Shiftwork in Air Traffic Services: coping strategies and well-being

A thesis presented in partial fulfilment of the requirements for the degree of Master of Arts in Psychology at Massey University.

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1997

ABSTRACT

It is becoming widely recognised that shiftwork has significant implications for the health, safety and quality of life of shiftworkers. To date, little research has been carried out on how individuals cope with the problems caused by shiftwork and how effective coping strategies maintain their health and well-being. It has been proposed, by Monk (1994), that there are a number of aspects of a shiftworker's life which are important in determining the ability of an individual to cope with shiftwork. These factors are an individual's circadian rhythms, sleep patterns, and social and domestic situation. Further literature also suggests that workplace factors and coping style are an important part of tolerating shiftwork. The primary aim of the present study was to determine which factors are important in predicting the physical and mental well-being of Air Traffic Services staff working on shifts. It was hypothesised that individuals who are evening types, have few social, domestic, sleep, and work place difficulties will be physically and mentally healthy. In addition, it was hypothesised that the use of engagement strategies in dealing with shiftwork related problems will relate to better physical and mental health. To test the hypotheses, 183 Air Traffic Services staff from Melbourne centre, Australia were surveyed by questionnaire. The results of the regressions showed that physical health was predicted by variables from each of the five areas considered; circadian typology, the social and domestic situation, work place factors, sleep patterns and coping style. Mental well-being was best predicted by a single domestic variable, which is the extent to which shiftwork caused domestic problems and the two coping variables of engagement and disengagement. The results support the suggestion that in order for an individual to be able to tolerate shiftwork they must have strategies in place to help them deal with the effect of shiftwork variables on a range of factors in their lives. An additional aim of the present study was to determine the reliability of a questionnaire for use with Air Traffic Services staff. This was due to a lack of suitable questionnaires for use in this occupational context. Overall the items in the questionnaire were found to have acceptable reliability, although the collection of sleep data by subjective reporting is not recommended.

Acknowledgments

Many thanks to Dr Anne Isaac for her guidance and forbearance and to Professor Nigel Long for his support, thanks also to Dr Fiona Alpass and Dr Ross Flett for their time and patience in dealing with my statistical dilemmas. Last but not least thanks to Ailsa Signal and Ben Fuller for their willingness to listen, discuss, read and re-read my work.

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1. INTRODUCTION

The term *shiftwork* refers to the allocation of work schedules to allow job duties to "shift" between groups of workers over various times of the day (Landy, 1989). Shiftwork has arisen because many industries or workplaces require round the clock operations, either for economic reasons or, like air traffic controlling, because of the continuous services they provide. These operations result in the need for personnel to be available during the day and night and to meet this demand work schedules are devised that cover a large portion of the 24 hour cycle.

Shiftworkers are often considered as people "who work while others are sleep" but shiftwork does not only refer to night work. Any work that occurs outside the normal work day window of 8.00 am to 6.00 pm can be included as shiftwork (Monk & Folkard, 1992). For example, working hours that mean a midday start and a 9.00 pm finish time can be considered shift work. The reason we should include such hours as shiftwork is because the problems associated with shiftwork can occur just as readily for those with changing or unusual work hours as for those who work through the night (Monk & Folkard, 1992).

Shiftwork is not a modern phenomenon and is believed to have been practiced, in some form, for centuries (Kogi, 1985; Scherrer, 1981). The most marked increase in the prevalence of this form of work system was during the industrial revolution, where organisations such as steel companies worked 24 hours a day because of operating costs and the impracticality of shutting industrial processes down.

The number of shiftworkers in European countries increased by 100% between 1950 and 1974 (International Labour Office, 1978) and in 1985 it was estimated that 15-30% of all workers in industrialised countries worked on some form of shift cycle (Kogi, 1985). The percentage of individuals working abnormal hours is often seen as a symptom of industrialised societies but is reported to be increasing in developing countries where legislation is less restrictive (Kogi, 1985). The growth in the number of shiftworkers has decreased since 1975 but will continue with new technology

requiring equipment to operate in a continuous or near continuous manner (Tepas, Duchon & Gersten, 1993).

1.1 Well-being of Shiftworkers

In the last decade the topic of shiftwork has received a great deal of research attention. This is in part due to the rapid rise in the number of people working on a shift system, and also a raised awareness of the difficulties shiftworkers experience. Probably the main reason for the large volume of research in recent years is the concern regarding changes in an individual's well-being and performance due to the number and arrangement of the hours they work. The accident reports of several devastating incidents, such as the nuclear power plant incidents at Three Mile Island and Chernobyl, the gas leak at Bhopal and the worlds worst air disaster at Tenerife, mention the time of day and fatigue of the individuals involved as contributing factors (Ehert, 1981; Folkard, 1990).

One of the earliest studies concerning the effect of shiftwork on workers was carried out by researchers at the University of Michigan (Mott, Mann, McLoughlin & Warwick, 1965). Their main findings indicated that shiftwork resulted in sleep related difficulties, that in turn led to a disruption in physical and social patterns. These findings first highlighted shiftwork as a potential work related stressor.

Rutenfranz, Haider and Koller (1985) and Monk (1988) argue that shiftwork can constitute an important source of stress for an individual, with stress meaning an imbalance between perceived demands and perceived resources (Haw, 1982). Environmental and physiological stressors are thought to be exacerbated by working odd hours (Sauter, Murphy & Hurrell, 1990). Such stressors arise from a continual sleep debt (Rutenfranz et al, 1985) and environmental risks, such as reduced lighting (Schmieder & Smith, 1996). In addition, the constant adjustment of normal body cycles is thought to affect many aspects of healthy biological functioning (Folkard, Minors & Waterhouse, 1985). All of these factors tend to make shiftwork a high stress activity.

Colquhoun & Rutenfraz (1980) proposed a model (*Figure 1*) of how the detrimental effects of shiftwork might arise. Shiftwork, with the constant phase shifting of work schedules, is known to cause disruption to an individual's physiological rhythms. This disruption is in turn thought to result in stress. Colquhoun and Rutenfraz (1980) believe that the effects do not stem directly from the actual stress of shiftwork but from the build up of strain within the individual as they try to cope (successfully or not) with an unnatural and changing daily pattern. The degree of strain experienced depends on certain intervening variables, including sleeping conditions, family factors and physiological adaptability.

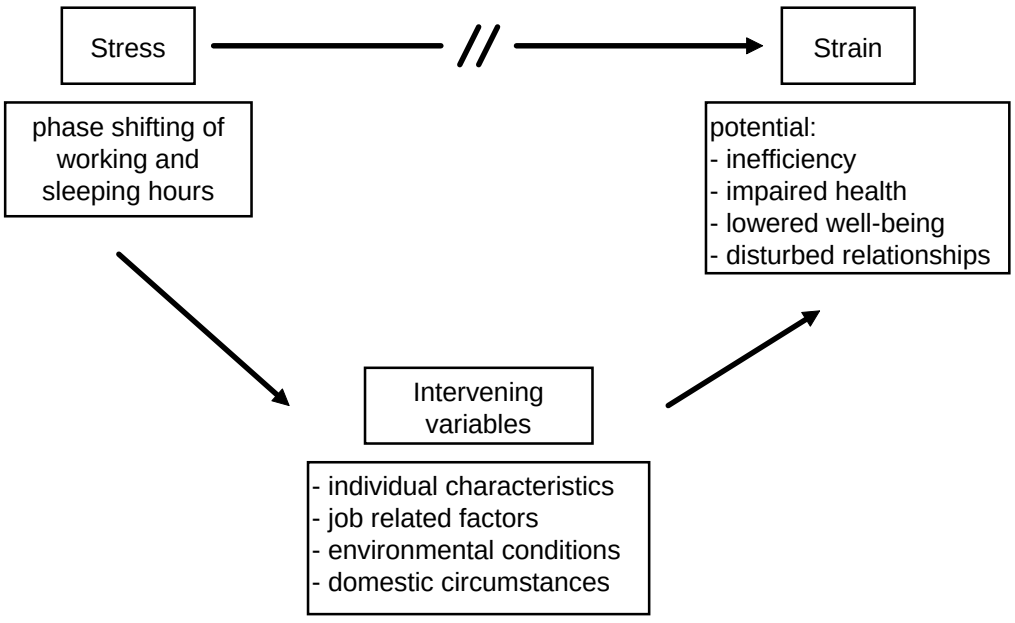

Figure 1: "Stress and Strain" model (Colquhoun & Rutenfraz, 1980).

The distinction between stress and strain is an important one. In many work contexts it is difficult to change the shift system and thus the level of stress imposed upon an individual. However, the subsequent strain can be minimised through learning and using coping strategies (Monk & Folkard, 1992). Coping, as a construct, has its beginnings in stress research and refers to all cognitive and behavioural efforts to manage, (reduce, minimise, or tolerate) experienced levels of stress (Folkman, 1984). Therefore, coping strategies may in turn significantly reduce the potential ill effects of shiftwork.

How an individual copes with shiftwork and how effective their coping strategies are at maintaining their health and well-being is receiving greater research attention but there are still no definitive findings. There are obvious differences in an individual's ability to tolerate shiftwork. Some shiftworkers report few problems and yet others working the same or similar schedules are barely able to cope (Monk & Folkard, 1985). With such a large proportion of the population working on a shift system it is necessary to discover more about how individuals vary in their ability to cope with the detrimental effects of shiftwork. Research on the influence of individual differences in determining tolerance to shiftwork has tended to focus only on personality type measures such as *morningness/eveningness*, *sleep rigidity*, *neuroticism* and *introversion/extroversion* (Monk, 1988; Monk & Folkard, 1985; Spelten et al, 1993).

It must be noted that approaching shiftwork from a coping perspective does not remove the need to restructure shift schedules, but if schedules can not be modified then education and other counter measures may make a difference. Monk & Folkard (1992) state that the incidence of poor physical health, such as gastric ulcers and heart disease, may be as much a function of the lack of social support and educational networks, as it is a function of the particular schedule an individual works. This implies that it is the intervening variable of coping ability that will largely determine the degree of harm experienced by an individual (Monk & Folkard, 1992).

1.1.1 Mental and Physical Well-being

There is evidence to indicate that shiftwork has a detrimental effect on the health and well-being of shiftworkers (Waterhouse, Folkard & Minors, 1992). Haider, Kundi & Koller (1981) have suggested that the inability to cope with shiftwork is manifested in health problems and individuals giving up shiftwork. In addition, Barton, Spelten, Totterdell, Smith, Folkard and Costa (1995) propose two long term consequences of shiftwork are decrements in mental and physical health. The finding that many health problems are found in shiftworkers who are failing to cope with shiftwork is significant since it means that if the strain produced by shiftwork can be minimised,

by educating the shiftworker about ways to best cope with this work schedule, then it is possible that the health consequences can be minimised even if the work schedule remains the same (Monk & Folkard, 1992).

Haider et al (1981) have suggested that with time and increasing exposure to shiftwork an individual passes through four phases; adaptation, sensitisation, accumulation and manifestation. If at any point a shiftworker reaches their tolerance limit and a further disturbance occurs, coping becomes impossible and giving up shiftwork is likely. After about 40 years of shiftwork, a phase occurs when coping with shiftwork rapidly deteriorates and health problems are then most likely to occur.

In each phase it is thought that different variables become important in sustaining tolerance to shiftwork. In the early adaptation phase, which is within the first five years of shiftwork, an individual becomes use to unusual work hours, changes in family life and social life. It is believed that the quality of sleep, family life and social activities have a strong influence on health and well-being during the adaptation phase (Koller, Kundi & Cervinka, 1979). The next five to twenty years of shiftwork is the sensitisation phase. Job satisfaction, career development, financial stability and family growth appear to be important. Attitudes to shiftwork and satisfaction with both shiftwork, family and social life play an important role in the incidence of health and well-being problems. Later in the accumulation phase, which is from about the twentieth year of shiftwork onwards, biological ageing plays a role and the effects of poor coping strategies accumulate. In the final manifestation stage, after 40 years of shiftwork, it is clear that adaptation to shiftwork has not occurred and disorders and disease are of the highest frequency in shiftworkers at this point. The difference between day workers and shiftworkers becomes more evident with increasing age. These differences may be deferred by some individuals but the continuation of these differences into retirement suggests the impact of shiftwork is inescapable.

Research findings on the physical effects of shiftwork has been inconsistent. There have been some reports of increased rates of cardiovascular and gastrointestinal disease among rotating and night workers compared to day workers (Costa, Apostoli, D'Andrea & Gaffuri, 1987; Waterhouse et al, 1992) but other studies have failed to show such differences (Aanonsen, 1964; Hakkinen, 1969). One of the main reasons

for the apparent lack of significant differences between shiftworkers and day workers may be the continuous process of 'natural selection' among shiftworkers. That is, most shiftworkers who do experience difficulties tend to transfer to day work. As already mentioned, many studies indicate that people often leave shiftwork if they find it difficult to tolerate or it has a direct effect on their health (Frese & Okenek, 1984; Koller, Kundi & Cervinka, 1978). Because many former shiftworkers appear to have poorer health than current shiftworkers, these experienced shiftworkers are often referred to as a 'survivor population'. However, this self selection process does not suggest that there is no longer a need to be concerned with shiftwork related issues.

One very reliable and detrimental effect of shiftwork on health is the increase in gastrointestinal symptoms and diseases. Waterhouse et al (1992) estimate that digestive and gastrointestinal complaints are between two and five times more common in shiftworkers than in day workers. Another study found that after sleep problems, gastrointestinal dysfunction comprises a major area in which shiftworkers and former shiftworkers have more trouble than day workers (Rutenfraz, Colquhoun, Knauth & Ghata, 1977). The nature of these gastrointestinal disorders includes loss of appetite, heartburn, constipation, stomach pain, flatulence and ulcers. Approximately 30-50% of shiftworkers are affected by such disorders, highlighting a major health problem for this occupational group.

Costa, Lievore, Ferrari and Gaffuri (1987) report that 67% of three-shift workers (shift cycle that rotates through three shifts eg: morning, day, night shifts) and 23% of permanent night workers were reported to have given up night work because of digestive problems. The length of time a person has been working in a shiftwork environment is important in the development of these disorders. Peptic ulcers tend to be diagnosed after 5-6 years of shiftwork compared to 12-14 years in day workers (Costa et al, 1987). In addition, other difficulties such as sleep related disorders tend to be transient and disappear after ceasing shiftwork but gastrointestinal complaints have been found to continue after shiftwork is ceased (Thierry & Meijman, 1994).

The reason for the prevalence of gastrointestinal complaints is unclear but several theories have been proposed. One theory focuses on the presence of a number of risk

factors including the timing and composition of meals, smoking and drinking. These factors are thought to lead to short term digestive disorders such as indigestion, heartburn and flatulence and may ultimately lead to ulcers (Barton et al, 1995). Another explanation focuses on the 24 hour cycle of the stomach and its associated enzymes. It is possible that the normal rhythm in gastric functioning does not adapt to night work and consequently eating during the night exacerbates gastric problems. Harrington (1978) suggests such problems are due to impoverished catering facilities and that poor food service or bad eating habits are a major cause of gastrointestinal disturbances. However, although there is presently a lack of clear evidence to support any of these mechanisms it is likely that a combination of these factors are responsible.

Another health complaint possibly linked to shiftwork is cardiovascular disease although the findings are not clear. Harrington (1978) reports little, if any, association between cardiovascular disease and shiftwork but recent studies have found a more conclusive relationship (Waterhouse et al, 1992). It is suggested that with increased exposure to shiftwork there is a greater the risk of heart disease. A 15 year study of workers in a paper mill found that the incidence of cardiac disease doubled depending on the exposure to shiftwork and that a steady rise in cardiovascular disease was found for shiftworkers with up to 20 years experience (Monk & Folkard, 1992). After this point in time there was no difference in the incidence of cardiac disease between shiftworkers and day workers, possibly because the shiftworkers had either died or shifted to day work.

Corroborating evidence shows that a change in the direction of rotation of a shift schedule, to a delaying rather than advancing rotation, directly lowered coronary risk factors such as serum triglycerides (Orth-Gomer, 1983). Ely and Mastardi (1986) found, in a less well controlled study, that shiftwork was associated with higher norepinephrine levels, which is also a risk factor in heart disease. When other risk factors, such as smoking, are taken into account the incidence of heart disease is believed to be about 40% higher in shiftworkers compared to day workers (Knutsson, Akerstedt, Jonsson & Orth-Gomer, 1986). In addition, Akerstedt, Alfredsson and Theorell (1986) report significantly increased morbidity ratios for cardiovascular

disease with increased exposure to shiftwork and work at irregular hours. The reason for the relationship between shiftwork and cardiovascular disease is not known, but akin to gastrointestinal disorders, it is likely a number of factors are responsible.

Other non-specific disorders resulting from shiftwork have also been noted, such as increased irritability and frequency of headaches (Minors, Healy & Waterhouse, 1994). The mortality rates of shiftworkers compared to day workers have been found to be similar. Taylor & Pocock (1972) compared the mortality rates of more than 8000 shiftworkers and day workers over a 13 year period and found no significant differences. However, shiftworkers who had given up shiftwork prematurely did show a higher mortality rate. The reduction in sleep length is another widely realised effect of shiftwork (Wedderburn, 1995). The reason for reduced sleep is discussed in more detail later. Some of the effects of reduced sleep are fatigue and lowered feelings of well-being. Ottoman, Karvonen, Schmidt, Knauth and Rutenfraz (1989) reported that complaints of sleep disturbances were associated with tiredness and nervousness and were nearly twice as frequent in shiftworkers than day workers.

Centres of psychiatric research have undertaken a great deal of research on circadian rhythms because depression has been linked to dysfunctions of the circadian system. A pattern has been found in the sleep length, waking times and diurnal variations in mood of depressed patients. The relationship between depression and variations in the circadian system are not well understood, although it is agreed they are inextricably linked (Krieger, 1988).

Jahar and Weller (1982) investigated the nature of psychiatric admissions to the medical centre at Heathrow airport. Their findings indicate that depression is associated with previous long westbound flights and hypomania with long eastbound flights. This indicates that with vulnerable individuals, manipulation of circadian rhythms can induce a recurrence or appearance of psychiatric symptoms.

Individuals who work or have worked on night shift report psychosomatic complaints or impaired well-being more frequently than day workers (Frese & Semmer, 1986). Costa et al (1981) report that 72% of male textile workers who gave up shiftwork did

so because of neurotic problems and Bohle and Tilley (1989) found that night work had a significant negative impact on psychological well-being. Findings from the latter study provide evidence that both organisational and behavioural variables moderate the impact of night work on psychological well-being.

Verhaegan, Dirkx, Maasen and Meers (1986) found increased levels of neuroticism over a 12 year period in a group of industrial shiftworkers. In addition, Vidacek, Kaliterna & Radosenc-Vidacek (1987) found that neuroticism scores of individuals who had done three years of shiftwork were associated with poorer health. The incidence of alcohol abuse, tranquilliser use and nervousness was also found to be higher in rotating shiftworkers than other shiftworkers (Gordon, Clearly, Parker & Czeisler, 1986). The concern about the incidence of drug or alcohol abuse of shiftworking drivers or pilots in public transport accidents indicates the potential prevalence of this problem (Lauber & Kayten, 1988).

Despite the inconsistencies in previous research findings there is sufficient evidence to indicate that both physical and mental health may be impaired by shiftwork. Gastrointestinal complaints, cardiovascular disease and sleep disturbances are the most widely recognised potential physical health consequences. Research evidence also indicates the incidence of neuroticism is greater for shiftworking individuals.

1.2 Well-being of Air Traffic Controllers

The following section focuses specifically on research that has investigated the relationship between shiftwork and health complaints in Air Traffic Service staff.

Many air accident reports cite Flight Crew or Air Traffic Controller fatigue as a contributing cause. The reduced ability of the individual to perform at the required level can most often be attributed to the effects of sleep loss, displacement of circadian rhythms and physiological symptoms caused through the arrangement of an individual's work hours, or the shift cycle they follow (Gander, Myhre, Graeber, Anderson & Lauber, 1985). It is therefore imperative that the shiftworker, as an integral part of a system particularly in high risk professions such as aviation, maintains optimum mental and physical well-being (Smith & Folkard, 1993).

