;68(3 Pt 1):787-98.

25. Chase M, McCarley B, Rechtschaffen A, Roth T. Basics of Sleep Behavior: WebSciences International and Sleep Research Society (United States). 1997.

26. Horne J. *Why We Sleep*. NY: Oxford University Press., 1988.

27. Cirelli C. How sleep deprivation affects gene expression in the brain: a review of recent findings. *J Appl Physiol* 2002;92(1):394-400.

28. Goji K. Twenty-four-hour concentration profiles of gonadotropin and estradiol (E2) in prepubertal and early pubertal girls: the diurnal rise of E2 is opposite the nocturnal rise of gonadotropin. *J Clin Endocrinol Metab* 1993;77(6):1629-35.

29. Krachman S, D'Alonzo G, Criner G. Sleep in the intensive care unit. *Chest* 1995;107(6):1713-20.

30. Kumar V. Melatonin: a master hormone and a candidate for universal panacea. *Indian J Exp Biol* 1996;34(5):391-402.

31. Backer A. Sleep: Roles of Thermoregulation, Energy Conservation & Restitution.: California Institute of Technology Technical Report Bi, 1999.

32. Stores G. *A clinical guide to sleep disorders in children and adolescents*. Cambridge: Cambridge University Press, 2001.

33. Rechtschaffen A, Bergmann B, Everson C, Kushida C, Gilliland M. Sleep deprivation in the rat: X. Integration and discussion of the findings. *Sleep* 1989;12(1):68-87.

34. Cirelli C, Shaw P, Rechtschaffen A, Tononi G. No evidence of brain cell degeneration after long-term sleep deprivation in rats. *Brain Res* 1999;840(1-2):184-93.

35. Tsai L, Bergmann B, Perry B, Rechtschaffen A. Effects of chronic total sleep deprivation on central noradrenergic receptors in rat brain. *Brain Res* 1993;602(2):221-7.

36. Lan C, Hsu J, Ling E. Influence of sleep deprivation coupled with administration of melatonin on the ultrastructure of rat pineal gland. *Brain Res* 2001;910(1-2):1-11.

37. Bennett A. Structural and functional determinates of metabolic rate. *American Zoologist* 1988;28:699-708.

38. Backer A. Sleep: Roles of Thermoregulation, Energy Conservation & Restitution: California Institute of Technology.

39. Gais S, Plihal W, Wagner U, Born J. Early sleep triggers memory for early visual discrimination skills. *Nat Neurosci* 2000;3(12):1335-9.

40. Vertes R, Eastman K. The case against memory consolidation in REM sleep. *Behav Brain Sci* 2000;23(6):867-76.

41. Stickgold R, Hobson J, Fosse R, Fosse M. Sleep, learning, and dreams: off-line memory reprocessing. *Science* 2001;294(5544):1052-7.

42. Drummond S, Gillin J, Brown G. Increased cerebral response during a divided attention task following sleep deprivation. *J Sleep Res* 2001;10(2):89-92.

43. Dawson D, Reid K. Fatigue, alcohol and performance impairment. *Nature* 1997;388(6639):235.

44. Ferber R, Kryger M. *Principles and practice of sleep medicine in the child*. Philadelphia: Saunders, 1995.

45. Ferber R. *Solve your child's sleep problems*. New York: Simon & Schuster, 1985.

46. Stores G. Practitioner review: assessment and treatment of sleep disorders in children and adolescents. *J Child Psychol Psychiatry* 1996;37(8):907-25.

47. Steiger A, Holsboer F. Neuropeptides and human sleep. *Sleep* 1997;20(11):1038-52.

48. Anders T, Halpern L, Hua J. Sleeping through the night: a developmental perspective. *Pediatrics* 1992;90(4):554-60.

49. Harrison Y, Horne J. Sleep loss and temporal memory. *Q J Exp Psychol A* 2000;53(1):271-9.

50. Okamoto, Kirikae. Electroencephalographic Studies on Brain of Foetus of Children of Premature Birth and New-Born, Together With Note on Reactions of Foetus Brain Upon Drugs. *Folia Psychiat Neurol Jap* 1951;5:135-146.

51. Scher M, Dokianakis S, Steppe D, Banks D, Sclabassi R. Computer Classification of State in Healthy Preterm Neonates. *Sleep* 1997;20(2):132-141.

52. Boselli M, Parrino L, Smerieri A, Terzano M. Effect of age on EEG arousals in normal sleep. *Sleep* 1998;21(4):351-7.

53. Gillberg M. Sleepiness and its relation to the length, content, and continuity of sleep. *J Sleep Res* 1995;4(S2):37-40.

54. Sterman B. The relationship of intrauterine fetal activity to maternal sleep stage. *exp Neurol* 1967;19:98.

55. Sadeh A. Actigraphic home monitoring of sleep disturbed infants: comparison to controls and assessment of intervention. In: Horne J, editor. *Sleep*. Bochum: Pontenagal Press, 1990:469-470.

56. Glenville M, Broughton R, Wing A, Wilkinson R. Effects of sleep deprivation on short duration performance measures compared to the Wilkinson auditory vigilance task. *Sleep* 1978;1(2):69-76.

57. Lan C, Hsu J, Ling E. Influence of sleep deprivation coupled with administration of melatonin on the ultrastructure of rat pineal gland. *Brain Res* 2001;910(1-2):1-11.

58. Pilcher J, Huffcutt A. Effects of sleep deprivation on performance: a meta-analysis. *Sleep* 1996;19(4):318-26.

59. Pilcher J, Lambert B, Huffcutt A. Differential effects of permanent and rotating shifts on self-report sleep length: a meta-analytic review. *Sleep* 2000;23(2):155-63.

60. Kerr SM, Jowett SA. Sleep problems in pre-school children: a review of the literature. *Child Care Health Dev* 1994(20):379-391.

61. Armstrong KL, Van Haeringen AR, Dadds MR, Cash R. Sleep deprivation or postnatal depression in later infancy: separating the chicken from the egg. *J Paediatr Child Health* 1998(34):260-262.

62. Hunsley M, Thoman E. The sleep of co-sleeping infants when they are not co-sleeping: evidence that co-sleeping is stressful. *Dev Psychobiol* 2002;40(1):14-22.

63. Maurer D, C M. *The world of the newborn*. New York: Basic Books, 1988.

64. Thoman E. Sleeping and waking states in infants: a functional perspective. *Neurosci Biobehav Rev.* 1990;14(1):93-107.

65. Ferber R. *Sleep disorders in infants and children*. London: Butterworths, 1985.

66. Mercier L, Pivik R, Busby K. Sleep patterns in reading disabled children. *Sleep* 1993;16(3):20715.

67. Lozoff B, Wolf A, Davis N. Cosleeping in urban families with young children in the United States. *Pediatrics* 1984;74(2):171-82.

68. Chavin W, Tinson S. Children with sleep difficulties. *Health Visitor* 1980(53):477-481.

69. Leger D. Public health and insomnia: economic impact. *Sleep* 2000;May 1(23 Suppl 3):69-76.

70. Harrison Y, Horne J. Sleep deprivation affects speech. *Sleep* 1997;20(10):871-7.

71. Dotto L. *Losing sleep: How your sleeping habits affect your life.* New York: William Morrow and Company Inc, 1990.

72. Harrison Y, Horne J, Rothwell A. Prefrontal neuropsychological effects of sleep deprivation in young adults--a model for healthy aging? *Sleep* 2000;23(8):1067-73.

73. Harrison Y, Horne J. The impact of sleep deprivation on decision making: a review. *J Exp Psychol Appl* 2000;6(3):236-49.

74. Bonnet M, DL A. The consequences of a week of insomnia. II: Patients with insomnia. *Sleep* 1998;15(21):359-68.

75. Bonnet M, Arand D. Heart rate variability in insomniacs and matched normal sleepers. *Psychosom Med* 1998;60(5):610-5.

76. Kant G, Genser S, Thorne D, Pfalser J, Mougey E. Effects of 72 hour sleep deprivation on urinary cortisol and indices of metabolism. *Sleep* 1984;7(2):142-6.

77. Daws D. *Through the night - Helping parents and sleepless infants*. London: Free Association Books, 1993.

78. Seymour FW, Bayfield G, Brock P, During M. Management of night waking in young children. *Australian Journal of Family Therapy* 1983(63):380-387.

79. VanTassel EB. The relative influence of child and environmental characteristics on sleep disturbances in the first and second years of life. *Developmental and Behavioural Pediatrics* 1985;6(2):81-86.

80. Werry JS, Carlielle J. The nuclear family, suburban neurosis and iatrogenesis in Auckland mothers of young children. *Journal of the American Academy of Child Psychiatry*, 1983(22):172-179.

81. Beltramini AU, Hertzig ME. Sleep and bedtime behaviour in preschool-aged children. *Pediatrics* 1983(71):153-158.

82. Richman W. A community survey of characteristics of 1-2 year olds with sleep disruptions. *American Academy of Child Psychiatry* 1981(20):281-291.

83. Weir IK, Dinnick S. Behaviour modification in the treatment of sleep problems occurring in young children: a controlled trial using health visitors as therapists. *Child: Care, Health and Development* 1988(14):355-367.

84. Bax MCO. Sleep disturbance in the young child. *British Medical Journal* 1980(May):Occasional Review.

85. Richman N, Stevenson J, Graham P. *Preschool to school: a behavioural study*. London: Academic Press, 1982.

86. Benoit D, Zeanah CH, Boucher C, Minde KK. Sleep disorders in early childhood. Association with insecure maternal attachment. *Journal of Adolescent Psychiatry* 1992;31(1):86-93.

87. Green C, Chee K. Management of attention deficit disorder: A personal perspective. *Modern medicine* 1994;37(2):27.

88. Barkley R. *Attention Deficit Hyperactivity Disorder: A handbook for diagnosis and treatment*. New York: Guilford Press, 1990.

89. Anders TF. Infant sleep, night time relationships and attachment. *Psychiatry* 1994;63(6):860-864.

90. Osterholm P, Lindeke, L.L., and Amidon, D. Sleep disturbance in infants aged 6-12 months. *Pediatric Nursing* 1983;July-August:269-273.

91. Adair R, Bauchner H, Phillip B, Levenson S, Zuckerman B. Night waking during infancy: Role of parental presence at bedtime. *Pediatrics* 1991;87(4):500-504.

92. Blampied N, France K. A behavioral model of infant sleep disturbance. *J Appl Behav Anal.* 1993;26(4):477-92.

93. Galbraith L, Hewitt K, Pritchard L. Behavioural treatment for sleep disturbance. *Health Visitor* 1993;66(5):169-171.

94. Adams LA, Rickert VI. Reducing bedtime tantrums: Comparison between positive routines and graduated extinction. *Pediatrics* 1989;84(5):756-760.

95. Kerr SM, Jowett, S.A., and Smith, L.N. Preventing sleep problems in infants: a randomised controlled trial. *Journal of Advanced Nursing* 1996(24):928-942.

96. Richman N. A double - blind drug trial of treatment in young children with waking problems. *Journal of Child Psychology and Psychiatry* 1985;26:591-598.

97. Kahn A, Hasaerts D, Blum D. Phenothiazine-induced sleep apnoeas in normal infants. *Pediatrics* 1985;75(5):844-7.

98. Green C. *Babies! A parent's guide to surviving(and enjoying!) baby's first year*. Brookvale: Simon & Schuster, 1988.

99. St James-Roberts I, Sleep J, Morris S, Owen C, Gillham P. Use of a behavioural programme in the first 3 months to prevent infant crying and sleeping problems. *J Paediatr Child Health* 2001;37(3):289-97.

100. Wolfson A, Lacks P, Futterman A. Effects of parent training on infant sleeping patterns, parents' stress, and perceived parental competence. *J Consult Clin Psychol* 1992;60(1):41-8.

101. Nikolopoulou M, St James-Roberts I. Preventing sleeping problems in infants who are at risk of developing them. *Arch Dis Child* 2003;88(2):108-11.

102. France K, Hudson S. Management of infant sleep disturbance: a review. *Clin Psychol Rev* 1993;13:635-647.

103. Simonoff E, Stores G. Controlled trial of trimeprazine tartrate for night waking. *Archives of Disease in Childhood* 1987;62:253-257.

104. Paul F. Sleep disturbance in young children. *Singapore Fam Physician* 1982(8):111-113.

105. Pritchard A, Appleton P. Management of sleep problems in pre-school children. *Early Child Dev Care* 1988(34):227-240.

106. Seymour FW, Brock P, During M, Poole G. Reducing sleep disruptions in young children: evaluation of therapist-guided and written information approaches: a brief report. *J Child Psychol Psychiatry* 1989;30(6):913-8.

107. CYH. *Settling Your Baby. A survival guide for parents birth to 12 months*. 6th ed. Adelaide: Child and Youth Health, 1994.

108. Pocock S. *Clinical Trials - A Practical Approach*. Bath: Pittman Press, 1983.

109. Barr R, Kramer M, Boisjoly C, McVey-White L, Pless I. Parental diary of infant cry and fuss behaviour. *Arch Dis Child* 1988;63(4):380-7.

110. St James-Roberts I, Hurry J, Bowyer J. Objective confirmation of crying durations in infants referred for excessive crying. *Arch Dis Child* 1993;68(11):82-4.

111. Radloff LS. The CES-D scale: A self-report depression scale for the general population. *Applied Psychological Measurement* 1977;1(3):385-401.

112. Health TNIoM. Depression inventory (CES-D): Center for Epidemiological Studies, 1977.

113. Symon B. *Your Baby*. Adelaide: University of Adelaide, 1997.

114. CDC. Epi Info, Version 6. A Word- Processing, Database, and Statistics program for Public Health on IBM-compatible Microcomputers: The Division of Surveillance and Epidemiology - Center for Disease Control and Prevention, Atlanta., 1995.

115. Liang KY, Zeger SL. Longitudinal data analysis using generalised linear models. *Biometrica* 1986(73):13-22.

116. SAS-Institute. *The Gennod Procedure, SAS-STAT software, changes and enhancements through release 6.12,*. NC: Cary, 1997.

117. ABS. Australian Bureau of Statistics 1991, Information paper: 1991 Census - Socio-economic Indexes for areas. 1993.

118. Moser CA, & Kalton, G. *Survey methods in social investigation*. Suffolk.: The Chaucer Press Ltd, 1983.

119. CDC. *Epi Info, Version 6. A Word- Processing, Database, and Statistics program for Public Health on IBM-compatible Microcomputers*. Atlanta.: The Division of Surveillance and Epidemiology - Center for Disease Control and Prevention, 1995.

120. DIMIA. English proficiency 1996 census.: DIMIA, 2001.

Appendices

Appendix I Index of Tables

Appendix II Index of Figures

Appendix III Glossary of Terms and Definitions

Absolute risk.

The incidence of d' in a population per year.

No correction made for those not at risk.

(Note that relative risk is calculated as = cases in exposed / cases in non exposed.)

Active sleep

REM sleep. In the neonate, the skeletal muscle atonia of mature sleep is absent and the neurological activity of REM sleep is reflected in an incomplete manner as motor activity.

ADHD – Abbreviation for Attention Deficit Hyperactivity Disorder

Advanced Sleep Phase Syndrome (ASPS)

Phases of the daily sleep/wake cycle are advanced with respect to clock time. This is classified as a circadian rhythm disorder. The sleep phase occurs well ahead of the conventional bedtime and the tendency is to wake up too early.

Agreement.

The number of positives for both observers + number of negatives for both / total number of cases then multiply by 100. (This result will often give a high level of agreement because of the large number of agreed normals.) Thus, percentage agreement is often calculated with the exclusion of agreed negatives and thus becomes; Agreement = a / (a + b + c) *100

Altricial

Anatomically and physiologically retarded in development at the time of birth as compared with "precocial" animals.

Alpha wave EEG activity

Awake, relaxed, drowsy, often with eyes closed, synchronized

Ambulatory monitor

Portable system used to record (continuously) multiple physiological variables during sleep.

Arithmetic mean

The arithmetic mean is what is commonly called the average: when the word "mean" is used without a modifier, it can be assumed that it refers to the arithmetic mean. The mean is the sum of all the scores divided by the number of scores. The formula in summation notation is: $\mu = \Sigma X/N$ where μ is the population mean and N is the number of scores. If the scores are from a sample, then the symbol M refers to the mean and N refers to the sample size. The formula for M is the same as the formula for μ. The mean is a good measure of central tendency for roughly symmetric distributions but can be misleading in skewed distributions since it can be greatly influenced by extreme scores. For normal distributions, the mean is the most efficient and, therefore, the least subject to sample fluctuations of all measures of central tendency.

Arousal

Abrupt change from sleep to wakefulness, or from a "deeper" stage of non-REM sleep to a "lighter" stage. This process is controlled by brainstem. The locus coeruleus in the pons releases norepinephrine. Other neurotransmitters of arousal include acetylcholine and serotonin.

Arousal disorder

Parasomnia disorder presumed to be due to abnormal arousal. Classical arousal disorders include sleepwalking, sleep terrors and confusional arousals.

Arousal threshold

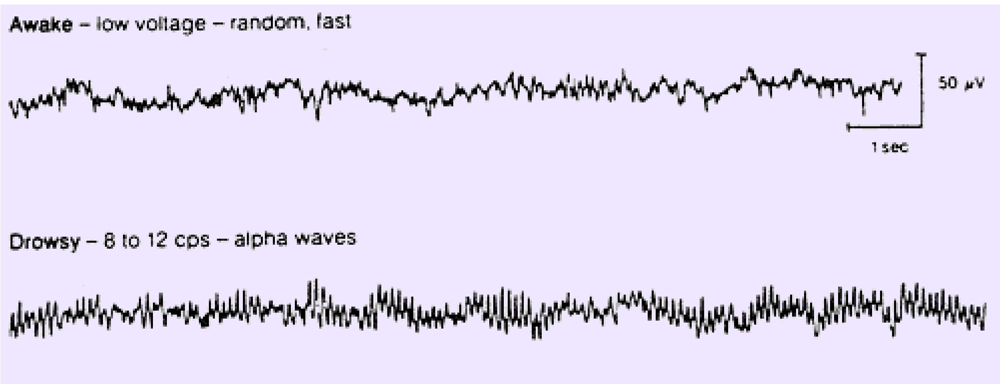
The ease with which a sleeping person is awakened.

Asleep

See Sleep

Awake

The state of not being asleep.



Basic sleep cycle

The progression through an orderly succession of sleep states and stages.

- For the healthy adult, the first cycle begins by going from wakefulness to non-REM sleep. The first REM period follows the first period of non-REM sleep, and the two sleep states continue to alternate throughout the night with an average period of about 90 minutes. A night of normal human sleep usually consists of 4-6 non-REM/REM sleep cycles.

- For the healthy infant, the first cycle begins by moving from wakefulness to REM sleep. The first NREM period follows the first REM. The two states continue to alternate through a block of sleep. The basic sleep cycle time is 45-60 minutes.

Behavioural observation

Direct observation of the sleeping subject in a controlled environment. The record which is created by coding for sleep or wake status may be correlated with other measurements of physiology such as PR or temp.

Beta EEG activity.

Alert, attentive, thinking, desynchronised.

Bias.

An error of design, conduct or analysis in a study which distorts the relationship between exposure and outcome events. Deviation of results from the truth as a result of **introduced** systematic errors**. Bias creates differences through the methods of the study**. An error of bias leads to a 'differential misclassification' i.e. subjects are more likely to reside in one group than another. Conversely, random error will lead to non-differential misclassification. Bias is minimised by good study design.

- Types of bias.
    - Design bias
    - Selection bias (Ascertainment or sampling bias).
    - Data collection e.g. using hospital patients or conversely, a healthy population. (Decreases external validity). Selection bias is a particular

problem for case-control and cross sectional studies. RCT's in theory control for bias through randomisation. Selection bias is controlled by;

- For cases
  - Careful case definition
  - Ensuring high participation rates
  - Selecting from a broad range of sources
  - Using an objective and recognised source of case definition
  - Making the selected groups representative of the population to which the results are to be applied.
- For controls
  - Comparing exposure to establish creditability
  - Drawing from representative sources

o Observational or measurement or information bias (should not be a problem with well designed cohort studies.) Information may be held or obtained more completely in one group e.g. Ca' breast subjects may have more information recorded about family history than non affected. Observational bias is controlled by;

- Attempting to standardise the questions or other measures of exposure
- Blinding the surveyor or, better still, surveyor and subject.
- Training surveyors
- Is the measuring instrument appropriate e.g. language?
- Is the object being measured e.g. blood pressure the correct measure for evaluating the effect of the exposure?

        - Interviewer bias e.g. interviewer has a belief in the intervention
    - Recall bias e.g. leukaemia in children
    - Reporting bias e.g. drinkers report less alcohol intake
    - Non response bias. Responders and non-responders are, in fact, different groups of people with different health outcomes.
    - Surveillance bias e.g. observing more closely those on treatment or those on treatment being more likely to respond.
    - Misclassification bias.
        - Differential misclassification. The misclassification is an error caused by an error of design.
        - Non-differential. The subjects are misclassified randomly. (Tends to dilute RR or the calculation of OR.)
    - Analysis bias.
    - Interpretation bias.
    - Publication bias.
    - Review of data bias.

Biological clock

Circadian rhythm The mechanism whereby variations in body temperature, hormone secretions, and other related bodily functions relate to a 24 hour clock. The principal control of the circadian rhythm comes from the suprachiasmatic nucleus which receives direct stimulus from the retina. The nucleus is also controlled by information derived from the pineal gland.

Blinding

Masking the subject (single blind) or masking both subject and investigator (double blind)

BPM – Abbreviation for beats per minute

Burden of disease

Burden of disease can be reported in multiple ways.

- Incidence. Number of new cases per time frame
    - Cumulative risk or incidence e.g. 100 cases per 10 years
    - Incidence density rates e.g. 2 cases per 105 man years of exposure
    - Attack rates = number attacked out of number at risk e.g. 23 cases per 99 persons at risk at a dinner party.
- Prevalence. Number of cases in a population of size ‘x’.
    - Point prevalence e.g. found in a cross-sectional study
    - Period prevalence e.g. cases in the first half of the year.
- Mortality
    - Crude mortality e.g. 23 deaths per 105 in Adelaide in 1999
    - Case fatality rate is number who died from number at risk in a nominated time. (this is a measure of fatality)
    - Five year mortality is the number of deaths within 5 years of diagnosis.

Canthus

The angle between the eyelids at the corner of the eye

Capacitor plates

A piece of equipment for evaluating muscle activity in a sleep study.

Case-control study

The study begins with cases or those with the ‘outcome’ in the population. Then previous exposures are analysed in comparison with appropriately chosen controls who **lack** the disease or outcome. Cases and controls are the columns of the 2x2 table. The design of case-control studies is always backwards. The enquiry is about **previous** exposures. For this reason, the case control studies are sometimes called retrospective studies. Thus exposures are in rows of 2x2 table. This study design is applicable to rare diseases. As cases are included in the selection process then cc studies can not give a relative risk (RR) but can give an odds ratio which works as an approximation of the RR.

	Cases	Controls	Totals
Exposed	a	b	
Not exposed	c	d	
Totals			

- A case is a person with the outcome. This needs to be precisely defined. Ideally, they would be incident cases in a defined population as prevalent cases may well be survivors and thus not true representatives of all cases.
- A control. They are defined to be comparable. They must be drawn from the population at risk. They may have other health problems as this does occur in the host population. A control would have been in the case group if they had had the disease i.e. all other variables are comparable between cases and controls.
- Advantages of a case controlled study.
    - Good for rare cases as smaller groups can be used to obtain a result.
- Disadvantages of a case controlled study.
    - It is not possible to do a RR as the cases are present at the outset.
    - The odds ratio is used as the surrogate.
    - It is not possible to talk about an incidence or prevalence from these figures as cases have been chosen at the outset.

    - Bias. As these studies are looking backwards, then the problem of recall bias is present e.g. recall of more information because the subject is a case.

- Odds ratio.
    - Odds of being exposed in cases = a/c
    - Odds of being exposed in controls = b/d
    - Odds ratio = (a/c)/(b/d) i.e. a/c * d/b = ad/cb (crossed ratio)
- Nested case control study. The study begins as a cohort study but a cc study is developed from incident cases identified, as this can decrease the costs incurred.

Causal relations

- Direct or Indirect
- Necessary and sufficient alone to cause the effect. (This is rare in biology.)
- Necessary but not sufficient to cause the effect. (It is common in biology that more than one agent is needed to cause an effect.)
- Sufficient but not necessary e.g. either benzene or radiation can cause Ca.
- Neither necessary or sufficient. Its presence is correlation not causation.

Causation

A relationship between events may be correlation or causation. The evidence in favour of causation has been developed into a hierarchy.

- The Bradford – Hill hierarchy of causation. (Acronym STAB DRACS)

o S Strength of association (RR or OR)

o T Temporal sequence or relationship (concurrent cohort)

o A alternatives considered (identify and exclude confounders) o B Biological plausibility (must fit with current knowledge if possible. Examples exist where the causal relationship preceded knowledge e.g. retrolental fibroplasia)

o D Dose-response (dose / response relationship supports causation)

o R Reproducibility (if causal then the association will occur in different populations and with consistency)

o A Any other knowledge

o C Cease exposure (if the cause is ceased then the incidence may decline.)

o S Specificity (one exposure one disease)

Chance event

Random error

Chronotherapy

Treatment for circadian rhythm sleep disorder by systemically changing sleeping and waking times to reset the biological clock.

Circadian rhythm

As for Biological clock

CNS – Abbreviation for central nervous system

Cohort effect

The effect of a cohort moving through the age population over a period of years. One birth cohort may behave differently to another.

Cohort study

A study which begins with people who are **disease or outcome free.** (e.g. they may have a health problem but the outcome e.g. death has not occurred.) These studies require observation for enough patient years to generate reliable incidence or mortality rates which often requires long periods of time. Exposure is measured during study. (this may be at the start e.g. exposed to gas and compared to a standard population.) Note that the selection by exposure can make it difficult to study other exposures. Selection on a non exposure basis e.g. address can allow for multiple exposure studies. Cohort studies are useful when the exposure is rare compared to case-control studies which are useful when the disease is rare. Development of new cases of disease is studied over time. Because the date of onset i.e. new cases are being identified then a temporal relationship is being reported between exposure and disease development. The direction of study is forward and attempts to link cause (exposure) with effect (outcome). Data measurement is forward and/or backwards. (Note that the IDEAL cohort study is as powerful as a RCT.) A cohort study design will give a measure of incidence.

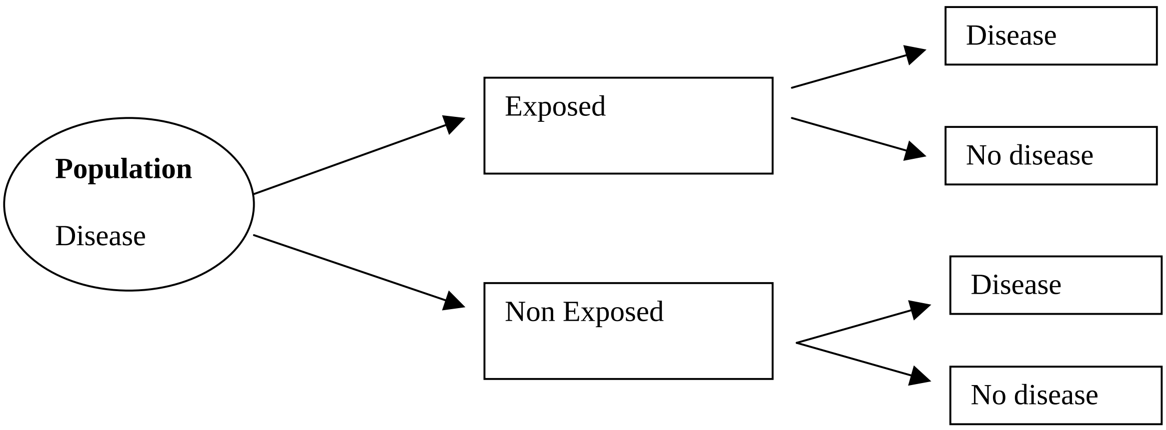
		Outcome		
		Diseased	Unaffected	
Population (disease free)	Exposed	a	b	a+b
	Unexposed	c	d	c+d
		a+c	b+d	Total

- Subgroups include;
    - Concurrent (time passes as the study occurs)
    - Non concurrent or retrospective cohort (looks back at data)

- Mixed (both)

- Types of cohort studies.
  - Population groups.
    - Total population
    - Exposed e.g. post Chernobyl or employment status e.g. Wittenoom
  - Time frames.
    - Concurrent (prospective)
    - Non concurrent (retrospective) the exposure has occurred in the past.
  - Comparison group choices.
    - Internal e.g. same company but different jobs
    - External e.g. different state
    - Reference population e.g. national data (age, sex matched)
  - Analysis available in a cohort
    - Incidence rate or risk or density or cumulative
    - Relative risk (risk in exposed / risk in unexposed)
- Advantages of cohort studies.
  - Direct measure of incidence
  - Time sequence is clear (exposure precedes disease or outcome)
  - Can be used in common conditions
  - Suits disease which has a short time frame e.g. food poisoning
  - Many outcomes can be studied
- Disadvantages of cohort studies.
  - Long times may be needed
  - Large populations may be needed
  - Can be expensive

- Need to collect data which includes other possible outcomes and even exposures
- Follow-up introduces the possibility of bias
- Assessment of outcome can introduce bias



Community trials

Useful when there is a complex intervention e.g. ceasing smoking and lifestyle rather than medical problems are targeted and there is high prevalence e.g. smoking again.