If shiftworkers in general have been found to experience mental and physical problems, then it would be expected that Air Traffic Service staff working on a shift system will to some extent also experience these problems. The risk to public safety, as well as the large financial cost involved, implies that it is essential to examine more closely the factors that may influence the well-being of Air Traffic Service staff. Coupled with this is that very few studies to date have investigated the factors influencing Air Traffic Service staff working on a shift system.

A lot of interest in pilot fatigue and working hours in evident with the amount of research and literature available on the subject. However, the findings of these studies are not directly transferable to the controlling environment. This is mainly because the tasks of pilots are very different from those of Air Traffic Service staff. The peak period of activity for a pilot is during take off and landing, with relative inactivity in between while an Air Traffic Controller must be highly focussed at all times.

A recently published report by the Committee on the Regulation of Air Traffic Controllers hours (1990) in the United Kingdom, indicates the raised awareness of the impact of shiftwork on Air Traffic Controllers. This report was commissioned for several reasons. Firstly the public perception of lessening Air Traffic Controller

safety in the United Kingdom, secondly growing discontent among Air Traffic Controllers and thirdly an overburdened system. Other reasons included an acceleration in air traffic in 1988 that had not been anticipated. This led to airspace congestion and increased Air Traffic Controller workload. Smaller aerodromes in the United Kingdom were found to be experiencing an increasing number of problems and a failure to rectify them. These problems were attributed to a shortage of Air Traffic Controllers and an increase in traffic. Both these conditions are now occurring in Australasian controlling environment.

The aim of the report was to determine what measures should be taken to regulate the hours of Air Traffic Controllers. The findings of the report do not indicate evidence of fatigue contributing to a lack of safety. They did find that the hours of work of Air Traffic Controllers in the United Kingdom could not remain unregulated. The guidelines proposed were in no way supposed to guarantee the elimination of fatigue but to introduce safety levels. The report also recognises that the reduction of fatigue does not alone address other factors which may affect safety on shift systems. These factors can give rise to health problems, sleep difficulties and disruption to social life.

Other previous research on the implications of shiftwork for Air Traffic Controllers has mainly been carried out in the North American Air Traffic Control system. The North American studies that have been conducted have focussed on the effect of rotating schedules on the sleep patterns and mood of Air Traffic Controllers. Rotating schedules are common within the Air Traffic Controlling environment. Prior studies have shown that rapid rotation maintains individuals' circadian rhythms in a diurnal orientation (Dahlgren, 1981; Daniel & Potasova, 1989). However on night shift, individuals must operate in the nadir (or trough) of their diurnally orientated circadian rhythms. Slower shift rotations and permanent shifts are another option. The disadvantages of these schedules include the low workload at many Air Traffic Centres on night shifts which would adversely affect an Air Traffic Controller's proficiency (Luna, French, Mitcha & Neville, 1992). An additional disadvantage is the requirement for a group of individuals to constantly work night shifts.

Smith, Melton and McKenzie (1971) in a study of North American Air Traffic Controllers found individuals reported increased levels of fatigue and tiredness after night shifts compared to day shifts. They also found that low intensity operations can give rise to tiredness and lack of attention because of boredom. In addition, Air Traffic Controllers at towers with moderate density traffic reported greater sleepiness on night shifts than the Air Traffic Controllers operating in conditions of high density traffic.

Saldivar, Hoffman and Melton (1977) compared North American Air Traffic Controllers working on a 2-2-1 shift schedule (2 evening shifts, 2 day shifts, 1 midnight shift, followed by 2 days off) with Air Traffic Controllers on a 5 day rotation pattern (5 evening shifts, followed by 2 days off, 5 day shifts, followed by 2 days off, 5 midnight shifts, followed by 2 days off). Their findings showed that the average amount of sleep over a seven day period did not differ between the two shift schedules but when comparing sleep length over the five day working period, Air Traffic Controllers working the five day schedule got significantly more sleep during a 24 hour period. On both type of schedules the greatest amount of sleep was obtained on the evening shift and the least amount of sleep on the midnight shift. In an earlier study, Melton, Smith, McKenzie, Saldivar, Hoffman and Fowler (1975) looked at the physiological stress experienced by Air Traffic Controllers working on the 2-2-1 and 5 day schedules and they found the 2-2-1 schedule to be less stressful.

Cruz and Della-Rocco (1995) compared American Air Traffic Controllers working 2-2-1 shift schedules, 2-1-2 shift schedules (2 afternoon shifts, a day shift, 2 morning shifts) and straight day shifts and investigated the amount and quality of sleep in relation to turn around times (time between subsequent shifts). The 2-1-2 schedule allows for longer turn around times. It was found this resulted in longer sleep duration but no difference in reported sleep quality or in sleepiness ratings during work compared to the 2-2-1 schedule. Cruz and Della-Rocco (1995) suggest that problems associated with forward, rapidly rotating work schedules may have more to do with working the night shift and early morning start times than with a rapid turn around.

Folkard and Condon (1987) investigated the frequency with which Air Traffic Controllers experienced night shift paralysis. This is described as "a sustained immobility involving the entire voluntary musculature, although full consciousness prevails and the subject can see and hear. Attacks last from a few seconds to as many as minutes" (Rudolf, 1946 pp. 132). Folkard and Condon (1987) reported that 6% of Air Traffic Controllers experienced night shift paralysis. Most individuals who reported such an event experienced it only one or two times, although some claimed five occurrences, and generally all experiences lasted for less than two minutes. Individuals were sure they were awake, their vision was unaffected and they remained aware of their surroundings. However, many Air Traffic Controllers became aware of their immobility when they tried to make gross motor movements, often in response to an external event. Findings indicate that the occurrence of this paralysis depended on four factors. These were the time of night, the number of previous consecutive night shifts, the occurrence of both a morning and night shift on the same day and individual differences in sleep flexibility. A cumulative sleep debt is thought to account for the increased incidence of this paralysis (Folkard & Condon, 1987).

An Air Traffic Controllers continued employment is dependent on their good health which may mean many health symptoms are under-reported. This may explain why research on the incidence of general health problems in this occupational group has been equivocal. A study by Smith (1980) failed to find any clear evidence of health problems associated with Air Traffic Controlling. Booze (1978) examined the medical records of 25,000 individuals working in air traffic services and found a lower than average rate of hypertension and no unusual rate of gastrointestinal complaints. A small study at O'Hare International airport also found no exceptional incidence of ulcers (Singal et al, 1977).

In contrast, Cobb and Rose (1973) found that hypertension, diabetes and ulcers were significantly higher in a sample of more than 400 Air Traffic Controllers compared to a group of 8000 individuals working in other areas within the aviation industry. They also found Air Traffic Controllers suffered from a higher incidence of hypertension and peptic ulcers when working in high density traffic areas. Studies comparing pilots and Air Traffic Controllers showed that one fifth of Air Traffic Controllers

suffered from borderline hypertension, which is twice the rate of that observed in pilots (Booze, 1982; Dougherty, 1967). Although these findings may be explained by the slightly more stringent medical requirements for pilots.

Rose, Jenkins and Hurst (1978) report that hypertension is the most prevalent chronic illness amongst Air Traffic Controllers with the incidence found to be three times higher than the American national average. Headaches were the most common health complaint with 69% of Air Traffic Controllers experiencing headaches each month and 45% of individuals having headaches of greater than 1 hour duration. Other earlier studies (Dougherty, Trites & Dille, 1965; Hauty, Trites & Berkley, 1965) associated air traffic work with gastrointestinal problems.

Costa, Schallenberg, Ferracin and Gaffuri (1995) found that Italian Air Traffic Controllers reported mainly gastrointestinal, musculoskeletal, cardiovascular and neuropsychic complaints. Compared with a group of male nurses of a similar age and length of shiftwork experience, the Air Traffic Controllers showed a higher prevalence of gastrointestinal and cardiovascular disorders and chronic anxiety but a lower prevalence of drug consumption.

MacLennan and Peebles (1996) investigated whether personality traits or other risk factors, such as diet, weight and family history, were more useful predictors of the incidence of health problems in Air Traffic Controllers. Surprisingly, they found personality traits to be better predictors of health problems than recognised health influences.

Smith (1978) reviewed the medical disqualifications of Air Traffic Controllers over five years and found that out of 79 individuals, 61 were removed from their position because of psychological problems. Rose et al (1978) surveyed Air Traffic Controllers over a three year period and found that 20% developed significant mental problems and 13% experienced depression and anxiety over the course of the study. Eight percent were reported as alcohol abusers and over 50% were heavy drinkers. Booze (1978) found a high incidence of psychological problems in Air Traffic Controllers and another study reported that in a group of 650 Air Traffic Controllers,

40% experienced severe distress within a six month period (McBride, Lance & Freeman, 1979). Such findings seem to indicate a high rate of psychopathology but without comparable norms this is difficult to verify.

Other studies that have investigated the health of Air Traffic Controllers have focussed on work related stress. The main factor that has been investigated as the cause of this stress is workload. Several studies have identified Air Traffic Controlling as a highly stressful occupation (MacLennan & Peebles, 1996; Shouksmith & Burrough, 1988) other studies have suggested conversely (Melton, 1982).

Melton (1982) reported that Air Traffic Controller's health was not unduly affected by job stress but other studies have shown short term changes in heart rate, hormonal secretion and vigilance due to increased workload (Costa, 1993; Tattersall & Farmer, 1995; Zeier, 1994). Costa (1993) concluded the physiological changes found indicated that Air Traffic Controller's stress was no greater than would be expected in the normal working population. In contrast, Zeier (1994) also measured psychological symptoms of stress and reported that 10-15% of Air Traffic Controllers could have serious stress problems at work or in their private life. Tattersall and Farmer (1995) also suggest that the patterns of hormone excretion, if sustained over long periods, may have long term health consequences for Air Traffic Controllers.

In summary, decreased sleep length and reports of subjective fatigue are associated with the work schedules of Air Traffic Controllers. The incidence of night shift paralysis in Air Traffic Controllers is a significant change in the well-being of individuals and its occurrence is thought to be due to cumulative sleep debt. Other studies on the general health of Air Traffic Controllers have produced ambiguous findings but it is suggested that hypertension and gastrointestinal complaints may be more prevalent in this occupational group.

1.2.1 Air Traffic Controlling

In order to better understand the issues faced by Air Traffic Service staff it is first necessary to understand the nature of their job. The following section briefly discusses the requirements of various positions within an Air Traffic Service centre.

In very simplistic terms, the task of an Air Traffic Controller is to provide safe aircraft separation. This is provided to differing degrees in different classes of airspace and is most often achieved by requiring aircraft to fly at different heights and/or along specific routes to provide horizontal separation. Along with safe aircraft separation, aircraft are controlled to allow traffic to flow in an orderly and expeditious manner.

Air Traffic Controllers are often also responsible for providing additional information to pilots, in particular the presence of other aircraft, navigational and meteorological information and emergency assistance. Some Air Traffic Controllers may also be required to inspect airfields and lighting facilities, conduct meteorological observations and carry out administrative duties.

Each country may have slightly different classes of airspace but generally there are controlled and uncontrolled areas. Aircraft flying in uncontrolled areas must follow rules of the air but can basically fly where they like. Flight Service staff may provide some information to aircraft in uncontrolled airspace and aircraft may be required to advise of their presence and intentions. Flight Service also provide advice to pilots on other traffic and weather information.

Controlled or regulated airspace requires aircraft to have a clearance in order to enter these areas and within this airspace aircraft must follow an Air Traffic Controllers instructions. Certain standards are followed by Air Traffic Controllers in separating aircraft and depending on the type of control, that is whether radar is available or not, separation values vary. Radar provides visual information on an aircraft's position, course and speed. Two forms of radar exist and include primary radar, which gives limited information of the position of the aircraft as a ‘blip’ on the radar screen, and secondary radar, which supplies additional information such as aircraft identification, height and speed. Radar controlled aircraft are separated by smaller distances because of the greater accuracy the radar provides.

Before a pilot flies into controlled airspace, they must submit a flight plan with details of the aircraft's route. This information is processed by Flight Data Officers who pass this information to Air Traffic Controllers who then coordinate the aircraft. Information regarding a single aircraft is passed by the Flight Data Officers to all Air Traffic Controllers having contact with the aircraft along its intended route.

Most Air Traffic Controllers work in one of three main areas. These are known as area control, approach control and aerodrome control. Area control is responsible for en-route flights in a sector of airspace and possibly also for flights inbound and outbound from a terminal control area (airspace in the vicinity of a major aerodrome). An Approach Controller is responsible for coordinating aircraft between area control and aerodrome control. Once the Approach Controller has established an aircraft on an approach to a runway it is passed to the Tower Controller. The Tower Controller is responsible for aircraft taking off, landing and moving on the ground at the aerodrome. In the opposite order to their arrival aircraft departing from an aerodrome are passed from the Tower to the Approach to the Area Controller. There may also be Flow Controllers, who coordinate and plan the traffic across the airspace of busy sectors. The existence of this position depends on the size of the airspace and the volume of traffic an Air Traffic Service centre is responsible for. Such Air Traffic Controllers do not control aircraft directly.

In different countries the control of air services differs. In Australia Air Traffic Controllers are employed by AirServices Australia and in New Zealand by the Airways Corporation. Air Traffic Controllers are all licensed in their respective countries by a single body and this organisation also carries out their initial training. Most training systems comprise firstly of classroom based work followed by operational experience. When finally assigned to the centre at which they are to work further training is given on the specific equipment, procedures and environment of the unit. Operational training is carried out under the supervision of an authorised Air Traffic Controller and once a minimum time has lapsed or certain conditions are met Air Traffic Controllers may then operate alone. Air Traffic Controllers are required to undertake a medical examination yearly to maintain their licence. Competency is

also checked annually and their licence remains current under these conditions unless they have a period of absence longer than 90 days.

Ab-initio Air Traffic Controllers should be well aware of the requirement to work a shift system, as the majority of centres provide services that extend beyond the normal work day. Most Air Traffic Controllers will spend their careers providing controlling services as there are few hierarchical or lateral opportunities in their own profession or for a similar service in other industries. Estimates indicate no more than 10% of Air Traffic Controllers move into senior, supervisory or management positions.

No two centres, even in one country, are the same. The disparity is due to the type and purpose of the centre. For example, whether a centre is required to control en-route traffic as well as provide approach facilities. The location of the aerodrome and the intensity of the workload also contribute largely to creating differences between centres. Some centres experience seasonal differences with holiday traffic, others may have to contend with mixtures of civil and military operations. The time of day will also predict the intensity of the traffic. In centres that control international arrivals and departures, day-light hours do not necessarily reflect the busiest periods. Traffic type is also an important determinant of the controlling environment, with some centres having to coordinate larger, faster aircraft with light training aircraft.

The number of aircraft movements has increased rapidly in the last five years but the number of Air Traffic Controllers has remained relatively stable. This growth in air traffic has resulted in less troughs in traffic activity and the lengthening of peak traffic times.

Depending on a countries specific air traffic system, the restriction of working hours is regulated differently. In Australia the Civil Aviation Authority and the Civil Air Operations Officers' Association of Australia has agreed to a set of guidelines on rostering in Air Traffic Control. Rosters are generally devised at each local centre in agreement with these working guidelines. Most schedules are currently devised on experience and industrial bargaining rather than specific scientific evidence. This results in little uniformity among rosters in different centres. Although guidelines are

in place to try and prevent Air Traffic Controller fatigue, it does not mean that this form of workplace stress is eliminated with the current rostering system. Problems can also arise when staff are absent and the remaining staffing levels are inadequate to cover shifts.

It is obviously the duty of the Air Traffic Controller to ensure they are fit and adequately rested before their controlling duty, but the lack of research on the implications of shiftwork for Air Traffic Service staff means individuals are not necessarily aware of the factors and the way in which they interact to affect their well-being.

1.3 The Conceptual Model

This next section introduces the factors that are believed to be important in coping with the effects of shiftwork. These include circadian characteristics, sleep, social and domestic factors, work place factors and the use of coping strategies.

Monk (1994) argues that the ability to cope with the strain of shiftwork depends on the interaction of three factors, these are circadian rhythms, sleep, and social and family life (see *Figure 2*). Each factor interacts with, and influences the others. Coping ability is dependant upon all three areas being addressed and problems, difficulties or disregard for one area can negate the successful contribution of other areas. For example, the ability to sleep is determined to a large extent by social, domestic and circadian factors so that a noisy household, children's needs and domestic commitments will all result in sleep loss and disruption.

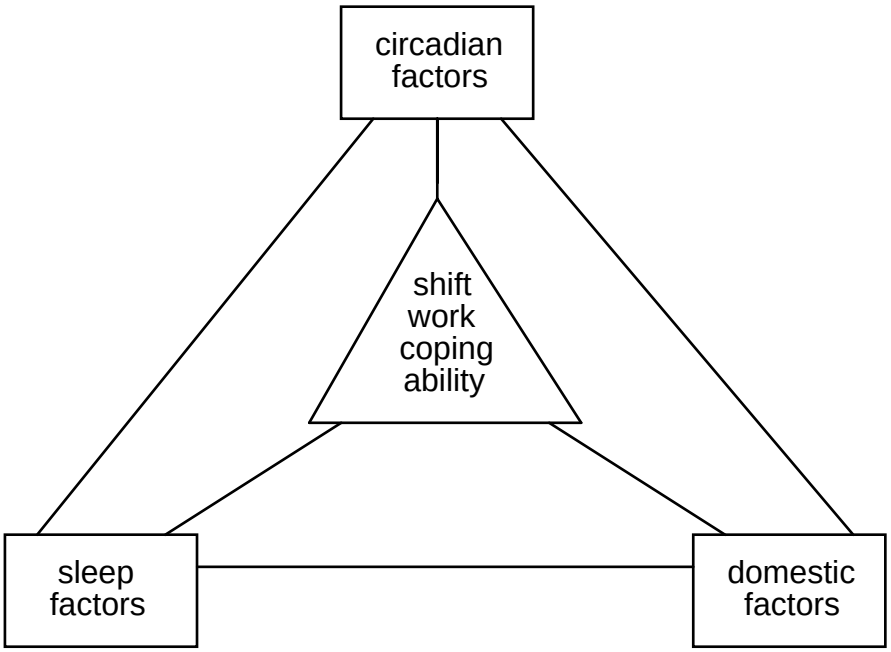

Figure 2: Relationship of Circadian Factors, Sleep Factors and Domestic Factors to an Individuals Coping Ability (Monk, 1994)

Normally, the human body functions on the basis that sleep will be at certain times. Therefore, attempts to sleep against our bodies intrinsic pattern is often difficult or impossible for many individuals. It may be that a shiftworker does manage to successfully balance their body's rhythms and get sufficient sleep but if these successes are at the expense of domestic disharmony then strain is still present. On the whole an individual will have to continually balance all three areas and consequently some sleep may be lost in order to spend time with the family or carry out domestic tasks. The aim is to achieve a compromise so that there is no great impairment of any one area.

Since each of these factors is important in the shiftwork equation, they will now be discussed in more depth.

1.3.1 Circadian Factors

Most animals show behavioural, biochemical and physiological variability over definitive time periods (Rosenzweig & Leiman, 1982). Many of these changes are far from random and can be linked to internal body cycles. The fluctuations that occur over a 24 hour period are known as circadian rhythms (from the Latin terms "circa" meaning about, and "dies" meaning day) (Bloom & Lazerson, 1988).

Recent developments in measurement instruments have allowed the detection of a large number of physiological rhythms. This research has indicated that humans have over a hundred circadian rhythms, including those of body temperature, blood pressure, heart rate, secretion of certain hormones, urine volume, drug sensitivity, frequency of yawning, frequency of eating, levels of cognitive and motor performance, and sleep/wake cycles (Kalat, 1992; Bloom & Lazerson, 1988). An example of the type of changes that occur in one of these rhythms, is that of body temperature. The body temperature of day workers is found to be at its lowest about 5.00 am. It then steadily rises to a high point at around 9.00 pm, with a difference of nearly one degree between the two times, as shown in *Figure 3*.

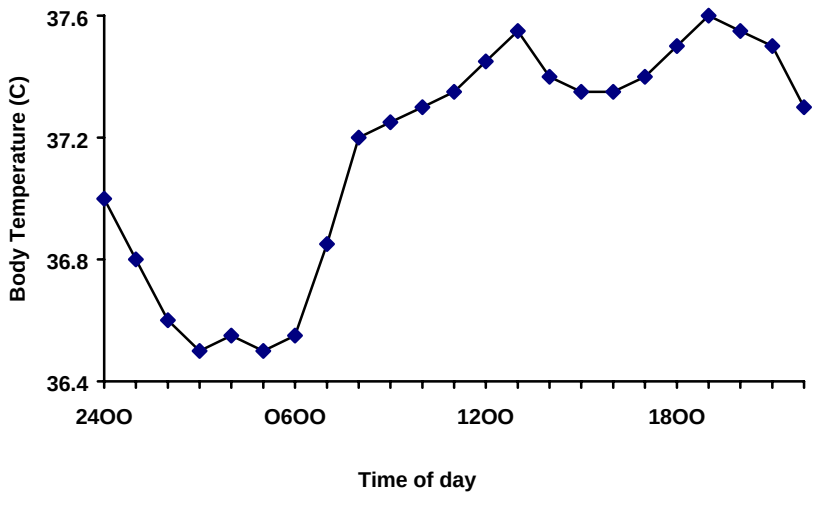

Figure 3: Circadian Rhythm of a Day Worker's Body Temperature (Minors & Waterhouse, 1990)

The knowledge of the existence of circadian rhythms can be attributed to Jean Jacques d'Ortous de Marian, who in 1729, observed that the opening and closing of the leaves

of the heliotrope plant still occurred when the plant was kept in constant darkness. Before this discovery it was presumed that these circadian rhythms might result from rhythmic changes in the environment (Kronauer, 1994).

In humans, these rhythmic changes in the body could be explained by changes in lifestyle and activity level. For example, during the day when an individual is awake and active it could reasonably be expected that their heart rate, blood pressure and temperature would be higher than during the night when they are asleep and inactive. However, subjective and objective evidence suggests the issue is more complex than this. Findings indicate that there are both internal physiological mechanisms, also known as endogenous components, and external factors, known as exogenous components, that control circadian rhythms (Minors & Waterhouse, 1990). Under normal conditions the endogenous and exogenous components are in phase with each other. For example, lowered body temperature in the early hours of the morning is reinforced by inactivity and fasting during sleep.

In studying the endogenous component of the body clock researchers have tried to eliminate all exogenous influences. Most information about the body clock has been gained from free running experiments, where individuals were isolated from all time cues and allowed to sleep and eat as they wished. From these experiments the rhythmicity of body functions was found to continue but these rhythms differed slightly from 24 hours. The average value of a cycle under free running conditions is 25 hours and the range is between 24-26 hours. Free running periods of 24 hours are unusual and less than this are uncommon.

It is unclear whether there are two or more body clocks in the brain. It is thought that the areas that do show some time keeping tendencies are normally synchronised and together produce the endogenous component of circadian rhythms (Minors & Waterhouse, 1990). It is possible that under certain conditions, such as desynchronisation due to changing sleep wake cycles, that the controlling areas become separated functionally.

One physical structure that is thought to be involved in producing these rhythms is the suprachiasmatic nucleus (SCN). This is a small area of the hypothalamus that lies just above the optic chiasm. The SCN generates its own rhythm which is demonstrated by neurons isolated from this area producing a pattern of impulses that follow a circadian rhythm. Although able to generate its own rhythm, the SCN receives input from the optic nerve and information from this source entrains the SCN's rhythms to a 24 hour cycle (Minors & Waterhouse, 1990).

In humans the SCN sends axons to other nuclei in the hypothalamus, to the pituitary and pineal gland, and parts of the brain stem responsible for sleep. The pineal gland is another area that is thought to be important in the generation of certain rhythms. In many animals the pineal gland receives light input, indicating entrainment to the light/dark cycle. Within the pineal gland the neurotransmitter serotonin is converted into the hormone melatonin which is then secreted into the bloodstream. Levels of melatonin vary over a 24 hour period and seem to be linked to the cycle of daily activity and night time rest and the cycle of body temperature changes.

As already mentioned, when there are no time cues present our body clocks run at about 25 hours, but in normal daily living they run at exactly 24 hours. This constant readjustment to the 24 hour cycle is known as entrainment and is achieved by rhythmic cues in the external environment. These cues are known as zeitgebers. In humans it is unclear exactly what effects individual zeitgebers have but it is thought that normally zeitgebers such as behavioural responses, feeding, social activity and light/dark all act together to entrain the body's rhythms to a 24 hour cycle.

The circadian control of our sleep/wake cycle causes one of the prime difficulties associated with shiftwork. Changing an individual's working hours also often means changing their sleep times. Trying to instantaneously adjust sleep patterns to a new schedule often causes sleep difficulties. This is because our circadian rhythms are stable and circadian realignment takes some period of time. This stability of the circadian system is normally an advantage, in that a brief period of darkness or a short sleep does not cause an unnecessary change in the body's rhythms.

Research indicates that complete circadian realignment can take at least a week to occur (Monk, 1994). Circadian realignment is also normally experienced when travelling across time zones and is referred to as 'jet lag' although, with 'jet lag' the physical and social zeitgebers encourage realignment of the circadian system. For shiftworkers, the physical and often the social zeitgebers work in opposition to the body realigning to a new schedule.

Monk (1994) likens the process of circadian realignment for the night worker to that of a salmon leaping up a waterfall. That is, it is difficult to achieve a nocturnal orientation (ie: reach the top of the waterfall) but easy to return to a diurnal orientation (ie: fall back down the waterfall). Although an organisation may perceive they have permanent night workers, in reality an individual may be alternating between nocturnal and diurnal orientations on their days at work and days off.

As an individual tries to adjust to a new work/rest cycle their many circadian rhythms are all resynchronising at different rates. This disruption not only leads to sleep disruption but also feelings of fatigue, performance decrements, irritability and other health problems; the most common being gastrointestinal complaints (Monk, 1994).

Shift schedules can be arranged in a wide variety of ways and these different arrangements influence the adaptation of an individual's circadian rhythms. Individuals face different concerns and difficulties with each type of shift but it has been shown that most fixed shift workers can eventually adapt to their new work cycle. Agervold (1976, cited in Landy, 1989) argues that if night shifts are absolutely necessary, then workers should be allowed to completely adapt. Such adaptation may mean greater on the job efficiency and also greater satisfaction from the worker, but it also means they are now out of phase for performing non-work activities. This adaptation may take weeks, even months and for a few it is almost impossible to adapt. More recent research (Tepas & Carvalhais, 1990) suggests that, because permanent night workers always revert to a diurnal orientation on their days off, the effects of rotating and permanent shifts may be more similar than previously thought.

Rotating shifts are more popular with workers but this arrangement does not allow the body time to adapt, hence subjecting the individual to constant stress. The direction of rotation is also important. Evidence from 'jet lag' studies indicates that backward rotations may be more problematic than forward rotations. A backward rotating shift cycle has start times that are earlier for each subsequent day. For example, a backward rotating cycle is one in which the first shift in a cycle starts at 1.00 pm, then the following day's shift starts at 10.00 am, and the next day's shift at 7.00 am. A forward rotating cycle has later start times for each subsequent shift in a cycle. Wolinsky (1982, cited in Landy, 1989) looked at shift rotations at the Great Lake Minerals and Chemicals Corporation in the United States. Both the direction and length of shift cycle were manipulated, producing positive outcomes for both forward rotation and lengthening of the shift cycle.

Adjustment to shiftwork is also believed to be greatly influenced by certain individual circadian characteristics. The preference for activities in the morning or evening, known as morningness/eveningness orientation, has been shown to be one of the strongest predictors of adjustment (Kerkhof, 1985a).

It has been found that on average, morning type individuals go to bed earlier and rise earlier than evening type individuals (Horne & Ostberg, 1977; Kerkhof, 1984). This is thought to be due to the relative phase advancement of the sleep/wake rhythm in morning individuals. As discussed in the next section, the shiftworker tends to follow a pattern of work, sleep, recreation as compared to a day workers work, recreation, sleep cycle. Therefore, on an evening or night shift a shiftworker is trying to sleep in the morning, and if they are a morning type individual they are naturally feeling most alert and wide awake. When working evening and night shifts it is more likely for the morning type individual to wake earlier when sleeping and therefore incur a greater sleep debt (Monk & Folkard, 1985). Evening type individuals are also thought to be able to stay awake late and sleep late because they are less susceptible than morning types to the physical and social zeitgebers that keep the circadian systems entrained to a 24 hour period (Monk & Folkard, 1992).

There is also believed to be a link between morningness and the natural free running endogenous rhythm. If isolated from all time cues it is believed that morning type individuals would show a shorter free running period than evening types (who tend to have a relatively delayed sleep/wake rhythm) (Kerkhof, 1985b). For example, morning type individuals may have a free running period of approximately 24.3 hours as opposed to evening type individuals who may be closer to 25.5 hours (Monk & Folkard, 1992). If this finding were more robust, there would be a more clearly seen advantage in forward rotating shift systems where phase delays of the circadian rhythm are required.

The result of these differences is that an evening type person tends to find shiftwork easier to cope with than morning individuals. This is supported in the research by Akerstedt and Torsvall (1981) who state that morning types are more likely to want to transfer to day work.

In summary, difficulty coping with shiftwork may be due to several reasons: firstly the zeitgeber influences are less potent for evening individuals, secondly evening individuals may have a longer free running period which allows them to cope more easily with forward rotations, and finally evening types also seem to find it easier to sleep during the morning resulting in less sleep deprivation.

1.3.2 Social and Domestic Factors

It may be that an individual's body is able to adjust to shiftwork, but their ability to cope still depends greatly on social and domestic factors. Walker (1985) argues that the social implications of shiftwork are just as important as the physiological aspects and normally, poor social and domestic adjustment will have the greatest impact through their effects on the circadian and sleep factors in the coping equation (Monk, 1994).

There have been many deficiencies in previous research on the effects of shiftwork on family and social life (Colligan & Rosa, 1990). This makes it difficult to make definitive statements about the impact of shiftwork on this aspect of an individual's

life. It is agreed however, that certain shifts pose particular problems for fulfilling family roles and participating in social activities.

Mott et al (1965) compared shiftworkers on fixed afternoon, fixed night, and rotating shifts to day workers. Their results showed that day workers have the highest marital satisfaction, greatest family integration and coordination, and the least domestic friction. Day workers also had the highest membership rates to community and sporting organisations, and spent more time participating in these organisations (Mott et al, 1965; Frost & Jamal, 1979). Khaleque and Rahman (1984) reported permanent day schedules to be the least disruptive to family life and leisure pursuits. Shiftworkers in general, report fewer friends (Herbert, 1983) and find it easier to engage in solitary activities such as gardening, fishing and home maintenance (Colligan & Rosa, 1990; Walker, 1985).

As mentioned, certain shifts pose particular domestic and social problems. The following discussion focuses on the social and domestic difficulties encountered for individuals working fixed afternoon shifts, fixed night shifts and rotating shifts.

Afternoon shifts:
Although fixed afternoon shifts do not cause circadian or sleep disruption they are highly disruptive to family and recreational activities. Mott et al (1965) found workers on fixed afternoon shifts reported fewer sleep and health complaints than individuals on fixed night or rotating shifts but they did report the most dissatisfaction with the amount of time available to spend with their spouse and relaxing. In addition to this, Wedderburn (1978), found that 79% of afternoon shiftworkers felt that their shift restricted their social and family life, while only 17% of day workers made similar complaints.

In addition, male workers on this shift schedule expressed concern about being unavailable to provide protection and security for their wives (De la Mare & Walker, 1968). Parenting also seemed to suffer greatly with fixed afternoon shifts and for these individuals during week days, school age children may be only seen while they are asleep. Mott et al (1965) reported that individuals on fixed afternoon shifts have

the greatest difficulty communicating with their children, compared to those on other shift schedules.

Night shifts:

This form of shift schedule causes the greatest disruption to sleep and circadian patterns, therefore very few work schedules now use fixed night shifts. It does have certain advantages, particularly the opportunities to spend time with family. Gadbois (1981) reported that 85% of nurses requested night shifts to allow them to spend time with their young children. Although, those nurses with children got less sleep than their fellow workers who do not have children. Night workers also complain of sexual dissatisfaction. Due to their work schedule and other obligations they find coordinating time for privacy with their partner much more difficult. Khaleque and Rahman (1984) reported that 85% of fixed afternoon workers and 61% of rotating shiftworkers felt their work schedules disrupted their social life. In comparison only 33% of night shift workers expressed this view.

Rotating shifts:

Workers on rotating schedules experience some of the extreme advantages and disadvantages of the different fixed shifts. The major advantage of this form of shift schedule is that the physiological effects of night work are shared across the entire pool of workers and hence they are only experienced periodically.

However, unique problems are created by this form of shiftwork. Partners of rotating shiftworkers report difficulty scheduling events because of the variability of schedules (Mott et al, 1965). Both workers and their partners report fewer friends than those on day shift and more family friction and interference between work schedules and family activities are noted (Walker, 1985). Men working this type of schedule report problems with sexual relations, finding time for companionship and communicating with children (Mott et al, 1965). Child care availability is a problem for rotating shiftworkers and Gadbois (1981) states that nurses agree to work fixed night shifts rather than rotating shifts because of the concern with this issue.

Rotating schedules often mean weekend work, further limiting family and social time. Weekend work, more than actual hours worked, has been frequently noted as one of the most dissatisfying aspects of this form of shiftwork (Banks, 1959; Chadwick-Jones, 1969; Shamir, 1983). Staines and Pleck (1984) reported that working non-standard schedules (weekends and irregular patterns) was associated with poorer quality of life and fewer hours per week spent with children.

Activities associated with the home are facilitated by a rotating schedule but activities that are time inflexible, such as visiting friends and social outings, are hindered by such a schedule (Herbert, 1983). Kurumatani et al (1994) found that nurses working on such a schedule spent more time on housekeeping but slept less and had less time for leisure activities. Therefore on the whole, time flexible activities are aided by rotating schedules and time inflexible activities are impaired.

Despite the advantages and disadvantages posed by this form of schedule it is thought that the effective use of free time may be hindered because of the strain produced by the variable schedule (Colligan & Rosa, 1990). It is suggested that rotating shiftworkers get less sleep than workers on fixed shifts (Tepas, Walsh & Armstrong, 1981) and report higher incidences of depression, confusion, tension and fatigue (Jamal & Jamal, 1982). The extra time available to perform activities may then be reduced by malaise and lethargy from the work schedule (Colligan & Rosa, 1990).

Monk and Folkard (1992) claim that three spousal roles can be affected by shiftwork; that of a care giver, social companion and sexual partner. Not suprisingly there are different problems which face females and males, depending on the roles they assume in the home. Female shiftworkers seem to encounter more of a problem than their male counterparts, probably because they are often still expected to carry out normal household tasks to the detriment of good sleep patterns.

Social isolation is another concern. With the high percentage of complaints from shiftworkers about the interference of shiftwork with social pastimes, Cohen (1988) proposes that shiftworkers may be at a greater risk from stress related complaints because of the lack of social support networks to ‘buffer’ individuals from

environmental stressors. Schmieder & Smith (1996) suggest that social support may be particularly significant in moderating the effects of shiftwork as a stressor. They also report findings that indicate social support from an individual's supervisor is important in reducing work related stress. Such a relationship was not found for day workers, possibly because of the greater access to outside sources of social support (Schmieder & Smith, 1996).

In some domestic situations family issues dictate the need for one of the parents to work shifts. Financial pressure may dictate the need for both parents to work, if so one of them may be forced to seek shiftwork so that child care can be provided (Presser, 1988). In some situations the financial situation may also result in one parent seeking two jobs and in order to combine them, one job must generally work on some sort of shift schedule. Many urban workers also elect to work shifts in order to avoid the rush hour traffic of the normal working day (Tepas, Duchon & Gersten 1993).

1.3.3 Sleep Factors

Some people seem to be more readily able to ignore their body clock, allowing them to sleep at unusual times. These people suffer less from the social and medical difficulties that other shiftworkers encounter, which may suggest that these are in some way linked to sleep disturbances (Tepas & Carvalhais, 1990).

It is reported that shiftworkers get five to seven hours less sleep per week than those who only work during the day and that sleep often becomes a major preoccupation for these individuals. Any sleep deficit is important in the effect it has on a workers mood and performance. Some shiftworkers state that if they could only solve the difficulties associated with sleeping then shiftwork would be quite tolerable (Tepas, 1982a). A night workers reduced sleep length is not only associated with decrements in performance but is also believed to be the forerunner to health problems (Lavie, Chillag, Epstein, Tzischinsky, Givon, Fuchs & Shahal, 1989).

Disrupted sleep is more a symptom than a cause of poor coping, since circadian adjustment is important in sleep onset and cessation. Social and domestic factors also influence sleep periods and quality and sleep interruptions are more likely for shiftworkers.

A survey by the Royal Air Force Institute of Aviation Medicine (RAF IAM) (1988) found that 30% of Air Traffic Controllers had interests or hobbies that affected the times at which they slept. Four percent had jobs other than that of controlling that also affected sleep times. The average sleep requirement of an individual Air Traffic Controller was reported to be 7.41 hours. The actual total sleep time on duty days was 6.61 hours and 7.15 hours on non-duty days.

Unlike day workers, night and evening/afternoon workers tend to sleep after work rather than before. On non-work days they then reverse this and adopt the sleep strategies of the day worker (Tepas & Carvalhais, 1990). This is illustrated in *Figure 4*.

A multitude of studies have found repeated night work leads to decreased sleep length and an increase in sleep complaints (Armstrong, 1982; Gersten, 1987; Tepas, 1982a, 1982b). Permanent night workers sleep longer on their days off but less total hours per week, on average, than day workers (Tepas & Carvalhais, 1990). These findings are clear evidence that the effects of shiftwork are very likely to be chronic.

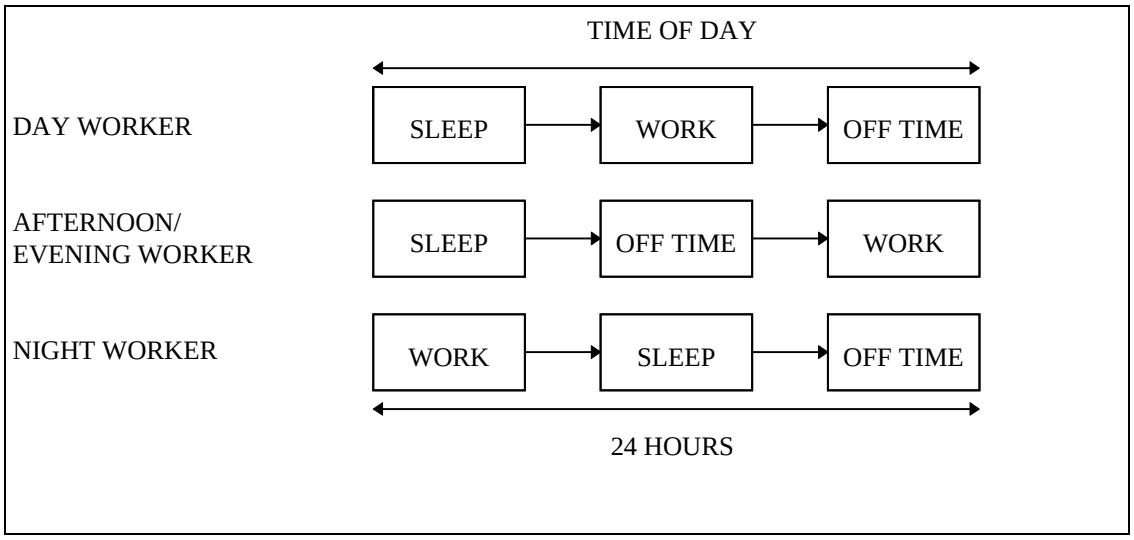

Figure 4: Model of Typical Work/Sleep/Off Time Strategies Used by 90% of Workers on the Day, Afternoon/Evening, and Night Shifts (Tepas, Walsh & Armstrong, 1981)

The shorter sleep length of night workers has been blamed on circadian factors (Akerstedt & Gillberg, 1981), environmental conditions (Kolgi, 1982) and day time social obligations (Tepas, 1982b). Female shiftworkers have been shown to get less sleep on average than their male counterparts, particularly those women who work night shifts. Their shortened sleep is thought to be due to added social commitments and domestic responsibilities (Gadbois, 1981).