Confidence interval

A site which demonstrates the principle.

http://www.stat.sc.edu/~west/javahtml/ConfidenceInterval.html

A confidence interval is a range of values that has a specified probability of containing the parameter being estimated.

The 95% and 99% confidence intervals which have .95 and .99 probabilities of containing the parameter respectively are most commonly used.

Another definition is that, if this study were repeated, multiple times, then 95% of the studies would provide results in the following ranges.

If the parameter being estimated were μ, the 95% confidence interval might look like the following: $12.5 \leq \mu \leq 30.2$ What this means is that the interval between 12.5 and 30.2 has a .95 probability of containing μ.

A confidence interval only has the specified probability of containing the parameter if the sample data on which it is based is the only information available about the value of the parameter. As an extreme example, consider the case in which 1000 studies estimating the value of μ in a certain population all resulted in estimates between 25 and 30. If one more study were conducted and, if the 95% confidence interval on μ were computed (based on that one study) to be: $35 \leq \mu \leq 45$, then it would be absurd to say that the probability that μ is between 35 and 45 is .95. It almost certainly is not. However, if the only data you had to go on were that one study, then, from your point of view, the probability is .95.

It is important to be very precise about the sense in which a confidence interval has a specified probability of containing a parameter: If the procedure for computing a 95% confidence interval is used over and over, 95% of the time the interval will contain the parameter.

Confidence intervals can be constructed for any estimated parameter, not just μ. For example, one might estimate the proportion of people who could pass a training program or the difference between the mean for subjects taking a drug and those taking a placebo.

Confounders

An independent variable which varies systematically with the hypothesised causal agent under study. Uncontrolled confounders cannot be distinguished from the study variable. E.g. studying hand grip without controlling for sex. Confounders are not errors but are real relationships which need to be understood. **They are a cause of the outcome independently of the disease or observed variable being considered.**

- They are a risk factor for the variable e.g. sex and strength

- They must be present in the exposed group
- They are part of the environment. (Easily confused with bias which is part of the STUDY DESIGN)
- Confounders are NOT in the causal path between exposure and disease.
- They decrease external validity.
- There can be positive and negative confounders;
    - Positive. There is an increased link between positive association i.e. increased exposure = increased risk or decreased exposure = decreased risk.
    - Negative. Increases the chance of a negative association i.e. increased exposure = decreased risk or decreased exposure = increased risk.

Confounders are to be excluded by study design even though they are part of the environment and NOT introduced by the design.

- Methods of controlling for confounders include;
    - Selection criteria. Definition of selection criteria so that confounders are controlled i.e. do not vary. e.g. select men only, or only one age group, or socio-economic group, or one race. Thus, because the confounder varies with the 'cause' under study, ensure selection so that variation of the confounder does not occur.
    - Matching pairs e.g. pairs of women, or pairs of sports players, or mine workers, or smokers.
    - Randomisation. Confounders are then allocated randomly across subjects and controls. E.g. smokers and non smokers randomly allocated to different study groups.
    - Analysis. For the analysis to handle the confounder, data must be collected during the data collection process.
    - Stratification e.g. only smokers analysed at one time.

- Standardisation. The analysis is standardised e.g. for age or sex or occupation or SES. This includes direct, indirect and multi-variate techniques.
- Confounders and cohort studies.
  - Difficult to change information on confounders
- Confounders and ecological studies.
  - Confounders cannot be assessed or controlled at the individual level.

Controls

Subjects who ideally would be cases if they had the disease or outcome under study. The function is to increaser the power i.e. the ability to adequately identify a true correlation. Power = 1 – type II error (false negative). This increase in power only really works up to 1 case to 4 controls

- Same type e.g. non hospital.
- Different types. This can assist in handling the possibility of some forms of bias.

Correlation

There can be causal or non causal correlation. Non causal correlation can exist because of

- Confounders
- Bias
- Random error or chance

CPS – Abbreviation for cycles per second

Critique

A written criticism or review.

Crossover

A planned or unplanned movement from one treatment group to another.

- Planned crossover = methodology moves subjects between different treatment arms. This has advantages of using individuals as their own controls, and can assist in decreasing the effect of confounders.
- Unplanned crossover = movement between treatment arms not proposed in the methodology.

Cross-sectional studies (prevalence study).

The examination of a disease and outcome variables in a population as they exist at a given time. Outcome and exposure are defined at one particular time.

- Weakness.
  - Only identifies prevalent cases
  - It is not clear what the temporal relationship between exposure and effect are.
  - May only deal with live persons as the deceased may not exist in the 'cross-section' analysed. Note the healthy worker effect. There is the possibility that the population is skewed to healthy survivors.
  - Not useful for rare conditions.
  - Does not predict future outcomes.
  - Limited value in short duration disease
- Advantages.
  - Quick, cheap.
  - Can show case load or prevalence
  - Generates hypothesis for testing

		Diseased	Unaffected	

Population	Exposed	a	b	a+b
	Unexposed	c	d	c+d
		a+c	b+d	Total

- Prevalence of disease in exposed = a/a+b
- Prevalence of disease in unexposed = c/c+d
- Prevalence of exposure in diseased = a/a+c
- Prevalence of exposure in unaffected = b/b+d

Crude rates

The summary of rate information e.g. 10 deaths per 10^5 per year. This does not allow a comparison of different ages, SES, sex etc.

Cumulative incidence.

See incidence.

Cycles (sleep cycles)

See sleep cycles

Denominator

The population at risk i.e. a+b. The numerator is the number affected i.e. a.

All persons in the denominator must have a chance of coming to reside in the numerator.

Deep Sleep

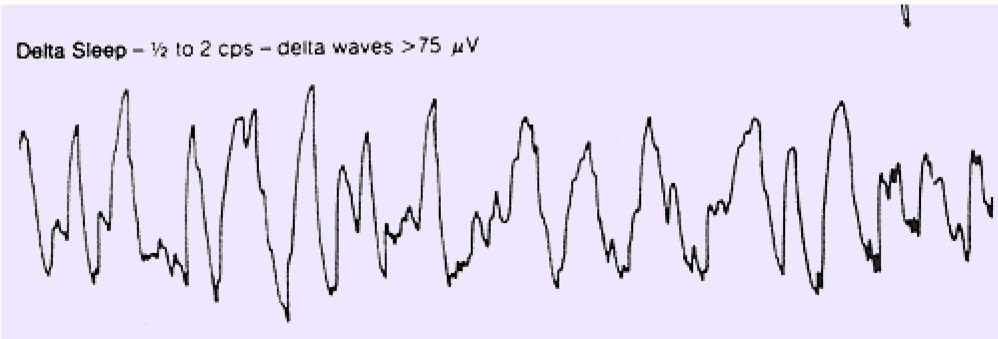
Generally used to refer to the combined periods of stages3 and 4 in NREM sleep.

Delta sleep (slow wave sleep)

Elements of the sleep cycle where the EEG is coded for Delta Waves. Delta Waves occur in stage 3 and 4 NREM sleep.

Delta waves

Occurring in phase 3 and 4 NREM sleep. High amplitude (>75mcV) slow waves (0.5 – 2 Hz) of at least 0.5 seconds duration.



Diagnostic Sleep Study

Monitoring of a subject's sleep in a controlled environment.

Differential misclassification

An error caused by bias, an error of design, compared with non-differential misclassification.

Diurnal

Awake and active in daylight as opposed to night-time (nocturnal).

DIMS – Abbreviation for Disorders of Initiating and Maintaining Sleep

Drowsy (Drowsiness)

A period of quiet wakefulness which may precede sleep onset.

DSPS Abbreviation for Delayed Sleep Phase Syndrome

Dyad.

Two individuals (as husband and wife) maintaining a sociologically significant relationship.

Ectothermic

An organism that regulates its body temperature largely by exchanging heat with its surroundings; a poikilotherm

EDS Abbreviation for Excessive Daytime Sleepiness

EEG Abbreviation for Electroencephalogram

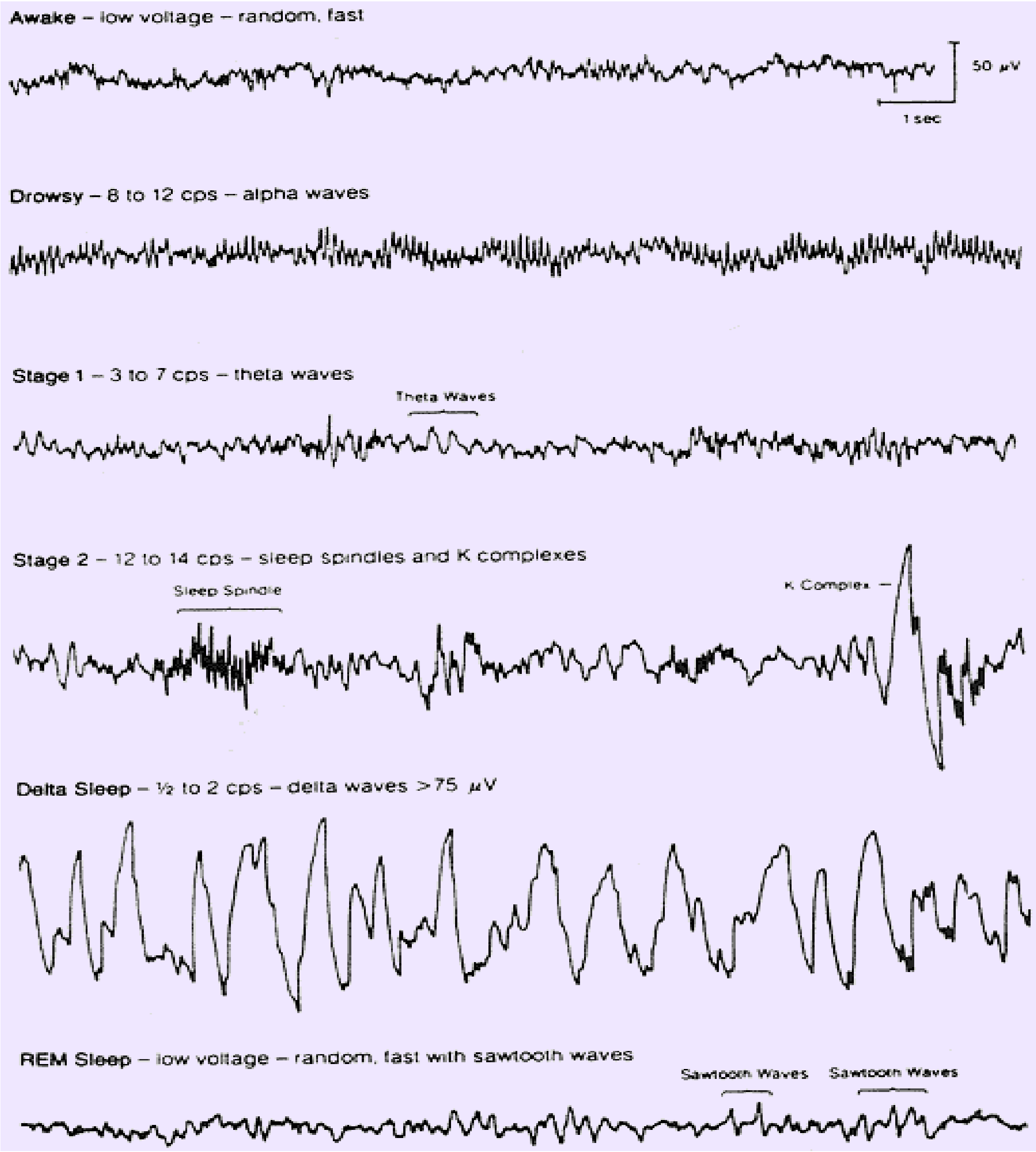
Electrodes

Devices for detecting and transmitting electrical activity from a subject to various forms of equipment which display this information in a visual form.

Electroencephalogram (EEG)

A visual print-out of the electrical activity of the brain. Electrodes on the scalp detect electrical discharges. Electrode points on the scalp are mapped to standard positions.

In certain operative and experimental settings, electrical information can be recorded from within the brain structure. A range of EEG patterns are presented below.



Electromyogram (EMG)

Recording of electrical activity from a muscle. In sleep studies, muscle activity from various points on the face and scalp can be used.

Electro-oculogram (EOG)

An electrical measurement of changes in the position of the eye. With the EEG and EMG, it is one of the three basic measures in a standard sleep study.

EMG – Abbreviation for Electromyogram

Endemic

A disease which is continuously present in a population or geographical location

Endothermic

Generating heat to maintain body temperature, typically above ambient temperature. Warm-blooded.

ENT Abbreviation for Ear, Nose, and Throat

EOG – Abbreviation for Electro-oculogram

Epoch

A standardised period of time for recording observations in a sleep study. A common epoch is 30 seconds.

Epworth Sleepiness Scale

An 8 question instrument for evaluating daytime sleepiness.

Foetus

The unborn young from the eighth week after conception to the moment of birth, as distinguished from the earlier embryo.

Forbidden zone

A period of time, usually in the evening, associated with increased alertness which is clock dependent. A period of decreased ability to achieve sleep.

Fragmentation (pertaining to sleep)

The disruption of a single sleep stage by movement into a lighter stage of sleep or wakefulness.

GABA - Abbreviation for Gamma-Amniobutyric Acid. A CNS neurotransmitter of NREM sleep.

Hertz (Hz)

Cycles per second (cps).

Histogram (sleep)

The sleep histogram is a graphical representation of sleep stages.

HMS

Abbreviation for home monitoring system.

Home monitoring system

A technique which by measuring movement and respiration gives a measurement of sleep performance.

Hyperactivity

Behavioural variation in children associated with increased disco-ordinate activity, and decreased responsiveness to moderating influences. May be associated with sleep deprivation.

Hypercapnia

Increased partial pressure of carbon dioxide in circulating blood.

Hypersomnia

Prolonged periods of sleep compared to normal subjects.

Hypnagogic

Pertaining to sleep achievement or, more specifically, the movement from wakefulness to sleep.

Hypnagogic hallucinations

Ideation immediately preceding sleep. Marked sensory images which occur at the time of sleep onset.

Hypnagogic startle

A sudden jerking movement of the body at the time of sleep achievement associated with temporary arousal.

Hypnotics

Drugs which induce a stage of sleep.

Hz - Abbreviation for Hertz (frequency)

Implicit learning

A term coined by Reber in 1965.

- Learning about a complex stimulus environment often in a passive and unintended manner.

- Knowledge acquired independent of conscious attempts to learn, and generally without the capacity to communicate what has been acquired.
- Implicit learning is a fundamental process that lies at the very heart of the adaptive behavioural repertoire of every complex organism..

Inappropriate Sleep

Unplanned and inappropriate transition to sleep as a consequence of sleep deprivation. The fatigued driver may experience inappropriate sleep.

Incidence

The number of **new** cases in a population over a time period e.g. 10 per year. **Incidence is a measure of risk.**

Incidence per 1,000 is calculated by then multiplying by 1,000 or other number e.g. 10,000.

- Numerator = number of new cases in a given time
- Denominator = persons at risk.
    - Persons in the denominator must have a chance of moving into the numerator.
    - If there is no chance of them being included in the numerator then they are excluded e.g. incidence of pregnancy needs to exclude males.
    - Persons in the denominator must be followed for the full time mentioned.
    - (Note that the denominator excludes persons affected at the start of the time frame.)
- Cumulative Incidence or incidence risk or incidence probability.
    - In this population all individuals were at risk for the time of study.
    - The risk of a new event occurring over a particular time = N / D
        - N = number who contract disease in a period of time
        - D = population at risk at beginning of time period.

- May simply be called RISK.
- Cumulative incidence is a probability of disease. E.g. 10 new cases per 100,000 persons observed. The question “Have you ever had asthma?” will give a cumulative incidence of asthma.

Incidence density

The incidence rate

Incidence rate

The rate of new cases occurring. I = number of new cases / sum of person years of each person in the population. E.g. 10 per 1000 person years. This allows for patients who move into and out of observation.

Indeterminate sleep. (see transitional sleep)

A sleep coding status used in foetal and neonatal sleep studies.

In the foetus and neonate, active and quiet sleep are not clearly segregated, thus a significant part of the sleep record is neither active or quiet but is, in fact, transitional or indeterminate

Infant

A baby beyond three months of age.

Insomnia

An inability to achieve and maintain sleep.

Interaction

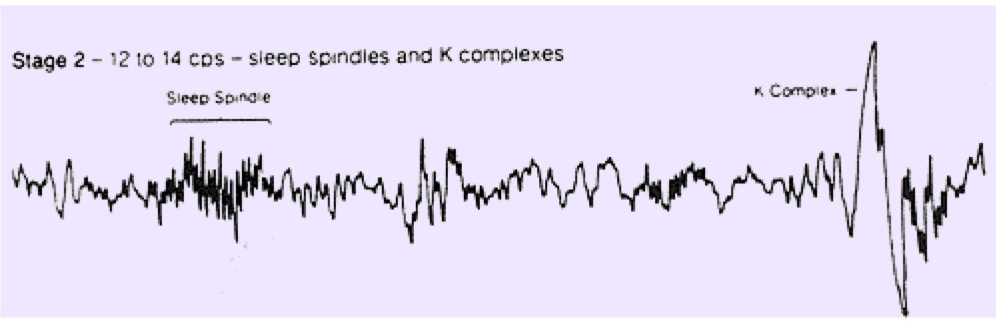
The relationship which exists between different variables. Interaction is present when the incidence rate of disease in the presence of two or more risk factors differs from the rate expected from their individual effects. Interaction can be synergistic or antagonistic. E.g. effect of asbestos exposure in smokers/non smokers on the incidence of mesothelioma.

Intermediate sleep

A time where criteria for different sleep / wake states coexist. Most frequently observed at times of sleep onset, when moving between sleep states, and upon awakening.

K complex

An electrical marker of NREM sleep which appears between 3 and 6 months of age. They occur in, and define, stage 2 NREM sleep. The K Complex is a sharp high voltage negative wave, followed by a slower positive wave.



Ligand

An ion, a molecule, or a molecular group that binds to another chemical entity to form a larger complex

Light Sleep

Stage 1 and 2 NREM Sleep.

Longest Sleep Period.

The time between awakenings. The longest sleep period is a measure associated with maturity. At age two weeks it is generally less than four hours. By five months, it is increased to seven hours.

LSP (N)

Longest sleep period at night.

LSP (D)

Longest asleep period in daytime.

Matching

Selecting controls who are similar to cases

- Types of matching.
  - Group matching e.g. 20% female
  - Individual matching or matched pairs
- Problems of matching.
  - Numbers of available controls may be decreased to zero if too many variables are matched

Once matching has occurred e.g. for sex, then this is fixed and cannot be studied as it is no longer a variable in exposure

Mature sleep

Often referred to as adult sleep. All elements of this sleep pattern are fully developed by early adolescence.

Measurement bias

Is an error in measurement between study group and population. E.g. women with a miscarriage may have different recollection of pregnancy problems than others. Different interview technique between subjects and controls. Errors of reporting within subjects e.g. heavy drinkers report low levels of drinking and, therefore, increase the risks ‘observed’ of low or moderate drinking.

Melatonin

A hormone secreted by the pineal gland in response to a light off stimulus. Melatonin has a significant influence on the suprachiasmatic nucleus in controlling sleep onset.

Mellifluous

Sweet or honey like. A sweet voice.

Meta-analysis

A systematic method of reviewing the epidemiological literature on a topic with the view of integrating the outcomes. The statistical analysis of a larger collection of analysis results from individual studies for the purpose of integrating the findings. It has qualitative and quantitative elements; qualitative e.g. criteria of quality, quantitative e.g. integration of data

Misclassification

Persons are misclassified. E.g. cases v’s controls and exposed v’s unexposed. A misclassification error results in the subject being in the wrong cell of a 2 X 2 table.

- Non-differential misclassification. An error in classification caused by random error. In this case, the subject is misclassified into the table by an error of study method e.g. sensitivity of a test.

- Differential misclassification = error caused by bias (an error of design.) compared with non-differential misclassification. There is a different rate of misclassification in cases and controls or exposed and unexposed. E.g. cases may have more time to reflect on exposures and be more likely to record exposure than controls.

Monotreme

A member of the Monotremata, an order of primitive egg-laying mammals restricted to Australia and New Guinea and consisting of only the platypus and the echidna.

Motor atonia

The absence of skeletal muscle activity in certain phases of sleep.

Movement arousal

An arousal within, or at the end of, a block of sleep or sleep cycle. Associated with body movement.

MSLT Abbreviation for Multiple Sleep Latency Test

Muscle tone

Muscle Tension as detected by an electrode.

Myoclonus

Sudden jerking or twitching muscular contractions without rhythm.

Nap

A short episode of sleep not associated with the successful achievement of a normal sleep wake cycle.

Negative confounders

An example of a confounder which is negative is physical activity in persons with cardiovascular disease (CVD). Increased activity will decrease the chance of MI but, in addition, women are less active and have decreased rates of CVD.

Negative EOG

REM sleep does occur in an epoch

Neonate :

- (standard definition) A newborn infant, especially one less than four weeks old.
- (definition for this paper) A newborn infant up to the age of three months.

Neuropeptide

Short chain peptides found in tissue of the central nervous system.

Direct neuropeptides have a direct impact on the synapse and facilitate neuro-transmission.

Indirect peptides do not have a direct synaptic effect but have a modulating influence on the nervous system.

Neurotransmitter

A peptide in the central nervous system which is released from the distal axon of a neurone and, by stimulating a neurotransmitter receptor on the distal axon, facilitate a transmission of an electrical impulse between axons. Neurotransmitters which have been found to be significant in sleep medicine include norepinephrine, serotonin, acetylcholine, dopamine, adrenaline and histamine.

Nightmare

A dream with negative emotional content usually associated with REM sleep.

Night Terrors

An incomplete and inappropriate arousal from sleep. Care providers find the subject incoherent, and that communication is difficult. Upon arousal, the subject has no memory of the preceding events. There is no emotional element to a night terror.

Nocturia

Passing urine involuntarily through the night or within a block of sleep.

Noise

When recording an electronic signal, extraneous information not related to the variable under study introduces artefact or 'noise' into the record.

Non compliance

The proposed treatment not followed.

- Overt = announced (dropouts.) the reverse of this is drop-ins who take the agent under study by 'mistake'.
- Covert = denied

Nocturnal

Events which occur in the hours of darkness.

NREM or NREM Sleep or non-REM sleep

Sleep which does not include rapid eye movements. In mature sleep, it constitutes approximately 80% of sleep time. The EEG shows slow, high amplitude brain waves and there is little or no dreaming. Divided into 4 elements. Elements of NREM sleep can be referred to as quiet or deep sleep.

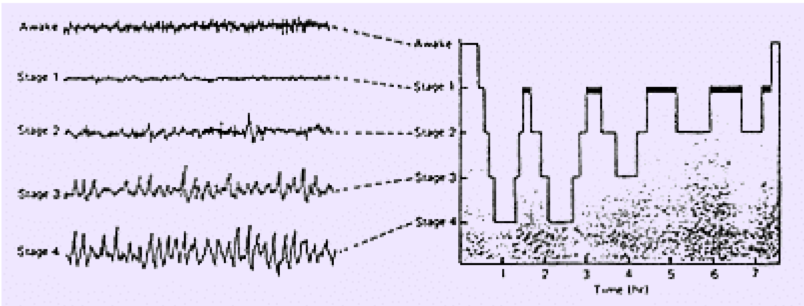
- Stage 1 : The first stage of NREM sleep.
    - EEG criteria include low voltage, slow waves much with a frequency of 3-7 Hz. Alpha activity less than 50% of the record.
    - EOG. Slow rolling eye movements.
    - EMG moderate to low
    - Represents 4-5% of mature sleep.
- Stage 2 :
    - EEG criteria include the appearance of characteristic sleep spindles and K Complexes against a background of low voltage mixed frequency signal. High voltage delta waves may appear.
    - EOG negative.
    - EMG low to moderate
    - Represents 45-55% of mature sleep.
- Stage 3 :
    - EEG criteria include delta waves which represent 20-50% of the record.
    - EOG negative.
    - EMG low to moderate
    - Represents 4-6% of mature sleep

- Stage 4 :

    - EEG criteria include delta waves representing more than 50% of the record
    - EOG negative.
    - EMG low to moderate
    - Represents 12-15% of mature sleep

Non REM sleep occurs most frequently in the first 50% of the night.

Distribution of non REM sleep through the night in mature sleep.



NREM – Abbreviation for Non-Rapid Eye Movement (sleep)

Numerator

The number of affected cases or the count of cases. The population at risk is the denominator.

Ondine's Curse

Impaired response of the brain's respiratory centre to an increased concentration of CO2.

Ontogenetic development.

Development of the individual from conception, foetal growth, birth and growth to adulthood.

Optimum Sleep

Sleep volume required for best CNS functioning in periods of wakefulness.

Pandemic

A worldwide epidemic.

Paradoxical sleep

REM sleep in adults

Parasomnia

An event occurring within sleep. Inappropriate walking while asleep is a parasomnia.

Pathological Sleep

Abnormal patterns of sleep maintenance.

Persistent Insomnia

Insomnia which has persisted for multiple weeks or months.

PET Abbreviation for Positron Emission Tomography

Phase advance

Phase advance sleep moves an event of a sleep cycle forward or in a clockwise direction.

Phase delay

Phase delay sleep moves an event of a sleep cycle backwards or in an anti-clockwise direction.

Phylogeny

- The evolutionary development of an organ or other part of an organism: *the phylogeny of the mammalian brain.*
- The study of evolutionary biology
- The evolutionary development and history of a species or higher taxonomic grouping of organisms. Also called phylogenesis.

Piezo electric crystals

Crystals that are able to generate an electric current in response to movement. (Example, sound to electricity in a microphone).

Pineal gland

A structure in the central brain substance which secretes the hormone melatonin in response to a light off stimulus.

Poikilotherm

A creature which largely maintains body temperature by heat exchange with the environment

Polysomnogram (polygraph)

A measure of multiple poikilotherm variables during sleep. The 3 basic recordings are EEG, EOG, and EMG.

Positive EOG

REM sleep occurs in an epoch

Power

The probability of a true negative result or 1 β. It is a measure of the ability of the study to show that a therapy does produce a difference.

PPO2

Abbreviation for partial pressure of oxygen (O2) in the blood.

Precocial

Covered with down and capable of moving about when hatched. Used of wading birds and domestic fowl.

Capable of independence at birth.

Premature morning awakening

Premature termination of nocturnal sleep associated with an inability to return to sleep and, in children, often associated with inappropriate behaviours.

Prevalence

Prevalence is a measure of disease burden. The number of affected persons at time x / population at risk. (point prevalence). N / D where N is the number of cases and D is the total population at the time. This does not give a measure of risk. E.g. the prevalence may be high for a disease with long natural history and the incidence rate or risk, low.

- Point prevalence. Prevalence at a given time.
- Period prevalence. Numbers affected over a given time period.

Note that in a steady state (stable population) prevalence = incidence X duration.