There is also evidence to suggest that age has a pronounced effect on the normal decline in daily sleep length and the finding of age related changes with shiftwork have been fairly consistent. A number of studies have found that both age and prolonged exposure to shiftwork determine a workers ability to tolerate shiftwork (Akerstedt & Torsvall, 1981; Haider et al, 1981). The critical age is seen to be 40 years and at some point after this, shiftwork becomes very difficult. The reason for this change is not clear. The literature suggests it may be due to altering circadian characteristics and studies suggest that with age we become increasingly 'morning' oriented and hence go to bed earlier and rise earlier. Another factor that results in older people finding it more difficult to tolerate shiftwork is slightly poorer health as a result of biological aging.

In summary, sleep demands influence other factors in determining tolerance to shiftwork, as much as being a product of them. The need for sleep is thought to attribute to domestic disharmony, mainly because sleep loss leads to irritability. Adjustment of an individual's circadian rhythms may be further disrupted by an individual sleeping at inappropriate times due to fatigue, or sleeping for shorter more frequent periods.

1.3.4 Shift and Work Factors

Monk (1994) states that difficulties in coping with shiftwork arise from factors within an individual and from work place factors. Some of the specific factors that cause problems have been identified and are listed in Table 1. The majority of these factors are important because of the impact they have on an individual's circadian rhythms, sleep patterns and/or social and domestic life.

Many of the factors listed previously apply to Air Traffic Service (ATS) staff. Obviously shifts involving heavy physical work and exposure to harmful agents or substances are not relevant to this occupational group and the problems associated with working night shifts, of rotating hours, a backwards rotating schedule, weekend work and complicated schedules have previously been discussed.

Increasing working hours beyond the normal eight hours per day has both advantages and disadvantages (Tepas, 1985c). Extended hours result in a compressed working week which in turn allows greater flexibility for leisure time but it seems that the negative features may outweigh the positive ones. This is particularly so if night work is involved. Potential disadvantages include excessively fatigued workers, difficulty with child care and family life, scheduling problems with weekend work and an increase in worker error rate (Tepas, 1985c). Kelly and Schneider (1982) predict an increase in worker error rate of 80-100% when changing from an eight hour shift to a twelve hour shift.

Table 1: Factors Associated with Work Systems and Work that are likely to cause Shiftwork Coping Problems.

- More than five night shifts in a row without days off
- More than four, 12 hour night shifts in a row
- Morning shift starting times earlier than 0700
- Rotating hours that change once per week
- Less than 48 hours off after a run of night shift work
- Excessive regular overtime
- Backward rotating hours
- Shifts involving critical monitoring tasks

- Shifts involving a heavy physical workload
- Excessive weekend working
- Long commuting times
- Split shifts with inappropriate break period lengths
- Shifts lacking appropriate shift breaks
- Shifts with exposure to harmful agents or substances
- Overly complicated schedules making it difficult to plan ahead

The type of task being performed is also an important consideration in determining the effect of extended working hours. For example, performance on vigilance tasks such as those performed by Air Traffic Controllers, has been shown to be very sensitive to fatigue and sleep deprivation (Froberg, 1985; Johnson, 1982).

Knauth (1993) states that the distribution of leisure time is very important for sleep, fatigue, well-being, social and family life as well as for the overall satisfaction of the shiftworker with the shift system. Too many working days in succession result in accumulated fatigue. The German chemical industry has a shift system which has 20 working days in a 21 day period followed by a week off. After some time on this shift schedule, workers found that it took them three to four days of their time off to recover, leaving only three to four days for leisure activities. A shift system must therefore allow enough time for recovery. Knauth (1993) recommends that every shift system should include at least two consecutive days off and some free weekends. Although there is no optimal solution for the timing of shifts there is much evidence to indicate that an early start for a morning shift should be avoided. One reason against early starts is the reduced sleep obtained prior to this shift, since the majority of individuals do not go to bed earlier than normal (Folkard & Barton, 1992). Other concerns are increased fatigue and the increased risk of errors during morning shift (Folkard & Totterdell, 1992; Knauth, 1993).

Long commuting times have the effect of extending the working day and if this time is excessive it can impinge on the length of sleep obtained. Tepas and Monk (1987) state that commuting time particularly affects female shiftworkers who generally have responsibility for household management and child care.

Split shifts and shift breaks are two means of breaking up the working day in order to overcome the effects of fatigue. However, if the breaks in split shifts are inappropriate or insufficient they can result in significant worker hardship (Tepas & Monk, 1987). Commuting time is again an important factor since in conjunction with shift breaks and split shifts the total time dedicated to work can be extended beyond 8 hours.

The report by the Committee on the Regulation of Air Traffic Controllers hours (1990) investigated the influence of work place and shift factors on fatigue and subsequently made a number of recommendations. These are listed in Table 2. The aim of these recommendations was to alter shift systems in order to delay the onset of fatigue rather than allowing recovery from it.

A survey by the RAF IAM (1988) of Air Traffic Controllers found that the duration of a shift and the interval between breaks were viewed as considerable stressors. Shift patterns were also noted as stressful, although less than the factors mentioned above. Fatigue scores were found to be higher on shifts starting between 2000 and 2400, indicating that time of day is an important determinant of Air Traffic Controller fatigue.

Table 2: Recommendations made by the Committee on the Regulation of Air Traffic Controllers Hours, United Kingdom (1990).

- Duty periods should not exceed 10 hours.
- There should be no less than 12 hours between duties.
- Delaying shift systems should be encouraged (morning to afternoon to evening) rather than advancing (night to afternoon to morning) in rapidly rotating systems.
- The number of consecutive days worked should be limited, particularly successive night and early morning shifts, and no more than 2 night shifts should be worked in succession (to reduce the accumulation of fatigue).
- No more than 2 hours should be worked without a 30 minute break.

1.3.5 Job Satisfaction

In an early study on the satisfaction with shiftwork, Wedderburnn (1978) compared three different shift schedules of British steelworkers. He found sleeping difficulties and social relations to be reported as dissatisfying aspects of shiftwork. Despite this, 18% of the workers said they liked shiftwork and certain shifts were reported to offer different advantages. Afternoon shifts were thought to be best for providing sleep opportunities, while night shifts were seen to provide more spare time and allow greater freedom from supervision. Days off, hours worked per shift, overtime and compensation are other factors that were found to influence satisfaction with shiftwork.

Despite the unique nature of an Air Traffic Controllers job, the main influences on their job satisfaction accord well with theories of job satisfaction (Arvey, Carter & Buerkly, 1991). Hopkin (1995) states that Air Traffic Controllers like controlling aircraft but they do not always like the conditions under which they have to operate. Smith, Cobb and Collins (1970, cited in Smith, Melton & McKenzie, 1971) report that Air Traffic Controllers find one of the most positive aspects of their profession to be the fast paced, challenging, constantly changing nature of their task while job dissatisfaction stems from scheduling, management and the quality of equipment. Similarly, Smith (1973) found job dissatisfaction in Air Traffic Controllers was focussed on management factors and working conditions but despite this 92% of individuals expressed satisfaction with their work. In comparison, 80% of workers in other occupations report being satisfied with their work.

In 1981, 11,500 North American Air Traffic Controllers walked out of work (although not a scientific study) and the source of their dissatisfaction appears to have been with their work environment rather than their actual work. This reflects a theme shown in the literature mentioned above. The North American Air Traffic Controllers consistently stated that they found the quality of management and administration to be dissatisfying. Jones (1982) criticised the management of North American Air Traffic Controllers as being insensitive, inflexible and overly authoritarian.

Saldivar et al (1977) compared Air Traffic Controllers on a 2-2-1 cycle to those on a 5 day rotation. They reported that approximately half the Air Traffic Controllers on each schedule were satisfied with their work schedules and those who indicated a preference for a schedule other than the one they were on, tended to prefer a schedule with few or no midnight shifts.

Existing literature suggests that there is a relationship between how an individual feels about their job and mental health (Warr, 1987). Rice (1984) has demonstrated a strong correlation between job satisfaction, life satisfaction and the relative absence of psychiatric symptoms.

Kavangh, Hurst and Rose (1981) state that there is a positive relationship between job satisfaction and psychological health in Air Traffic Controlling. In addition, MacLennan and Peebles (1996) found that job satisfaction was a leading predictor of symptoms of gastrointestinal disorders and of headache and vision problems in Air Traffic Controllers. Rose et al (1978) also reported that poor morale and job satisfaction predicted a higher incidence of non-cardiac illness in Air Traffic Controllers and Tattersall, Farmer and Belyavin (1990) found a relationship between Air Traffic Controllers dissatisfaction with management and the development of adverse health effects.

1.3.6 Coping Strategies

Some shiftworkers seem to be able to develop strategies that effectively help them deal with each area that influences their ability to cope with shiftwork. Barton et al (1995) proposed that the use of coping strategies improves an individual's ability to tolerate shiftwork. The use of these strategies is thought to show a greater commitment to shiftwork and a more disciplined use of time. Minors et al (1994) also suggest that individuals differ in their ability, or willingness, to develop coping mechanisms for shiftwork.

The importance of developing coping strategies to deal with shiftwork is reflected in the number of booklets and guidelines for shiftworkers that deal with this issue (eg: Koen, 1984; Monk & Folkard, 1992; Wedderburn, 1991). Despite this, very little research has been undertaken that examines how effective an individual's coping strategies are at maintaining their health and well-being.

Previous research on coping with shiftwork has been based on general models of occupational stress and coping (Olsson, Klandolin and Kauppinen-Toropainen, 1990) or based on interview data (Adams, Folkard & Young, 1986). Spelten et al (1993) believes that there is a need for a more systematic approach to investigating why some individuals cope better with shiftwork than others.

Coping as a psychological construct and its role in moderating the effects of shiftwork as already been briefly discussed. Earlier research on coping has distinguished between emotion focussed coping, which is aimed at controlling emotions, and problem focussed coping, which is aimed at dealing with the problem (Lazarus, 1966). Another approach is based on the approach/avoidance dichotomy and distinguishes between engagement and disengagement processes (Scheier, Weintraub & Carver, 1986; Tobin, Holroy & Reynolds, 1984). Engagement refers to attempts to engage in active efforts to manage or change the source of stress, while disengagement refers to attempts to avoid or ignore the sources of stress. Both engagement and disengagement strategies may involve the earlier recognised forms of emotion focused and/or problem focussed coping (Scheier et al, 1986)

Much of the previous research on coping strategies has focussed on the development of sleep strategies (Kogi, 1985) but, as it has already been argued, coping strategies need to be developed in all areas that affect tolerance to shiftwork. It is suggested that some coping strategies are more successful than others and as such Folkard, Monk and Lobban (1978) found that the circadian rhythms of full-time night nurses were more adjusted to their work/sleep schedule than those of part-time nurses. This finding was related to the greater lifestyle commitment to night work by the full-time nurses. Another study focussed on night working nurses who adapted to night work

despite other factors predicting they would find it difficult. These nurses were found to be very disciplined in their use of time (Adams et al, 1986).

Spelten et al (1993) also investigated the coping strategies used by shiftworking nurses. They found that the use of disengagement strategies related to poorer psychological health and that individuals who used engagement strategies in conjunction with disengagement strategies showed improved psychological health. Although there is a relationship between disengagement and psychological health no causal inferences can be drawn. Spelten et al (1993) suggest that individual's with poorer psychological health disengaged as a result of their inability to cope successfully with the situation, rather than their poor psychological health resulting in the use of disengagement strategies. Their argument was supported by the finding that individuals who used both disengagement and engagement strategies showed better psychological health than individuals who only used disengagement strategies. Their findings also suggest that coping with shiftwork is an ongoing iterative process and individuals adjust the use of engagement strategies according to the level of problems they experience. The use and effect of disengagement strategies appears to be more dichotomous, in that they were either used or not, and this indicates that individuals only disengage when their problems are severe.

In investigating the ability of Air Traffic Controllers to cope with shiftwork the RAF IAM (1988) reported that 71% of Air Traffic Controllers stated shiftwork was easy to cope with but 46.4% also stated that shiftwork was more difficult to cope with over time. Those over 39.7 years of age reported more adversely in these matters. Heslegrave, Rhodes, Szlapetis, Ujimoto, Hahn and Moldofsky (1995) report that 30% of Air Traffic Controllers in the 25-29 age group found shiftwork slightly more difficult to cope with as they got older. In the 35-39 year old age group 52% found shiftwork slightly more difficult to cope with and 28% found it much more difficult to cope with. By 40-44 years of age 43% and 42% found shiftwork slightly and much more difficult to cope with respectively.

In summary, there is very little literature that addresses the relationship between coping with shiftwork and well-being of shiftworkers. The findings of one study

suggests that the use of different types of strategies is related to psychological well-being. Despite the limited research it is recognised that coping is an important part of tolerating the effects of shiftwork.

1.4 Research Goals

Although a relatively small research area, shiftwork in general has received a disproportionate amount of attention from researchers. This is possibly due to the far reaching consequences of incidents related to shift systems. Despite being a well researched topic, there is still much disagreement over the exact effects of many factors on the well-being of shiftworkers.

There are three significant reasons for this present research. Firstly, to investigate the reliability of a questionnaire for use with Air Traffic Service staff. Barton et al (1995) state that currently there is a lack of standardised questionnaires appropriate for use in a range of work places and countries. The questionnaire used in the present study included a questionnaire developed by Rhodes, Szlaptis, Hahn, Heslegrave & Ujimoto (1994) specifically to assess the impact of shiftwork on Air Traffic Controllers and two scales from the Standard Shiftwork Index (Barton et al, 1995). In order to be sure of the questionnaire's usefulness in this work context it was first considered necessary to determine its reliability.

The second reason for the present study is to add to the pool of research findings. Colquhoun and Rutenfraz (1980) believe that the detrimental effects of shiftwork are due to unsuccessful coping with a constantly changing daily pattern, but the health effects of unsuccessful coping are still unclear. Gastrointestinal problems are believed to be more prevalent in shiftworkers but there is ambiguity regarding the prevalence of other physical and psychological problems. From the previous discussion it is suggested that there are a number of factors that will influence the ability of an individual to tolerate shiftwork. These are the circadian typology of an individual, the amount of sleep they get, aspects of the work system, coping strategies and a range of social and domestic factors. At present little is known about which of these factors are important in predicting the health of shiftworkers.

The third reason for the present study is to be able to make a more accurate statement about tolerance to shiftwork in a particular work context. There are few studies that have investigated the effects of shiftwork on Air Traffic Controllers and those studies that do exist have tended to focus on the incidence of sleep related changes. Air Traffic Controllers are well aware that their work schedules are fatiguing but the consequences of this fatigue has not been well investigated. Air Traffic Controlling is also a unique occupation and individuals who work in this area must meet certain health requirements. In addition, Air Traffic Controllers are to some extent a "survivor population", in that individuals who do not adjust well to shiftwork would probably not choose such an occupation or would transfer to another job at the beginning of their careers. Because of such peculiarities it is not always possible to generalise findings from other shiftwork studies.

1.4.1 Aims of the Present Study

The first aim of this research is to investigate the usefulness of a questionnaire for measuring shiftwork related problems in Air Traffic Services.

The second aim is to determine which factors including the circadian typology of an individual, the amount of sleep, aspects of the work system, coping strategies and social and domestic factors, are important in predicting the physical and mental well-being of Air Traffic Service staff.

1.5 Hypotheses

The literature strongly suggests that the inability to cope with shiftwork is manifested in health problems (Barton et al, 1995; Haider et al, 1981; Monk & Folkard, 1992). Therefore, the following variables were selected as dependent variables in the present research; physical well-being, self rated health and mental health.

It is also clear from the literature that there are a number of factors important in determining an individual's tolerance to shiftwork, hence the following hypotheses are proposed:

Hypothesis 1: Individuals who are evening oriented will have better physical well-being, higher self rated health, and better mental well-being than individuals who are morning oriented in their circadian typology.

Hypothesis 2: The less shiftwork is perceived to have an effect on, and cause difficulties with, social life and domestic life the better an individual's physical well-being and better mental well-being, and the higher their self rated health.

Hypothesis 3: Individuals with fewer domestic commitments and greater spousal support will have better physical well-being, higher self rated health, and better mental well-being than individuals with greater domestic commitments and less spousal support.

Hypothesis 4: Individuals who have spent less time as shiftworkers will have better physical well-being, higher self rated health, and better mental well-being than individuals who have had a longer exposure to shiftwork.

Hypothesis 5: Individuals who have stable work schedules and work on shift cycles that conform to a normal work week will have better physical well-being, higher self rated health, and better mental well-being than individuals who have more irregular work schedules.

Hypothesis 6: Individuals who experience fewer difficulties with their performance due to shiftwork, have fewer problems with the organisation, and report greater satisfaction with their work will have better physical well-being, higher self rated health, and better mental well-being than individuals who find shiftwork causes performance problems, believes the organisation has difficulties, and reports less satisfaction with their work.

Hypothesis 7: Individuals who experience few sleep related difficulties will have better physical well-being, higher self rated health, and better mental well-being than individuals who experience problems with sleep.

Hypothesis 8: Individuals who find it easier to cope with shiftwork and use engagement strategies in coping will have better physical well-being, higher self rated health, and better mental well-being than individuals who find it difficult to cope with shiftwork and use disengagement strategies in coping.

2. METHOD

2.1 Overview

Shiftwork studies generally utilise three experimental methods; field studies, laboratory simulations and surveys (Monk & Folkard, 1992). Field studies are rare because of their high cost and the political difficulty of collecting objective data over extended periods of time. Laboratory simulations have resulted in detailed sleep and circadian information but have ignored the social and domestic aspects of shiftwork. Survey studies have been the most common approach in studying shiftwork as they allow measurement of a wide range of variables. Because of the lower cost of this approach, the practical limitations with gathering data in an overseas setting, and the success of previous research on which this study is based, a cross-sectional survey format was chosen for collecting data in the present study.

It is widely recognised that one of the main problems with existing shiftwork research is the lack of standardised measures (Nachreiner, 1990; Wilkinson, 1992; Barton et al, 1995). As a result, efforts have been made to develop questionnaires that could be used in a range of work places and countries, for example, the Standard Shiftwork Index (SSI) developed by Barton et al (1995). The SSI is a lengthy questionnaire and not all questions are suitable for ATS staff. So there is still a need for a well validated, self report questionnaire that is appropriate for use with ATS personnel.

The measures used in this study were chosen because they had either been used previously with Air Traffic Controllers or were considered appropriate for use with this population. It was also important that the questionnaire was easy to administer in an overseas setting and an acceptable length.

For some of the measures used in this study little psychometric information was available. It was therefore considered a necessary first step to determine the questionnaire's reliability. Sixteen Air Traffic Controllers from Ohakea Air Force Base, New Zealand completed the questionnaire on two separate occasions, with a 4 week test-retest period. Results indicated that the majority of variables had good

reliability while other variables were excluded from use in the main study because of their poor reliability. Further details of participants, procedures and results of this study can be found in Appendix A.

2.2 Participants

One hundred and eighty three Air Traffic Controllers, Flight Service staff and Flight Data Officers employed by AirServices Australia were involved in the present study. Individuals were all based at Melbourne International airport which provides air traffic services in the following areas; tower control, terminal and en-route radar control, flow control, procedural control, flight service information and flight data assistance.

A total of 263 questionnaires were distributed over a period of three days. In the following four weeks a total of 183 completed questionnaires were returned. This yielded a response rate of 70%. The high return rate is thought to be due to the widespread concern about the detrimental affects of shiftwork, although several individuals also voiced distrust about the managements use of the results.

2.3 Measures

A study by Rhodes et al (1994) developed a questionnaire to specifically assess the impact of shiftwork on Air Traffic Controllers. This questionnaire contained 114 items relating to a variety of areas which included demographics, job and shift characteristics, social and family factors, subjective health, sleep duration, job satisfaction, and strategies used in coping with shiftwork. The questionnaire was constructed from portions of the SSI (Barton et al, 1995). In addition, professional input on the construction of this questionnaire was received from the Air Traffic Controller Occupational Health programme (Canada), The Canadian Air Traffic Controllers Association and operational Canadian Air Traffic Controllers.

The questionnaire by Rhodes et al (1994) did not include a measure of mental health or coping style. Therefore scales from the SSI (Barton et al, 1995) were also included in the present study.

In order to reduce the number of variables in subsequent analyses, certain variables were examined to see if they were suitable to be combined (Tabachnick & Fidell, 1989). Single variables were calculated for items relating to the effects of aspects of shiftwork on family life, the effects of shiftwork on off-work activities and personal relationships and the adequacy of breaks during work.

The questionnaire used in the present research is reproduced in Appendix D and comprises of the following measures:

2.3.1 Demographic Items

A number of general items were used to record age, gender, marital status, ethnic group and educational level. Job related questions such as length of time in ATS, length of time in current position, type of work, primary duties and periods working overseas or absence from ATS were also included.

2.3.2 Shift and Hours of Work Information

Shift information was recorded by participants selecting their current shift cycle from several listed. They were also asked the number of months they had worked on this cycle. A further question asked about the shift schedule. Again respondents selected a schedule from those listed. Two items ascertained the shift cycle and shift schedule individuals would prefer to work.

Additional questions regarding shift factors dealt with the frequency of short change shifts (shifts with less than 12 hours between the end of one shift and the start of the next), the maximum number of days worked consecutively in the last six months, and the number of consecutive midnight shifts worked in the last six months. A single item recorded how frequently individuals changed their regular shifts in order to accommodate other activities.

Two questions referred to hours of work. The first pertained to the typical number of hours of overtime an individual would work under normal circumstances and under 'peak traffic' or 'under staffed' periods.

A second question required individuals to rate, on a six point Likert scale, whether they felt they were able to get sufficient breaks on each type of shift to maintain their level of alertness and performance. A single variable, which was the average rating for each shift, was calculated. Higher scores on this item relate to individuals perceiving they have insufficient breaks. Inter-item correlations were moderate to high and ranged between .33 and .81.

As included in the Standard Shiftwork Index (Barton et al, 1995) a question asked how long it took to travel to and from work on each different shift. An additional item questioned if individuals had ever fallen asleep when driving to or from work.

2.3.3 Circadian Factors

Composite Scale of Morningness (CSM)

The CSM was developed by Smith, Reilly & Midkiff (1989) in response to the poor, or lacking, psychometric properties of previous morningness questionnaires. Items in the scale originate from two earlier morningness questionnaires, those of Horne and Ostberg (1976) and Torsval and Akerstedt (1980). Factor analyses of these scales resulted in 13 items being selected for the CSM. Each item is scored in Likert-like format, with three items having a 5 point range and the remaining 10 items a 4 point range. A higher overall score indicates morning preferences and a low score indicates evening preferences. A moderate score is categorised as being of an intermediate type.

Two items from the CSM were included in the questionnaire by Rhodes et al (1994) as a measure of morningness. Rhodes et al (1994) found the responses from just two questions difficult to interpret. Because morning/eveningness has been shown to be a good indicator of circadian and sleep adaptability the entire CSM was included in the

present questionnaire. This entire scale is also found in the Standard Shiftwork Index (Barton et al, 1995).

The CSM has been correlated with many external criterion, including mental and physical performance, timing of sleep, and sleep difficulties (Smith et al, 1989). Inter-item correlations in a previous study were all found to be acceptable. They ranged from 0.13 to 0.79, with a mean of 0.36 (Smith et al, 1989). The coefficient alpha of the entire scale in previous studies has been found to range between 0.87 and 0.88 (Smith et al, 1989; Greenwood, 1994), and indicates good internal consistency. Inter-item correlations in the present study ranged from .05 to .80 and the alpha coefficient for the present sample is 0.88 (M = 35.6, SD = 6.89, N = 182). This confirms the reliability reported in previous studies.

2.3.4 Sleep Factors

Average sleep length on different shifts was recorded. The question asked for an estimate of the total hours of sleep when working each different shift and the total hours of sleep obtained on days off. It was also asked whether the sleep obtained was continuous or split up into different periods.

2.3.5 Social and Domestic Factors

A number of items gathered information on domestic issues, domestic support and the impact of shiftwork on an individual's social and family life. Three questions referred to the shiftworker's partner and asked about their current work schedule, work hours and the level of support the shiftworker felt they received from them. Higher scores on the support item indicated a lower level of perceived support.

Other items that dealt with the domestic situation asked about the number of children living in the home and the presence of any other dependents. Three items were used to determine the perceived effect of shiftwork on family life. These items were scored on a six point Likert scale and asked about the effect of the shift cycle, shift schedule, and overtime on family life. Inter-item correlations for these 3 items range

between .34 and 0.80, with a mean of .50. An alpha coefficient for these items was not calculated as Joyce and Slocum (1984) suggest that for scales with a small number of items, mean inter-item correlations are a better estimate of internal consistency. This is because alpha is a function of both the average correlation among items and the number of items.

Subjective ratings regarding the effect of shiftwork on social life were scored on a six point Likert scale. Six items dealt with the impact of shift cycle, hours of work and overtime on leisure activities and personal relationships. These six variables were summed to produce a single score. Inter-item correlation coefficients were moderate and ranged between .11 and .71. An alpha coefficient of .80 was calculated for the six items.

Higher scores on both the social and domestic subjective rating items indicated a greater perceived impact of shiftwork on these factors.

2.3.6 Coping Style

Coping with Shiftwork Questionnaire (CSQ)

The CSQ was included as a measure of coping. The CSQ was developed because existing measures of coping were considered too long and not specific to shiftwork. The CSQ is a modified version of the Coping Strategies Inventory (Tobin et al, 1984). It was developed for use in the shiftwork context and has been included in the SSI (Barton et al, 1995).

The CSQ was not part of the questionnaire constructed by Rhodes et al (1994) but was included in the present study because of the availability of psychometric data and its subsequent use in several shiftwork contexts (Barton & Folkard, 1993; Barton, Smith, Totterdell, Spelten & Folkard, 1993; Spelten et al, 1993).

Items in the CSQ cover the use of engagement and disengagement strategies within four problem areas for shiftworkers which include disruption to sleep, social life, domestic life and work. Individuals are asked to rate the use of eight different coping

strategies for each problem area, giving a total of 32 items. Each item is scored on a five point Likert scale. Scores were calculated on the two sub-scales of engagement and disengagement by combining relevant questions from each of the four problem areas. Higher scores on the sub-scales indicate greater use engagement or disengagement strategies.

Inter-item correlations have been found to be moderate to high, ranging from 0.30 to 0.63 (Spelten et al, 1993). The sub-scales of the CSQ have moderate to high internal consistency, with alpha coefficients ranging from 0.56 to 0.89 (Spelten et al, 1993). In the present study alpha coefficients for the two sub-scales of engagement and disengagement were .80 and .91 respectively.

Age and Coping

A single item asked if individuals had found it more difficult to cope with shiftwork as they had grown older. Ratings were made on a six point Likert scale, with higher scores indicating less difficulty in coping with shiftwork with increasing age.

Global Questions

Four global items questioned the extent to which shiftwork caused problems with sleep, social life, domestic life, and work performance. Individuals were also asked if they felt there were organisational problems at their work and whether they found it difficult to cope with these problems. All these items are included in the Standard Shiftwork Index (Barton et al, 1993).

Each item was rated on a five point Likert scale, with higher scores indicating a greater level of perceived problem or greater difficulty coping with the problem.

2.3.7 Job Satisfaction

Individuals were asked how much they agreed with four statements relating to satisfaction with the kind of tasks they do, the job as a whole, the shift cycle they work, and the daily hours of work. Each item was rated on a six point Likert scale, with higher scores indicating greater disagreement with the statement.

2.3.8 Well-being

Physical Health Scale

This scale comprised twenty questions relating to health and illness. Questions related to three areas of physical health and asked the frequency with which events, feelings or symptoms occurred. The first area covered by the scale was health and sleep and included questions regarding health, exercise, diet, quality of sleep and ease of sleeping. The second area included questions relating to the presence of symptoms of ill health. The final area referred to fatigue and mood related problems. Each item was scored on a six point Likert scale, with higher scores indicating greater frequency of events, feelings or symptoms. Some items were reverse coded so that when responses on all items are summed, higher scores indicate poorer physical well-being.

Inter-item correlations, for the present sample, were found to range between .01 and .64 and alpha coefficient was calculated as .86, indicating moderate internal consistency.

Self Rated Health

Physical well-being was also assessed with a single item. This question was not present in the questionnaire developed by Rhodes et al (1994) but was included because of lack of psychometric data on the existing physical health scale.

The question asks individuals to rate their current health compared with a person in excellent health on a seven-point Likert scale. Scores range from 1 (terrible) to 7 (excellent). Such ratings have been shown to be better predictors of mortality than other indicators of physical health (Idler & Angel, 1990). Self rated health has also shown reasonable correlations with physician's ratings of an individual's health (Idler & Kasl, 1991).

General Health Questionnaire (GHQ)

The questionnaire by Rhodes et al (1994) contained no scale for mental health, yet there is a great deal of evidence to indicate that an outcome of intolerance to shiftwork is poor mental health (Bohle & Tilley, 1989; Costa et al, 1981; Monk & Folkard, 1992).

In order to correct for this the GHQ was chosen as a measure of mental health. Developed by Goldberg (1972), it is a widely used, well standardised measure, designed to detect minor psychiatric problems in the general population. The items cover recent levels of self-confidence, depression, sleep loss and problem solving, resulting in a single measure of mental health over the previous few weeks. The 12 item version was chosen for use in the present study.

A recent study, using the 12 item GHQ, found that night work has a significant impact on psychological well-being (Bohle & Tilley, 1989). Another study (Spelten et al, 1993), again using the 12 item GHQ, found a relationship between coping and GHQ scores for shiftworkers. The GHQ has been found to correlate well with other mental health measures, including the Hopkins Symptom checklist (Goldberg, Rickels, Downing & Hesbacher, 1976). Split-half reliability has been reported to be .83 (Goldberg, 1987). Internal consistency of the GHQ in the present study was investigated by calculating alpha coefficient. This was .90 and indicates good internal consistency.

Each item has four response options, which were scored as a Likert scale. A total score is calculated, with higher scores indicating poorer psychological health.

2.4 Procedure

The methodology for this study including the questionnaire and participant information sheet were approved by the Massey University Ethics Committee.

Air Traffic Service staff were approached through their workplace and asked to participate in the study. Most of the questionnaires and information sheets (see Appendix D) were distributed by the researcher, who was present for the first three days after initial distribution. In all other cases questionnaires were distributed by the individual's direct supervisor. Additional questionnaires were also available from the Centre Coordinator if one was not received through the normal channels. Once questionnaires were completed they were placed in an envelope and returned to a postal box in one of several locations within the work place.

3. RESULTS

3.1 Analyses

The statistical package, SPSS/PC (Norusis, 1988) was used to analyse the data and investigate the relationships between variables. Analysis of data involved calculating descriptive statistics for variables, and Pearson's correlation coefficients were calculated between continuous independent variables. The hypotheses were then investigated using regression analyses.

3.2 Data Screening

Data was screened prior to statistical analysis in order to determine accuracy of data entry, check for missing values, and ensure that the assumptions of the analyses could be met.

Several transformations were conducted to reduce skewed univariate distributions. The frequency of changing shifts was positively skewed although square root transformation significantly reduced this. The frequency of short change shifts and the extent of organisational problems were both negatively skewed. Logarithmic transformations reduced skewness for both these variables. Logarithmic transformations also reduced skewness for the number of years in current position, the level of spouse support, number of months on current cycle, average time to get to work, level of satisfaction with the kind of work and disengagement. All these variables were initially positively skewed.

All subsequent analyses were undertaken on transformed variables, except in the case of descriptive statistics, untransformed means and standard deviations were reported to assist in interpretation.

For the univariate analyses missing cases were left as missing since they were randomly distributed across variables. Because cases with missing variables were

deleted the number of cases vary for each analysis. Therefore, *N* is reported for each analysis.

In the regression analyses, the cases with missing values were replaced with the mean for that variable. This conservative approach was taken in order to retain cases and maintain statistical power while not changing the mean for the distribution as a whole (Tabachnick & Fidell, 1989).

A single case, with a high *z* score on the General Health Questionnaire was identified as a univariate outlier and was subsequently excluded from further analyses. Multivariate outliers were detected by the calculation of Mahalanbois distance. Three cases were identified as outliers according to a conventional and conservative probability level ($p < .001$) as suggested by Tabachnick and Fidell (1989). Regressions were run with and without the outlying cases and the results were found not to differ. Therefore, it was decided to retain the outliers in order to increase statistical power. All other multivariate assumptions were met (Tabachnick & Fidell, 1989)

3.3 Questionnaire Reliability

The first aim of the present study was to determine the reliability of the questionnaire, since little psychometric data was available for many of the scales. Test-retest reliability was determined through two subsequent administrations of the questionnaire to 16 Air Traffic Controllers at Ohakea Centre, New Zealand.

The detailed results of the reliability study can be found in Appendix A. The questionnaire was deemed to be reliable with the large majority of questions having acceptable reliability coefficients. Some sleep length variables, sleep continuity variables and overtime variables did not have acceptable reliability and were excluded from the remainder of the study.

3.4 Sample Description

Table 3 outlines the demographic data for participants in the main study. All participants were Australian Air Traffic Service personnel working at Melbourne Centre, Australia. Each demographic item was not completed by all participants, so the number of respondents for each item is given.

A total of 183 individuals participated in this study, with 88.5% being males and 11.5% females. The average age of participants was 38 years, ranging from 22 years to 55 years (*SD* = 8.5).

As outlined in Table 3, the majority of participants identified themselves as being of Australian (27.9%) or European (55.2%) ethnicity. A total of 6.7% of the participants identified themselves as British and the remaining 10.3% from a range of other cultures. These included New Zealand, Pacific Island, Irish, North American and Asian cultures.

Only 1.6% of participants had no formal school qualifications and 65% had a formal school qualification as their highest level of education other than their Air Traffic Service training. Nine percent had a trade certificate, professional certificate or diploma and 23.5% of the present sample had a University degree, diploma or certificate

Seventeen percent of participants had never been married, with the largest proportion (64.8%) being married, and 10.4% were currently living with a partner. Only 3.3% of the sample was separated and 9.8% reported being divorced. Exactly 50% of respondents had children and only 2.7% had other dependents, such as parents living with them, while the large majority, 97.2% did not. Tabachnick and Fidell (1989) recommend a split of 10%/90% for dichotomous variables in multivariate analysis since an uneven split on a dichotomous variable deflates its relationship with other variables in subsequent analyses. This variable was therefore not included in further analyses.

Table 3: Demographic Data of Australian Air Traffic Service Staff

Variable	Frequency	Percentage
Gender	183	
Male	162	88.5
Female	21	11.5
Ethnicity	165	
Australian	46	27.9
European	91	55.2
British	11	6.7
Other	17	10.3
Education	183	
No formal school qualification	5	1.6
Formal school qualification	119	65.0
Trade certificate or professional certificate or diploma	16	8.7
University degree, diploma or certificate	43	23.5
Marital status	182	
Never married	31	17.0
Married	118	64.8
Living with partner	19	10.4
Separated	6	3.3
Divorced	8	9.8
Have children	182	
Yes	91	50.0
No	91	50.0
Have other dependents	179	
Yes	5	2.7
No	174	97.2

As shown in Table 5, individuals had worked in ATS for an average of 14.6 years (ranging from 1 year or less to 32 years of service, *SD* = 9.3) and averaged 8.5 years in their current position (ranging from 1 year or less to 32 years, *SD* = 7.5).

Table 4: Summary of Air Service Data

Variable	Frequency	Percentage
Type of work	179	
En-route radar (includes procedural radar)	80	44.7
Terminal radar (includes flow control)	24	13.4
Tower	36	20.1
Flight Service and Flight data	39	21.8
Primary duties		
Operational Controller	118	64.8
Other duties (includes Supervisor, Stream Specialist, Team Leader and Instructor)	38	20.9
Flight Service and Flight data	26	14.3
Current shift cycle	182	
4 on / 2 off	120	65.9
5 on / 2 off, 5 on / 3 off	21	11.5
other	41	22.5
Current shift schedule	181	
ADMG	18	9.9
EADM	9	5.0
AADM	6	3.3
EAMG	49	27.1
no fixed schedule	31	17.1
other	68	37.6
Worked in another country	179	
Yes	9	5.3
No	170	95.0
Absent from AirServices Australia	177	
Yes	26	14.7
No	151	85.3
Preferred shift cycle	182	
4 on / 2 off	104	57.1
5 on / 2 off, 5 on / 3 off	48	26.5
other	30	16.6
Preferred shift schedule	181	
permanent morning shift	28	15.5
permanent day shift	16	8.8
permanent afternoon shift	29	16.0
permanent evening shift	6	3.3
permanent night shift	2	1.1
rotating shifts	100	55.2

Participants were asked about the type of work they did and selected one of six options. It can be seen in Table 4 that in the present sample 44.7% of individuals worked on en-route radar (including procedural controllers) and 13.4% worked on terminal radar (including flow controllers). In the radar centre, controllers were allocated to teams, which control fixed geographic areas. Because of this arrangement of work stations, flow controllers also train as terminal controllers and were therefore grouped with them for analyses. Similarly, procedural controllers also work on en-route radar and were grouped with them for analyses. Tower Controllers comprised 20.1% of the sample and 21.8 % of participants had positions in Flight Service and Flight Data.

When questioned about their primary duties, the majority of respondents were Operational Controllers (64.8%) while 14.3% undertook the responsibilities of Flight Service or Flight Data. The remaining 20.9% of individuals had additional responsibilities, these include the positions of Supervisor, Stream Specialist, Team Leader and Instructor.

Two main shift cycles were worked by Air Traffic staff, with 65.9% of respondents working on a 4 on / 2 off cycle and 11.5% of individuals working on a 5 on / 2 off, 5 on / 3 off cycle. The remaining 22.5% of individuals worked on a wide variety of shift cycles.

Four main shift schedules were commonly worked, these included evening, afternoon, morning night rotations (EAMG) (27.1%), afternoon, day, morning, night rotations (ADMG) (9.9%), evening, afternoon, day, morning rotations (EADM) (5%), and afternoon, afternoon, day, morning rotations (AADM) (3.3%). Some individuals (17.1%) had no fixed shift schedule and 37.6% worked on a variety of other rotating schedules. All shift schedules recorded were backward rotating. That is, each subsequent shift in a cycle had a start time that was earlier than the previous shift. Because of the similarity of all shift schedules and the fact that they were all backward rotating this variable was not included in further analyses.

Individuals were also asked if they had ever worked in another country's Air Service organisation. A small percentage of individuals (5.3%) had, but the majority (95%) had only worked for AirServices Australia. When individuals were asked if they had ever been absent from their position at AirServices Australia for reasons other than normal annual leave or sick leave, 14.7% replied that they had.

Table 5: Means and Standard Deviations for Continuous Variables.