- Problems with prevalence calculation.

- Numerator. Who has the disease? How is it diagnosed?
- Denominator. Who belongs to the at risk population? How many are there?

Note that, in public health, a new treatment may decrease death rates and thus increase the prevalence.

Primary case

This person was affected by the initial exposure. Note that the very first case is the ***index*** case. (A secondary case is infected by contact from a primary case.)

Proportion

Calculated as a/a+b (there is no dimension of time)

This is sometimes reported as a rate which is incorrect. As a rate, must include a time element. Note that a proportion is not a rate and does not equate to risk.

Proportions are a measure of the distribution of disease e.g. 1 in 30 of women aged >45 will have trisomy 21 pregnancies.

PS – Abbreviation for paradoxical sleep

Publication bias

The bias against non significant or non interesting data which may be relevant.

QS – Abbreviation for quiet sleep

Quiet Sleep

A term commonly used to describe NREM sleep.

Random error

A chance event

The divergence of an observation from a true or mean population value by chance. Possible causes include;

- Biological variation
- Sampling error e.g. 20 of 200 marbles
- Measurement error eg the wrong tool is used

Randomisation

Allocation into exposed and unexposed groups is controlled by a mathematical model where the chance of arriving in either group is equal. Randomisation removes selection bias in allocating to intervention or non intervention groups. The allocation is controlled by chance. If randomisation is vigorous, the intervention and control groups should be similar (including variation caused by random chance) at the outset of the study.

Randomised controlled trial. (RCT)

An epidemiological experiment in which subjects are randomly allocated into exposed and unexposed. They are the most rigorous method of hypothesis testing in epidemiology.

- Ethics of an RCT.
    - It is unethical to allocate a subject to a control group when the intervention is known to offer a protective benefit.
    - A treatment which has not been shown to be effective may be ethically tested even if its use is common.
- Design.
    - Hypothesis
    - Calculate sample size
    - Develop eligibility criteria

- Obtain consents
- Randomisation e.g. balanced, blocked, stratified.
- Treatment. Masked or not. Double blind or single.

* Quality control. Protocols must exist for monitoring
    - Compliance
    - Randomisation
    - Data quality
    - Follow-up
    - Analysis according to intention to treat
    - Analysis of subgroups
    - Unexpected findings
    - Ability to generalise.

Rates

Rates allow comparison across time frames, different places, different social groups. Time is important in defining RISK. E.g. mortality rate = deaths per year / population at risk

Calculated as = $(a/t)/P \times 10^k$ (introduces time).

* a = number of events
* t = time
* p = population
* k = scale multiplier
* Numerator = people with disease in a given time frame. Numerator is dependent upon the accuracy of mortality data.
* Denominator = all people in population in that time frame. Denominator is dependent upon quality of population data.

Ratio

Calculated as = a:b. (this does not tell what is changing.)

- Numerator = people with disease
- Denominator = people without disease

Recall bias

- Limitation of recall e.g. the information is not known
- Recall bias due to an event e.g. the parents were badly affected by infant crying at night.

Relative risk (RR)

The rate in exposed / rate in unexposed (a/a+b) / (c/c+d)

Relative risk is a measure of the strength of association. The relative risk allows comparisons e.g. 10% mortality versus 50% mortality gives a relative risk of 5. Numbers >1 show increased risk for the exposure and <1 = protection from the exposure. E.g. if absolute risk = 10% in the whole population and the risk in exposed = 15% while the risk in unexposed = 2%. Then relative risk = 15/2 i.e. 7.5.

Note that, while RR may be high, it must be considered along with the absolute risk to judge the health burden on the community i.e. if RR is 50 but the absolute risk is 1 per 10^6, then the burden on the community is low.

Reliability

The ability of the test to give a consistent result.

Variables include;

- intra subject variety e.g. Blood Pressure varied through the day.
- inter observer variety

REM Abbreviation for Rapid Eye Movement (sleep)

REM Sleep

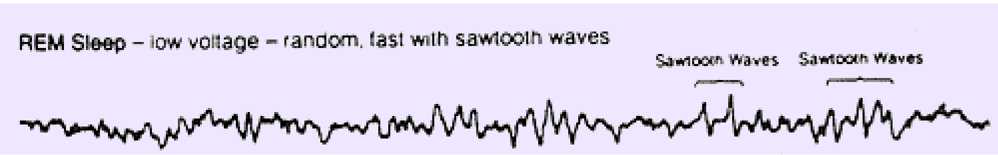
Rapid Eye Movement Sleep.

A stage of sleep common to all mammals characterised by an active EEG, active eye movement and dreaming. It includes intensive brain activity with increased oxygen consumption. The majority of dreaming occurs in REM sleep. EEG Characteristics include low voltage, high frequency, non-alpha recording.

In the foetus, it is the dominant form of sleep

In neonates, it represents between 50-60 % of sleep

In mature sleep, it is associated with skeletal muscle atonia and generally represents 20-25% of total sleep



REM density

The frequency of eye movements in an epoch of REM sleep.

REMS latency

The time taken from sleep initiation to the first REM sleep episode.

REM atonia

A degree of paralysis of the skeletal muscles which exists in mature REM sleep. REM Atonia is absent in the neonate.

REML – Abbreviation for REM latency

REM onset

The time of REM sleep commencing.

REM sleep episode

A single period of REM sleep.

REM sleep rebound

An increase in REM sleep following a period of REM sleep deprivation.

Reticular activating system (RAS)

A section of the brain structure which controls body movement, posture, sleep/wake cycles. A system which is able to maintain output after a short stimulus.

Risk

The probability of disease = case no' / population size. E.g. cumulative incidence risk is total no' of cases / no' of potential cases.

Risk assessment

The potential adverse health effect of exposure to environmental hazard. Four steps in the process are;

1. Hazard identification. Does the exposure impart risk?
2. Dose response assessment. How much exposure is needed to create risk?
3. Exposure assessment. How much exposure is occurring?
4. Risk characterisation. The nature and magnitude of the risk.

Sample bias

Selection bias

Sample size

The sample needed to give a valid result. To calculate this we need;

- An estimate of the difference in response rates (i.e. rate of improvement or difference) to be detected
- An estimate of the response rate in one group
- Level of significance or p value desired
- Power desired
- Is the test one sided or two sided? Two sided testing will detect both an improvement and a decrease in effectiveness, one sided only improvement or decrease.

SD

See standard deviation

Selection bias

Bias in the way subjects have been chosen to represent the population.

- Inappropriate definition of subjects.
- Hospital patients do not reflect the population.
- Women seeing the doctor are more likely to have a problem detected that non attenders.
- Readers of a conservative magazine will not be a good population to predict election results.
- Inappropriate participation rate. Increases random error.
- Participation may give a bias.
- Responding to a survey may give a bias of health or vigour.

Self soothers

Infants capable of resettling within a block of sleep without signalling.

SEM – Abbreviation for Slow Eye Movement

Sensitivity

The ability to distinguish those with disease. (a/a+c). The proportion of positives detected by the test e.g. below 350/500 = 70% (Note that repeat testing can decrease net sensitivity by adding a second group of false negatives.)

		Disease		
		+	-	
Test result	+	350	1900	2250
	-	150	7600	7750
		500	9500	10000

Serotonin

A CNS neurotransmitter which plays a role in modulating mood, eating, sexual activity, thermo-regulation and sleep.

SIDS – Abbreviation for Sudden Infant Death Syndrome

Signalling.

Crying at the end of a cycle of sleep.

Signallers.

Infants who cry at the time of a sleep arousal within a block of sleep.

Sleep

A state marked by lessened consciousness and movement of the skeletal muscles, a posture linked to sleep, reduced responsiveness to stimulation and slowed metabolism which is rapidly reversed in response to intense stimulation.

Sleep (inaccurate definitions)

- a state of torpid activity {wrong};
- state of an animal during hibernation {wrong};
- the natural periodic suspension of consciousness {wrong}
- a state during which the powers of the body are restored {partially right};
- a state marked by a diminution of feeling followed by tingling {true, but unrelated}.
- a biological state consisting of non-rapid eye movement sleep and rapid eye movement sleep. {contains the term being defined}

Sleep architecture

REM/NREM cycles and their interaction.

Sleep cycle

A complete sequence of sleep events from arousal or wakening through sleep to arousal.

Sleep debt

Persistent loss of sleep creates a sleep debt which must be fulfilled to return the subject to a sense of well-being.

Sleep deprivation

Insufficient hours of sleep from whatever cause.

Sleep efficiency

The proportion of time spent in bed when the subject is asleep.

Sleep fragmentation

The disruption of REM and NREM sleep with brief arousals. Severe sleep fragmentation reduces the total amount of time in restorative or deep sleep.

Sleep hygiene

Behaviour patterns which support effective sleep achievement and maintenance.

SL – Abbreviation for sleep latency

Sleep latency

Time taken to achieve sleep from a nominated time when sleep would be appropriate. The time from lights out to sleep being achieved.

Sleep element latency.

The time taken for a sleep element to occur within a block of sleep. E.g. REM sleep latency of 90 minutes indicates that from the time of sleep achievement the first REM sleep appeared after 90 minutes.

Sleep diary

A written record of a subjects sleep/wake patterns over time.

Sleep onset

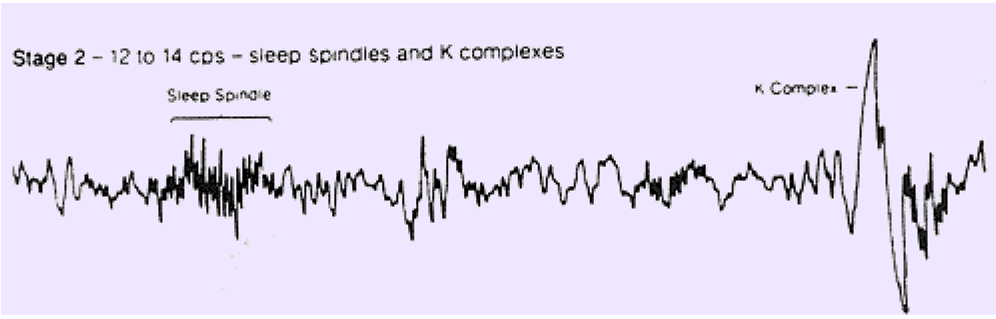
Sleep latency.

Sleep-onset REM period

Time taken from sleep onset to initiation of the first REM episode.

Sleep spindle

An EEG phenomena characterising stage 2 NREM sleep. A distinctive aggregation of 12 to 14 Hz sinusoidal waves lasting 0.5 – 1.5 seconds. These spindles reoccur with a frequency of 0.1 – 0.2 Hz. Sleep spindles may arise by four weeks and then develop rapidly and are clearly part of NREM sleep by three months of age.



Sleepiness

A sensation of needing to achieve sleep.

Sleep vocalisation

Vocalisations occurring within a block of sleep. Usually associated with REM sleep. Full consciousness is not present. In mature sleep, there is no memory of this vocalisation.

Sleep walking

Walking while asleep. Typically an event of deep NREM sleep.

Sleep-wake transition disorder

A parasomnia where there is difficulty in the transition from wakefulness to sleep or in returning to sleep from an arousal within a block of sleep. Can be a problem of sleep maintenance or sleep achievement.

Slow wave sleep (SWS)

Delta waves are the EEG signature of NREM Stage 3 and 4

SO – Abbreviation for sleep onset

Somnambulism

Sleepwalking.

Somnolence

Prolonged periods of sleepiness.

Specificity

The ability to detect those without disease. (d/d+b). The proportion without the disease identified correctly. E.g. above = 7600/9500. Repeat testing can increase specificity by increasing the numbers who are detected as true negatives. Sensitivity and specificity tend to be alternatives to each other and a gain in one is lost in the other. Repeat testing adds to the specificity by increasing the numbers correctly labelled as disease free.

Standard deviation

The formula for the standard deviation is very simple: it is the square root of the variance. It is the most commonly used measure of spread. An important attribute of the standard deviation as a measure of spread is that, if the mean and standard deviation of a normal distribution are known, it is possible to compute the percentile rank associated with any given score. In a normal distribution, about 68% of the scores are within one standard deviation of the mean and about 95% of the scores are within two standard deviations of the mean.

The standard deviation of a collection of numbers is the square root of the difference between the mean of the squares of the numbers and the square of the mean of the numbers.

It is a measure of spread of the numbers. Thus a 'tight' distribution around a mean will give a small SD and a 'loose' distribution a large SD. When viewed on a normal distribution curve, a small SD is associated with a peaked bell curve. One SD unit will contain approximately 68% of samples. Two SD units will contain about 95% of samples and three SD units will contain about 99%.

Stanford Sleepiness Scale

An instrument for assessing subjective levels of sleepiness.

Stratified randomisation

The subjects to be randomised have an important variable e.g. age. The subjects are first stratified into age groups and then randomised. This can be applied for multiple strata e.g. age and sex before randomisation. The end point is two groups who are randomly allocated but with a fixed distribution of age and sex, thus making the groups more comparable.

Sudden Infant Death Syndrome (SIDS)

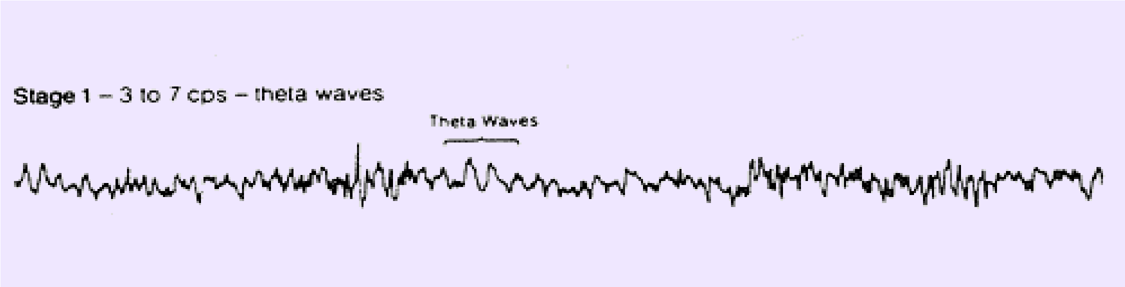
The death of an apparently healthy infant while asleep. Post Mortem is normal.

SWS – Abbreviation for slow wave sleep

S1-S4 – Abbreviation for sleep stages 1-4

Theta waves

EEG signals with a frequency of 4-6 Hz. These are typical in REM sleep. The pattern shows desynchrony.



Video recording of sleep where an image is recorded once per nominated time period e.g. one second per twelve seconds.

TLVR

Time Lapse Video Recording

Tonic Sleep

REM sleep component

Total sleep period

The sum of all time spent, both asleep and with arousals, from the time of initial sleep onset to final awakening from that block of sleep.

Total sleep time

Sum of time spent asleep within a block of sleep. This does not include periods of arousal and awakening. The sum of all REM and NREM sleep within a single block of sleep.

Trace alternant

A sleep pattern seen in the foetus by 28 weeks gestation. Marked by 2 – 6 second bursts of high amplitude slow waves separated by 4-8 seconds of low voltage mixed activity. It evolves into quiet sleep by 32 weeks.

Trace discontinue

Bursts of high voltage, slow wave pleomorphic activity alternating with long periods of very depressed activity. A pattern of sleep seen in the foetus between 2 and 27 weeks.

Transient arousals

Brief awakenings between two sleep cycles.

TREM – abbreviation for Total REM Time

Transient insomnia

Difficulty sleeping which lasts for a short period of time, usually several nights.

Transitional sleep

A sleep coding status used in foetal and neonatal sleep studies. In the foetus and neonate, active and quiet sleep are not clearly segregated thus a significant part of the sleep record is neither active or quiet but is, in fact, transitional or indeterminate

TSD – total sleep deprivation

TST – Abbreviation for total sleep time

TSW – Abbreviation for total slow wave sleep (Stage 3 and 4)

Turgid.

Swollen or distended

TWT – Abbreviation for total wake time

Type I error

A test or study can give a false positive result.

Probability = c/a+c = α = ρ value which is the probability that a false positive has occurred by random error or chance.

Type II error

A test or study can give a false negative result

Probability = b/b+d = β. The probability of a true negative result is 1 β. This figure of the probability of correctly detecting a negative is the power of the study.

		Real result		
		No difference	Difference	
Test result	No difference	a	b	a+b
	Difference	c	d	c+d
		a+c	b+d	Total

Two by two tables.

		Diseased	Unaffected	
Population	Exposed	a	b	a+b
	Unexposed	c	d	c+d
		a+c	b+d	Total

Ubiquity

Existence, or apparent existence, everywhere at the same time; omnipresence

Validity

The degree to which a study assesses what it aims to assess. Of a screening test or diagnostic test = the ability to distinguish between disease and non disease. It has two components, sensitivity and specificity.

- Validity is decreased by:
    - random errors
    - bias
    - confounders
- Internal validity = the degree to which the study conclusions apply to the studied population. The degree to which separation between subjects and controls is random.

o Sample technique (achieving conformity)

o Randomisation

o Crossover

o Testing bias (different instruments for study groups)

- External validity = the degree to which the sample truly reflects the population.

o The main threats to external validity include inappropriate people (sample), places (experimental environment), or times (intervention occurring at the same time as a confounding the external influence).

Variance

A measure of how spread out a distribution is. It is computed as the average squared deviation of each number from its mean. For example, for the numbers 1, 2, and 3, the mean is 2 and the variance is: $\sigma^2 = \frac{(1-2)^2 + (2-2)^2 + (3-2)^2}{3} = .667$ The formula (in summation notation) for the variance in a population is $\sigma^2 = \frac{\Sigma(X - \mu)^2}{N}$ where μ is the mean and N is the number of scores. When the variance is computed in a sample, the statistic $S^2 = \frac{\Sigma(X - M)^2}{N}$ (where M is the mean of the sample) can be used. S^2 is a biased estimate of σ^2, however. By far the most common formula for computing variance in a sample is: $s^2 = \frac{\Sigma(X - M)^2}{N-1}$ which gives an unbiased estimate of σ^2. Since samples are usually used to estimate parameters, s^2 is the most commonly used measure of variance.

Weighted rate

- Direct adjustment; (borrow population weights from a comparison population)
    - (group 'a' specific rate * proportion of group 'a' in the comparison population) + (group 'b' specific rate * proportion of group 'b' in the comparison population)
    - This gives the rate of disease if the population had the same subgroup weighting as the comparison population.
- Indirect adjustment; (borrow rates from a comparison population)

- (group ‘a’ size * borrowed rate) + (group ‘b’ size * borrowed rate)
- This gives the number of expected cases if the population behaved as the comparison population

White Noise

Background noise of mixed frequency and volume, commonly used as a background to infant sleep.

Zeitgeber

A cue which participates in the synchronisation of biological rhythms. In sleep medicine, light off and melatonin secretion are known Zeitgebers.

Appendix IV Written material used to support the intervention tutorial

YOUR BABY
CONTENTS

INTRODUCTION.

The first twelve weeks of a child's life are a time of challenge and intense learning for parents. Pregnancy is a time of great expectations and of varying health. After months of waiting and for most women a certain degree of tiredness, labour begins. Labour varies dramatically in its ease or difficulty. The fortunate few have strong contractions for less than one hour and then deliver easily. After this they walk back to their rooms, smiling at the staff as they go. At the other extreme, an unfortunate few, labour hard for more than 24 hours, require extensive pain relief, become exhausted and finally have a difficult delivery or are assisted by forceps, caesarean or some other technique. These few take days to recuperate and wonder why they ever planned to get pregnant.

The majority of mothers lie somewhere in between. Labour lasts between four and twelve hours, is handled with dignity and results in the delivery of a healthy child from a healthy and tired but pleased mother. While labour requires courage, strength, composure and co-operative effort it is largely not a learned skill. By this I mean that the events of labour are largely determined by the body without conscious effort by the mother.

Usually the body determines when labour starts, its rate of progress and the details of the delivery. In today's world I know that the medical profession of which I am a member have a tendency to become involved. However I wish to highlight that if the medical profession are ignored, labour does occur and does not require the cooperation or learned skills from the mother. My point being that delivery is not an intellectually "learnt" skill. If the mother knows nothing about it, it will still happen. As long as she is attended by a companion, or midwife or medical attendant with experience, then in the majority of occasions a live birth will occur.

Once the baby is born however, the "auto-pilot" is off and learned skills become all important. Advice from those providing care to the mother with a newborn child is very important. The quality of that advice varies dramatically. When we have our first baby in our arms we will receive "tit bits" from many *helpful* people. Some is helpful, some useless, some dangerous and quite a bit will be contradictory. How does one decide for example between the advice from a paediatric psychologist that a child should never be struck and the women next door who encourages a smack on the backside every time a child is naughty. There is no perfect answer to that problem. My attitude is that life is a balance between forces, that no single answer will fit all circumstances. Harmony for the family unit is achieved by a balance of many things, often a balance between conflicting interests or contradictory modes of behaviour. Interests of parent and child may be different. Love and discipline are contradictions in some people's minds but must exist in adequate balance for a child to develop successfully.

BALANCE AND HARMONY

When dealing with human behaviour there is rarely a rigid point of view which applies to all people at all times. It is the ability to choose the appropriate action at the time which makes us successful when interacting with others. One code of behaviour exists at home, a modified code in another's home. One set of rules exists for one's children and a modified set for someone else's. By and large as we grow older we recognise these differences more and by being less simplistic and rigid, by becoming more flexible, we are more successful and useful to those with whom we interact.

The aims and purpose of human interaction vary from person to person. Some for one reason or another are unable to interact at all, for example the severely retarded or mentally distorted. A very few people regard others as only a means of achieving their own ends for increasing their power, or wealth or pleasure. Despite these extremes the vast majority of people wish to live in harmony with others. To achieve a balance between privacy and satisfying social interaction. To feel the security of receiving good leadership from some and the satisfaction of taking on the mantle of giving leadership to others. To feel a sense of belonging and at the same time to feel that your individuality is recognised. To give and receive love, both in reasonable measure.

It is the balance of these things, often contradictions, which leads to harmony and contentment within our lives.

As parents, perhaps one of our aims is to help place our children on a path which will make it more likely that they can achieve harmony in their lives.

No stable house can be built on an unsound foundation. A rounded, stable individual is the result of a sound foundation at home. My aim in this document is to assist parents in the first twelve weeks of life to begin work on a sound foundation for their children. By finding the compromise between conflicting answers, to produce a rounded, harmonious and constructive solution to some of life's problems.

A child needs in the first twelve weeks are relatively simple.

FOOD, SLEEP, LOVE and SHELTER

It is the first two which cause the most problems.

This book has been written as an aid to the care which I provided for my patients as a General Practitioner initially in a country town and later as a city doctor with a special interest in the success of families with young children. Hopefully it will be of some assistance to you. The book has been written with the expectation that few parents will have the energy to read it from cover to cover in a short time. Many readers will probably look at the one or two chapters which seem most appropriate to them right now. The chapters have thus been written to attempt to be fairly complete in their own right. This has led to a degree of repetition if you do read everything. Please accept this explanation if you find that a problem.

The sequence of chapters in the book has been chosen to reflect the way that I handle children's problems. In the first few weeks of life my main focus is on the child's feeding regime and weight gain. In these consultations I do not talk too much about sleep. The reason being that if the baby is receiving adequate nutrition and if overtiredness is avoided then often the sleep pattern will develop to the parents satisfaction anyway. The chapter on starting solids thus comes quite early in the book to keep it logically with the chapter on feeding even though it relates to a later age for the infant. Issues about sleep are then discussed at length in the middle of the text even though this may be where many of you wish to start.

Issues of sexuality and parents needs are discussed in a chapter of their own because they are important. A child is an extension of a family. A child will thrive only if the family is successful. It is difficult for a family to thrive if the parents are not receiving adequate rest, nutrition and emotional support. Some of the issues of loving are not obvious and I hope some of you find that section helpful.

Above all else I wish you well with your parenting. May your child or children bring you much joy. If you are having trouble at the present possibly this book will help return some sanity to a situation which I know can sometimes be more than you ever expected. I believe that having children is mainly for the joy of it. So let’s enjoy them. If it’s not fun at the present then let’s see if we cannot change things a little so that the joy returns.

CHAPTER 1. FOOD, FEEDING AND BREAST CARE

A child at birth has been growing rapidly in the womb. To achieve normal health the newborn will continue to grow rapidly. The source of nutrition for growth varies with the child's age and the mother's circumstances. There is no debate that the best source of nutrition for the newborn baby is breast milk from a healthy mother. The complexity of breast milk will never be equalled by an artificial feed. This is partly because breast milk varies according to changes in the environment of the family. A mother in contact with a virus will develop antibodies and pass a degree of immunity on to her child. Such a development is impossible with artificial feeds.

If breast milk is available then the next requirements for the baby to achieve good growth are quantity and quality.

BREAST MILK QUANTITY

Quantity of milk relates to the volume of milk that the breast is able to produce. Later in this chapter we will discuss **quality**. Please note that when breast feeding a baby both these issues are interconnected.

Most women in our society are able to eat well. Their bodies are presented with enough calories and nutrients to allow the breasts to produce milk. What needs to be made clear is that each woman is unique. Her ability to produce breast milk varies. Some women are so well supplied with milk from their breasts that they could feed twins easily. Other women are unable to produce useful **volumes** of milk despite their best efforts. This variation is due to normal differences between individuals. Some of us are tall, some short, some produce much breast milk, others produce a little.

Breast milk is the best feed as long as there is enough of it. The volume of milk being delivered to the baby can be checked quite easily and in a number of different ways.

CHECKING QUANTITY BY OBSERVATION OF THE BABY.

A child who sucks vigorously, swallows well, becomes comfortably sedated at the end of the feed and then settles into a deep useful sleep is probably getting enough milk.

Urine.

The normal, adequately fed baby passes urine as often as every fifteen minutes. Despite the mother's best efforts, which may include nappy changes as often as twelve or more times per day, the baby is "always wet". This indicates that the child is probably receiving an adequate volume of milk.

Bowel action.

If the bowel is being presented with adequate volumes of milk it will produce a soft, yellow, non offensive bowel action at least once per day and often more frequently. If the bowel action is hard, small and difficult to pass, this suggests that the total volume of milk may be inadequate.

Body shape.

A baby receiving enough nutrition becomes "rounded” and chubby. Thick cheek pads form and the arms and legs fill out.

Behaviour.

The baby's behaviour is an excellent indicator of the adequacy of milk supply. If the child is well enough to suck and swallow vigorously, becomes settled and "sedated" by the feed, settles to sleep quickly, sleeps for say three to five hours and then awakens to feed vigorously again, then milk supply is probably adequate.

Conversely the baby's behaviour may suggest that milk supply is inadequate. If the child is irritable at the breast, unwilling or too tired to drink, sleeps before the feed is finished or fails to settle within 15 minutes of the end of the feed, sleeps for only 1-2 hours **or** sleeps for 5-6 or more hours during the day, then milk supply may be inadequate. I will enlarge on the above by dividing babies into two groups.

a) Underfed but coping.

This baby is going to give you a hard time. He/she is not getting enough and plans to do something about it. The baby demands the feed vigorously, sucks hard, may continue to demand after the feed, settles poorly and awakens early demanding the next feed. If measured, weight gain is less than 20 gm per day.

b) Underfed and not coping.

This is a very dangerous situation. The child demands weakly or not at all. The feed is poor and is interrupted by episodes of "waking" the baby. The child sleeps quickly and sleeps through the next feed time. Production of urine decreases, bowel actions tend to be small, irregular and difficult to pass. If measured weight gain is low or negative eg: less than 10 gm/day or even losing weight.

This problem needs to be recognised and treated with additional feeding.

Check on milk quantity by weighing.

If in doubt about milk volume, measure it. The question is important to the mother and baby. If the question of the amount of the supply arises it can be so easily answered by weighing. If the volume is inadequate then that information needs to be available so that remedial action can be taken. At the same time the information that the milk supply is excellent will cause no harm and must boost the confidence of the mother.

a) Baby's weight.

If the baby is gaining weight on a daily or weekly basis then the milk volume is adequate. I set as a base line weight gain of at least 30 gm per day. So if over several days the average weight gain is 30 gm/day or more then the mother can be reassured that her milk supply is adequate. Weight gain over 30 gm/day varies greatly. 30,40,50,60 gm/day or occasionally even more may be quite normal for that child.