Variable	N	Mean	SD	Range
Age	182	38.45	8.54	22-55
Workplace variables				
Number of years in Air Services	178	14.61	9.28	1-32
Number of years in work position	174	8.49	7.48	1-32
Months on current cycle	176	60.68	82.58	1-371
Number of short change shifts	180	4.13	1.04	1-5
Frequency of changing shifts	176	2.24	1.28	1-5
Consecutive days at work	176	8.46	2.85	4-21
Performance problems	181	2.45	.95	1-5
Organisational problems	182	4.06	.96	1-5
Satisfaction with work tasks	181	1.97	1.08	1-6
Satisfaction with job	181	3.22	1.31	1-6
Satisfaction with shift cycle	181	3.12	1.33	1-6
Satisfaction with hours of work	181	2.67	1.17	1-6
Average travel time	154	30.78	14.27	8.4-100.8
Coping variables				
Coping with organisational problems	182	3.04	1.16	1-5
Ability to cope with increasing age	182	3.48	1.45	1-6
Engagement	175	43.90	8.69	16-67
Disengagement	169	31.76	11.42	16-71
Social and domestic variables				
Social problems	182	3.40	.99	1-5
Domestic problems	182	2.90	1.06	1-5
Effect of shiftwork on family life	159	11.30	3.17	3-18
Effect of shiftwork on social life	176	22.04	5.01	10-36
Spouse support	141	2.14	1.17	1-6
Sleep variables				
Day shift sleep	153	7.37	1.00	5-11
Afternoon shift sleep	177	7.84	.91	5-10
Evening shift sleep	159	7.81	1.09	5-10
Sleep problems	182	3.17	1.06	1-5
Circadian factors				
Morningness	182	35.60	6.89	18-50
Dependent variables				
Physical Well-being	122	57.89	14.34	28-100
GHQ	181	12.36	5.48	0-32
Self Rated Health	181	4.83	1.21	1-7

3.5 Descriptive Statistics

3.5.1 Workplace Variables

The descriptive statistics for both the number of years in AirServices and the number of years in the current work position have been previously mentioned in the sample description and can be found in Table 5. Frequency distributions for both the number of years in AirServices and the number of years in the current work position can be seen in Figure 5. The graph highlights the fact that a large portion of the sample had spent between 1 and 8 years in both AirServices and in their current work position. There was a very noticeable decrease in the number of individuals who have spent 9 to 12 years in AirServices and in their current position. Subsequent to this, the number of individuals who had spent greater than 12 years in AirServices and in their current work position rose again until dropping off after 29 years and 24 years respectively.

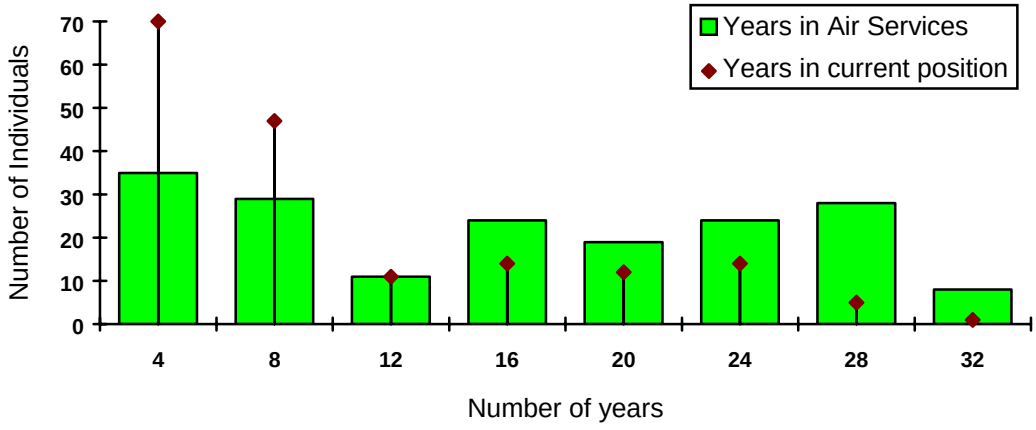

Figure 5: Number of Years in AirServices and Number of Years in Current Work Position

As shown in Table 5, the mean number of months on the current shift cycle is 60.68 (*SD* = 82.58, range = 1-371, *N* = 176). The frequency distribution for the number of months on the current shift cycle can be seen in Appendix B, Figure B1. The large majority of individuals had worked on their current shift cycle for less than 96 months and, like the distributions for the number of years in Air Services and number of years

in the current work position, there was a low point at 9 to 12 years (108 - 144 months).

Inter-correlations between these continuous variables were calculated in order to investigate possible relationships and can be found in Table 6. Not surprisingly, the number of years in Air Services correlates moderately with the number of years in the current work position, $r = .626$, $p < .001$. In addition, the number of years in the current work position has a small but significant correlation with the number of months on the current shift cycle, $r = .275$, $p < .05$. However, there was an absence of any significant correlation between the number of years in Air Services and the number of months on the current shift cycle.

The correlation between an individual's age and the length of time they have worked in Air Services is high, $r = .843$, $p < .001$. Tabachnick and Fidell (1989) recommend that for regression analyses, bivariate correlations between two independent variables should not be greater than .7. This is because highly correlated variables reduce degrees of freedom for error and weaken an analysis. The literature suggests that both age and length of exposure to shiftwork are important in coping with shiftwork. It was decided to retain the length of service variable since a greater length of time in Air Services would also indicate greater age, yet greater age would not necessarily be indicative of a longer employment period in Air Services.

Inspection of other inter-correlations in Table 6 shows that the number of years in the current work position had a small negative correlation with the extent to which shiftwork causes domestic problems ($r = -.341$, $p < .05$). This means that a greater number of years spent in the current work position relates to an individual perceiving shiftwork as less likely to cause problems with domestic life. In addition, a greater number of months on the current shift cycle had small correlations with greater reported satisfaction with the job as a whole ($r = .239$, $p < .05$) and a greater level of perceived support for working shifts from an individual's spouse or partner ($r = -.243$, $p < .05$).

Participants reported that the mean frequency with which they did short change shifts (less than 12 hours between the end of one shift and the start of the next) was once per

shift cycle. The largest proportion, 45%, did short change shifts once per shift cycle and 41.1% did a short change shift twice per shift cycle. The bar graph in Appendix B, Figure B2 details this distribution.

A small positive correlation is shown between the number of short change shifts and the frequency with which an individual changes their shift in order to accommodate other activities ($r = .277$, $p < .01$). Working a greater number of short change shifts also correlates with shiftwork having less of an effect on social life ($r = -.262$, $p < .05$).

The frequency with which individuals changed their regular shifts in order to accommodate other activities is shown in Appendix B, Figure B3. Most individuals (36.6%) almost never changed their regular shift, while 25.7% changed their shift once per month and only 14.8% of individuals changed their shift twice per month. Twelve percent of individuals changed their shift three times per month and the smallest proportion, 7.1% changed their shift once per week in order to accommodate other activities.

Interestingly, there was a moderate positive correlation between the frequency with which an individual changed their shifts and the effect of shiftwork on family life ($r = .50$, $p < .01$). This correlation implies that individuals who changed their shifts frequently also found that shiftwork interferes more with family life.

Table 6: Inter-correlations between Continuous Independent Variables

	Age	Years in AirServices	Years in current position	Months on current cycle	Number of short change shifts	Maximum number of days on	Frequency of changing shifts	Performance problems	Organisational problems	Satisfaction with tasks	Satisfaction with job
Age	1.000										
Years in AirServices	.843***	1.000									
Years in current area	.608***	.626***	1.000								
Months on current cycle	-.065	-.011	.275*	1.000							
Number of short change shifts	.080	-.067	-.220	-.062	1.00						
Maximum number of days on	-.081	-.073	.055	.133	.115	1.00					
Frequency of changing shifts	.045	-.029	.067	.296	.277**	.403***	1.00				
Performance problems	.088	.083	.135	.142	.057	.112	.096	1.00			
Organisational problems	.049	-.039	.126	.126	-.197	.043	.019	.287*	1.00		
Satisfaction with tasks	.180	.135	.107	.151	-.023	.304**	.017	.124	.013	1.00	
Satisfaction with job	.207	.226	.226	.239*	.043	.143	.155	.147	.458***	.270*	1.00

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6 continued...

	Age	Years in AirServices	Years in current position	Months on current cycle	Number of short change shifts	Maximum number of days on	Frequency of changing shifts	Performance problems	Organisational problems	Satisfaction with tasks	Satisfaction with job
Satisfaction with shift	.031	-.147	.059	.219	-.230	.017	-.048	.409***	.287*	.233	.231
Satisfaction with hours of work	.092	-.323	-.147	.199	-.009	.395*	.284	.365	.240	.298	.444*
Time to get to work	.172	.076	.065	.066	-.099	.093	.062	.234	.073	.339**	.075
Morningness	.093	.120	.015	-.005	.025	-.063	.127	-.033	-.070	-.132	-.066
Sleep problems	-.038	-.108	.025	.201	-.172	.220	.054	.626***	.415***	.169	.195
Sleep length on day shift	.097	.141	.207	.110	-.098	-.063	-.124	.038	-.064	-.156	.083
Sleep length on afternoon shift	-.221	-.041	.031	.072	-.086	.019	-.100	-.095	-.052	-.180	-.077
Sleep length on evening shift	-.449**	-.275	-.209	-.025	-.088	.080	-.109	-.030	.050	-.159	-.056
Spouse support	.072	-.021	-.070	-.243*	-.150	-.004	-.020	.174	.094	.107	-.092
Social problems	-.140	-.149	-.153	.089	-.222	.146	.147	.385**	.239	-.035	-.102
Domestic problems	-.142	-.172	-.341**	-.102	-.106	.379**	.136	.256*	.165	.064	-.069
Effect of shiftwork on family	-.145	.105	.232	.154	.018	.184	.500**	.055	.354*	.110	.185

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6 continued...

	Age	Years in AirServices	Years in current position	Months on current cycle	Number of short change shifts	Maximum number of days on	Frequency of changing shifts	Performance problems	Organisational problems	Satisfaction with tasks	Satisfaction with job
Effect of shift work on social life	.060	.005	-.123	.028	-.262*	.285*	.145	.032*	.177	.185	.083
Coping with increasing age	-.078	-.154	-.147	-.084	.080	-.040	.131	-.473***	-.153	-.046	.008
Coping with organisational problems	.012	.041	-.030	.064	-.125	.073	-.097	.375**	.660***	.127	.473***
Engagement	.098	.071	.134	-.134	-.122	-.050	-.060	.166	-.021	-.134	-.071
Disengagement	-.091	-.003	-.068	.032	-.164	.024	-.061	.389**	.221	.147	.100

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6 continued...

	Satisfaction with shift	Satisfaction with hours of work	Time to get to work	Morningness	Sleep problems	Sleep length on day shift	Sleep length on afternoon shift	Sleep length on evening shift	Spouse support	Social problems	Domestic problems
Satisfaction with shift	1.00										
Satisfaction with hours of work	.615***	1.00									
Time to get to work	.049	.172	1.00								
Morningness	.066	-.282	-.035	1.00							
Sleep problems	.479***	.560**	.271*	-.082	1.00						
Sleep length on day shift	.013	-.154	-.127	.226	.003	1.00					
Sleep Length on afternoon shift	-.248*	.190	-.191	-.164	-.044	.568***	1.00				
Sleep length on evening shift	-.105	.084	-.007	-.292	-.076	.187	.649***	1.00			
Spouse support	.181	.103	.213*	-.269*	.132	-.351**	-.343**	-.162	1.00		
Social problems	.271	.190	.248	-.123	.472***	-.183	-.035	.037	.288*	1.00	
Domestic problems	.159	.330	.137	-.095	.325***	-.270*	-.191	.076	.488***	.483***	1.00
Effect of shiftwork on family	.195	.208	.122	-.124	.301	-.287	-.296	-.244	.592***	.151	.320

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6 continued...

	Satisfaction with shift	Satisfaction with hours of work	Time to get to work	Morningness	Sleep problems	Sleep length on day shift	Sleep length on afternoon shift	Sleep length on evening shift	Spouse support	Social problems	Domestic problems
Effect of shift work on social life	.468***	.134	.191	-.228	.474***	-.138	-.122	-.035	.358**	.552***	.624***
Coping with increasing age	-.224	-.047	-.162	-.181	-.271*	-.114	-.092	-.053	-.012	-.188	-.132
Coping with organisational problems	.360**	.433*	.086	.023	.511***	.027	-.053	-.065	.118	.407***	.338**
Engagement	.051	-.124	.203	.191	.056	.253*	.082	.006	-.033	.068	-.058
Disengagement	.344**	.027	.213	.055	.304*	.159	-.014	.133	.218	.309*	.289*

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6 continued...

	Effect of shiftwork on family	Effect of shift work on social life	Coping with increasing age	Coping with organisational problems	Engagement	Disengagement
Effect of shift work on social life	.348	1.00				
Coping with increasing age	.015	-.094	1.00			
Coping with organisational problems	-.041	.316*	-.434***	1.00		
Engagement	.218	.026	-.094	-.148	1.00	
Disengagement	.060	.267*	-.296*	.439***	.089	1.00

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The mean number of days worked consecutively in the last six months was 8.46 (*SD* = 2.85, range = 4-21, *N* = 176). As shown in Appendix B, Figure B4, 45.7% of individuals worked a maximum of 9-10 days consecutively in the last 6 months, with the next largest proportion of individuals working 5-6 days consecutively. One individual stated that they had worked 21 days consecutively in the last 6 months.

The number of days worked consecutively in the past six months showed small significant correlations with several variables. These included the frequency of changing shifts, satisfaction with work tasks, satisfaction with the hours of work, the extent to which shiftwork caused domestic problems and the effect of shiftwork on social life. The highest correlation of these ($r = .403$, $p < .001$), suggested that the greater the number of days worked consecutively the more frequently an individual changed their shifts. Not surprisingly, the greater the number of days worked consecutively the more shiftwork was perceived to cause domestic problems, and to have a greater effect on social life. It was also related to lower satisfaction with work tasks and lower satisfaction with the daily hours of work.

Air Traffic Service staff rated the extent to which they thought working shifts caused problems with their work performance. As seen in Table 5, the mean rating was 2.45 (*SD* = .95, range = 1-5, *N*= 181).

The inter-correlations in Table 6 show that if shiftwork is perceived to cause problems with work performance individuals are more likely to perceive it causes problems with their social life, domestic life and sleep. Problems with work performance was also correlated with a perception of greater organisational problems and a lower level of satisfaction with the shift cycle worked. If shiftwork was perceived to cause problems with work performance then individuals were also more likely to report greater difficulty in coping with shiftwork with increasing age, greater difficulty in coping with organisational problems and report a greater use of disengagement strategies.

Individuals were asked to rate the extent of organisational problems at their work and the mean rating was 4.06 (*SD* = .96, range = 1-6, *N* = 182). The large majority of

individuals perceive that there were organisational problems at their work. A large proportion of individuals (38.3%) replied “very much so”, when asked if there were organisational problems at their work, while only 2 individuals (1.1%) replied “not at all” when asked this question.

Inter-correlations from Table 6 show that a greater level of perceived organisational problems correlates with lower job satisfaction ($r = .458$, $p < .001$) and lower satisfaction with the shift cycle worked ($r = .287$, $p < .05$). A greater perception of organisational problems was also found to relate to shiftwork causing problems with sleep ($r = .415$, $p < .001$) and shiftwork having a greater effect on family life ($r = .354$, $p < .05$). Not surprisingly, there was a reasonable correlation between the level of organisational problems and the difficulty an individual had in coping with these problems ($r = .660$, $p < .001$).

Air Services staff were asked to indicate how much they agreed with statements regarding satisfaction with the kind of work they did, their job as a whole, their shift cycle and their daily hours of work. Figure 11 shows the frequency of ratings for each of these variables. The highest mean rating was for the satisfaction with the kind of work done (eg.: controlling aircraft), and was 1.97 ($SD = 1.08$, range = 1-6, $N = 181$). While the mean rating for the job as a whole (eg.: work environment) was 3.22 ($SD = 1.31$, range = 1-6, $N = 181$) and the mean rating for satisfaction with the shift cycle (eg.: days on, days off) was 3.12 ($SD = 1.33$, range = 1-6, $N = 181$). The mean rating for satisfaction with the daily hours of work was 2.67 ($SD = 1.17$, range = 1-6, $N = 181$).

As would be expected, satisfaction with the kind of work was positively correlated with satisfaction with the job as a whole ($r = .270$, $p < .05$), although this correlation was smaller than would have been expected. Less satisfaction with work tasks was found to relate to longer travel times to and from work ($r = .339$, $p < .01$) and with a greater difficulty in coping with organisational problems ($r = .473$, $p < .001$).

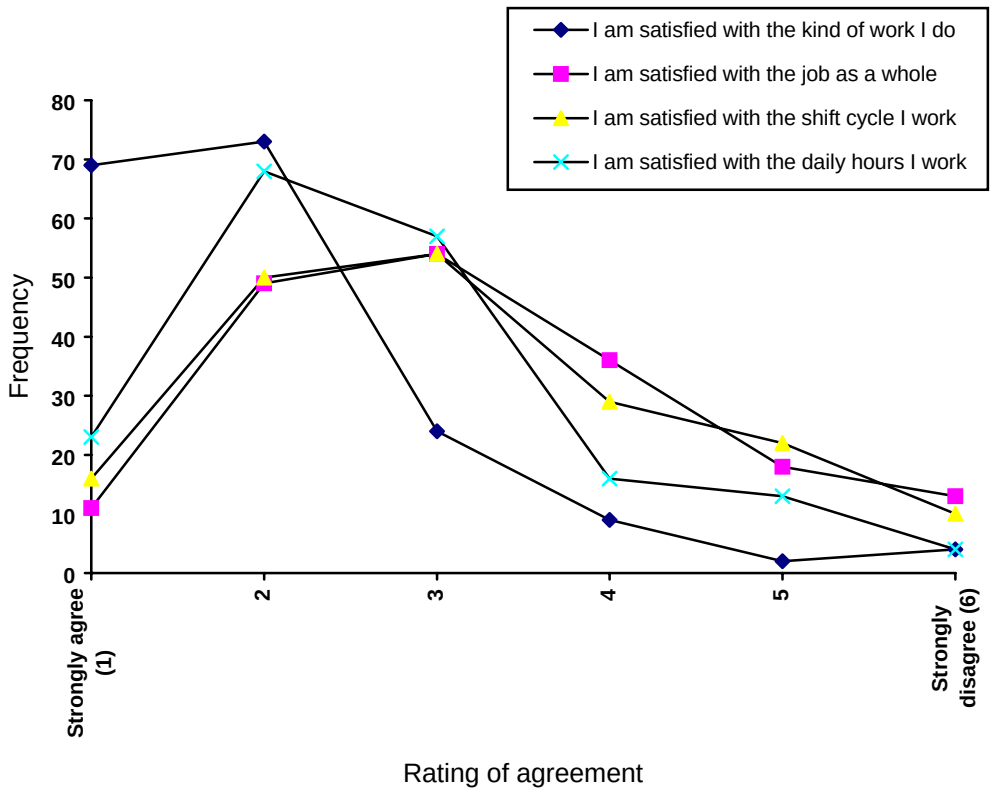

Figure 6: Ratings of Agreement with Satisfaction with Work Tasks, the Job as a Whole, Shift Cycle, and Daily Hours of Work

Satisfaction with the job as a whole was moderately correlated with the satisfaction with daily hours of work (r = .444, p < .05) and not surprisingly, satisfaction with the daily hours of work also had a reasonable positive correlation with satisfaction with the shift cycle worked (r = .615, p < .001). Higher levels of satisfaction with the hours of work related to less reported problems with sleep caused by shiftwork (r = .560, p < .01) and less difficulty in coping with organisational problems (r = .433, p < .05).

Lower levels of satisfaction with the shift cycle correlated with shiftwork causing more problems with sleep (r = .479, p < .001) and with shorter sleep length on afternoon shifts (r = -.248, p < .05). Less satisfaction with the shift cycle worked also correlated with a greater reported effect of shiftwork on social life (r = .468, p < .001) and with increased difficulty in coping with organisational problems (r = .360, p < .01). There was also a correlation between satisfaction with the shift cycle and a greater use of disengagement strategies (r = .344, p < .01).

For each of the five shifts; morning, day, afternoon, evening and night, individuals recorded the average amount of time it took to travel to and from work. The average travel times over all the five shifts was calculated to produce a single variable. Table 5 lists the mean for this variable as 30.78 minutes (*SD* = 14.27, range 8.4-100.8, *N* = 154). Table B1, Appendix B details the distribution of this variable.

The time to get to and from work had a small positive correlation with the extent to which shiftwork caused sleep problems ($r = .271$, $p < .05$). Individuals who took longer to get to and from work reported that shiftwork caused greater sleep problems. Longer travel times were also correlated with spouses being less supportive of an individual working shifts.

Descriptive statistics regarding the type of work, primary duties, current shift cycle and current shift schedule have been discussed in the sample description, details of which can be seen in Table 4. It was decided not to include the variable, type of work, in subsequent analyses since there was a category for Flight Service and Flight Data in both this variable and the primary duties variable. Including both variables in regression analyses would result in ambiguity. The variable, primary duties, was used in regression analyses because it differentiated between Air Traffic Controllers, Flight Service and Flight Data personnel, and individuals with additional responsibilities.

Individuals reported on what shift cycle they would prefer to work. The majority of individuals (57.1%) selected a 4 on / 2 off cycle. However, this proportion is slightly lower than the proportion currently working on this cycle (65.9%). Over a quarter of the sample (26.5%) would prefer to work on a 5 on / 2 off, 5 on / 3 off shift cycle which is a much greater proportion of the sample than is currently working on this shift cycle. The remaining 16.6% of individuals preferred to work on a range of other shift cycles.

Individuals were asked to select a shift schedule that they would prefer to work. Relatively small proportions of the sample preferred to work on permanent morning shifts (15.5%), permanent day shifts (8.8%) and permanent afternoon shifts (16%).

Only 6 individuals (3.3%) preferred to work on permanent evening shifts and 2 individuals (1.1%) on permanent night shifts. The largest proportion of individuals (55.2%) preferred to work on a rotating shift schedule. Because three of the categories each have less than 10% of the sample and these categories could not be meaningfully combined this variable was not used in further analyses (Tabachnick & Fidell, 1989).

3.5.2 Coping Variables

Individuals were questioned regarding coping with organisational problems. The mean rating for this variable was 3.04 (*SD* = 1.16, range = 1-5, *N* = 182). It is interesting to note that a very large number of individuals (125 or 69%) rated their difficulty in coping with organisational problems as "sometimes" a problem or greater.

Correlation coefficients, from Table 6, show that individuals who reported greater difficulty in coping with organisational problems also reported that shiftwork caused problems with social life, domestic life and sleep. In addition, those who had difficultly coping with organisational problems, showed greater use of disengagement strategies ($r = .439$, $p < .001$) and greater difficulty in coping with shiftwork with increasing age ($r = -.434$, $p < .001$).

Individuals were also asked whether they found shiftwork more difficult to cope with as they increased in age. The mean rating for this variable was 3.48 (*SD* = 1.45, range 1-6, *N*= 182).

Unexpectedly, there was no correlation between the age of an individual and whether shiftwork was reported to be more difficult to cope with as they increased in age. There was a small correlation between difficulty in coping with shiftwork with increasing age and the extent to which shiftwork caused sleep problems ($r = -.271$, $p < .05$). There was also a correlation between difficulty in coping with shiftwork with increasing age and a greater use of disengagement strategies ($r = -.296$, $p < .05$).

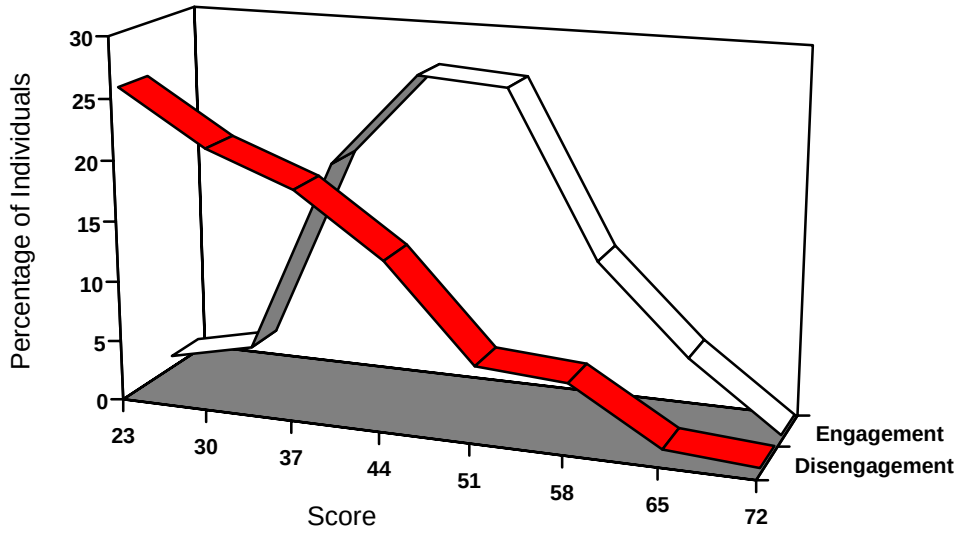

Figure 7: Frequency of Use of Engagement and Disengagement Strategies

The CSQ assessed the extent to which individuals used engagement and disengagement strategies in coping with shiftwork in their social life, domestic life, sleep and work performance. Figure 7 provides an overview of the distribution of scores on both the sub-scales of engagement and disengagement. The mean score on the sub-scale of engagement was 43.90 (*SD* = 8.69, range = 16-67, *N* = 175). The mean score on the sub-scale of disengagement was, as expected, considerably lower at 31.76 (*SD* = 11.42, range 16-71, *N* = 169), indicating much less use of these types of coping strategies.

A small positive correlation existed between the use of engagement strategies and sleep length on day shifts ($r = .253$, $p < .05$). The use of disengagement strategies correlated with the perception that shiftwork caused problems with social life,

domestic life and sleep. Greater use of disengagement strategies was also found to correlate with shiftwork having more of an effect on social life.

3.5.3 Social and Domestic Variables

Individuals were asked to rate the extent to which shiftwork caused problems with their social and domestic life. The mean rating for shiftwork causing problems with social life was 3.40 (*SD* = .99, range = 1-5, *N* = 182) while the mean rating for shiftwork causing problems with domestic life was slightly lower at 2.90 (*SD* = 1.06, range = 1-5, *N* = 182). Figure 8 displays the distributions for both these variables. The distributions show that a greater number of individuals perceived shiftwork to more frequently cause problems with their social life than with their domestic life.

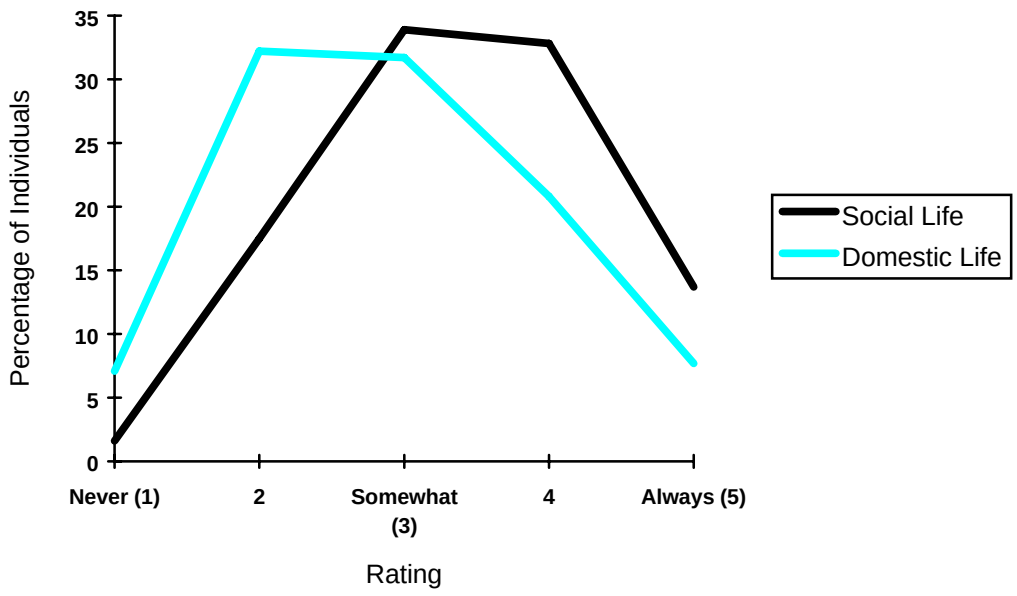

Figure 8: Frequency of Scores for the Extent to which Shiftwork Causes Problems with Social Life and Domestic Life

The extent to which shiftwork caused problems with social life correlated moderately with shiftwork causing problems with domestic life ($r = .483$, $p < .001$). A moderate positive correlation existed between shiftwork causing problems with social life and the effect of shiftwork on off work activities and personal relationships ($r = .552$, $p <$

,001). The extent to which shiftwork caused problems with domestic life had a slightly higher correlation with the effect of shiftwork on off work activities and personal relationships ($r = .624$, $p < .001$).

Three variables were summed to produce a single score for the effect of shiftwork on family life. The mean for this variable, as seen in Table 5, is 11.30 (*SD* = 3.17, range = 3-18, *N* = 159). The effects of shiftwork on social life had a mean score of 22.04 (*SD* = 5.01, range, 10-36, *N* = 176). The distributions for both the effect of shiftwork on family life and the effect of shiftwork on social life can be seen in Appendix B, Figure B5 and Figure B6 respectively.

Both the effect of shiftwork on family life and the effect of shiftwork on social life correlated with the level of spouse support for working shifts. The more supportive an individual perceived their spouse or partner to be of them working shifts the less shiftwork affected family life ($r = .592$, $p < .001$) and social life ($r = .358$, $p < .01$).

Individuals with spouses recorded the average number of hours per week that their spouse was committed to activities outside the home and how supportive their spouse or partner was of them doing shiftwork. The largest proportion of the sample (27.5%) had a spouse that was committed between 36 and 45 hours per week outside the home. The next largest group had a spouse that was committed for less than 10 hours per week outside the home. The frequency distribution of this variable is shown in Appendix B, Figure B7. The mean rating for the level of spouse support is 2.14 (*SD* = 1.17, range = 1-6, *N* = 141).

Interestingly, the level of spouse support for working shifts was found to have a small correlation with morningness ($r = -.296$, $p < .05$). This correlation suggests that those who are evening types are more likely to report greater supportiveness for working shifts from their spouse or partner.

Other domestic variables already reported on in the sample description are marital status and whether individuals had children or not. The frequencies for these variables can be found in Table 3.

3.5.4 Sleep Variables

The questionnaire asked individuals to record the length of sleep obtained on each shift. Unfortunately, some of the sleep questions were found to be unreliable, including the questions regarding the length of sleep obtained on morning shifts, night shifts and days off. Data was considered reliable for the length of sleep obtained on day shifts, afternoon shifts and evening shifts. The distributions of these variables is shown in Figure 9. The mean length of sleep obtained on day shifts was the shortest at 7.37 hours (*SD* = 1.00, range = 5-11, *N* = 153) and the mean length of sleep obtained on afternoon shifts was the longest at 7.84 hours (*SD* = .91, range 5-10, *N* = 177), while the mean length of sleep on evening shifts was slightly shorter than that for afternoon shifts, and was 7.81 hours (*SD* = 1.09, range = 5-10, *N* = 159).

As would be expected, sleep length on afternoon shift correlated moderately with sleep length on day shift ($r = .568$, $p < .001$) and sleep length on evening shift ($r = .649$, $p < .001$) but there was no correlation between sleep length on day shift and sleep length on evening shift.

Figure B8, Appendix B depicts the groupings for the dichotomous variables of sleep continuity on day shift and night shift. Only a small percentage of individuals (4.9%) stated that their sleep on day shifts was split into more than one period while 95.1% obtained their sleep in a continuous block. Because this variable had less than the desired 10%/90% split suggested for dichotomous variables it was excluded from further analyses (Tabachnick & Fidell, 1989). Sleep continuity on night shift was not so unevenly divided, with 76.6% of individuals splitting their sleep when on night shifts and less than one quarter (23.4%) obtaining their sleep in a continuous block.

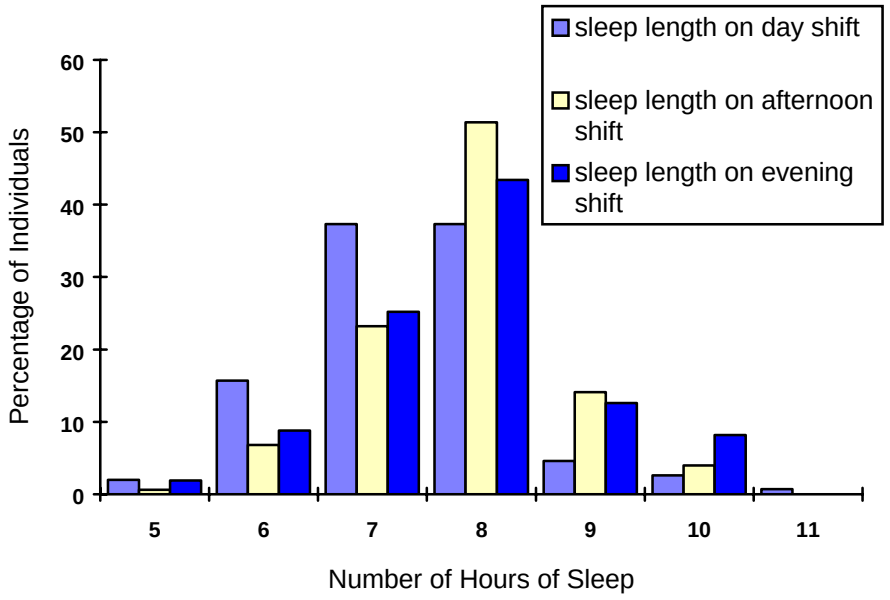

Figure 9: Mean Sleep Length on Day Shift, Afternoon Shift, and Evening Shift

Like the questions regarding the extent to which individuals felt shiftwork caused problems with their social and domestic life and work performance, there was also a question asking the extent to which shiftwork caused problems with sleep. The mean rating for this variable was 3.17 (*SD* = 1.06, range 1-5, *N* = 182).

A single question asked individuals whether they had ever fallen asleep on the way to or from work and a surprisingly high number (76 or 39%) said that they had.

3.5.5 Circadian Variable

Circadian typology was measured by the CSM and as seen in Table 4, the mean score was 35.60 (*SD* = 6.89, range = 18-50, *N* = 182). Smith et al (1989) determined raw scores on the CSM to differentiate morning, intermediate and evening type individuals. According to their criteria 13.1% of individuals in the present study are morning types, 83.1% are intermediate types and 3.3% are evening types, as shown in Figure 10.

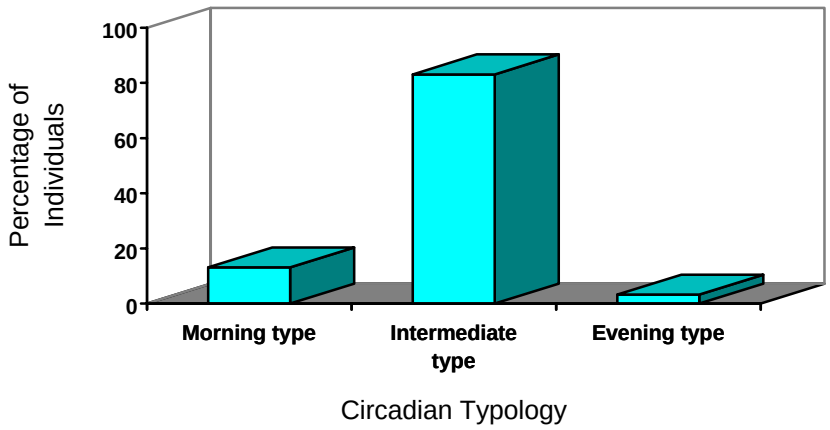

Figure 10: Frequency of Circadian Types

3.5.6 Physical Well-being

The physical well-being scale comprised 21 items and as shown in Table 4 the mean score was 57.89 (SD = 14.34, range = 28-100, N = 122). The sleep variables are plotted in Appendix B, Figure B9 and show clearly that a greater number of individuals have trouble sleeping well during the day than with falling asleep, waking up, or sleeping well through the night.

Four questions were included in the physical well-being scale regarding fatigue related issues. Figure B10, Appendix B shows the distributions for these variables. Although no individuals stated that they frequently had periods where they froze on the job, only 93 individuals stated that this had never occurred to them. For the question "how often do you experience lapses in attention?" a reasonably large number of individuals (28) rated themselves as frequently having this problem.

The physical well-being scale included questions that asked about the frequency of certain health symptoms. The distribution of ratings on these items can be seen in Appendix B, Figure B11. Because of the strict medical requirements for Air Traffic Controllers, few individuals suffered frequently from these symptoms. However, the fact that 3 individuals frequently felt short of breath, 6 individuals frequently felt their

heart racing or skipping and 7 individuals frequently had headaches is possibly cause for concern. These ratings were from 14 separate individuals of which 11 were Air Traffic Controllers and 3 were Flight Service or Flight Data (who don't have to conform to such strict medical requirements).

Despite having to meet yearly medical requirements very few individuals (22) stated that they frequently felt fit and healthy, as shown in Appendix B, Figure B12, yet a larger number (38) stated that they frequently engaged in regular physical exercise.

The frequency with which individuals suffer from certain gastrointestinal complaints can be seen in Appendix B, Figure B13. There were a reasonable number of individuals who suffered from constipation or diarrhoea, heart burn, stomach ache, and found their appetite disturbed. Feelings of nausea were the least common gastrointestinal complaint, while appetite disturbances were the most common. It was also interesting to note that while a large portion of the present sample frequently ate 3 nutritious meals a day, an equally large portion did not.

3.5.7 Mental Well-being

The GHQ (12 item version) was used to measure the mental well-being of the present sample. Scores ranged from 0 to 32, with the mean being 12.36 (SD = 5.48, N = 181). Table B2 in Appendix B details the frequencies of the scores on the GHQ.

3.5.8 Self Rated Health

Table 7 details the frequency of individual's health ratings. The largest proportion of the sample (31.7%) rated their health as 'good', while the next largest group rated their health as 'fair'. Only 7.1% of the present sample rated their health as 'excellent' and a very small percentage of individuals rated their health as 'very poor' (2.2%) or 'terrible' (1.1%).

Table 7: Frequency of Self Rated Health Ratings

Self Rated Health	Frequency	Percentage
Terrible	2	1.1
Very poor	4	2.2
Poor	15	8.2
Fair	48	26.2
Good	58	31.7
Very good	41	22.4
Excellent	13	7.1

3.6 Regression Analyses

To examine the contribution of workplace variables, social and domestic variables, coping variables, sleep variables, and circadian typology on physical well-being, self rated health and mental well-being standard regression analyses were run. The results of these three regression analyses are presented below.

For the purposes of the regression analyses, marital status, primary duties, current shift cycle worked, and preferred shift cycle worked were dummy coded. This form of coding re-categorises variables into a set of dichotomous variables. For example, for the variable preferred shift cycle worked the categories are recorded as: 4 on / 2 off vs 5 on / 2 off, 5 on / 3 off and other shift cycles, 5 on / 2 off, 5 on / 3 off vs 4 on / 2 off and other shift cycles and other shift cycles vs 5 on / 2 off, 5 on / 3 off and 4 on / 2 off. When the set of 2 level variables are entered into the regression the variance due to the original categorical variable is analysed and the effects of the new dichotomous components can be examined.

As has been discussed, the dichotomous variables; having other dependents, working in an other country's Air Service organisation, and sleep continuity on day shift were excluded from the regression analyses because the split of responses was less than 10%/90% as recommended by Tabachnick and Fidell (1989).