If the weight is less than 30 gm/day over several days then the milk supply **may** be inadequate. A weight gain of 15 gm per day or less is almost always inadequate and requires remedial action.

b) Test weight.

While in hospital the baby can be weighed before and after a feed giving the weight of milk ingested. The required volume varies with the baby's weight and the number of days after birth. Test weighs done over 24 hours rapidly answer the question "Do I have enough milk?".

BREAST MILK QUALITY.

Milk quality relates to energy density or the ability of milk to deliver calories to the baby.

Occasionally the breasts will produce adequate milk volume but of poor energy density. This tends to be determined by genetic factors in the mother and can not be altered no matter how she tries. It is important to point out that the woman is not responsible for this. It is similar to the woman's height or hair colour. It reflects the complex genetic factors inherited from her parents. If the genetic pattern determines that breast milk energy density is low then it cannot be improved by trying hard any more than we can change our height by working out in the gym.

Other factors.

Sometimes for no easily defined reason a women will have a "poor" lactation. With the next child the milk production may be very different. I have certainly cared for women where one lactation was difficult but another was quite successful.

Occasionally a woman is attempting to lose weight and may be drinking only water to decrease her total calorie intake. In this setting the baby is feeding well, has ample urine and bowel actions but is not settled and has poor weight gain. I generally request that dieting and weight loss not be planned by the mother until the child's growth is well established, solids have been started and the baby is sleeping at least 10 hours a night. In fact dieting is rarely required in the breast feeding mother as her body's allocation of energy to the production of milk usually means that she is losing weight anyway.

WHAT TO DO ABOUT INADEQUATE MILK SUPPLY.

We have diagnosed one way or another that the milk supply is low. What do we do about it?

It is difficult to exaggerate how busy a mother is. The amount of work increases with every child. Once a mother has two or three children, a husband, a house, a social circle and perhaps some employment responsibilities she has become so busy that she is really being asked to do the work of more than one person.

Our culture is not set up to meet the needs of these women. In some cultures the mother’s responsibilities will be spread amongst other members of the group while she is given some months to concentrate on feeding and caring for her newborn. Our society does not provide that luxury.

The human body has a given number of "energy units" to spend each day. Some of those "energy units" will be used in the breast feeding mother for milk production. If the total number of "energy units" available to the body is inadequate milk production will suffer.

Milk supply may be inadequate for one or more of three reasons:

a) inadequate energy or fluid intake
b) excess energy expenditure
c) genetic factors which determine a low breast milk output.

INADEQUATE ENERGY INTAKE

A breast feeding mother should eat three meals per day. These should contain contributions from the five basic food groups. Protein, vegetables, dairy products, cereals, fats. The volume should give adequate calories to fill her energy needs. When choosing fluids she should choose those which give energy as well as water. Milo, milk, ice-cream, milkshakes, egg nog all give calorie value as well as fluid volume. I recommend at least a litre of milk-based fluid per day. If you do not like milk then cheese, yoghurt or ice-cream can act as alternatives. If you are not thirsty enough to drink a litre per day then salted nuts will help create a thirst and at the same time provide energy.

A woman who is breast feeding well and eating adequately will often still lose weight. I generally request that a woman defer dieting until the baby is gaining weight well, started on solids and sleeping at least 10 hours per night.

EXCESS ENERGY EXPENDITURE.

A mother is busy to a level which is difficult to exaggerate. How many mothers say to each other "What did I do with my time before I had children?" The work of caring for children, house, husband and possibly employment uses energy. Assuming that the diet is providing adequate calories and nutrients, the milk supply can still be impaired by an excessive work load. The single most helpful strategy when life is too busy is sleep. For the first few weeks of her baby's life mother will have disturbed sleep as there are feeds every three to four hours. If at all possible then mother should join the baby in a day time sleep. Two hours' sleep in the early afternoon can be a very "humanising" event. As the number of family members increases an afternoon sleep becomes both more necessary and at the same time less possible. When it is impossible, then going to bed at the same time as the children can be helpful until the baby is sleeping at least eight hours at night.

GENETIC FACTORS AFFECTING MILK PRODUCTION.

Being female, having a baby and having breasts does not mean that all women can produce milk. Humans vary in their abilities for every measurable parameter. Some are tall, others short. Some are dark, others light. The ability to produce breast milk and its energy density are biological parameters which will vary from woman to woman. Therefore it is not surprising that some women produce more and others less. There is no rule which makes it possible to predict milk supply. Despite this there are some guidelines which experience tells me are often, although not always, valuable. Often a bigger breast before the lactation produces less milk and the smaller breast more, once the lactation begins. A women of 120 Kgm with pendulous breasts may have little milk supply despite her best efforts. A woman of 60 Kgm with small breasts can often blossom in this area and to her own surprise be an excellent breast feeder.

Measuring baby's weight gain and test weighing feeds can help inform a women of her breasts' ability to produce milk. If there is little intrinsic milk production then she should be informed so that an alternative can be used. Nothing can be more cruel than insisting that a mother attempt breast feeding when her breasts just do not produce an adequate volume of milk in any circumstances. She feels frustration and a sense of failure, the baby fails to grow and is unsettled. The family becomes unhappy. There is no guilt in not producing breast milk. No more guilt than in being 150 cm or 190 cm tall or having black hair. If low milk production is the woman's norm, in this pregnancy, then so be it. Alternatives need to be found. This does not mean that breast feeding must fail completely, it may still be partly successful if supported. In addition, inadequate milk supply in one pregnancy does not mean that there will be an inadequate supply in the next pregnancy.

ALTERNATIVE STRATEGIES FOR BREAST FEEDING.

As mentioned above the ability to produce milk varies up and down the scale. Let us assume that an imaginary healthy, happy, growing baby requires 100 units of milk per day. If we measured the milk production of 100 women we would find that some could produce 200 units of milk. Some would produce very little. There would be a large majority whose production was near the 100 units required. There will be a significant minority who under ideal circumstances produce less than 100 units which our imaginary baby needs. These women **are** producing breast milk. It is of good quality and is beneficial to the baby. However, there is not quite enough. I have never understood why feeding should be seen as only fully breast or only fully bottle. If a woman is producing good **quality** breast milk but in slightly inadequate volumes, why not complement it with an alternative feed? There are many good milk substitutes on the market. They are not as perfect as human milk but they can be a very adequate supplement and if necessary can be the basis for total feeding. Some mothers will find that if they supplement from the bottle immediately following the breast feed the baby settles well, sleeps deeply and awakens to feed efficiently at the next 'meal' time.

This pattern can be made a little more specific. The supply of breast milk tends to decrease in the late afternoon. While feeds in the morning may be adequate for the baby’s needs, by late afternoon the milk supply may be inadequate to supply the baby’s whole requirement. Tea time can become less than the ideal family event. Baby has fed but is unsatisfied and crying. The children from school are tired, demanding and hungry. Husband is home for tea and being more or less useful. You are tired having been up once or twice overnight. It is a fun time!! The sort of time of day when being alone in the Simpson desert seems the easy option. One step in improving this time of day can be complementary feeding at the baby’s 'evening meal'. If the baby has settled after an adequate feed it becomes easier to concentrate on the needs of the rest of the family. So the suggestion here is to give a breast feed before starting to commence preparation of the evening meal. Follow the breast feed with a complementary bottle feed to the volume which the baby desires. It might be 20 ml or it might be 100 ml. The correct volume is the one which returns sanity to the family.

A development upon this idea is for those babies where weight gain is a little inadequate. In this setting a top up for all p.m. feeds, that is between 12 noon and 12 midnight can support the milk supply through that part of the day when it is at its lowest ebb. The baby receives normal breast feeds overnight and in the morning. This is the time when mother is most rested and has the best milk supply. From 12 noon onwards, when energy is starting to decrease, offer a complementary or top up bottle after the breast feed.

BREAST CARE.

Breast feeding should be a pleasant, relaxing time. Enormous satisfaction can be gained watching a baby suckle contentedly and then sleep soundly in a relaxed pose. It is a time when love blossoms, life's worries retreat and you just know that this is what you want to be doing at this particular time in your life. If you are tearful, upset or in pain things need to change. If baby is unhappy, angry, unsettled there is a problem.

PAIN.

Breast feeding can be sore if the nipple becomes 'cracked'. The pain is most severe as the baby attaches to the nipple. If left untreated feeding can become impossible. Nipple care is best carried out before the problem develops. In those years that I provided hospital care, the time that a baby was allowed to suck increased from a starting point of about 3 minutes per side on the first day. This increased by about 2 minutes per side per day until the feeds were approximately 10 by 10. This allows the skin of the nipples time to adjust to the new requirements being placed upon them.

Anyone who has suffered from dry cracked lips as a consequence of excessive licking knows that it removes moisturising oils from the skin. Once the skin is not 'oily' it becomes brittle and prone to cracking. Application of an oily substance to the nipple can avoid painful cracking. The skin covering the nipple is thinner than skin in most parts of the body. Because it is so thin it is very prone to water loss and then cracking. Many agents are used in different institutions for keeping the skin of the nipples moist and oily. Wool fat, lanolin, moisturiser. I have had the best success with a proprietary product containing a local anaesthetic and an anti-inflammatory in an ointment base. The product is 'Proctosedyl' and it is a haemorrhoid cream.

Seems a strange place to put haemorrhoid cream, but it works. If this was applied at the first signs of any pain or cracking I had good success in avoiding failure of breast feeding because of pain.

FRUSTRATION.

A) Mother.

If you are frustrated by breast feeding perhaps you should review why you are doing it. Occasionally a woman finds that it is an unattractive and unpleasant event. Perhaps a sense of obligation is not the best motivation for breast feeding. More commonly a mother wishes to breast feed but has a sense of frustration because it is not working for the baby.

B) Baby.

Very, very few babies will fail to display a sucking reflex. Even the most immature babies born before the reflex develops will at the appropriate time begin to suck. This reflex will be reinforced by the satisfaction of swallowing milk making the behaviour pattern stronger.

It is not uncommon to see a mother whose baby is getting angry at the breasts. Mother is upset because despite her best efforts, feeding times have become a time of dispute between her and the baby. The common scene is that the baby comes to the breast hungry. Initially there is strong sucking but after one or two minutes the baby comes off the nipple and starts to cry. After some persuasion he or she re-attaches but after a short time comes off and cries vigorously. Further attempts at re-attaching are not very successful and the baby turns away from the nipple. If the other breast is offered, after a short interval the same performance is repeated. Baby's mother can often see milk on the nipples and in the baby's mouth and believes the supply is adequate. The most common causes in this setting are inadequate milk volume or an overtired baby. Another problem which can exist is flat nipples. These can make it very difficult for baby to attach and medical assistance may be required. Diagnosing these problems and their treatment are dealt with specifically in other areas. The easiest diagnostic step is to offer a bottle. If the baby feeds well, then the problem is probably a slightly decreased milk supply compared with the baby's needs.

CHAPTER 2. STARTING SOLIDS

There will always be a time for each child to commence feeding with solid food. For some children this will occur later and for others it will occur sooner. No-one should define to you a set and rigid time that a child should or should not be consuming solid food. I did see the point, made by one of my lecturers when I was a medical student, that if the child has teeth nature is probably giving you a strong hint. The last section of this chapter gives some guidelines on time frames.

For those who have read elsewhere in this booklet, you will be aware that I try to encourage the majority of children to be sleeping between 10 and 12 hours as an unbroken block of sleep at night by three months of age. The majority of children can achieve this target with guidance from Mum and Dad. Some children may start on solids very early in their lives as a part of achieving the above sleep target. This will depend on the amount of breast milk which the Mother is able to produce and the amount of growth which the child's genetics are attempting to achieve.

Let's start the discussion assuming that the child has achieved 10 to 12 hours sleep at night and is fully milk fed. At what stage do we start solids for this child ? The answer is that we allow the child to determine the age for progressing to the next stage of feeding. We wait for a cue from the child that he or she is not receiving enough total nutrition. The cue which will be used is a change in the child's night sleep pattern. Whereas the child has been sleeping for the whole night for many days or weeks, for no apparent reason there is a change. The baby is well, has had good days and we know or believe that he or she is not over tired. The baby begins to awaken during the night. Despite being in a good pattern for some time the baby is 'seriously' awake in the middle of the night and is very difficult to settle without a feed. Instead of 'crying down' from the episode of wakefulness the baby 'cries up', becoming louder and more demanding. You may recognise a 'Hungry' cry. The answer to this problem is definitely not to re-start night time feeds on a regular basis. You may need to feed once or twice at night to convince yourself that hunger is the problem but then switch the focus to the starting of solid foods during the day.

FEEDING VOLUME.

A child starting on solids will need only a small volume initially for a couple of reasons. Firstly the child needs only a small addition to the breast or bottled milk that the mother is providing. Secondly the child’s system of digestion does not contain adequate volumes of the chemicals required to break down the new foods to the point that they can be absorbed. The bowel is able to produce the chemicals, called enzymes, if it is given a gentle hint that a new food is to be introduced. A small volume of the new food can be given at any one time. Over a number of days the gut will develop the enzymes of digestion required for that food and the child will be able to handle a bigger volume.

An example of this from adult life may help you understand this idea. Imagine that you have not eaten meat for a long time, say for some weeks. Suddenly you eat a big volume of meat which contains a fairly high content of fat. In quite a number of people this can be a very nauseating experience. Part of the reason is that the body is producing less of the enzymes required to digest the meat and fat in the volumes required for that food. The point that I wish to make here is that sudden changes in the type of food that a child receives or increases in the volume given could be counter productive. There is no point in being overly enthusiastic and making the child sick. You will lose confidence and then there will be a delay in progressing to the next stage in the child's development.

The initial volumes are quite small. On the first occasion the child may only consume one half teaspoon of food. Please do not expect the child to cope with a new feeding implement and a new food taste on the first occasion with speed and enthusiasm. In fact the child will probably cross its eyes, make a funny face and 'tongue' the food forward onto the teaspoon from which it came. This may be accompanied by a facial expression of surprise. Occasionally a child will take to solids at the first time. Often however, the babies face gives a wonderful display of emotion as it tastes a new flavour and texture. It may take two or even three days before the 'penny drops' and the child's expression becomes one of enthusiasm. The baby will then move the food to the back of the mouth and swallow with greater efficiency.

The child is now able to commence solids regularly. The volume which you give will depend upon the baby's interest and the routine which you establish. Increase the volume at a slow regular rate. At the end of the first week the baby may be taking only one teaspoon and continue to increase at that rate. Routine is useful. Babies function best with a sensible, predictable routine. For example once the solids have started, let them be continued. The solids become a regular part of their nutrition. Do not give solids for a couple of days and then miss for a few days. Do not give the solids only on those days when the baby 'looks' as if he or she needs it.

TIMING (PRE OR POST BREAST FEEDING)

The question of when to give the solids while still breast or bottle feeding is a little complex. Initially the solid feeding is an **addition** to milk feeding. The breast feed is given first and the solids are a top up. At this stage the majority of the child’s calories come from milk.

No one argues that breast feeding should continue permanently. At some stage the combination of solids and non breast milk fluids will become a more important source of calories. A time will be reached when breast feeding is given second. The timing of this change over is not critical. Some mothers even give solids before the breast feeding from the very beginning and claim that it can be very successful and does not interfere with their breast feeding.

TIMING (MORNING , NOON OR NIGHT ?)

As will be obvious from reading elsewhere in this booklet one of the major reasons for starting solids is to assist in the achievement of a full night’s sleep for the child and thus the parents. As a parent I thought a full night’s sleep was a great idea. Don't apologise to anyone for seeking a full nights sleep. If the parents are fresh and in good humour they are far more likely to provide good parenting.

I believe that it is logical to give the solids at the evening meal. The child thus has a supply of nutrition in it's stomach to settle for the night. Yet again this issue is not critical. Some mothers give the solids in the morning and argue that it is just as successful.

TASTE

The taste of the baby's food can be a factor in determining your success. For those of you who have tasted breast milk, you will have found that it is quite sweet. The taste is about half way between cow's milk and cordial. There is quite a significant and pleasant sweetness.

When 'designing' foods it can be helpful to mimic this degree of sweetness. For vegetables if a potato is being used as the base, then some apple, pumpkin, or carrot can be added for sweetness. If using rice cereal, which by itself is quite bland, then a little apple puree or banana pulp may give it a little more interest.

CONSISTENCY

Infants are not keen on lumps. Most children will be on at least some solids before they have teeth. The food should be a fine puree particularly when first started. This can be achieved using a food processor, vitamiser, or forcing through a sieve. In addition to avoiding lumps, the child requires a mixture which is reasonably fluid. For first solids I generally recommend a consistency similar to thickened cream.

FOOD CHOICES

What solid food to give young children is an area of great discussion. Foods which are commonly used in our society include rice cereal, various fruits and vegetables, and some other cereal foods.

Common sense must prevail and many adult foods are not considered. Young infants certainly have a decreased ability to handle a salt load and what some physicians refer to as a solute load.

What this means is never add salt and choose foods with a higher water content. For example vegetables are often 80-90% by weight water.

There are certainly many fine books and booklets on infant feeding which I will not try to equal.

The most specific I will be is to describe what we used for our own children. Even though my wife had a very generous milk supply, we started solids early as part of encouraging night sleep. We used vegetables to start. Boiled potato was vitamised with some other vegetable such as peas, pumpkins, or maybe apple. Introduce one vegetable at a time to detect any intolerance. The mixture ended up being either green or orange mush. One advantage of mixed vegetables is that they can be frozen as ice cubes and in an emergency 'tea' can be produced from the freezer in a couple of minutes by using the microwave. After vegetables we used Weetbix made into a creamy paste with milk. This tended to be the breakfast meal, vegetables at the evening.

There are certainly many variations on this theme.

FOODS TO AVOID

Babies have a limited ability to handle salt. Do not add salt to infant food. For the majority of infants there is no need to add butter or margarine. Avoid foods which may have a strong flavour. Baby food tends to be fairly bland. Meats, fats and in fact most adult food will be introduced quite slowly and well over six months.

FOOD VOLUMES

Once started on solids the volume will increase slowly but steadily. Remember that growth is hugely energy expensive. It takes a lot of food to build a body, even a small body.

My personal experience is that boys will eat more than girls, but I have not seen any research to support that impression.

Do not be surprised if the baby, once started on the solids, comes to believe that they are a really good idea. The volumes which are taken are sometimes quite large. It is not uncommon for a healthy baby of six to nine months to be taking in addition to their breast or bottle milk a volume of food almost as large as an adult woman.

The other thing which goes with volume is speed. Once solids are a regular part of their nutrition many babies will want them delivered fast. The spoon can become a bit of a conveyor belt. If you are too slow you will hear all about it. I am told that feeding twins can be fun where it is almost impossible to keep up with the needs of two mouths.

Beware of increasing volumes too quickly. Some babies will believe that the food is a good idea and eat greedily to the point of being sick. That is counterproductive. You will set the upper limit. If the baby is finishing all that you offer, add a little more each day so that the volume gradually increases. On the majority of feeds the baby will lose interest at the appropriate point and simply stop opening the mouth in response to the spoon.

Once solid foods are a regular feature on the menu, you will also set the minimum volume. On some days they will not be so interested. Do not be discouraged and gently persist. Try to achieve at least half of their normal volumes.

WHEN TO START SOLID FOODS.

I have left this to last because it is quite controversial. Okay so I'm a coward.
All that I can say is that my private, unpublished research shows that the majority of babies are receiving solid food by four months. These results come from a survey of over two hundred city and country families which showed the following.

14% of babies had started solids at two months or younger.

47% of babies had started solids by three months.
73% of babies had started solids by four months of age.

When advising parents the specific answer depends upon a number of factors. The most important variable is the baby's weight gain. If the child's weight gain is low then start solids a little earlier.

If the weight gain is excellent, and the sleep is evolving nicely then delay solids. In fact this later group are fairly easy in that they make the decision themselves. Their sleep gradually develops. Lets say they are being perfect, with eight hours straight sleep at 8 weeks, ten hours at 10 weeks, and twelve hours at twelve weeks. Then out of the blue they begin to wake up at, say 2am, genuinely hungry. This is the signal. Time to start solids please Mum.

This gives us three groups of babies.

Solids started a little early, say eight to twelve weeks of age to support poor weight gain.

Solids started a little early, say eight to twelve weeks to encourage longer night sleeps. (These children will often be gaining weight well, but are still unsettled. Given more food they gain weight at an even greater rate, and become more content and sleep longer.)

Solids started late. Twelve weeks to six months. These babies did perfectly and then began to awaken hungry through the night.

CHAPTER 3. SLEEP BASICS

An understanding of sleep is needed to achieve control of your child's sleeping pattern. An acceptable sleeping pattern is essential for constructive family life. Good quality sleep is necessary for the baby's growth and development.

I do not believe that it is necessary to tell any young mother reading this that sleep is essential for well being. We all suffer quickly from a lack of sleep. Sleep deprivation affects our mood, our ability to think quickly, to learn skills, to cope with life's little frustrations and still smile. Who is smiling when the kids spill the cereal on the carpet and you've been up four times during the night?

To expand your understanding of sleep, I discuss various elements of sleep. At the end of the chapter are other related issues under separate headings.

SLEEPING

What happens when we are asleep? The answer to this is difficult to define although it is clear from recent research that it is a complex process.

It has been known for many years that sleep has different parts to it. Doctors sometimes divide sleep into levels such as REM or NREM. These letters stand for Rapid Eye Movement or Non Rapid Eye Movement. Another style of defining sleep components is simply 0, 1, 2, 3, or 4.

Where 0 is awake, 1 sleepy and 2, 3, or 4 are different types of brain wave pattern while sleeping.

For the purpose of this book, however, I will focus on several details of sleep.

A block of sleep contains times of being awake.

Going to sleep is a process which is in part dependent upon the events which occur around us.

Achieving sleep is **usefully** regarded as a **learned skill**.

Tiredness interferes with the performance of all learned skills **including achieving sleep.**

We will return to these ideas under various sections of this chapter.

Sometimes it is easier to discuss the purpose of sleep by looking at the effects of not getting enough..

SLEEP DEPRIVATION.

Sleep deprivation is a terrible thing. When the mind does not receive enough rest through sleep its function is decreased. All of us have experienced sleep deprivation to some extent. I find that women with young children have a better understanding of sleep deprivation than men. This is simply because young women with children have more experience with sleep loss. On average, women spend more time attending to children through the night than do their men. This is not said in any critical way, it is simply a statement of common practice. As a consequence though, many women spend quite significant lengths of time feeling very tired while their children are young.

When we do not get enough sleep our bodies continue to function. Our hearts beat and pump blood, our lungs continue to expand and give us oxygen. The bowel still digests and the other organs of the body continue to function. The brain however complains. The brain is in fact totally unenthusiastic about sleep loss. Of course there is a degree of resilience. We can all function well after losing one or two hours' sleep. However as the number of hours of sleep loss expands and particularly if we are not able to get a full night's sleep to recover, the consequences of missing sleep increase. We all know about the tired mind. Memory is impaired. Things which we know that we know are more difficult to recall. I well recall a young mother having a difficult time who said to me, "Doctor, I couldn't remember my own telephone number". We all know about this as it is almost universally part of human experience to lose sleep at certain times in our lives. Most of us dislike it. (Although teenagers seem to need a phase in their lives where they actively seek out sleep deprivation.) With sleep deprivation mood is impaired. It is difficult to feel positive about the world when we are overtired. Once overtired we tend to see life through glasses which give a negative look to everything. The children's arguing is more difficult to handle. The pile of ironing looks even higher than normal. Frustrations are worse than normal. Problems are more likely to reduce you to tears.

Libido is decreased. Who feels like making love when we are so tired? This part of the brain seems to switch off early and turn back on late. It can be a cause of great worry in a relationship and requires great understanding and sympathy from the male partner. This is discussed at greater length in the chapter about sex. I enjoyed the comment from one of my more cheerful patients and a friend who suggested that the advice to men on sex should be repeated as every second chapter to get it through to them.

Moving back to babies for the moment however, I ask you to consider the effects of sleep deprivation on children. Our newborn infants have very little stamina. This "weakness" applies to all of their abilities. Would we expect a newborn to go without feeding for twelve hours? As adults we do routinely. Would we expect a newborn to walk 50 metres. As adults we do routinely. Would we expect a newborn to eat with a spoon without help? Babies are fragile in many ways. They are less tolerant of many things than are adults. This is normal and expected. It hardly needs stating. But remember babies are less tolerant of sleep loss. Their minds do not have the stamina to cope well with sleep deprivation resulting from a failure to receive enough sleep. Their mood will be irritable and tearful. Their ability to learn new skills and then to perform them will be decreased. This is a very important point which will be discussed again under cues of sleep achievement.

To conclude this section. Sleep deprivation is easily recognised. Its main effect is upon the brain and shows up most clearly as irritability and a decreased ability to perform learned skills.

BLOCKS OF SLEEP.

We don't really think about sleep a lot until we don't get enough. It is a statement of the obvious that we sleep in blocks lasting hours. The average adult will have between six and 9 hours sleep per day. This is taken as a single block of sleep. During our sleep the brain does function. In fact sleep is a time when the brain is doing many things but we are largely unconscious of its functioning. Sleep contains periods of physical movement, periods of lying quite still, periods of dreaming and periods of no dreaming. Sleep contains important parts of the process of learning. Recent reports from the Institute of Technology in Arizona and the Weizmann Institute in Israel have shown that new skills are "replayed" by the brain during sleep. In addition if sleep is disrupted the learning of new skills can be disrupted. Sleep appears to be a time when learning is consolidated.

Children function differently in many areas. Blocks of sleep are shorter. For the newborn, sleep is interrupted for feeding which will occur at 3 to 4 hourly intervals. This is not surprising when we consider that before birth the baby receives continuous nutrition from the placenta. It takes time for children to develop the body reserves to cope with longer periods of fasting.

We understand as adults, particularly after parenthood, that broken sleep is not as useful as continuous sleep. For children too it is easy to observe that if their blocks of sleep are broken up, then there are consequences. If instead of 5 or 6 **blocks** lasting 3 to 4 hours a newborn baby gets say 10 sleeps each lasting 1 hour then there are particular problems. These babies become overtired, are tearful, feed erratically, occupy much of their mothers' time and in particular are **difficult to settle to sleep**.

One of our fundamental aims as parents needs to be the achievement of blocks of sleep. These blocks need to be of appropriate lengths for both our children and also for ourselves. This is the road to sanity and happiness. Constant sleep interruptions for our children and ourselves leads us in a different direction.

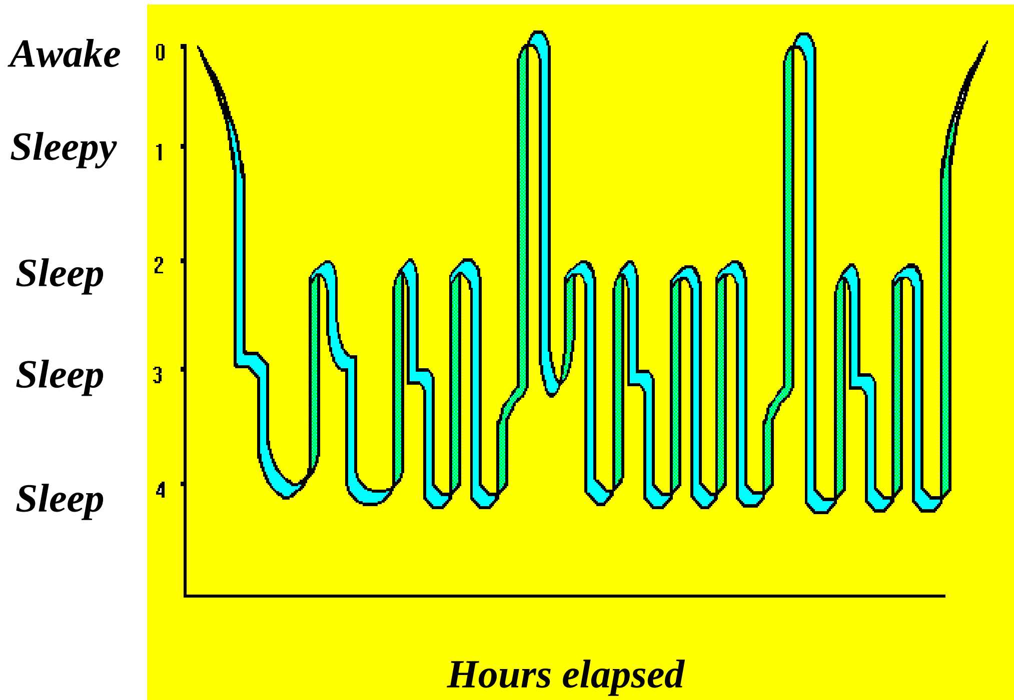
WAKING EPISODES

This is a key topic.

Please read this section carefully. If you understand this well it will aid your parenting tremendously.

Below is a graph of sleep levels. It shows a **"block of sleep"**. It is easiest to understand if we consider it for ourselves as adults. So for the present look at the graph and think of it as showing a full night's sleep from say 10 pm to 7 am. (Remember the days when that was normal. It will come again soon. Promise.)

Phases in a block of sleep.



At the left end of the graph is shown the change from being awake (0) moving through drowsiness (1) to various levels of sleep (2,3,4). Once asleep, our brain does what it wishes or needs. To the best of my knowledge we have no control over the activities of our brain once asleep. At some time during the night the line moves back to wakefulness (0 and 1). This waking is repeated a couple of hours later.

I need to make a few points about these waking episodes.

Firstly, all humans from very early in life have episodes of wakefulness during blocks of sleep. This includes babies.

Secondly, the waking episodes are short lived. Normally we recall the episode of wakefulness the next day as simply a period of becoming comfortable, rolling over, adjusting our pillow or cuddling into our partner. In fact as adults we often forget them until specifically asked. For newborn infants studied in sleep centres there are generally 2 or 3 per block of sleep each lasting 1 to 2 minutes.

Thirdly, being awake **always** needs to be followed by a sleep transition. Once awake our minds need to go through a sequence of steps which results in us being asleep again. This is a sleep transition. Thus for a baby a normal block of sleep will contain about 3 sleep transitions. This will include the first sleep transition at the start of the block of sleep.

Fourthly, a waking episode in a block of sleep is in normal situations a period of hazy consciousness. We do not wake completely. It is generally a time of minimal body movement and no language. For our babies, they should be silent. You should be unaware of them unless you were at the cot side.

In conclusion. All humans experience waking episodes in blocks of sleep. They are short and should be silent. They are a normal event in normal sleep. Their biological purpose is unknown. If you have any confusion about this concept please read it again. It is important to grasp this well to plan the development of our baby's sleep pattern.

SLEEP TRANSITIONS.

In the above section, I pointed out that blocks of sleep contain several sleep transitions.

Going to sleep is a more sophisticated thing than you might think. When I ask patients why we go to sleep they generally say because we are tired. While this is true it is only part of the story.

Achieving sleep is something which we can do in one of two ways. Firstly there is normal sleep achievement. We feel tired, it is the correct time of day, we move to our normal place of sleeping, lie down, close our eyes and go to sleep. For children this is equivalent to having a good feed, a nappy change and then being placed in their cot or bassinette. The child is awake, may whimper for a short time and then goes to sleep.

The second method of achieving sleep is the sleep of exhaustion. We are tired, overtired, profoundly tired. It is difficult to stay awake. When sitting we doze off, when horizontal the mind is unable to stay conscious. If awake we know that our mind is having great trouble functioning. For babies this is equivalent to a situation which you may have seen. I will describe it for older children. They, the children, have been busy, active, noisy. They are walking or running around. It is late at night. When encouraged to go to bed they refuse. If put down they complain vigorously. Eventually at 10 or 11 pm or later they crash. The unconscious children are found around the house in strange postures. They are then carried off to bed. For newborn babies this style of sleep occurs upon a background of sleep problems. They have short sleeps. Often they only achieve sleep with parental reassurance. The child may doze in mother's arms or be patted or rocked off to sleep and then awaken tearfully a short time later calling the parents back into service.

There are some major differences between these two methods of sleep achievement. I will ignore the effects of broken sleep here. That is dealt with elsewhere. For this section the important thing is that the two styles of sleep are fundamentally different.

In the first or "normal" sleep transition there is a sequence of events which must be gone through. There are a number of factors which need to be present which I will discuss under the heading of **Cues Of Sleep Achievement**. A normal sleep transition is a **skill** to which we are trained. It contains a **learned element.** It can be likened to gently applying the brakes of a car until it comes to a stop.

In the second or the sleep of exhaustion the mind is grinding to a halt. The mind is so fatigued that it is refusing to move any further. It lacks a learned element. It lacks predictability. It can be likened to a car stopping because it has run out of fuel. This will always occur eventually if we don't fill the tank. It may not occur at the most convenient place and it certainly interferes with the appropriate continuation of the journey.

To conclude. Achieving sleep involves a transition from consciousness to unconsciousness. This should occur predictably, at certain times and in certain places. It is useful for parental success to regard achieving sleep through a sleep transition as a **learned process**. The sleep of exhaustion lacks the elements of a learned skill and does not reinforce the development of that skill.

CUES OF SLEEP ACHIEVEMENT.

As explained above, blocks of sleep contain times of wakefulness. These are normal. Returning to sleep requires a sleep transition. I argue that these sleep transitions are usefully regarded as learned skills.

I now wish to expand upon the process of **learning** to go to sleep. I know that this sounds a strange concept. Please bear with me. This is a fundamentally important topic and needs to be well mastered before you can understand and develop your child's ability to sleep. We go to sleep everyday. The process is generally regarded as occurring because we are tired. We all understand that concept. I ask you now to regard achieving sleep as being dependent upon 2 factors.

Firstly, tiredness.
Secondly, everything else which is happening around you.

Tiredness does not require explanation. For the audience who have an interest in this book tiredness is a part of most of your days. It is a constant companion whom you would love to leave behind. I hope that I help you succeed.

Tiredness is relieved by sleep. Enough said.
The really interesting part is the second factor or group of factors. The things which are happening around you at the time of sleep achievement are the **Cues of sleep**.

The Cues of sleep achievement for a baby may include:

the time	(relative to feeding and hunger)
the place	
smells	
sounds	
internal comfort	(eg. a full stomach)
external comfort	(eg. warm clothes, tight wrappings)
comfort objects	(eg. a soft toy or a dummy)
parental care	(eg. holding, patting or rocking).

Any and all of these can be learned as part of the process of sleep achievement. Now this may all seem a little obscure, so let me give some examples. I have to totally convince you of the importance of this concept. If I fail at this point then everything else fails. This is the key to it all working for you, your child and your family.

To convince you of the significance of cues of sleep transitions let's talk about us as adults.

Imagine that I am talking to a woman who normally lives in her own home with a stable family. In this example you, the woman, are going to a motel in an interstate hotel. You are alone, the bed is too small, the pillow too thick, the man across the corridor looked a little strange and the building next door is a bus depot. Will you achieve sleep normally? Will you stay asleep normally? The answer is no, and we know from life experience that when we change the cues of sleep achievement so greatly, it is difficult to achieve sleep and stay asleep.

Thankyou to the lovely patient who listened to my story from the beginning to end and then said politely "No, Doctor I can sleep anywhere. I'm an air-hostess". Luckily she could see my point and believed me. She and her baby succeeded very well. Now some of you may well say that the example is too severe. The situation has been changed too greatly from normal. So let's think of a less severe example.

You wake normally at 2 am. It is a normal episode of wakefulness in a block of sleep. It should normally last between 1 and 2 minutes or even less. Tonight your pillow is gone. You reach out for it, half asleep. (You are not allowed to steal your partner's.) It is not in reach. You wake up some more and reach for it again. Still not there. Eventually you would probably be sitting on the edge of your bed with the light on looking for the pillow. You find it, lie down and go quickly to sleep.

The points I am making are two fold.

Firstly, even small objects can be important parts of the process of sleep achievement. The presence or absence of a pillow can reinforce or interfere with the process of going to sleep. A pillow is one important cue of sleep achievement.

Secondly, in the absence of the correct cues, the process of sleep achievement is disrupted. **This results in an elevated level of consciousness**. As we fail in returning to sleep quickly we become even more wakeful.

Now I have convinced you that cues of sleep achievement exist. I mean it really is obvious when you think about it. Don't you agree? My next task is to show that cues of sleep achievement are learned. Again let's use adults as examples, as they are easy to relate to.

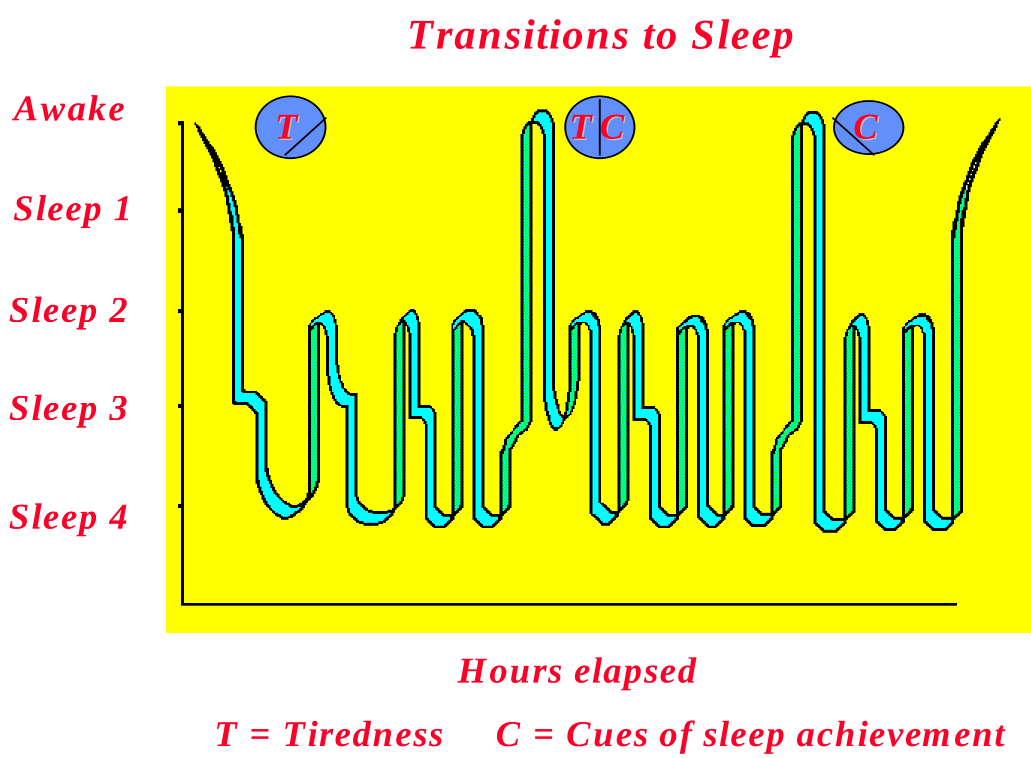
Imagine yourself as a single person. You sleep alone. You are used to sleeping in your bed, your room, your house. Then overnight everything changes. You are married (or whatever), you are in a big bed, a new room, a new house and there is another body in the bed. Going to sleep is different. For some days the process of sleep achievement is interfered with (not just by him). After a number of days you adjust to the new cues. You have erased the old cues and **learned** new ones. A similar thing happens when we move homes. After a few days in the new place we **learn** the new cues.

The process of sleep achievement is in part cue dependent. Cues are learned. They can be changed and re-learned.

What does this all mean? So what is the significance of these arguments?

Let me use the following graph to develop the argument.

In the graph below I have now added the two elements which encourage us to achieve a sleep transition.



This graph is the same as the previous one in this chapter with one addition. For each of the sleep transitions or waking episodes, if you like, I have entered a circle. Within this circle there are the two influences leading towards sleep. **T** for tiredness and **C** for cues of sleep achievement. Now the important point here is to notice the different contribution of each as the block of sleep proceeds. If we use an example from adult life again. Many of us can wake at say 5 am for a minute and then return to sleep. Obviously by 5 am our tiredness is largely gone. If need be, we could get up and go about our day's work. However, we don't. We go back to sleep. This return to sleep is partly a response to tiredness, but is now largely cue dependent.

Thus as we go further into a block of sleep, the sleep transitions becomes more cue dependent. The cues which have been learned to help achieve sleep at the start of the block of sleep will become **more significant** as the person sleeping moves **further into the sleep**.

Now let me show how this affects our care of children.

Children rapidly learn cues of sleep in their first weeks of life. Within the first month styles of sleep are emerging. Let us divide the cues of sleep for babies into two simple groups. Firstly those involving parental participation. Anything will do. Feeding, holding, walking, patting, rocking. For the really desperate there is driving around the block. They all work. They will all provide an environment within which sleep is achieved. The parental care will be taken on by the child and learned as part of the complex process of going to sleep.

The second group of cues exclude parents. Once there is a full stomach, clean dry nappy, appropriate wrapping, their cot, their room, normal smells and background noises the child will achieve sleep. If details of the environment are provided consistently they will be **"learned"** as the cues of sleep.

Let's try putting this all together.

Our child is normal. During sleep the child will have episodes of waking which should last 1-2 minutes. The transition back to sleep is partly dependant on cues from the environment around the child. These cues can be changed and re-learned. As a child moves further into a block of sleep the cues become **increasingly** important in achieving sleep. If the cues of sleep achievement include parental participation then it is likely that we, the parents, will be called back later in the block of sleep to participate in another sleep transition.

Isn’t it fun to understand why you are up every 90 minutes through the night?

Let’s do something about it.

The cues of sleep achievement which are most useful for baby, mother, father and family are those that are parent independent. A baby goes to sleep with a full tummy, a clean nappy, appropriate wraps, in an appropriate bed and room **AND ALONE**.

TIREDNESS AND SLEEP ACHIEVEMENT..

I once asked an eminent paediatric scholar as to the effect of fatigue on sleep achievement in children. He stated publicly that as children became more tired they were more likely to go to sleep. This answer staggered me. Mothers know that the reverse is true. This point appears to have received little recognition in the medical literature.

Those children who are sleeping well go off to sleep most easily.

Tired children are difficult to get to sleep.

Very tired children are very difficult to get to sleep.

Now these observations are so universal in young families that I will not defend the above statements. What I will do is try to explain why it is so.

In the previous section I argued that sleep was in part cue dependant and that this element of sleep achievement was learned. Now if going to sleep is a learned skill then it should behave like other learned skills. And it does.

As children become more tired they have more trouble performing their first learned skill. This is the skill of achieving sleep when certain parameters in the environment exist. Adults have increasing difficulty performing learned skills as we become increasingly tired. So do children. The tired child has trouble achieving sleep. The very tired child has great trouble achieving sleep.

The reverse of this situation is also true. The child who is well rested is better able to perform a learned skill. Thus the child who is ready for bed but has not yet become overtired achieves sleep efficiently. In addition the more often the child achieves sleep in a given situation the better those cues are learned. Just as we learn our alphabet and our tables by repetition, so repeated exposure to certain cues of sleep achievement helps their being learned.

The final aspect about tiredness and sleep achievement is that tiredness interferes with learning new skills. Overtired children have difficulty recognising the lessons that life is presenting. This is the same for adults. As we become more tired it becomes harder for new skills to be learned.

The better the child sleeps the better they sleep. The worse the child sleeps the worse they sleep.

I do not find many men who have experience of the situation of profound fatigue. Unfortunately a reasonable number of the young mothers who I see, do. In this situation the patient is so tired, so desperately tired, that once they get to bed and close their eyes, they cannot sleep. Once the eyes are closed the mind is spinning. You know that sleep is essential, you crave for it. You get to bed at last and the brain has trouble reading the code for sleep achievement. Eventually sleep is achieved but after much longer than normal. This is just the same for young babies. Once they are profoundly overtired they have very great trouble achieving sleep.

DEPTH OF SLEEP.

Once children have gone to sleep they become less responsive to what is happening in the house. Now just as there was a trap for young players with tired babies being difficult to get to sleep, so the same trap exists once sleep has been achieved.

The baby who is getting enough sleep, sleeps beautifully. They sleep through telephones ringing, doors banging, T V, radio, conversations, vacuuming and moving around in their room.

For the babies who are not getting enough sleep it is the reverse. As they become more overtired they are more easily roused. A telephone ringing, a door creaking, your footsteps. Sometimes you could swear to yourself that just the sound of your breathing wakes them. Because they are overtired they wake easily and begin to cry at once.

It is not fair for the world to do this. Where is justice? Where is common sense?

Well understanding is a wonderful thing. Once you understand the above concept then the answer is obvious. If the child is restless because of fatigue then everything else has to be put into second place to increase the hours of sleep which the child achieves. Once the baby has caught up on its sleep, it will achieve a more sound sleep.

The child who is getting adequate sleep is very easy to define. These children are calm, they go to sleep efficiently on their own, they sleep through all normal domestic noises. They return to sleep from their normal waking episodes without your help and almost always without you knowing they have been awake.

The tired baby is also easy to pick. It takes a long time for them to achieve sleep. They waken easily to normal domestic noises. They waken for their normal waking periods within a block of sleep and then are unable to achieve sleep alone, so they cry.

The moral of the story is to make sure that the baby is getting adequate sleep to perform the learned skill of sleep achievement. In the next chapter on sleep I describe sleep training and give guidelines on the amount of sleep that children usually need.

REWARDING BEHAVIOUR.

This is slightly complex section but it is important to understand. As soon as you understand it you will realise why it is important.

As the mother of the child it is important to understand your status. You the mother are wonderful. You in fact are the most wonderful person in the world. Your smell, your touch, your milk, the sound of your voice, your warmth. To a baby these things, each and everyone are attractive, pleasant and reassuring. As the mother, and also as the father, it is a joy to feel our child's security in our arms. This is how life is. These contacts provide some of life's great pleasures and contentments.

Contact with mother or father is a reward. Now there is a time and a place for rewards. 12 midnight and 2 am and 4 am and 5 am are not the times for rewards. These are times when as soon as possible after our child's birth we want and need to be asleep.

From the baby's point of view any behaviour pattern which is rewarded by parental contact is worth the effort. So if crying or kicking does the trick, so be it. I have even had older children who I believed had learned to cause vomiting in themselves as a way of blackmailing mum into coming to them during the night.

The first point that I am making is that contact with you is a reward even if it does not include a feed. It is to your advantage not to reward behaviour that you do not want to see reproduced. If you are happy that the child is well fed, is clean and dry, is in good health and has not got themselves into an uncomfortable or dangerous position in the bed, then leave them alone. If you know that the child is only one hour into a three hour sleep and they start to cry a little **do not** attend. Your attending is a reward to crying and will slowly increase the frequency with which that behaviour is exhibited. This is not being unloving but the reverse. Do you love your baby enough to allow him or her to learn the skill of sleep achievement alone?

Now the final point is a little more difficult to grasp but is easily proven by scientists. If you reward behaviour occasionally eg one time in three this is a stronger reward than if you reward the behaviour every time. Thus if a reward is given occasionally there is an increased chance of the behaviour pattern being repeated more often and for a longer period of time once the reward is finally withdrawn.

What does this mean?

If you have decided that your child needs to learn a sensible sleep pattern and you have stopped attending to crying between feeds, then stick to it. If you find that one time in 3 or 4 or 5 that you attend and give the child comfort then the lesson that is learned by the child is "If I cry often enough and long enough the reward will come." The sooner the pattern of rewards are consistent, the sooner the desired sleep pattern will emerge.

Cuddles, feeding, laughing, touching, loving are wonderful. Enjoy them to the full. But they are for wake times. Sleep times are for sleep and only sleep. Love your baby enough to help them learn the skills of sleep. Babies need much more sleep than adults. They need it in blocks of at least 3 to 4 hours. By twelve weeks of age many of "my" babies can sleep ten or more hours at night in a solid block.

But enough of that here. More in the next chapter.

I hope that once you have mastered the ideas raised in this chapter it will give you confidence. Understanding why you are helping your baby to learn the skills of sleep will greatly increase your chances of success.

CHAPTER 4. SLEEP PROBLEMS

Sleep. One of life's great pleasures. Few things can start a day better than waking with the realisation that you have slept well. The body feels refreshed. The mind works with clarity. Your sense of energy is renewed. Your mood tends to be more positive and cheerful. At least, until the family works you over for the two hours before they go to school.

The absence of sleep is an interesting state of affairs. Assuming that we get **'some'** sleep we cope with several disturbances of a night’s sleep fairly well. Initially. If the number of disturbances continues and our bodies or, more importantly, our minds are not allowed to recover, all of the above positive events move in reverse. The body is tired and listless. The mind does not work clearly or quickly and in fact becomes quite forgetful. Rational thought becomes more difficult. The mood becomes less than enthusiastic. Problems are approached with a negative attitude and we are more likely to burst into tears or be in a negative mood.

How many mothers of young children are left in this state? For days, weeks, months or even years?

While we can all relate to this situation the problem for children is less clearly defined. Some authors suggest that the need for sleep in young children varies greatly. While it is suggested a proportion of children cope with 20 hours of sleep per day others can cope with six or less. I am not so sure.

What is sleep for?

Some animal species cope with no sleep, ever. Others like humans require regular sleep for normal functioning. Experiments with enforced sleep deprivation show that after a variable period of time the mind begins to function incorrectly. When chronically sleep deprived, rational thought, concentration and memory are disturbed. Abnormal thought processes can occur.

All of us, as adults, can relate to the negative consequences of sleep deprivation. It is the central nervous system, the brain, which needs sleep more than any other human organ. In fact the majority of organs and functions continue while the mind is asleep. The heart beats, the lungs breathe, the bowel digests, the liver metabolises and the kidneys excrete.

My point being that **sleep is essential** for normal brain function. I would argue that it is part of the function of sleep to repair the wear and tear of the day's mental stresses. It is perhaps that time when growth of brain tissue can occur most rapidly.

The newborn child is undergoing dramatic development in brain size and function. The immature, growing, brain has a greater requirement for sleep than the mature one. In addition, the newborn has little in the way of resources of strength to handle the unprecedented inflow of information to which the brain is quite suddenly submitted. Babies have a great need for sleep. Success in achieving the sleep which a baby needs is fundamental to the well being of the newborn infant.

The next section will discuss sleep disturbances and advice for mothers about babies.

MOTHERS' SLEEP PATTERN.

Pre-Delivery.

Occasionally a mothers tells me that in the weeks leading up to her confinement she finds that at some time of the early morning say one, two or three a.m. she finds that for no good reason she is awake. Wide awake. This lasts for an hour or so and then she returns to sleep. She is otherwise well and feels normal. (If anyone can describe the clumsiness and indigestion of being 38 weeks pregnant as feeling normal.) This change in sleep pattern may be preparation for the night feeds required by a newborn. It is not a problem and does not need treatment.

Post Delivery.

Almost universally the newborn will feed three to four hourly throughout the night for the first few weeks of life. The mother is thus woken on these occasions and misses her normal total sleep requirement. Just occasionally a baby starts sleeping through for eight or ten hours in their first weeks of life. I well remember a couple of worried calls from mothers asking if it was alright to let the baby sleep. As long as the baby is feeding well, gaining weight and normally communicative it is fine. However, for the majority, the routine of night time feeds can go on for several weeks.

For the first baby it may be possible for mother to join in a sleep during the afternoon, thus catching up on her total hours of sleep per day. For subsequent children when there may be a toddler or pre-schooler at home this can be difficult. The only strategy left may be to retire to bed with the other children in the early evening.

As soon as possible it is essential for the mother to be getting a full night's sleep. Every effort must be placed on encouraging the baby to sleep at least eight hours at night. For the majority of babies this can be achieved by six weeks of age. If you expect to be feeding your baby at three a.m. when he or she is six months old you probably will be. The importance of achieving a full night's sleep can not be overstated. Not only does the mother feel mentally and physically better, but her milk supply improves in volume and quality. This improved supply then means that the baby is more rested and settled.

BABIES' SLEEP PATTERN.

As mentioned above I believe that babies have a greater need for sleep than adults. This need is at its greatest at birth and gradually decreases as time passes. Sleep requirements are at their least in adult life.

One of the most important things I wish to say about sleep in children is the irony of over tiredness. The overtired adult behaves very differently to the overtired baby. As an adult the more tired we become, the more we desire sleep. This can develop to the stage that if we sit down when desperately tired, there is a danger of going to sleep in that position. How many young mothers caring for a family and a newborn child find that the horizontal position means instant sleep? How many young husbands observe that their partner's horizontal position means sleep and **only** sleep.

The overtired baby does not work that way. The overtired baby is a trap for young players. The overtired baby is the most common cause of problems in the first twelve weeks of life. The problem and the contradiction is that the overtired baby **cannot and will not** go to sleep. He or she cries vigorously and long. They keep the whole family awake when what they and the rest of the family need is sleep.

I will now expand this area under the following headings.

a) Establishing a sleep routine

b) Establishing a night's sleep

c) The overtired baby

ESTABLISHING A SLEEP ROUTINE.

Philosophies vary as to how a child should fit into the family's pattern. At one extreme is the concept of demand feeding and sleeping where timing is controlled entirely by the baby. At the other extreme is feeding and sleeping by the clock irrespective of the baby's apparent needs.

From my experience the most successful path is a balance between the two.

I have been lectured to by eminent professionals on the virtues of demand feeding and constant physical contact between mother and child. I have been told of idyllic African villages where babies never cry because they are demand fed and are held in their mothers' arms or on her back 24 hours a day. The only problem with this philosophy is that very few of my patients live in idyllic African villages. Our culture sets other demands upon a mother. She is responsible for at least one child, a house, shopping, cooking, a husband or partner and variable commitments. Our culture does not allow the luxury of a mother sitting or lying with her newborn for 24 hours a day for three months. Any workable plan has to recognise the constraints placed upon the mother by our social norms. For most of her conscious day mother has to put her child down to allow her to continue with other tasks.

So what advice do I give?

As mentioned above I believe that the baby has a major need for sleep in the early part of life. My observations are that for the first five to six weeks of life a healthy baby feeds and sleeps and does little in the way of communicating. To establish a good foundation to allow the development of good communication, I emphasise the need for success in achieving a good feeding and sleeping pattern during the first six weeks.

Contact between mother and child is fundamentally important. It is essential to the normal psychological health of both the developing child and the parent. For the first six weeks the baby's important contact time is during feeds. Once the feed is finished, the nappy changed and clothing arranged, the baby needs to sleep. Mother is usually happy about that. If the baby is unsettled, there may be a feeding problem or reflux or colic. These problems should be handled as indicated elsewhere in this booklet. But assuming that the child is well and fully fed he or she will need to sleep at this time. Usually within five to fifteen minutes of being in bed the well fed, healthy, tired baby should be asleep. Other members of the family can be a problem. Playful brothers and sisters, loving grandparents and doting fathers. All must be kept at arm’s length once it is sleep time. If these attentive relatives wish to cuddle and stroke, kiss and play that’s fine. But after feed time for a few minutes only or at bath time. Over handling at feed times is a potent cause of over-tiredness in the newborn baby.

Once the baby is fed and changed it is time to sleep. Good quality sleep for the **18 or more hours per day** is as essential for healthy development in these first few weeks, as is good nutrition.

A development upon this theme is whether a child should be disturbed once he or she is asleep. The temptation will occur to hold children once they are asleep. Sleeping babies are easy to love. Proud husbands may wish to show off their newborn to a visitor. I plead guilty to this offence which preceded my "education". The golden rule is **"let sleeping babies lie"!** Once sleep is established, let it continue until the next feed time.

A healthy sleep will last for times varying between two and five hours in these first six weeks. Over a period of weeks a pattern needs to be established. The pattern needs to satisfy the baby's requirements and leave the family routine reasonably intact. It is helpful for the mother to have a plan in her own mind so that she can develop and encourage the baby towards this desired objective. I will discuss this plan in three ways.

A) Time interval between feeds	(what is normal)
B) Age of baby	(what to aim for)
C) Time of day	(what to expect)

A) TIME INTERVAL BETWEEN FEEDS. (What is normal)

1 Hour.

A baby does not demand feeds one hour apart unless there is a problem. The most common problem is hunger i.e.: the previous feed lacked adequate volume of calories. Feeding volumes must be built up. The second most common problem is the over-tiredness. The irritable overtired baby can be woken by a minor stimulus and then cry vigorously. This baby needs to increase the number of hours sleep per day. (See overtired baby) The third most likely cause is reflux and then finally colic and other problems.

2 Hours.

A healthy thriving baby will not demand feeds 2 hourly. The comments for 1 hour apply but for one exception. This exception is the first two feeds of the day. As the child becomes stronger and is sleeping 6-12 hours at night; which can often be achieved at 6-12 weeks, then the early feeds change. The first feed of the day, say at 6 am is a full, successful feed, the baby sleeps and then perhaps by 8 am, only two hours later demands another feed. When offered, the feed is successful. This can be seen as perhaps a 'catch up' feed for the one missed during the extended sleep overnight.

3 & 4 hours.

Most newborn babies will sleep for at least 3 or 4 hours between feeds. The sleep should be deep, peaceful and not easily disturbed. The healthy baby in a deep sleep will ignore most noises, the telephone ringing, the radio on, the sound of normal conversation, the vacuum cleaner i.e.; normal house sounds. If the baby wakes too easily and if you are tip toeing around the house talking in muffled whispers the baby is probably overtired. (see that section).

5 Hours.

Within a few weeks, say by 3 or 4 weeks the thriving baby will begin to have at least one five hour sleep per day. Hopefully this will be overnight. Often it is in the afternoon.

6 Hours.

Again this tends to occur at about 3-4 weeks. If it is occurring during daylight hours it should be discouraged. Not for the baby's benefit, but the mother's. If baby is to receive five feeds in 24 hours and there is a 6 hour sleep in the afternoon it will probably mean two night feeds. Mother does not need that. So after four hours gently wake the baby (break the golden rule) and give a feed. Try and move the six hours sleep into night time.

7 Hours.

The baby is now several weeks old and growing well. He or she is strong enough to sleep this long. Again it should be at night. There is little to be gained by letting baby sleep this long in the day. If the baby is small, thin and gaining weight poorly it should not sleep this long at any time. A baby who is too weak to waken for a feed needs significant help. Seek medical advice and supervision.

8 Hours.

The thriving baby should be able to achieve eight hours sleep at night by six weeks of age. This is quite a land mark in the family’s return towards normal sleeping patterns. Mother can have close to a full eight hours sleep and this creates an excellent platform for her next day. However if the baby is small due to poor or no weight gain, or if feeding poorly they should not sleep that long. It is a bad sign and requires medical supervision.

9-12 Hours.

For the thriving baby a night time sleep of this length can be achieved before 3 months of age. Again this is another landmark because it establishes a sleep pattern for the child for the next five or six years. Once sleeping say 7 pm to 7 am then the child should keep that pattern until school age. It also now gives mother and father time together after the children are in bed. The return to a new but manageable family life is reasonably complete.

The tired, thin, underweight baby should not sleep this long. It is short of nutrition and needs medical assistance.

B) AGE OF BABY. (What to aim for.)

At birth	3-4 hourly feeds for 24 hours averaging 6 feeds a day.
1-6 Weeks	3-4 hourly feeds, perhaps a single sleep lasting 5-6 hours. About 5 feeds a day.
6 Weeks	3-4 hourly daytime feeds. A single night sleep of at least 6-8 hours. Perhaps a 2 hourly catch up feed in the first part of the day. About 5 feeds a day.
12 Weeks	4-5 hourly feeds a day. 12 hour sleep at night. Perhaps a 'catch up' feed in the morning. About

4-5 feeds a day. This pattern continues until solids are started.

C) TIME OF DAY (What to expect)

This will vary dramatically as your baby matures and strengthens.

6 am. Often regarded as the start of the day. For the newborn it is another feeding time of the 3-4 hourly routine. By 6-12 weeks of age baby is sleeping longer at night and may have two quick feeds i.e.: one at 6 am and one at 8 am.

10-12 noon - For the newborn the 3-4 hourly ritual continues. As they mature the feeding time will move towards the family’s normal lunch time.

1-4 pm - The newborn is feeding 3-4 hourly. If the mother’s milk supply is decreased for one reason or another it may be a time to start complementary bottle feeds after the breast feeds.

5-6 pm - Perhaps the most demanding time of the day. What hotels refer to as the 'happy hour'. Mother is most in demand. She is attempting to divide herself into two or more equally capable and attentive parts. The milk supply is at its lowest ebb simply because of tiredness. If a complementary bottle feed is needed this is the most likely time. If necessary give a top up feed, let the baby settle and free up your time for the rest of the family. Remember the wisdom of having meals in the freezer and re-heating in the microwave. A little technology can help a great deal to return some sanity to this time of day.

7-10 pm - The newborn continues to have 3-4 hourly feeds. The more mature baby may have a late 'settling' feed before sleeping 8 hours. By three months baby should be sleeping through till morning and this time can be spent in the luxury of your partner's company. It is nice to have a time of day when you can talk to someone over school or pre school age.

11 pm-6 am - 3-4 hourly feeds for the newborn but by six weeks and definitely by twelve weeks these hours should be yours for sleep.

ESTABLISHING A NIGHT'S SLEEP.

As mentioned above a full night's sleep is a most refreshing event for the young mother. She is the axis of the young family and her mental and physical health is of fundamental importance to every other member of the family. Adequate nutrition and adequate rest are the principal requirements for her health.

The baby who is thriving will be able to sleep 8 hours at night by 6 weeks of age. Once it is known that the baby's weight gain is 30 gm/day or more and that all else is well then the baby can sleep for eight hours. Some babies will continue to awaken at 3 am for the 'night time' feed. Of course the angelic children will be sleeping through of their own accord but some will not. If the baby has good weight gain, is relaxed and comfortable and is otherwise well, then you can begin winding down the 3 am feed. For those babies who are looking only for a dummy and who are sucking lazily - give them a dummy. For those looking for some fluid and not satisfied by a dummy then give the shortest feed which will allow the baby to settle. Keep cuddles and changing time to a minimum and get the child back to sleep as soon as possible. Sometimes just a bottle with some boiled water will allow baby to settle. Another strategy, if you are sure that the baby is well, gaining weight and thriving and is simply awake for some contact, is to ignore him. Often the chubby contented baby will cry for a few minutes in a half hearted fashion and then go back to sleep with no more attention than a nappy change.

If you, the mother have a clear desire to achieve 8 hours' sleep and are willing to 'urge' the baby in that direction it can be achieved. If you believe that 3 am feeds are normal until twelve months then that is what you will be doing. Remember that sleep is as important to the baby in its own way as nutrition. You are not being unkind by 'insisting' that the baby increase its total hours of sleep. In fact by allowing the total hours of sleep to increase then everyone gains. Baby wakes next morning strong and hungry and most likely to feed well. You have had a good sleep and will have maximum milk supply. Nothing starts the day better than a full night's sleep, a rapid successful breast feed and then to sit for a few minutes gazing into the relaxed, sedated face of a well fed thriving baby. Allowing yourself a full night's sleep is in fact a significant contribution to the health and well being of the whole family.

THE OVERTIRED BABY.

Few situations cause more concern and family disturbance than the overtired baby. This problem is extremely common but I am greatly surprised at how infrequently it is recognised. There are few areas in medicine where I believe that my advice is more helpful. As mentioned above, sleep is fundamentally important to the normal functioning of the body and particularly the nervous system. Every mother who has had children recognises the significance and disruptiveness of being overtired.

Multiple nights of broken sleep result in emotional variability, irritability, a decreased ability for rational thought, a sense of tiredness and overwhelming fatigue. This occurs in a grown woman whose strength and stamina are much greater than that of a newborn. The baby's nervous system is undergoing dramatic growth both in size and function. Every moment awake is filled with new sensory information. All the senses are bombarding the central nervous system. The brain’s ability to handle and filter information is very limited. It is not in the least surprising that the newborn is very susceptible to central nervous system fatigue. To understand the significant consequences of this I return to the purpose of sleep.

I am unable to say scientifically that sleep has an essential purpose in the human species to allow any particular chemical to be renewed. From a scientific perspective we still have much to learn about sleep. What we do know from life experience is that sleep has an essential function in maintaining smooth, purposeful, rational brain function. When fatigued we are able to rejuvenate during our sleep. The deprivation of sleep in the strongest and best trained of adults will eventually result in unstable brain function. Memory fades. Rational thought becomes imperfect. The ability to learn decreases. Emotional responses to situations become exaggerated and unpredictable. This is in an adult where the brain has matured and stabilised. The newborn has much less stamina.

In the newborn the nervous system is undergoing dramatic growth at the same time that it is learning to filter and process the large amount of information being presented to it. The strength to handle sleep deprivation has not developed. A baby will show the effects of sleep deprivation rapidly and will recuperate slowly (depending on the length of deprivation). The newborn is also developing new mental skills. Sleep deprivation **will slow this down**. At its most extreme, the child may become trapped in a stage of imperfect development. These chronically overtired children may show short attention spans, varying degrees of abnormal behaviour, disordered play, irregular feeding and immature personalities. I believe many children take years longer to achieve neurological maturity than they need due to sleep deprivation as newborns, which was never diagnosed and treated.

THE PRESENTATION OF OVER-TIREDNESS

If this problem is so common, what are the details of the presentation which suggest it?

Children of this age, less than six weeks, have a limited repertoire of symptoms and signs. Often a symptom, for example crying, can represent a multitude of problems. The history therefore needs to be taken carefully.

The major areas of the history which the mother will be able to report on are feeding, sleeping and crying disturbances.

I) FEEDING DISORDERS IN THE OVERTIRED BABY.

The overtired baby may feed satisfactorily but is often inconsistent. The child will suck for a short time and then become sleepy before the feed is finished. Mother will know that the feeding time is inadequate and attempt to wake the baby. Conversely the baby may start to feed but quickly become irritable at the breast and refuse the nipple. The feed may in fact be quite drawn out and not succeed in giving the baby the milk volume it requires.

A crucial element here is that despite hunger and tears before the feed, the baby sleeps in mother's arms. The overall feeling at the end of the feed is that it has been unsuccessful.

II) SLEEPING DISORDER OF THE OVERTIRED BABY.

The overtired baby displays a clear and consistent contradiction in its behaviour. Whereas the tired mother sleeps rapidly once lying down the overtired baby does not. **The overtired baby is very difficult to get to sleep**. This behaviour is not 'logical', it is not how we behave as adults**, it is not expected**. It is this contradiction which can lead to difficulty in making the diagnosis and the ultimate worsening and prolonging of the problem.

After a difficult feed the baby settles in mother's arms. Upon laying the baby in its cot he or she rapidly begins to cry. The crying is long, long and distressing. If the parents are strong willed enough to leave the child unattended, the child will eventually begin to settle. After a long time, say 15 minutes the crying stops. Despite this, minor disturbances in the house interrupt the baby's sleep. These may be very minor**-** a child talking, a door opening or even the baby's own movements. If disturbed from sleep the baby begins to cry at once. They will sometimes wake from a sleep quite suddenly and may sound loud and distressed. Once again baby is difficult to settle.

The majority of loving, attentive mothers facing this tearful distressed child give what their hearts tell them to give. Attention. The child is lifted and held or rocked in a cradle or walked around the house. The most extreme example I know of was a family who found that their child only settled when driven around in the car.

Handling the overtired baby is counterproductive. It simply prolongs the time when the baby is awake and should be asleep.

Many mothers say to me that their babies are in pain. They look upset. They shed tears, become red in the face, have a worried expression, draw their legs up. "Doctor there is obviously something wrong".

The clue to the problem is the child’s response to comforting. When held or rocked or driven around, they settle. How many husbands have spent countless hours rocking the cradle bringing peace to the household. A child who really has 'something wrong' is not usually pacified by simple contact. A sore ear or colic or other true pain causes discomfort to an extent that rocking the cradle does not help.

The next clue is that when the child settles for a second time, as a result of this attention, they are not deeply asleep. Within minutes of putting the settled baby down or stopping the cradle the child is crying again. The intervention has not allowed the baby to go into a deep restful sleep. Even when the baby has started to doze in the parents’ arms it has not achieved deep restful sleep.

III) CRYING DISORDERS IN THE OVERTIRED BABY.

The overtired baby is perhaps best described by comparing it with a well rested baby. A baby who is feeding and sleeping well is not particularly tearful. They wake for a feed and demand strongly but then feed well and go to sleep with a minimum of fuss. Once asleep the child achieves a great depth of sleep. People talking, children playing, telephones ringing do not wake the child from its sleep.

The overtired baby has an irritable nervous system. Many minor disturbances result in crying. The crying is loud and long. The baby is difficult to settle because of its deep seated irritability. It is so irritable and unsettled that many events result in loud distressed crying. To this baby the whole world is a bit of a pain really. The crying of this baby may be similar in volume and length to a fit but ravenously hungry baby demanding a feed. It is a noise which is difficult to resist.

IV) EXAMINATION OF THE OVERTIRED BABY.

The overtired baby has an interesting examination. Detailed examination of the baby is normal. Ears, throat, chest, abdomen are all normal. The clues lie in the general observations. If the baby is old enough to be making eye contact then in the overtired baby the eye contact is poor. When looking into the eyes of a healthy infant of more than six weeks of age two things emerge. There will often be a smile reflex and secondly the contact will be "meaningful". I am not sure how to describe “meaningful eye contact”. Despite this difficulty in achieving a word picture, every woman that I ask understands at once what it is. The overtired baby is very difficult to get to smile. It is also difficult to achieve "meaningful eye contact". These babies are difficult to establish emotional rapport with. They are a bit hard to give to emotionally. They certainly give little out.

The second general observation of overtired babies is their movements. Babies who are well rested move their arms and legs in a smooth fashion. When they are lifted or moved their muscle tone is relaxed. The overtired baby has movements which are tense rather than calm. At the most extreme the baby may lie in the cot with a slightly worried expression and a mild but persistent tremor of the hands. When lifted and moved the baby's muscle tone is not relaxed. If the arms are quickly extended and then released they flex with a tremor and cause the baby to cry. The healthy well rested baby tends to lie with limbs extended and relaxed muscle tone.

V) DIAGNOSES OTHER THAN OVER-TIREDNESS.

As will be obvious to all experienced mothers and fathers, the disorders of behaviour listed above can also occur in other settings. A baby may be irritable and tearful because of hunger. Feeding may be poor because of oral thrush or tonsillitis. Sleep may be disturbed because of reflux and ‘indigestion’. Colic may cause pain and present as an unsettled tearful baby who feeds poorly. It is the combination of examination coupled with the observations of the mother, that makes the final diagnosis.

An important, almost fundamental, part of establishing a diagnosis is firstly establishing that weight gain is satisfactory. The baby must be bare weighed and a weekly or daily weight gain calculated. If the baby is gaining more than 30 gm/day or 200 gm per week then underfeeding is probably not the cause of distress. Despite this reassurance, just occasionally a baby with normal or largish parents may be ‘needing, a weight gain of 45 gm/day even 60 gm/day to be satisfied. Generally though if the baby is gaining 30 gm/day the focus can move from consideration of a feeding problem to sleeping disturbance. Obviously if the weight gain is less than 20 gm/day then the focus moves to feeding. As always there is an exception. Occasionally a child of smallish parents may be comfortable and relaxed with a weight gain as low as 15 gm/day. When this occurs it will probably occur in that child’s brothers and sisters as well. The overall behaviour of the child must be considered.

If the general examination is normal and the baby's weight gain is satisfactory; if the baby is not showing signs of constipation or reflux, then the most likely cause of distress is tiredness.

An appropriate plan of management from the mother will help the baby achieve the number of hours' sleep that the child needs for calm functioning. Treatment of the overtired baby is discussed in the next section.

VI) TREATMENT OF THE OVERTIRED BABY.

The overtired baby is very easy to treat. Unfortunately few treatments are so difficult to carry out. First time mothers are hesitant to carry it out.

The treatment is no treatment.
The treatment is do nothing.

The treatment is put your hands in your pockets and walk away.

But what does this mean?

We have outlined above that the problem is over-tiredness. The treatment is aimed at increasing the number of hours sleep that the baby receives in 24 hours.

The common approach of holding or rocking or walking fails in the long run. Although it succeeds in soothing the baby, it fails in the long run because it does not establish sleep. The baby may relax and doze in your arms or at the breast, often when they should be feeding, however, when put down to sleep they awaken almost at once. The baby does not need a snooze, it requires hours of deep, refreshing sleep.

While the healthy, well rested baby does go to sleep rapidly in almost any reasonable circumstances, some compromises must be made for the overtired baby.

Like all of us a tired baby will find it easiest to sleep in a quiet, dark, warm place. In addition the baby will be reassured by 'tight' supporting wrapping. The technique of wrapping can be a little difficult and you may need some teaching. Take care not to over-wrap in warm weather as overheating can be dangerous.

Once in this position the mother and father must leave. The baby will cry. Do nothing. Hold each other's hands, play cards, watch TV but do not pick up the baby.

The baby will cry. The crying will be loud and long. It can last for a very long time. The more overtired a baby the longer it can cry, until exhaustion takes over.

Most mothers find this instruction difficult to obey. On the surface it appears unkind to leave the baby crying. You will need to have faith in me for the moment. This does work and is not unloving. In fact the reverse is the case. Helping the child to 'learn' good sleep habits is one of the kindest most loving things you will ever do for your baby. But getting back to the crying baby. After a short time they 'give comfort'. This can be disastrous. Even if the baby stops crying in the mother's arms, at some time the baby has to be put down. Let's say the parents spend 15 minutes settling the baby. Eventually the baby goes back into the cot and starts to cry again. All that has been achieved is that the baby is now 15 minutes or more deprived of sleep.

There has to be an emotional outlet to this hard line attitude. It is cruel to ask a mother to sit for ‘hours’ listening to her distraught infant. The programme here is to allow contact at given time intervals. Time has to be measured on a watch not in the heart. It is amazing how long 60 seconds of loud crying seems to have gone on for.

To maintain her sanity and her belief in herself the mother must be allowed to have contact with her crying baby. But when? I recommend that the parents wait for at least 10 or 15 minutes. However the time needs to be chosen by the mother. If she finds it emotionally impossible to wait for 10 minutes, then try 5. At the end of the time that Mum or Dad feel is the maximum that they can wait then go to the baby. At this time spend a maximum of 1 or 2 minutes with the child. DO NOT SETTLE THE BABY IN YOUR ARMS. Use soothing touch or words. Reassure the babe that you are still around and then leave. The child may still be sobbing. Leave the room. The next non contact time is 20 minutes and then 25 minutes etc. The majority of babies achieve sleep in the 15 minute time frame. Please try to remember that the child will not be injured by crying. Nothing breaks and nothing falls off.

This programme works. It may take several nights and be emotionally very draining but it is worth the effort.

CRYING DOWN.

This is a term which I use to describe the pattern of crying when the overtired baby is going to sleep. By creating a mental picture of the noise which will be heard, the mother is assisted by knowing what to listen for.

Crying down is in essence the reverse of crying up. Crying up is the description of a child waking from a good sleep and starting to demand feeding. Crying up starts with silence. The child is asleep. They awaken. First sounds are soft, gentle, subtle. After some time, perhaps a minute or two of being ignored, the baby begins to cry. After a short time of crying the baby will be silent for some moments. If ignored the crying starts again but at a louder volume. Crying gradually increases in volume and with the gaps between cries becoming shorter until the baby is emitting a continuous loud bellow that few human beings conscious or unconscious can ignore. It's feed time.

Crying down is the reverse of that picture. This is the noise of the overtired baby going to sleep. The child is put down after the feed. The nappy is clean and dry. Mother knows that the baby needs sleep. Unfortunately the child's nervous system is irritable and despite its need for the rest it starts to emit a continuous loud bellow which is difficult to ignore.

If mother and father are attempting to sleep the crying of the tired baby makes it impossible. Unless both partners are aware of the problem at least one will be inclined to 'do something' about the baby. Herein lies the chief pitfall. Both partners need to do **nothing** and **support each other** in doing nothing. It is amazing how hard doing nothing can be. Watch the clock, after 10 minutes you are allowed to touch.

The loud, continuous bellow continues for a few minutes. At some stage the child will have a short break to catch breath. The silence is short lived and crying soon recommences. The volume may be a little less. After some time a longer break occurs. The next bout of crying may be a bit softer. The next break may be a little longer. Gradually the volume decreases and the breaks between bouts of crying become longer to the point that the baby achieves sleep. This process of crying down can take 10 minutes, 15 minutes or 30 minutes. The length of time reflects the degree of tiredness. The more overtired the baby the more difficult it is to get to sleep. The more overtired the baby the more important it is to let the baby cry itself off to sleep so that sleep is achieved. The sooner the baby catches up on the total number of hours sleep required then the more rapidly it will sleep easily. The above technique of observing the baby crying down to sleep I call controlled crying. There are few pieces of advice I give to the families for which I care that are more important. Few are as useful in improving family harmony and allowing members of the family to get on with the task of enjoying each other. The overtired child finds it difficult to relate to the parents. Its behaviour is erratic and annoying. It is more tearful, more demanding and harder to placate. The overtired child is harder to love. The problem, if left untreated can lead to fundamental disruption in the building of a strong life-long bond of affection between parent and child.

Parenthood should be emotionally rewarding. It is the emotional reward that we are getting out of parenting. There are certainly no other rewards. In every other respect parenting is give, give, give. That’s fine. The emotional reward far outweighs any cost of time, effort or money. Over-tiredness of child and then the parent, interferes with the development of the calm, happy, loving relationship which enriches our lives and makes all the effort worth while. Parenting is fun. Allow yourself that pleasure.

The self discipline of controlling over-tiredness in a young child is essential in allowing the positive aspects of parenting to flourish.

CHAPTER 5. THE ESSENTIAL ADVICE

This chapter has been written to present the ***most important*** elements of this book in a way that is logical and compact. The six points made in the following pages reflect the tutoring which I give in my surgery. While much of it has been said elsewhere in this book, presenting in this way appears to work well for many families.

(1) Blocks of sleep contain multiple sleep cycles.

Humans, like almost all other higher creatures, require sleep. We find that sleep is most effective when it is achieved in blocks lasting a number of hours. Most adults, for example, feel most refreshed by achieving between 8 to 10 hours sleep in a single block, overnight.

In recent years the development of technology has allowed us to study sleep in sleep laboratories. One of the interesting findings is that sleep occurs at different levels during a block of sleep. In particular, all people - from birth and through their whole life - experience awakenings throughout a block of sleep. The purpose of these shallow awakenings is not known. A block of sleep is thus divided into **multiple sleep cycles.** A sleep cycle is one circuit starting with wakefulness followed by a period of sleep and **concluding in a waking episode.** The length of these sleep cycles varies with age. For a young baby they may be as short as 40 to 50 minutes. In adults sleep cycles are approximately 90 minutes long.

Most of us will therefore have between 5 and 6 awakenings in an eight hour sleep. Fortunately we have little or no recall of these awakenings the next day. Despite this ‘forgetability’ these awakenings contain an element of awareness. It is in these episodes that we would recognise that a pillow has fallen off the bed, for example.

The importance of these awakenings or arousals with regard to infant sleep is that they conclude in a *return to sleep*. Thus a block of sleep contains not only multiple arousals but *multiple episodes of sleep achievement*. The length of a single block of sleep can vary from approximately three hours soon after birth to as long as 12 hours after some months. The individual sleep cycles within that block of sleep only change slowly over a period of years Sleep cycles in the first few months of life last about 40-60 minutes. These cycles conclude with a shallow awakening which should be silent and last 30 to 60 seconds. The awakening will then be followed by a return to sleep. Of course if the block of sleep is now complete the arousal will lead to full awakening. For the arousals within a block of sleep the person in question will return to sleep silently and rapidly.

Thus to summarise this section:

-A block of sleep contains multiple sleep cycles.

-Sleep cycles conclude in an awakening and then usually a silent return to sleep.

-A block of sleep contains multiple episodes of sleep achievement.

(2) Sleep achievement is in part, ‘cue’ dependent.

Having made the point that a block of sleep contains multiple episodes of achieving sleep, then what helps this to occur? Going to sleep is in fact a complex event which sleep researchers continue to study. For the purpose of understanding and controlling infant sleep I suggest two causes as causing the change from consciousness to unconsciousness which is represented by sleep achievement. I do not pretend that this explanation even attempts to reflect the complex biochemistry which is occurring at the time of sleep achievement. Despite this, my simple analysis is accurate enough that we can all relate to it and the advice which it leads to works for most families.

What makes us go to sleep?

In my consulting room there is normally a very tired pair of parents sitting with me. They rarely have any trouble volunteering that tiredness causes sleep to occur. For many of the parents whom I see the tiredness has changed to exhaustion.

On a personal note I well recall when my children were very young, my wife appeared to be deeply asleep about one second *before* her head hit the pillow. None of us have any trouble agreeing with the following statement. Tiredness leads to sleep. Unfortunately this simplicity is incomplete and as you will see in point **5** below, it is somewhat misleading when discussing infant sleep. However, for the moment, let us accept the statement because it is still largely true.

Despite the presence of tiredness other things are required to be present for sleep achievement to occur smoothly and efficiently.

As an example imagine the following scenario:

You are very tired, the children are asleep, the house is quiet, all the important work is complete, and you are ready for bed and sleep. However instead of lying down in your normal bed, in your own bedroom, for my own reasons I ask you to lie on a portable bed, in a sleeping bag, on your own in the car port. Your tiredness is still complete, you are just as badly in need of sleep, but because the setting for your sleep achievement is so different, the ability to achieve sleep is decreased. I call these environmental factors the **cues of sleep achievement**. For normal sleep the ability to go to sleep is dependent upon a combination of tiredness and appropriate cues of sleep. The common cues are being in the right bed with normal sounds, smells, warmth, blankets, pillow, the correct company, and at the appropriate time of the day. The more we disrupt the cues of sleep the more difficult it becomes to achieve sleep.

SLEEP ACHIEVEMENT = TIREDNESS + CUES.

(3) Cues of sleep are learned, and they can be changed and relearned.

I have made the point that a block of sleep contains multiple sleep cycles and therefore multiple sleep achievement episodes. The achievement of sleep is brought about by the sum of correct levels of tiredness and appropriate cues of sleep.

Cues of sleep achievement reflect your surroundings. Each of us has a subconscious list of cues which we recognise. These cues are learned and completely changeable. The example which I normally give to the families which I see relates to ourselves as adults. As single adults we have certain sleep skills. We achieve sleep and maintain sleep in, for example, our parents' home. We take these sleep skills for granted. At some stage we form a relationship and begin sleeping with a partner at a different site.

Overnight all the cues have changed. A new bed, a new bedroom, a different house or flat, and two bodies in the bed. Most of us accept that our sleep skills are temporarily disrupted. It takes a little longer to achieve sleep, we are more conscious of arousals overnight, are aware of our partner turning over or snoring through the night. Thankfully the disruption to our sleep is short lived. Within a week or two the subconscious reprograms itself and our sleep skills return towards normal.

I talk about a ‘computer programme’ which we store in our brain which has a title ‘This is how I go to sleep.’. When we need to achieve sleep, we pull this programme out from its file and then use it as a reference point to assist us. When the lines in this computer programme are changed, i.e.. when the cues of sleep are changed, our efficiency at achieving and maintaining sleep is decreased. Then over a period of days or a couple of weeks we rewrite the programme. Old cues are erased and new cues are written in. As this new programme takes shape our sleep skills come back towards normal. We do this so well that soon we *need* the new cues, For the majority of women that I see, their husbands or partners were disruptors to sleep at first, *but now* if he is away for the night they do not sleep as well. So in adult life we change cues of sleep, suffer some sleep disruption, and then relearn new cues which allows our sleep efficiency to return towards normal. Another example which most of us can relate to is the temporary sleep disruption of changing house or flat. In the new environment we rapidly rewrite our sleep programme and our sleep efficiency returns to normal.

In conclusion : Cues of sleep are learned, and can be changed and relearned.

(4) Sleep achievement is usefully regarded as a learned skill.

This point is one of the keys in my method of caring for infant sleep. This way of analysing sleep achievement suggests that it is in part cue dependent. Cues of sleep are learned. By combining these two points we arrive at the above statement. Now I can not prove one way or another if sleep achievement is a learned skill. What is important is that if we accept this analysis of sleep then the advice which it leads to works. The advice also reflects what we see with infant sleep and, to an extent, adult sleep.

So for the moment let's choose to look at sleep achievement as being one of our many learned skills.

(5) Fatigue interferes with sleep achievement.

It is difficult to overstate the importance of this point. This is a tripping up point for many young parents. It is a trap for the innocent or well intentioned. This is where the majority of infant sleep problems have their origins.

The first problem is that on first glance this proposal seems wrong. "Fatigue interferes with sleep achievement"? Haven't we already agreed that sleep achievement is the result of a combination of tiredness plus cues? Now I am saying that tiredness interferes with sleep achievement? Have faith, it all comes together soon.

Let us return to point **4**. Sleep achievement is a learned skill. Now if this is correct then sleep achievement should behave like other learned skills. Our school tables, telephone numbers, our alphabet, appointments and what we have come to the supermarket to buy are all things we would more usually associate with memory and learned skills. So let's think for a few moments about these learned skills and the effect of tiredness. It is really not in the least controversial to suggest that tiredness interferes with the performance of learned skills. Almost universally the parents I see and in particular the mothers of sleepless infants are suffering from sleep deprivation of varying degrees. Almost all of these women agree that their memory is atrocious. They are having trouble remembering telephone numbers, shopping has become a bit random where afterwards several things are forgotten and they are having to write notes to themselves to avoid forgetting important events.

Our life experience teaches us quite clearly that fatigue interferes with the performance of learned skill.

Now I have stated above that sleep achievement is a learned skill. Therefore, if this is true then fatigue should interfere with sleep achievement. Once again, this point is one we can recognise and accept from our life experience. As mentioned several times already, parents of young children are often very tired. The mothers in particular have gone past tired, have become overtired, and then exhausted. Body and soul are crying out for sleep. Now the following scene emerges. The children are asleep, at last, the house is quiet, you badly need to sleep, you get to bed, lie down, close your eyes, and what do you find? The mind is spinning, your emotions are annoyed, on edge, and sleep fails to arrive. You have become so tired that it is hard to get to sleep. Sleep is eventually achieved but it is slower than normal to come. During this time the mind is not relaxed and peaceful. Becoming overtired can interfere with efficient sleep achievement. Returning to the example of the computer programme called “This is how I go to sleep.” , you can become so tired that it becomes difficult to retrieve that programme from its file. Just imagine your tired mind at 2am after a busy day asking itself “Now where did I put that note about sleep? Just cannot find the darn thing at the present.”.

The relevance of this to infant care is as follows. We as adults can become overtired to the point that sleep achievement is difficult. Infants have much less stamina than adults, and are more prone to overtiredness. They will achieve the overtired state rapidly. For the newborn this can occur within one day or even less. The older infant and later the toddler are more resistant but will eventually achieve overtiredness if they miss enough sleep.

Most parents have little trouble recognising a scene where their children have missed a sleep, and are then late for bed. An afternoon birthday party is a great example. The children have been playing vigorously, much food has been eaten, they have begun to be silly and the tears begin to flow. You know that they are tired, and then overtired, so you suggest bed. Do they go off to sleep easily? No! As their tiredness increases, their ability to go to sleep decreases. Mum and Dad then pay the price for their children's lack of sleep. Fatigue can interfere with sleep achievement.

Before concluding this section I will point out something more about sleep. In terms of sleep for infants I look at three areas.

a) Sleep achievement. The ability to change from the conscious to the sleep state.

b) Sleep maintenance. The ability to return to sleep from a normal arousal within a block of sleep.

c) Sleep depth. The ability to remain asleep despite background noise.

Being overtired will interfere with all three of these elements. Thus if your baby takes a long time to achieve sleep, is tearful every 45 to 60 minutes at the end of each sleep cycle or is easily woken by creaking doors or floorboards then overtiredness is often the cause.

(6) Parent independent cues of sleep are the most useful for family life.

This final point brings all the previous elements together into a logical whole.

Let's revisit the cues of sleep as mentioned above in point **2**. Children do respond to cues from an early age. By six weeks of age the hormonal cycles of the body are responding to day and night. The child has begun to return a smile and as parents we can feel the first flickering of a personality emerging.

For my purpose I divide cues of sleep for infants into only two broad groups.

a) Parent dependent.

b) Parent independent.

Parent dependent cues contain an element of protracted parental care. Common examples include patting, rocking, holding till asleep, breast feeding till asleep, pushing the pram around the house, or driving the baby around in the car. From all the child's perspective these are powerful and effective cues. Children are deeply connected to their parents by emotions. Mum and Dad's attention and love are the most significant reward structures for a young child. Parental contact is more important than food and certainly more important than sleep.

These parent dependent cues are thus written into the sleep programme rapidly. The process of sleep achievement is thus in part triggered by parental activity. Parental attention works.
We have a problem.

A block of sleep contains multiple sleep cycles. Sleep cycles conclude in an episode of waking. The return to sleep is driven by a combination of tiredness and cues. As the block of sleep continues during the night tiredness decreases as the 'batteries recharge'. As the tiredness decreases the return to sleep from a normal, healthy arousal is *increasingly* cue dependent.

If a child is recognising parent dependent cues then as the block of sleep proceeds it becomes *increasingly* likely that the parents will be politely requested to return to provide the care which triggers sleep.

This sequence works. How many of you find that you have only to get out of bed each hour or two to pop in the dummy or pat for a few minutes to get the infant back to sleep.

Unfortunately this then fragments a block of sleep for several members of the family. It does not need me to point out that one eight hour sleep has a different effect on your sense of well being than eight one hour sleeps.

Parent dependent cues of sleep thus disrupt blocks of sleep.

Parent independent cues of sleep also exist. I generally talk about these cues being a full stomach, a clean dry nappy, the child's pyjamas, their blankets, their bassinet or cot, and their room. Say goodnight.

The child will incorporate these cues into a sleep programme to develop what I call independent sleep skills.

Thus during a block of sleep the child can have hourly arousals, do a cue check, find that all is normal, and then return to sleep. This process will occur silently or nearly silently. Mum and Dad can then continue with their important task of being asleep and recharging their own batteries. Given a full night's sleep the parents feel refreshed and have more energy and affection to give. The children are thus able to receive more affection and time from a happier, stronger parent.

Parent independent cues are thus more useful for family life.

So to complete this chapter I will simply list the six points which work together to suggest a philosophy of care which seems to work to the advantage of many families.

Blocks of sleep contain multiple sleep cycles.

Sleep achievement is in part, cue dependent.

Cues of sleep are learned, can be changed and relearned.

Sleep achievement is usefully regarded as a learned skill.

Fatigue interferes with sleep achievement.

Parent independent cues of sleep are the most useful for family life.

CHAPTER 6. DAY SLEEP

Achieving good sleep during the day can be just as difficult as the night for parents with a tired infant. The advice about daytime sleep is similar to that for the night but with a couple of minor variations.

While the vast majority of parents come to see me about night time sleep problems, quite often day time sleep problems are harder to solve. This is not such a great problem for the parents in that once the child's night sleep has improved and they, the parents, are sleeping well overnight it is possible to be far more patient and forgiving during the day. When night sleep is terrible it is very hard to cope with some of the normal frustrations of the day.

I divide sleep periods into three groups.

Night.
Morning.
Afternoon.

Interestingly while the night is usually the biggest problem for families it is the one area which improves most rapidly. The morning is next to improve. The most difficult time of day to achieve good control of an infants' sleep performance is the afternoon. Remember that while this is generally true, some babies will be different. They may not have all read this book.

DAY TIME ADVICE

The key to day time success is a concept which I call the **Happy Wake Time (HWT)** It will be worth reading this section a couple of times as the HWT is a very powerful and useful tool in your understanding and management of daytime sleep disorders.

Imagine your child having slept well overnight. He or she wakes in a good mood. (It will happen I promise.) They are usually hungry and then once fed are happy. They are in a happy wake time. The key to a happy wake time is that it has a beginning, a middle and an end. **The end of the happy wake time** is announced by changes in the child's behaviour. They begin to rub at their eyes, to whimper, to seek out your company for support or to become grizzly in the number of little ways which you will come to recognise rapidly and quite accurately.

This is the time to put them down. This is the time when they are best able to achieve sleep. With every half hour which passes beyond that point the child is going deeper into **overtired time.** The more overtired the child becomes the more difficult to get to sleep. Remember that sleep achievement is a learned skill. Learned skills are more difficult to perform as we become more tired. The more overtired the infant the more trouble it will have in achieving sleep efficiently.

Many parents who I see are missing the end of the happy wake time and allowing the child to become overtired. The child then has trouble achieving sleep and cries vigorously. The parents then lose confidence in their decision that the child was tired and needed to go down. The baby is then lifted up, settled in the mother's arms but becomes increasingly tired and grizzly and less able to achieve sleep efficiently. A common time for this can be the afternoons. One of my patients described 5 pm as suicide hour.

The key advice here is as follows. When you know that the baby is well, has had enough to eat and has reached the end of its happy wake time, then put him or her down and allow them the chance to achieve sleep alone. If you pick the time accurately then sleep will be achieved efficiently. The more tired the child becomes, the more they need sleep, the more tearful they may become while sleep is being achieved. A common mistake is to miss the beginning of the end of the happy wake time and to allow overtiredness to occur. **Remember it is only appropriate to ignore the crying baby when it is well, gaining weight correctly and no other cause for distress exists.**

How long are happy wake times?

This question is often asked and unfortunately it has multiple answers. Generally they are shorter than most people expect. For example a baby of twelve weeks who is sleeping well overnight may be tired and ready for another sleep of two or three hours after only two hours of being awake. The shortest happy wake times tend to be early in the day. This appears a little illogical as they have just had their longest sleep. Despite the lack of logic that is how they work. The babies own behaviour is the best indicator of the length of the HWT. A baby who is sleeping well and receiving adequate food is generally in a good mood. As they become tired their mood deteriorates. They become more tearful, seek out parental care more, are less emotionally independent, play for shorter times with one object and are more likely to be destructive in their play. Use your child's behaviour as the guide to the length of waking time which is appropriate.

BLENDED BEHAVIOUR

This is a concept which I find helpful for parents whose children have got them confused. If you are feeling that this is “**all the time**” then relax help is on the way**.**

Imagine that a child’s behaviour is divided into two styles only. I know that is simplistic but trust me it works. The two styles of functioning are:

Happy and well.
Tired and ‘scratchy.’

As the child becomes more overtired these two patterns of behaviour blend together. They become harder to ‘read.’ You think that they are tired and then they give you a big smile. At another time you believe that they are well and happy but their smile will suddenly change to loud inconsolable crying for no obvious reason. This is ‘blended behaviour.’ It is a catch for the unwary. It can leave you confused and desperate in trying to understand your baby. Once recognised for what it is then you are a long way towards getting control of the situation. Blended behaviour is most commonly a result of fatigue. The child wants to be cheerful and loving but is just too tired to put it together consistently. The solution is obvious. More sleep.

CONCLUSION

Daytime sleep requires just as much attention as night sleep. It can be a little confusing when the child is overtired. The pearls of wisdom can be distilled down to the following few points.

Use the concept of the Happy Wake Time to choose when the child is ready for sleep.

Avoid the child becoming overtired which will interfere with it's ability to achieve sleep. Put the child down sooner rather than later.

Once you know that the child is ready for sleep go through your normal preparations for bed time and then leave the child **alone** to achieve sleep.

If the baby is demonstrating 'blended behaviour' then there is almost definitely a need for more sleep to be achieved.

Do not be discouraged if you have good control at night and that it takes longer to achieve satisfactory control of the day. That is normal.

CHAPTER 7. LOVE, DISCIPLINE AND TOUCHING

LOVE

Why are we parents?

There is no single answer to the question. The answer varies from person to person and from one extreme to another. At one extreme there will be the married women who feels strongly the need to give of herself by having and caring for a child. Success as a parent can be fundamental to her perception of success in being female. At the other extreme is the young, single girl who has conceived as a result of casual contact with an unknown person. This girl will have no concept of the consequences and responsibilities of parenting and has come to this point almost by accident. Whatever the reason for conception successful parenting is about love. By giving in large volumes and then alternately receiving. This exchange of love, when successful, forms a basis for life and becomes ultimately life's great achievement. For the majority of people when they are counting the worth of their life it is the success or otherwise within the family that counts. Family in this context means those with whom we share the emotions of love. Those to whom we give it and those from whom it is received. For some this is a small circle, for others a large one.

In the final counting financial or political success may be of worth. For most of us, however, it is love which predominates in making our lives worthwhile.

Love is life's basic currency.

The presence of love in a transaction overwhelms other considerations. Time, effort, cost, difficulty all are unimportant if the person who is receiving this effort gives or receives love.

The moral of the story?

It will be the bonds that form with our family and children which ultimately give value to life for most of us. Therefore it is an investment which shows the highest return over the longest time.

DISCIPLINE.

Some of you may feel surprised to see this heading in a chapter on love. Discipline and love are interconnected. As mentioned elsewhere success in handling life's problems often requires a balance between opposite choices. The successful allocation of appropriate amounts of love and discipline are important ingredients in creating a harmonious child. Too much or too little of either can lead to an unbalanced individual unable to blend in with and contribute to society. The question of discipline as punishment really has little place in the first twelve weeks of life. The child's mind has not developed to a point where discipline in the form of punishment has a place.

Discipline can come in forms other than punishment. There is the self discipline of parenting. In giving up things which were previously important, for the benefit of your child. In denying your child handling time when he or she really needs sleep. In keeping loving relatives at arm's length when your child is sleeping. The discipline of establishing routine.

Parents, as has been mentioned elsewhere, will have much varying advice presented to them. It can be difficult to work out priorities. Elsewhere I have outlined achievements to be reached in weight gain and sleep. Often it will require significant self discipline to achieve these aims. The early effort is well worth it. The child who by twelve weeks of age is feeding 4 or 5 times per day, sleeping 12 hours at night and growing well, has a set pattern of behaviour which may last for the next five years at least. The whole family benefits from a successful routine. Our society is time orientated. For each individual to function efficiently in a social context requires the recognition of others' routines and fitting in with them. Do not feel guilty at guiding your child to sleep and eat at particular times. By doing so the child is moving towards integration in a family unit. It is the success of the integration of individuals into a family unit which leads to the next step of moving successfully into society as a whole. Our babies are precious individuals. Despite this they must fit into the routines of society at large and their families in particular to lead worthwhile lives.

MIRROR, MIRROR ON THE WALL.

Love is but one emotion which exists between mother and child. Mother will be a complex collection of emotions depending upon other circumstances. This is normal. Mother and newborn child share a very significant degree of emotional interconnection. The newborn child is an emotional mirror for the mother's feelings. If mother is tense the baby will reflect it. If mother is calm baby is more likely to be calm. If mother is confident then the baby is more likely to be comfortable. This emotional interaction is unavoidable. In a way baby is an emotional extension of the parent. Recognition of this mirroring of your emotions may help explain certain difficult situations. If you are tense it may be difficult to settle your child. By recognising the interconnection you may on occasion avoid the trap of looking for a problem in the baby when he or she is simply being an emotional mirror of your own distress. Rather than seeing this as a problem, the reflection of your own emotions is a meaningful expression of the depth of the bond between yourself and the baby. Marriage may or may not succeed in binding two together as one, motherhood certainly does.

TOUCHING

Much is made of the importance of contact between mother and child. Very few people involved in family care would debate the value of affectionate touching as an invaluable part of communication. The ability to give and receive affection through appropriate touching is a measure, I believe, of the success of our own emotional development. Again what we aim for is a balance between the overly effusive person who physically drapes themselves over others and the ‘stiff upper lip’ person whose physical contact never goes beyond a limp handshake. Learning to feel comfortable with touch begins early in life. Similarly giving and receiving affection are learned skills. In some societies mother and child are in almost constant contact. I suspect that this develops a deep and meaningful relationship. For better or worse our culture does not allow mothers the time or energy to have such prolonged contact with her baby. This is our reality. Contact time still needs to be emphasised and enjoyed when it is appropriate. Contact time is part of the development of communication. I refer back now to the emphasis I placed upon sleep. Many hours of good quality sleep are fundamentally important to the baby’s well being. In some settings and at some times I see sleep and contact as being alternatives to each other. When the baby needs sleep then allow it. Encourage the sleep to be deep, uninterrupted and of the appropriate length. Just as importantly the baby should almost always be sleeping alone. When the baby is rested, fed and looking for communication, then give as much as possible. This is the time for touching and holding. Enjoy these times. The pleasure of holding and talking to a thriving baby who is enjoying its parents company is immense.

In the first six weeks of life, if all is going well, the baby largely sleeps and eats. At between 5 and 6 weeks most babies will begin to recognise and respond to a human face. In fact any human face. This is a great time. Relatives far and wide can stand before the infant, provide the smiling face and become the beneficiaries of a wonderfully cheering unhesitating smile. Everyone gives and receives undiscriminating cheer. The party stops, however, later in life when the child begins to recognise individuals. Thus when you are recognised as being a non-regular smiler the child will not automatically return you affection. In fact it can be quite dispiriting to hear the plaintive wails of the distressed infant despite one's best efforts at providing a friendly smile. It is important though for the child to recognise who is family and who isn't. Life could become quite complex if we remained forever undiscriminating about whom we should share our affections with.

Once the smile reflex commences at about 5-6 weeks meaningful eye contact develops. These are times when the baby is starting to communicate. These are pleasant contact times which are initially quite short. To a certain extent the baby will 'announce' the times when they are ready to interact. These times vary somewhat. It really can be quite frustrating at 2 am when baby is well rested, had a good feed and decides that it's party time. Usually, however, the **happy and awake** times come in the afternoon. Initially they last for a few minutes only and then gradually increase in length. As our focus is the first twelve weeks, they are usually a few minutes extending up to about 30 minutes or sometimes even more by the time baby is twelve weeks old. By this age there may be two or three times per day when baby is happy to play and communicate.

As important as recognising these times is the need to recognise when they finish. The very young infant will tire quite rapidly. The mood can change within a couple of minutes from happy play to tearfulness. It is important to watch for this change in attitude. The baby’s contact time has expired as the ‘batteries’ have run down. It is now time for sleep. So as rapidly as practical, change the nappy and place the child into bed. The danger in delaying the sleep is the problem of over-tiredness. If the cue for bed is missed or you are simply too busy to put baby to bed they may become overtired rapidly. Once this has occurred the child may be more difficult to get to sleep. The irony of this situation is that the child who is not overtired but who is ready for sleep and has had a good feed settles well. The overtired child may become irritable, can cry quite vigorously and may be difficult to get into a deep restful sleep.

Feeding times are the other time of contact. Breast feeding is a very pleasant time when all is going well. Conversely if things are not going well it can be a time of frustration, pain and tears. Thankfully for the vast majority of women, most feeds are successful. This is a time of intense closeness. The physical handling of the baby is an important step in developing bonds between mother and child. It is part of the child’s learning about physical contact. Whenever possible enjoy these times to the full.

While emphasising the need for contact and its contribution to the child’s and parents’ well-being it is equally important to highlight non-contact time.

If the child is due for a sleep or is asleep everyone should be kept at arms length. Let the sleeping baby sleep. Repeated interruption of sleep is a potent cause of over-tiredness. Playful brothers and sisters, doting husbands and attentive grandparents need to be kept away. This can be difficult in the first few weeks when the baby is so new and special. It is very important for mother to protect the child from overhanding. This is particularly so as she, the mother, has to cope with the consequences if the baby becomes overtired.

Contact time for relatives occurs at feeding times. When baby is awake and resting between sides or after finishing the feed while mother is organising the cot or the baby is simply, happily awake. As the baby grows and becomes more resilient so there will be more time for play and other physical contact. Take the long term view. Baby will be part of the family for years. Being patient and self disciplined in the first few weeks can pay great dividends in establishing a workable family routine.

CHAPTER 8. THE MOST COMMON QUESTION FROM PARENTS

The question which is asked more commonly than all others is in the area of emotional damage. "If I let my baby cry itself to sleep will I damage him or her emotionally? - It certainly breaks my heart."

This question only occurs at the first consult and is irrelevant by the second. Bear with me while I explain the sequence of events.

At the first visit I usually have two tired or exhausted parents and a tired sleepless, irritable infant. The family unit is under stress. As parents we never stop loving our children but when overtired it can be difficult to like them as much.

I return to a concept raised earlier that tiredness interferes with normal brain functions. It is so obvious that we all know when overtired, we do not function to our full potential. The memory is weak, emotions are more fragile, frustration tolerance is lower, tears are closer to the surface, and we do not feel as affectionate to anyone. Men turn to the chapter on sex at this point. Conversely as we get better sleep, all of the above problems reverse towards normal.

A child that is overtired has the same problems but because of it's immaturity is even more prone to the effects of overtiredness.

If several members of a family are overtired then the chance of them interacting harmoniously is reduced. The joy of parenting is to share love with a child who accepts us unquestioningly. If we are too tired to function well then those relationships do not thrive.

Therefore if I modify a child's behaviour such that he or she sleeps more effectively then this allows the parents to sleep well. If child and parents wake refreshed then their functioning is improved. This includes the ability to give and receive affection.
A family which is sleeping well is far more likely to enjoy each others company.

Yes, hearing a baby cry itself to sleep can be painful. However it often only takes 3 to 5 nights and then sleep is improved for everyone. Once the children are getting the sleep they need, they are *so* much happier that the parents know without any doubt that they have done the right thing by their baby as well as themselves.

Once you are through the storm and out the other side, you will be totally sure that you and your children are emotionally strengthened, not weakened.

One note of warning. If you are starting with an older child, say twelve months, there may be several days where you are not so sure. The child has eventually cried itself to sleep and sleep reasonably. However, during the day the child wants you around more than normal, wants to touch and be held more. What follows is the interpretation which works in this setting.
For the child the relationship with its parents is the most important thing in life. This child had been receiving a lot of parental contact overnight. That was the problem for the family. Now quite suddenly that contact has been withdrawn overnight. The child's emotional world is challenged. During the day they therefore want to 'touch base' with mum more often to check out that relationship. This behaviour which we will interpret as insecurity lasts a few days and

then settles for two reasons. Firstly the child feels better emotionally because of better sleep. Secondly, mothers affection is not only still present but increased because of better sleep.

I promise you that if you and your child get improved sleep you will enjoy living with each other more.

CHAPTER 9. SEX AND PARENTHOOD

Life is full of contradictions. For example there is no parenthood without sex. Once achieved, however, parenthood does not mean an uninterrupted sexual co-existence. Sexuality is one of the casualties of parenthood. Having achieved its desired aim or perhaps, more accurately, one of its aims, sexuality becomes a victim of its own success.

To those young parents who have an uninterrupted sexual relationship after the birth of their children, congratulations, read no further. For those who have experienced the occasional problem. Read on. You are not alone.

If you find that parenthood has led to a significant decrease in the frequency and enthusiasm for making love then there are explanations. There is also some good news, it will return. **Eventually**.

Men are interesting creatures. They are fairly predictable. The majority have a continuing interest in making love despite the ups and downs of life. Very few say no, once it is offered. Most are perplexed when it is not offered 'like before'. In fact the sometimes dramatic change in sexual activity after the birth of a child can be quite threatening to a man's perception of himself. Making love is an important expression of mutual affection and attraction. In our society most men place great emphasis upon making love successfully and frequently. When, after the birth of a child, the partner is suddenly very much less interested it is easy to see this as a loss of interest or affection. In fact the causes are much more complex. Sexuality is hormone dependant to a very significant extent. Ask any neutered Tom cat about his interest and the answer is nil. A man who loses his testes and thus his testosterone has no sexual drive. Most men however retain their testes and produce testosterone in adequate and fairly constant volumes. Their interest in sexuality is fairly constant.

A woman is also strongly influenced by the hormones in circulation in her body. It comes as no surprise to most women to state that there are days of the month when their partners are attractive and when love making is pleasant. Conversely there are days of the month when their partners are attractive but love making is not ‘on the agenda’. The exact time of the month varies, but most women are most ‘receptive’ around ovulation. The reproductive sense of this is obvious.

Once a child is born two important things happen. Firstly a woman’s hormones undergo a major change and she may cease to ovulate while breast feeding. Secondly she is doing a huge amount of work. The baby who is breast fed and getting pleasantly round is getting all of that energy for growth from mum. The mother is putting out that energy from her body. In addition to that there is the physical work of caring for house, children, clothing, husband, shopping etc. If your partner says she is ‘too tired tonight’ what she probably means is ‘I’m exhausted”. ‘It is difficult to do another solitary thing without some sleep’.

The altered hormone status is another powerful inhibitor of sexual interest. While breast feeding there is usually an inhibition of ovulation and the hormonal variations which go with it. As woman’s interest may peak around ovulation, if she is not ovulating, there may be little interest.

Is there any good news here?

Well an end is in sight. Breast feeding will finish eventually. As the months go by the baby will hopefully come into a routine which allows mother more rest and this frees up energy for other things.

A most important point here is about a man's masculinity and attractiveness. In the woman's eyes he is just as manly and attractive. It is just that 'circumstances beyond her control' do not allow her to express it as frequently or with the same enthusiasm as before the pregnancy and birth of the child.

It is tragic to see a young couple being torn apart through a lack of understanding of these issues. The man must be allowed to realise that the absence of sexual activity is not a comment upon his masculinity. The woman deserves understanding and support at a time when her body is working extremely hard.

A major reward for the husband who is understanding and supportive is that, as time goes by, his actions strengthen the relationship with his spouse. When his companion's energy returns she will have more regard and love for him. The sexuality of this maturing relationship may be more meaningful and satisfying in the long term.

CHAPTER 10. NAPPY RASH

You may wonder why this topic exists in a booklet about sleep. There are two reasons. Firstly one of my patients who used the original version of the booklet asked me to write about the topic, as she had problems. Secondly like so many things which can go wrong with a young child, nappy rash can be severe enough to make a young mother worry as to whether it is causing sleeplessness. So this is my short effort at giving advice on nappy area care.

I do not propose to enter the debate as to whether disposable nappies are good or bad from society's view point. The reality is that large numbers of babies are wearing large numbers of disposable nappies. My comments below really relate to cloth nappies. Disposable nappies are in fact more efficient at removing moisture from contact with the skin. The figures given below relate then to material or cloth nappies. If using disposables then you can approximately halve the recommended rate of usage. Thus while I generally recommend twelve cloth nappies per day then 6 disposables is probably adequate on an average day when the baby's skin is healthy.

Nappy rash is one of the most common problems seen by the General Practitioner. Sometimes the nappy area is infected with thrush or affected by dermatitis. In the majority of cases, the skin in the nappy area is suffering from moisture damage.

A baby passes small volumes of urine quite frequently. Perhaps as often as every fifteen minutes. What this means is, if the nappy is changed hourly i.e.: 24 times per day then the nappy area would be wet for 18 hours a day. If any adult left their hands in moisture for 18 hours a day the skin would become red and cracked. It is little wonder that babies get nappy rash. Perhaps the question should be, why don't all babies get it more severely than they do?

Some hints on nappy area care. Please note that these comments relate to cloth nappies. Disposable nappies are technically different and need less changing as they are able to keep the moisture of the urine away from the baby's skin.

Change as often as possible. Before and after feeds, if you use cloth nappies. Between feeds if the baby has been disturbed for some reason. Perhaps change as you are going to bed. Aim to use a minimum of twelve nappies per day.

Despite the most intense care, some babies will still get a degree of nappy rash.

Nappy rash is the response of the skin to moisture and the chemicals in that moisture. That is, urine and the waste products in that urine. If the skin can be protected from the moisture then it is less prone to break down. A water repellent layer of vaseline, lanoline, zinc cream or one of many other products may be helpful.

Obviously, the more often these protective layers are applied the better. Washing the nappy in a soap powder i.e.; lux, velvet soap and not a detergent washing powder will also be of benefit. In addition make certain that they are rinsed properly preferably in rain water.

If despite your best efforts the child still develops nappy rash. So be it. See the Doctor.

CHAPTER 11. INSTANT DIAGNOSIS

This chapter is an attempt at giving mothers and fathers a diagnostic tool to sort out some of the commonly observed behavioural variations. By its very nature it is simplistic and should be used as a guide only. If in doubt ring your medical adviser for assistance.

1. BABY CRYING.

A) Takes a feed well and then settles — HUNGRY

B) Takes a feed poorly

Settles well in your arms

Unsettled in cot — OVERTIRED

C) Takes a feed poorly

Unsettled in cot

Unsettled in your arms

COLIC OR OTHER
ILLNESS OR VERY
OVERTIRED

D) Taking feeds well or poorly

Bowels not open well

Hard pebbly bowel motions — CONSTIPATION

2. FEEDING PROBLEMS.

A) Feeds poorly at breast

Fails to sleep well

Settles in arms

Tearful — OVERTIRED

B) Feeding hungrily at breast

Becomes frustrated and angry

Rejects breast

Fails to settle — POOR MILK SUPPLY

C) Feeds well at breast

Spills frequently

Vomits after feed

Fails to settle — REFLUX

D) Feeds poorly at breast

Very Sleepy

Poor weight gain

Few bowel actions — POOR MILK SUPPLY

(NEEDS HELP FROM YOUR MEDICAL ADVISER QUICKLY)

3. SLEEP DISTURBANCES.

A) Difficult to get to sleep

Woken by minor noises

Irritable — OVERTIRED

B) Constantly sleepy

Poor weight gain

Small hard irregular bowel action

UNDERNOURISHED

(NEEDS HELP)

C) Tearful in late day or after travelling

COLIC OR TIRED

CHAPTER 12. COLIC

Colic is mentioned several times in this booklet. It is a diagnosis which is made very commonly in circles discussing child care. Colic exists. It can be very troublesome and cause significant anxiety and sleeplessness. Unfortunately I think that it is a diagnosis which is overused and often applied incorrectly.

In my own practice I regard colic as a diagnosis of exclusion or to put it another way it is my last choice as a diagnosis. For many mothers "colic" simply means that the baby is crying. The most common causes of the baby's crying are as mentioned elsewhere hunger and over-tiredness. These need to be excluded first. The hungry baby will respond to being fed; end of problem. The problem of the overtired baby I have discussed extensively elsewhere in this document. This needs to be excluded as well before retreating to the diagnosis of colic.

The cause of colic is not known as far as I am aware. The children suffering from it are otherwise well and for most of the day behave well. Typically the child is well fed, lying in a clean dry nappy and should be going to sleep. Unfortunately they are tearful and difficult to settle. If examined by a doctor generally nothing untoward is found. The time tends to be late in the day although this is not universal. Fortunately the majority of babies grow out of colic by twelve weeks of age. What however do we do in the time while waiting for the problem to go away?

Treatment tends to have limited success. Be sure in your own mind that the baby has had sufficient to drink, check that the nappy is clean and dry, make sure that the wraps are firm while at the same time the baby is not overwrapped and hot. Some paracetamol may be helpful; if nothing else it helps the parents to know that they have done something. Once these steps have been taken it may be necessary to stand back and wait for the baby to settle. This can be hard.

The baby with colic looks and sounds very unhappy. They cry very loudly. Tears may run down their cheeks. They may pull up their legs as if in pain. Generally they are difficult to console and do not want to feed. Fortunately once you have waited the 15 or 30 or 60 minutes that the baby takes to settle they do sleep successfully and then awaken quite cheerfully as if there had never been a problem. Your thoughts may be a little ungenerous next morning when the beaming child has had you up several times overnight.

Finally a short comment on what can cause colic. Again there are no hard and fast rules and different babies behave differently, however, riding in the pusher on a windy day and driving in the car can increase episodes which we may call colic. Driving the car is interesting. Most parents find that children travel well in the car. Perhaps the noise and movement is reassuring. The problem arises **after** the journey. That night may be more difficult with the child being tearful and unsettled. The treatment is the same as for over-tired babies. Once the child is well fed, clean and appropriately wrapped put them down and leave them alone to achieve sleep. Again I repeat that this can be difficult and stressful for the parents particularly when it is your first child. But forewarned is forearmed.

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Appendix V Forms used

Baseline study

Questionnaire

A SURVEY OF CHILDHOOD WELLBEING IN SOUTH AUSTRALIA.

CODE NUMBER		<A >
1. NAME OF CHILD		
2. SEX	{SEX}	<A>
3. DATE OF BIRTH.		<DD/MM/YY>
4. BIRTH WEIGHT	{BIRTH.WT}	#.### Kgm
5. AGE.	{AGE}	## Months
6. WEIGHT AT SURVEY.	{WT.NOW}	##.### Kgm
7. CHILDS POSITION IN FAMILY.		
	{CHILD.NO}	#

FEEDING DETAILS.

8.(a) BOTTLE FED ONLY.	{BOTLEFED}	<Y> ** IF YES GO TO 9.
(b) BREAST FED ONLY.	{BRESTFED}	<Y> ** IF YES GO TO 11.
(c) BREAST AND BOTTLE FED.		
	{MIXEDFED}	<Y>
8. HOW MANY ARTIFICIAL FEEDS PER DAY ?		
	{NO'OFBOT}	#
**NOTE ANSWERS ARE 3,8,13,18,23,28,35.		
9. FEEDING TIME AT BOTTLE ?		
	{BOT.TIME}	## MIN
** GO TO 14		
10. HOW MANY BREAST FEEDS PER DAY ?		
	{NOOFBRES}	##

** NOTE: ANSWERS FOR THE FOLLOWING QUESTION ARE

3,8,13,18,23,28,30.

12. FEEDING TIME AT BREAST ?	{BRESTIME}	## MIN
13. NO' OF TOP UP FEEDS PER DAY	{TOPUPNO'}	##
14. AGE OF STARTING SOLIDS ?	{SOLIDS}	##.# MONTHS
15. ARE FEEDS IN A ROUTINE ?	{REGFEEDS}	<Y>
16. DOES THE CHILD DRINK NORMALLY	{DRINKWEL}	<Y>

** NOTE: IF THE CHILD IS NOT ON SOLIDS THE NEXT ANSWER IS BLANK.

EAT NORMALLY	{EATWELL}	<Y>
FEEDING PROBLEM	{FEEDSBAD}	<Y>

SLEEPING DETAILS.

17. SETTLING TIME OF MAIN NIGHT SLEEP.

{BEDTIME} ## PM

**(NOTE THAT IF A TIME IS ENTERED THEN THE NEXT ANSWER IS YES.)

PATTERN TO BEDTIME {REGBEDTM} <Y>

** NOTE: ANSWERS ARE 2,7,15,30,50,80,99.

18. SETTLING TIME TO ACHIEVE SLEEP. {SETLTIME} ## MIN

**(NOTE THAT IF A TIME IS ENTERED THEN THE NEXT ANSWER IS YES.)

PATTERN TO LENGTH OF SETTLING TIME

{REGSETLR} <Y>

19. AVERAGE LENGTH OF NIGHT SLEEP.

{SLEEPTME} ## HRS

20. LONGEST NIGHT SLEEP.	{LONGNSLP}	## HRS
21. SHORTEST SLEEP.	{SHORTSLP}	## Hours

22. METHOD OF SETTLING BABY.

PUT TO BED	{SETLDMIN}	<Y>
BATHED BEFORE BED	{BATH&BED}	<Y>
FED WHILE ACHIEVING SLEEP	{FEDTOSLP}	<Y>
HELD UNTIL ASLEEP	{HELDTOSL}	<Y>
ROCKED TO SLEEP	{ROCKED}	<Y>
LIGHT LEFT ON	{LIGHT.ON}	<Y>
NOISE e.g. RADIO	{RADIO.ON}	<Y>
IN BED WITH PARENTS	{SLP.MUM}	<Y>
OTHER METHOD	{SLEEPHOW}	<Y>
23. HOW MANY DAY TIME SLEEPS.	{DAYSLEPS}	#
24. LONGEST DAY TIME SLEEP.	{LONGDSLP}	#.# HRS
25. SHORTEST DAY SLEEP.	{SHRTDSLP}	#.# HRS
26. AVERAGE DAY TIME SLEEP.	{AVGDSLP}	#.# HRS
27. DOES BABY'S SLEEPING HAVE A PATTERN ?		
	{SLPPATEN}	<Y>

** NOTE THAT FOR THE FOLLOWING QUESTION ANSWERS ARE

1,4,8,13,18,21.

28. HOW LONG WOULD YOU ALLOW BABY TO CRY BEFORE		
ATTENDING TO IT?	{CRYTIME}	## MIN
29. HOW OFTEN ARE YOU WOKEN FROM YOUR SLEEP BY		
THE BABY CRYING, ON AN AVERAGE NIGHT?		
	{WAKETIMS}	#
30. ON AN AVERAGE NIGHT HOW OFTEN WOULD YOU		
ATTEND TO YOUR BABY?	{ATENDO/N}	##
31. HOW MANY NIGHTS PER WEEK WOULD YOU OR YOUR		
PARTNER ATTEND TO YOUR BABY ?	{ATEND/WK}	#

33. HOW MANY TIMES PER WEEK WOULD YOU TAKE YOUR BABY OUT OF THE HOUSE eg SHOPPING?

1) DAYTIME	{DAYSHOP}	##
2) NIGHTTIME	{OUTATNIT}	#

34. DO YOU THINK YOUR BABY:

SETTLES TO SLEEP NORMALLY	{SETLSWEL}	<Y>
SLEEPS THROUGH NORMAL SOUNDS	{SLEEPWEL}	<Y>
WAKES EASILY	{LIGHTSLP}	<Y>
HAS A SLEEPING PROBLEM	{SLPPROBM}	<Y>
DEFINE SLEEPING PROBLEM IF YES....	<A >	

34.(a) DOES THE CODER BELIEVE THAT THERE IS A FEEDING OR SLEEPING PROBLEM ? {PROBLEMS} <Y>

HEALTH

35. HAS YOUR CHILD HAD ANY SIGNIFICANT HEALTH PROBLEM

SINCE BIRTH ? {ILLBABY} <Y>

**(FOR INFORMATION IN THE NEXT SECTION USE CODE

eg FITS FOR FEBRILE CONVULSIONS)

THE HEALTH PROBLEM IS {ILLNESS} <A >

36. IS YOUR BABY SICK AT PRESENT ? {SICKNOW} <Y>

THE PROBLEM IS {SICKNESS} <A >

37. DO YOU BELIEVE THAT YOUR BABY HAS

TROUBLESOME WIND AFTER MEALS? {COLIC} <Y>

38. a) IS YOUR CHILD HAPPY ? {HAPPYKID} <Y>

b) IS YOUR CHILD GRIZZLY ? {SADKID} <Y>

c) IS YOUR CHILD HYPERACTIVE ? {HYPERKID} <Y>

d) IS YOUR CHILD PLACID ? {PLACID} <Y>

e) DOES YOUR CHILD HAVE TANTRUMS ? {TANTRUMS}<Y>

f) IS YOUR CHILD NORMAL FOR AGE ? {NORMAL} <Y>

MOTHER

39. AGE {MUMSAGE} ## YEARS

40. RACE {ABIGLMUM}<Y>

{ASIANMUM}<Y>

{WHITEMUM}<Y>

{MUMSRACE}<A >

41. FINAL YEAR OF EDUCATION {MUMEDUCN} ##

ANY OTHER TRAINING ? {XTRAEDMM} <Y>

TYPE OF EXTRA EDUCATION ? {TYPEXEMM} <A >

**(FOR THE NEXT QUESTION THE FOCUS IS WHETHER THE MOTHER IS WORKING NOW, i.e. WORKING AS WELL AS PROVIDING CHILD CARE.)

42. ANY EMPLOYMENT OUT OF HOME {MUMINWRK} <Y>

FULL TIME WORK ? {FULLWRKM} <Y>

PART TIME WORK ? {PTWORKMM} <Y>

CASUAL WORK ? {CASWKMUM} <Y>

TYPE OF WORK ? {MUMSJOB} <A >

**(THE ANSWER TO THE FOLLOWING QUESTION WHILE NOT ASKED IN THE QUESTIONAIRE MAY EMERGE FROM THE ANSWERS WHICH ARE GIVEN.)

HAS MOTHER BEEN EMPLOYED BEFORE THE BIRTH OF THIS CHILD?

{WKB4BABY} <Y>

FULL TIME WORK ? {FULLWKB4} <Y>

PART TIME WORK ? {PTTMWKB4} <Y>

CASUAL WORK ? {CASWKB4} <Y>

TYPE OF WORK ? {MUMJOBB4} <A >

43. MOTHER'S NUMBER OF ADDRESSES IN 3 Y

{ADDRESMM} #

FATHER

44. AGE	{DADSAGE}	## YEARS
45. RACE	{ABIGLDAD}	<Y>
	{ASIANDAD}	<Y>
	{WHITEDAD}	<Y>
	{DADSRACE}	<A >
46. FINAL YEAR OF EDUCATION	{DADEDUCN}	##
ANY OTHER TRAINING ?	{XTRAEDDD}	<Y>
TYPE OF EXTRA EDUCATION ?	{TYPEXEDD}	<A >
47. ANY EMPLOYMENT OUT OF HOME ?	{DADINWRK}	<Y>
FULL TIME WORK ?	{FULLWRKD}	<Y>
PART TIME WORK ?	{PTWORKMD}	<Y>
CASUAL WORK ?	{CASWKDAD}	<Y>
TYPE OF WORK ?	{DADSJOB}	<A >
48. FATHER'S NUMBER OF ADDRESSES IN LAST 3 YEARS		
	{ADDRESDD}	#

FAMILY

49. TOTAL NUMBER OF CHILDREN LIVING AT HOME.		
	{KIDSATHM}	#
50. FAMILY FORMAT		
TWO PARENTS ?	{TWOPARNT}	<Y>
SINGLE PARENT ?	{ONEPARNT}	<A>
SINGLE FEMALE CARER........	{MUMONLY}	<Y>
SINGLE MALE CARER..........	{DADONLY}	<Y>
OTHER FAMILY FORMAT ?	{UNUSUAL?}	<A >

51. HAS THE FAMILY GROUP BEEN STABLE IN THE LAST YEAR ?

NO CHANGE	{STABLE}	<Y>
SEPARATED ?........................	{SEPARATD}	<Y>
DIVORCED ?.........................	{DIVORCED}	<Y>
NEW PARTNER ?......................	{NEWPRTNR}	<Y>

52. IS THE FAMILY GROUP SUCCESSFUL ? ..

{HAPPYFAM}. #

**(SCORE OUT OF 5. 1 = HAPPY. 5 = UNHAPPY)

GENERAL INFORMATION

53. ARE YOU ENJOYING THIS BABY ? {ENJOYBAB} #

** SCORE OUT OF 5. 1 = ENJOYING BABY

2 = ENJOYING MOST OF THE TIME

4 = ENJOYING BABY SOMETIMES

5 = RARELY ENJOYING BABY

54. HAVE YOU RECEIVED ADVICE ON CARING FOR YOUR BABY FROM

A) {DOCTOR}	<Y>
B) {HOSPITAL}	<Y>
C) {CAFHS}	<Y>
D) {RELATIVE}	<Y>
E) {FRIEND}	<Y>
F) {OTHERADV}	<Y>

55. WAS ADVICE USEFUL ?

** SCORE OUT OF 5.

1 = MOST OFTEN

3 = SOMETIMES

5 = RARELY

A) {DOCSADVC}	#
B) {HOSPADVC}	#
C) {CAFSADVC}	#
D) {RELSADVS}	#
E) {FRNDADVC}	#
F) {OTHRADVC}	#

56. IS BABY'S CARE SHARED ?	{SHARCARE}....	<Y>
REGULARLY ?...	{REGHELP}.....	<Y>
OCCASIONALLY ?	{OCASHELP}....	<Y>
IF YES HOW MANY DAYS PER WEEK ? {CAREDAYS}....		#

57. WHO ASSISTS WITH BABY'S CARE ?

A) {DADHELPS}	<Y>
B) {RELSHELP}	<Y>
C) {FRENDHLP}	<Y>
D) {PAIDHELP}	<Y>
E) {CRECHE}	<Y>
F) {OTHERHLP}	<Y>

58. HOW MANY HOURS PER DAY DO YOU RECEIVE HELP WITH THE CARE OF YOUR CHILDREN AT HOME eg FROM YOUR PARTNER ?

{HRSHELP} # # HRS

59. YOUR FAMILY INCOME IS ABOUT

A) LESS $25,000. {LESS$25K} <Y>

B) BETWEEN $25,000 & $50,000

{25TO$50K} <Y>

C) MORE THAN $50,000

{MORE$50K}.. <Y>

60 SURVEY DATE {SURVDATE} <dd/mm/yy>

61 {SURVEYOR} <A >

Randomised controlled trial

A STUDY OF CHILDHOOD SLEEP IN SOUTH AUSTRALIA.

<u>Patient information sheet (Control)</u>

The Women's and Children's Hospital has a deep interest in the well being of the women, children and families for whom we provide care.

Our experience, which is supported by studying the world literature, shows that as many as 30% of families with children aged one year or less will experience problems associated with sleep patterns. There are many possible causes for sleep disorders and there are many ways of treating them.

This project will, with your consent, enrol you in a research study which will study the range of sleep patterns in normal infants in our community. This study will not be a measure of whether you are a more or less successful parent. The results from your baby and your family will allow us to understand more completely the range of behaviour occurring in '**normal'** families in South Australia.

The study will measure sleep using two sleep diaries. The first will be used when your baby is six weeks old and the second when the child is twelve weeks. We will also be studying the emotions of the parent using a mood scale. The sleep diaries will allow us to measure how much sleep the baby is getting. The mood scale will measure your own feelings of well-being.

Although you have given consent to participate in this project, you may withdraw at any time and for any reason that you see fit. If you do decide to withdraw from the project it will not affect your care at the Women's and Children's Hospital in any way.

While participating in the project you are free to seek any medical advice that you wish. We do ask, however, that you inform us of other care which you receive when we contact you. For example, this may include a visit to your General Practitioner or CAFHS sister. This is simply to keep our records and understanding as complete as possible.

Again I thank you for your participation in our research.

Yours Sincerely Dr Brian Symon

A STUDY TO MAXIMISE THE EFFICIENCY OF CHILDHOOD SLEEP

Patient information sheet (Intervention)

The Women's and Children's Hospital has a deep interest in the well being of the women, children and families for whom we provide care.

Our experience, which is supported by studying the world literature, shows that as many as 30% of families with children aged one year or less will experience problems associated with sleep patterns. The published literature and our own clinical work suggests that sleep problems in children can be helped. In fact, a number of published papers show that children's sleep patterns can be modified. There are a number of methods used by different doctors and carers around the world. What has never been done before is to attempt to prevent sleep problems before they occur. This project will, with your consent, enrol you in a research study which will attempt to maximise your baby's sleep as early as possible in life.

You will be offered education and supportive care by the researcher and his staff. This help and advice will be received at the Women's and Children's Hospital in the weeks after your discharge from hospital. In addition to the program of consultations, you may request our help about specific sleep problems at any time. The information and advice we give may be new to you or it may differ from advice which you receive elsewhere. Please feel free to discuss these differences with the researcher or with your usual care provider.

The main focus of this study will be to assist you by providing education about sleep. You will develop an understanding of how sleep is achieved and maintained. This education will occur through individual meetings with the research officer. Initially these will be by recommendation but, as your confidence grows, then they will be at your request. The major aim of this project will be to assist your child to sleep in long uninterrupted blocks, particularly at night. We hope to return you to a full night's sleep as soon as possible. This may occur as early as the baby being six or eight weeks old.

While every effort will be given to assist parents it should be realised that there are multiple causes for sleeplessness. Despite your and our best efforts some children may still be restless. This should not be seen as failure on your part.

The effects of the study will be measured using a sleep diary and a mood scale. The sleep diary will allow us to measure how much sleep the baby is getting. The mood scale will measure your own feelings of well-being.

An important part of the study will be to check that your baby is well and gaining weight at the correct rate. While we will attempt to maximise the success of breast feeding we may on occasion advise the use of top up feeding.

Although you have given consent to participate in this project, you may withdraw at any time and for any reason that you see fit.

While participating in the project you are free to seek any other medical advice that you wish. We do ask, however, that you inform us of other care which you receive. For example, this may include a visit to your General Practitioner or CAFHS sister. This is simply to keep our records and understanding as complete as possible.

Again, I thank you for your participation in our research.

Yours Sincerely

Dr Brian Symon

Consent form

Project Title

A study of sleep patterns in newborn children.

Chief Researchers

Dr B G Symon	Dr James Martin
Department of General Practice	Director Respiratory Medicine
University of Adelaide	Women's and Children's Hospital
Adelaide	Adelaide

1. The nature of the research project has been explained to me. The attached information sheet has been explained to me. I agree to take part in the study.

2. I understand that my child and I may not directly receive medical care by participating in the trial.

3. I understand that while information gained from the study may be published, neither I or my child will be identified. All information gained from the trial will be treated as confidential.

4. I understand that I may withdraw from the trial at any stage and that my medical care will not be affected.

5. I understand that there will be no payment to me or my family for participating in this study.

6. I understand the need to retain a copy of the consent form and information sheet.

Signed ....

Full name: ....

Mother of: ....

Born: ..../............/1996

Dated: ..../............/1996

I certify that I have explained this study to the person named above and consider that she/he understands the explanations.

Signed: ....

Title ....

Date: ..../............/1996

Guide to using the sleep diary at six weeks

UR

WHEN TO START.

PLEASE BEGIN ON THE DAY THAT YOUR CHILD TURNS 6 WEEKS.

Thus, if the baby were born on a Monday, then the first record begins on a Monday 6 weeks later.

WHAT TIME TO START AND STOP.

Begin the record from 6 am on the first day.

Finish the record at 6 am at the end of the night on the last day.

HOW TO RECORD.

Please fill the blocks with solid marks to the best of your ability. To use ticks or crosses will make coding the data hard.

■■ = MOST USEFUL. PLEASE TRY TO AVOID THE FOLLOWING //// or √

Please do not divide 10 min' blocks into smaller parts. If the baby spent 6 min' crying and 4 min' sleeping, then record the 10 min' time slot as crying.

4. WHAT COLOUR TO RECORD IN.

there are choices for the colours of recording.

blue biro

black biro

black pencil

coloured pencils (for the very enthusiastic.)

awake	=	yellow	sleep	=	blue
crying	=	red	feeding	=	green

Guide to using the sleep diary at twelve weeks

UR

WHEN TO START. PLEASE BEGIN ON THE DAY THAT YOUR CHILD TURNS 12 WEEKS.

Thus, if the baby were born on a Monday, then the first record begins on a Monday 12 weeks later.

WHAT TIME TO START AND STOP.

Begin the record from 6 am on the first day.

Finish the record at 6 am at the end of the night on the last day.

HOW TO RECORD.

Please fill the blocks with solid marks to the best of your ability. To use ticks or crosses will make coding the data hard.

■■ = MOST USEFUL. PLEASE TRY TO AVOID THE FOLLOWING //// or √

Please do not divide 10 min’ blocks into smaller parts. If the baby spent 6 min’ crying and 4 min’ sleeping then record the 10 min’ time slot as crying.

4. WHAT COLOUR TO RECORD IN.

there are choices for the colours of recording.

blue biro

black biro

black pencil

coloured pencils (for the very enthusiastic.)

awake = yellow

sleep = blue

crying = red

feeding = green

FINALLY. THE MOOD SCORE.

The last two pages of this document contain a ‘mood score’. This can be filled in on the very last day of the study. Please check the third to last page which tells you about this score. It will take only a couple of minutes.

Guide to using the CES-D mood score instrument

From: Dr Brian Symon

University of Adelaide

83033469 P

83033511 F

Re: 'Mood score.'

Thank you for all the work that you have done so far. We appreciate that as young parents you are very busy with the work of caring for your new infant. It has been most heartening to find that so many families have been happy to assist in the study.

There is one final piece of information which is of interest to us.

As you would be aware, the focus of this study has been sleep. It is well known that sleep deprivation leads to the mood being less happy that normal. We are trying to see if we can show a relationship between sleep and mood in this study.

The next two pages are copies of a mood score. This will take only a couple of minutes to fill in. There are copies for each parent. It would be great to get one for each person. Please fill them in independently otherwise there will be a pressure to produce answers which are not exactly as you might feel if you were only answering for yourself.

Please remember that there are no right and wrong answers. How you feel is how you feel.

If only one parent wishes to fill in the score that is fine. Please indicate who it is though.

The day to fill in the mood score is the last day of recording the baby's sleep pattern.

Once again we thank you sincerely for your help in this study.

Yours sincerely

Dr Brian Symon.

CES-D

INSTRUCTIONS FOR COMPLETING QUESTIONS.

Below is a list of the ways you may have felt or behaved. Please tell us how often you have felt this way during the past week . Circle one of the numbers for each of the twenty mood possibilities. Please tick one box to indicate your relationship eg MOTHER ✔

MOTHER ❐ PARTNER OF MOTHER ❐	Rarely or none of the time Less than one day	Some or a little of the time One or two days	Moderate amount of the time Three or four days	Most or all of the time Five to seven days
DURING THE PAST WEEK				
1. I was bothered by things that usually don't bother me.	0	1	2	3
2. I did not feel like eating ; my appetite was poor.	0	1	2	3
3. I felt that I could not shake off the blues even with help from my family and friends.	0	1	2	3
4. I felt that I was just as good as other people.	3	2	1	0
5. I had trouble keeping my mind on what I was doing.	0	1	2	3
6. I felt depressed.	0	1	2	3

7. I felt that everything I did was an effort.	0	1	2	3
8. I felt hopeful about the future.	3	2	1	0
9. I thought my life had been a failure.	0	1	2	3
10. I felt fearful.	0	1	2	3
11. My sleep was restless.	0	1	2	3
12. I was happy	3	2	1	0
13. I talked less than usual.	0	1	2	3
14. I felt lonely.	0	1	2	3
15. People were unfriendly.	0	1	2	3
16. I enjoyed life.	3	2	1	0
17. I had crying spells.	0	1	2	3
18. I felt sad.	0	1	2	3
19. I felt that people disliked me.	0	1	2	3
20. I could not get ‘going’.	0	1	2	3
TOTALS				

(Note to data manager. 4,8,12,16 require reverse score.)

UR

DATA ENTERED ❒

Instructions for data entry person

SLEEP STUDY DEFINITIONS.

NIGHT.

The hours of approximately 6 pm to 6 am. The hours of darkness. The time from the start to the finish of the longest continuous sleep in the hours of darkness.

DAY.

The hours of approximately 6 am to 6 pm. The hours of light.

TOTAL NIGHT SLEEP.

This is the sum of sleep achieved through the night. This time will often overflow from one sleep diary sheet to the next.

The **starting point** will be either the start of the longest night sleep or 6 pm whichever is **earlier.** Thus, if a child goes to sleep at 5 pm then the hour between 5 pm and 6 pm counts for the night sleep but not the day.

The **end point** will be either the end of the last night sleep or 6 am whichever occurs **last**. Thus, if a child sleeps to 7 am the hour between 6 am and 7 am counts for the night sleep but not the day.

Please note that the longest night sleep may be greater than 12 hours.

TOTAL HOURS SLEEP.

The total hours sleep per 24 hrs. Note that this **does not** overflow across two diary sheets.

TOTAL DAY SLEEP.

The total hours of sleep from 6 am to 6 pm.

The **starting point** will be either the start of the first day sleep or 6 am whichever is **later.** Thus, if the night sleep finishes at 7 am and the next sleep begins at 9 am then the hour from 6 am to 7 am is counted in the night sleep but not the day.

The **end point** will be either the end of the last day sleep or 6 pm whichever occurs **first**. Thus, if a child begins a long sleep at 5 pm having waken from a day sleep at 3 pm then the day sleep record finishes at 3 pm and the hour between 5 pm and 6 pm counts for the night sleep but not the day.

If a child sleeps for a period which overlaps 6 pm almost evenly then the time before 6 pm is allocated to day and after 6 pm to night sleep.

LONGEST NIGHT SLEEP.

The length in hours of the longest single sleep which occurs during the time defined as night.

LONGEST DAY SLEEP.

The length in hours of the longest single sleep which occurs during the time defined as day.

TIME RECORD.

Time will be recorded to the nearest 10 minutes. Thus the record will show the following decimal choices. **0.17** **0.34** **0.5** **0.67** **0.84** **1.0**

Sleep diary

See next page

MORNING	AM 6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00
AWAKE													
SLEEP													
CRYING													
FEEDING													

AFTERNOON	PM 12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00
AWAKE													
SLEEP													
CRYING													
FEEDING													

EVENING	PM 6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00
AWAKE													
SLEEP													
CRYING													
FEEDING													

NIGHT	AM 12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00
AWAKE													
SLEEP													
CRYING													
FEEDING													