3.6.1 Physical Well-being

A standard multiple regression analysis was used to estimate the contribution of work factors, social and domestic factors, sleep factors, coping factors and circadian factors to an individual's physical well-being. In total 42 variables were entered in the regression equation. This is slightly less than the ratio of cases to independent variables suggested by Tabachnick and Fidell (1989). The effect of having fewer cases than recommended is a reduction in statistical power. To remedy this problem Tabachnick and Fidell (1989) suggest combining independent variables. This was not considered a suitable option since independent variables that were suitable to be combined as a single variable had been. Instead, the loss of statistical power is noted and accepted.

Results, including standardised beta coefficients for each variable and the total variance explained by the equation (R^2 and adjusted R^2) are presented in Table 12.
R was found to be significantly different from zero, F (42, 140) = 5.68, $p < .0001$. Work factors, social and domestic factors, sleep factors, coping factors and circadian factors accounted for 52% of the variance in physical well-being.

Table 12 details the beta coefficients for each variable. These explain the influence of each variable in the regression equation. From inspecting Table 8, it can be seen that there are a number significant variables.

Circadian typology was one of the significant contributors to the total explained variance. Surprisingly, this suggested that improved physical well-being was predicted by being an morning type individual ($p < .001$). Of all the social and domestic variables, only the extent to which shiftwork was reported to cause domestic problems was found to contribute to better physical well-being ($p < .05$).

Several work place factors were significant in predicting physical well-being. Both the dichotomous variables for primary duties were significant which together infers that the primary duties of an individual are important contributors to physical well-being. All three categories of primary duties, Air Traffic Controllers, having additional responsibilities and working in Flight Service or Flight Data, were different from each other on the dependent variable of physical well-being. Examination of the

means shows that individuals who worked in Flight Service or Flight Data had the best physical well-being with a mean of 57.73 (*SD* = 18.15, range = 31-99, *N* = 22) and Air Traffic Controllers had a slightly higher mean of 58.60 (*SD* = 13.69, range = 31-91, *N* = 113). Individuals who had additional duties such as being a supervisor, stream specialist, team leader or instructor, had the poorest physical well-being with a mean of 63.86 (*SD* = 14.64, range = 41-85, *N* = 14). The other workplace factors that were significant in the regression equation were the number of months on the current shift cycle and the satisfaction with the shift cycle. Both, longer periods spent on the current shift cycle ($p < .05$) and less satisfaction with the shift cycle ($p < .05$) were predictive of poorer physical well-being.

An individual's perception that shiftwork caused sleep problems also contributed to poorer physical well-being ($p < .05$). In addition, using both engagement and disengagement strategies in coping with shiftwork were important in determining physical well-being. Greater use of engagement strategies predicted better physical well-being ($p < .05$), while the use of disengagement strategies contributed to poorer physical well-being ($p < .001$).

Table 8: Standard Multiple Regression of Workplace Factors, Coping Factors, Social and Domestic Factors, Circadian Factors, and Sleep Factors on Physical Well-being, Showing Standardised Regression Coefficients, R, R^2 and Adjusted R^2 for all Participants (*N* = 182).

Predictors	
Circadian factor	
Morningness	-.243***
Social and domestic factors	
Sex	.017
Children	.079
Marital status 1	-.084
Marital status 2	.022
Marital status 3	-.003
Number of hours worked by spouse	.041
Level of spouse support	.074
Social problems	-.051
Domestic problems	.175*
Effect of shiftwork on social life	.085
Effect of shiftwork on family life	-.059
Workplace factors	
Number of years in AirServices	-.010
Number of years in present position	.008
Primary duties 1	.307*
Primary duties 2	-.237*
Current shift cycle 1	-.064
Current shift cycle 2	.093
Preferred shift cycle 1	-.060
Preferred shift cycle 2	-.030
Absent from AirServices	-.083
Months on current shift cycle	.167*
Number of short change shifts	.104
Number of consecutive days worked	-.032
Frequency of changing shifts	-.080
Performance problems	.130
Organisational problems	.048
Satisfaction with work tasks	-.051
Satisfaction with job	.055
Satisfaction with hours of work	-.120
Satisfaction with shift cycle	.176*
Average time to travel to and from work	.120

* p < .05, ** p < .01, *** p < .001

Table 8 continued...

Predictors	
Sleep factors	
Sleep length on day shifts	.031
Sleep length on afternoon shifts	-.057
Sleep length on evening shifts	.098
Sleep continuity on night shift	.017
Fallen asleep on way to or from work	.000
Sleep problems	.178*
Coping factors	
Engagement	-.130*
Disengagement	.309***
Coping with increasing age	-.077
Coping with organisational problems	.079
R	**.794*** **
Total R^2	**.630**
Adjusted R^2	**.519**

* p < .05, ** p < .01, *** p < .001

3.6.2 Mental Well-being

A standard multiple regression analysis was also used to assess the influence of work factors, social and domestic factors, sleep factors, coping factors and circadian factors on an individual's mental well-being. The same 42 variables were entered in the regression equation. R was found to be significantly different from zero, F (42, 140) = 3.15, $p < .0001$ and the total variance explained was 33%. Beta coefficients for these variables as well as total variance explained by the equation are presented in Table 9.

Examination of the beta coefficients indicated that only three variables were significant in the equation. The first of these was the extent to which shiftwork was perceived to cause problems with domestic life. A greater level of perceived problems with domestic life contributed to poorer mental well-being. Again both the use of engagement and disengagement strategies in coping with shiftwork predicted mental well-being. Greater use of engagement strategies related to better mental well-being and greater use of disengagement strategies contributed to poorer mental well-being. This meant that individuals who actively tried to cope with shiftwork had improved mental well-being, while those who avoided dealing with difficulties caused by shiftwork had poorer mental well-being.

Table 9: Standard Multiple Regression of Workplace Factors, Coping Factors, Social and Domestic Factors, Circadian Factors, and Sleep Factors on Mental Well-being, Showing Standardised Regression Coefficients, R, R^2 and Adjusted R^2 for all Participants (*N* = 182).

Predictors	
Circadian factor	
Morningness	-.121
Social and domestic factors	
Sex	.053
Children	-.035
Marital status 1	.065
Marital status 2	-.092
Marital status 3	.084
Number of hours worked by spouse	-.071
Level of spouse support	-.102
Social problems	-.030
Domestic problems	.219*
Effect of shiftwork on social life	.088
Effect of shiftwork on family life	-.055
Workplace factors	
Number of years in AirServices	.036
Number of years in present position	.059
Primary duties 1	.057
Primary duties 2	.056
Current shift cycle 1	-.023
Current shift cycle 2	-.080
Preferred shift cycle 1	.129
Preferred shift cycle 2	-.078
Absent from AirServices	-.062
Months on current shift cycle	.014
Number of short change shifts	-.060
Number of consecutive days worked	.029
Frequency of changing shifts	.058
Performance problems	.113
Organisational problems	-.080
Satisfaction with work tasks	.098
Satisfaction with job	.118
Satisfaction with hours of work	-.046
Satisfaction with shift cycle	.049
Average time to travel to and from work	-.025

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 9 continued...

Predictors	
Sleep factors	
Sleep length on day shifts	.000
Sleep length on afternoon shifts	-.039
Sleep length on evening shifts	.033
Sleep continuity on night shift	-.120
Fallen asleep on way to or from work	.006
Sleep problems	-.144
Coping factors	
Engagement	-.191**
Disengagement	.254***
Coping with increasing age	-.168
Coping with organisational problems	.177
R	**.697*** **
Total R^2	**.486**
Adjusted R^2	**.332**

* p < .05, ** p < .01, *** p < .001

3.6.3 Self Rated Health

The third standard multiple regression analysis was used to assess the contribution of work factors, social and domestic factors, sleep factors, coping factors and circadian factors to self rated health. As for the previous two analyses the same 42 variables were entered in the regression equation. Standardised beta coefficients and the total variance explained by the equation can be seen in Table 10. With self rated health as the dependent variable, R was found to be significantly different from zero, F (42, 140) = 2.06, $p < .001$. The total variance explained in self rated health was 20%.

Circadian typology was a significant predictor of self rated health, in that being an morning type individual contributed to higher health ratings ($p < .05$). Not having children was also found to contribute to improved self rated health ($p < .05$).

Three work place variables were significant in the regression equation. The first of these was one of the dichotomous variables for primary duties. The beta coefficient infers that there was a difference in health ratings between those who are Air Traffic Controllers and those who had additional responsibilities or worked in Flight Service or Flight Data ($p < .05$). The mean health rating for Air Traffic Controllers was 4.85 (SD = 1.13, range = 1-7, N = 117) and the mean health rating for Flight Service and Flight Data personnel was slightly higher at 5.0 (SD = 1.54, range 1-7, N = 25), while the mean health ratings for those individuals with additional responsibilities was lower at 4.57 (SD = 1.16, range = 2-6, N = 14) Another dichotomous variable, that for preferred shift cycle, was found to significantly contribute to self rated health ($p < .05$). Individuals preferring to work on a 4 on / 2 off shift cycle had significantly different health ratings than those who would rather work on a 5 on / 2 off, 5 on / 3 off shift cycle or another shift arrangement. The mean health rating for individuals preferring to work on a 4 on / 2 off shift cycle was the lowest at 4.76 (SD = 1.24, range = 1-7, N = 103). Both, preferring to work on a 5 on / 2 off, 5 on / 3 off shift cycle and preferring another shift arrangement had higher means for self rated health. They were 4.98 (SD = 1.26, range = 2-7, N = 47) for the 5 on / 2 off, 5 on / 3 off shift cycle and 4.80 (SD = 1.03, range = 3-7, N = 30) for preferring to work on another shift arrangement.

Thirdly an absence from Air Services, other than for normal annual leave or sick leave, predicted higher health ratings ($p < .05$). Again the use of engagement strategies to cope with shiftwork predicted higher health ratings ($p < .001$), while greater use of disengagement strategies in coping with shiftwork predicted poorer self rated health ($p < .05$).

Table 10: Standard Multiple Regression of Workplace Factors, Coping Factors, Social and Domestic Factors, Circadian Factors, and Sleep Factors on Self Rated Health, Showing Standardised Regression Coefficients, R, R^2 and Adjusted R^2 for all Participants (*N* = 182).

Predictors	
Circadian factor	
Morningness	.217*
Social and domestic factors	
Sex	-.077
Children	-.247*
Marital status 1	.032
Marital status 2	-.149
Marital status 3	.045
Number of hours worked by spouse	-.017
Level of spouse support	.062
Social problems	.070
Domestic problems	-.047
Effect of shiftwork on social life	-.105
Effect of shiftwork on family life	.008
Workplace factors	
Number of years in AirServices	.170
Number of years in present position	-.008
Primary duties 1	-.377*
Primary duties 2	.191
Current shift cycle 1	-.098
Current shift cycle 2	.139
Preferred shift cycle 1	.215*
Preferred shift cycle 2	-.086
Absent from AirServices	.161*
Months on current shift cycle	-.001
Number of short change shifts	.074
Number of consecutive days worked	-.051
Frequency of changing shifts	.106
Performance problems	.043
Organisational problems	-.067
Satisfaction with work tasks	.132
Satisfaction with job	-.095
Satisfaction with hours of work	.069
Satisfaction with shift cycle	-.119
Average time to travel to and from work	-.113

* p < .05, ** p < .01, *** p < .001

Table 10 continued...

Predictors	
Sleep factors	
Sleep length on day shifts	-.045
Sleep length on afternoon shifts	.007
Sleep length on evening shifts	-.067
Sleep continuity on night shift	.079
Fallen asleep on way to or from work	.031
Sleep problems	-.070
Coping factors	
Engagement	.303***
Disengagement	-.173*
Coping with increasing age	.116
Coping with organisational problems	-.026
R	**.618*** **
Total R^2	**.382**
Adjusted R^2	**.196**

* p < .05, ** p < .01, *** p < .001

3.7 Summary of the Results of the Regression Analyses

A summary the significant predictors of physical well-being, mental well-being and self rated health can be found in Table 11. By looking at the significant variables for each of the three regression analyses certain variables can be seen to be consistently involved in predicting each of the three dependent variables.

Table 11: Summary of the Significant Variables for Physical Well-being, Mental Well-being and Self Rated Health in each Multiple Regression Analysis.

Significant Variable	Physical Well-being	Mental Well-being	Self Rated Health
Morningness	Significant		Significant
Children			Significant
Domestic problems	Significant	Significant	
Primary duties 1	Significant		Significant
Primary duties 2	Significant		
Preferred shift cycle			Significant
Absent from AirServices			Significant
Months on current shift cycle	Significant		
Satisfaction with shift cycle	Significant		
Sleep problems	Significant		
Engagement	Significant	Significant	Significant
Disengagement	Significant	Significant	Significant

Both physical well-being and self rated health were predicted by circadian typology, and the primary duties of an individual. Whereas the extent to which shiftwork caused problems with domestic life contributed to both physical well-being and

mental well-being. Both the use of engagement strategies and disengagement strategies in coping with shiftwork were significant predictors for physical well-being, mental well-being and self rated health. In summary, variables that had been highlighted include; circadian typology, the extent to which shiftwork causes domestic problems, primary duties and the use of engagement strategies and disengagement strategies in coping with shiftwork.

4. DISCUSSION

4.1 Reliability Study

Determining the test-retest reliability of the questionnaire for use in an Air Traffic Service environment is the first aim of the present study. On the whole the questionnaire is deemed reliable for use with Air Traffic Service staff, although the measurement of several variables requires further investigation.

The large majority of variables have moderate to high reliability. The independent variables of sleep length on evening shift, satisfaction with the hours of work, and the extent to which shiftwork caused sleep problems and organisational problems have only moderate reliability. Despite this the reliability coefficients were considered sufficient for these variables to remain in the study. Variables with low reliability are excluded from the remainder of the study.

The scales taken from the SSI (Barton et al, 1995) have acceptable reliability, although the GHQ is slightly low. All coping variables, social and domestic variables, and most work variables from the questionnaire constructed by Rhodes et al (1994) are found to be reliable.

Concern is noted regarding the lack of reliability for the self reported sleep length and sleep continuity variables. Although, self reporting of sleep length has been widely used in studies of sleep and shiftwork (Lavie et al , 1989; Knauth & Kieswetter, 1987; Rosa, Colligan & Lewis, 1989, Folkard & Barton, 1992). However, it is widely accepted that other methods of collecting sleep data, such as sleep diaries/logs, EEG monitoring, and actigraph devices provide more detailed and more objective data. Sleep logs have been widely used in shiftwork studies (Suvanto, Partinen, Harma & Ilmarinen, 1994; Dekker, Paley, Popkin & Tepas, 1993) but they too have specific problems. This method requires daily recording of sleep times and subsequently places a burden on participants to maintain accurate and complete records. The number of incomplete records tends to be high, yet the information gained from this method can be much more detailed than that obtained from simple sleep length

periods (Kurumanti et al, 1994). Other more objective methods include EEG monitoring and the use of actigraphs. These methods are much more accurate but there is a financial cost as well as a much more extreme commitment required by participants. In summary, it is realised that subjective reports of sleep length have problems but so do the other objective measures. Overall, it is necessary to weigh up the advantages and disadvantages of each. It is suggested from the findings of this reliability study that more objective methods, other than self reporting, should be used in gathering sleep data.

Other variables with unacceptable reliability include self reports of the number of hours of overtime worked and the adequacy of breaks during shifts. The questions regarding overtime ask for an estimate of the number of hours typically worked in the last month under (a) 'normal' and (b) 'peak' or 'under staffed' periods. Self reported data such as this may not be very accurate due to difficulties in recalling this information. Individuals possibly only consider the amount of overtime worked in the previous few days and inaccurately extrapolate this value over the last month. In addition, there is possibly a tendency to over estimate the amount of overtime worked in order to portray the situation as being worse than it actually is. Another concern with these questions is the possible ambiguity between what is considered 'normal' conditions and what is considered 'peak' or 'under staffed'. A number of participants commented on their questionnaires that 'peak' or 'under staffed' was the norm in their workplace, hence the number of hours recorded is the same for each question. There is also the consideration that the question on the amount of overtime worked in 'peak' or 'under staffed' periods immediately followed the question on overtime in 'normal' conditions. This could easily bias individuals to inflate the number of hours of overtime worked under 'peak' conditions because they believe this value *should* probably be greater whether in reality it may not be.

Information such as the number of hours of overtime worked should be relatively easy to obtain from more objective sources, such as work records. Obviously the full cooperation of management would be required, but this source of information would overcome the inaccuracies in participant recall and bias. With additional information

on the number of staff working and air traffic levels the distinction could be made between ‘normal’ conditions and ‘peak’ or ‘under staffed’ conditions.

A further variable that is unreliable is the reference to adequacy of breaks on each shift worked. It is likely that in answering this question an individual considers how they felt about the adequacy of their breaks only in the previous few shifts. Such feelings may not remain constant over time, hence the lack of reliability for this variable. There may also be a range of other factors which constantly change how an individual feels about their breaks. Such factors could include the number of staff working, the workload on a shift, the particular shift cycle being worked and the actual tasks an individual is performing. Therefore, like sleep data, this data may be better collected by some other means. For example, a daily log in which an individual records how they felt about their breaks at the end of each shift over a number of shift cycles. Additional comments could also be made by the individual so other trends could be identified and a fuller picture of the situation developed.

The demographic characteristics of the New Zealand Air Services staff who participated in the reliability study were very similar to the sample of Australian ATS staff who participated in the main study. The only notable differences were that a much greater proportion of Australian ATS staff had tertiary qualifications and that New Zealand ATS staff were much more likely to have worked in another country. With these differences taken into account the questionnaire is expected to be reliable when used in another country.

4.2 Overview

The findings of the present study support the position that a range of factors are important in determining an individual’s tolerance to shiftwork. Many previous studies have focussed on the effects of a single variable or combinations of only a few variables in investigating the ability of an individual to tolerate shiftwork. It is clear from the findings of the present study that the issue of tolerance to shiftwork is a complex one and that predicting this requires looking at many aspects of a shiftworker’s life. In the present research, self rated health and physical well-being

are predicted by a range of variables that are from each of the five areas considered; circadian typology, work place factors, social and domestic factors, sleep factors, and coping factors. Mental well-being is found to be best predicted by a single domestic variable, which is the extent to which shiftwork caused domestic problems and the two coping variables of engagement and disengagement. Therefore for an individual to be able to tolerate shiftwork they must have strategies in place to help them deal with the effect of shiftwork on a range of factors in their lives.

Certain variables from each of the areas deemed important in contributing to tolerance to shiftwork are found to significantly predict physical well-being. The important contributors are circadian typology, the extent to which shiftwork is perceived to cause domestic problems and sleep problems, the primary duties of an individual, the number of months spent on the current shift cycle, the level of satisfaction with the shift cycle and the use of engagement and disengagement strategies. The total variance explained by all the variables in the regression equation is 52%.

Work place factors, social and domestic factors, sleep factors, coping factors and circadian typology account for 33% of the variance in mental well-being, with the extent to which shiftwork is perceived to cause domestic problems, and the use of engagement and disengagement strategies identified as significant predictors. No workplace or sleep factors are found to significantly predict mental well-being.

Circadian typology, having children, the primary duties of an individual, preferred shift cycle, absences from Air Services, and the use of engagement and disengagement strategies significantly contributed to the regression equation for self rated health. In all, 20% of the variance in self rated health is explained by the variables in the regression equation.

The sample of Air Traffic Service staff in the main study are largely European, middle aged males. This is expected because the occupation is known to be male dominated, with few individuals from ethnic minorities, and individuals tend to remain in the occupation for their entire working lives (Hopkin, 1995). The large proportion of individuals with only a formal school qualification as their highest

educational qualification, other than their Air Traffic Controlling qualification, supports the position that people enter this occupation at an early age and remain in it for some time. As would be expected the majority of individuals are married and the percentage of individuals separated or divorced does not seem excessive. Although the sample is probably very unlike the general Australian population it is expected to be representative of Australian ATS staff. However, due to demographic information on this population being unavailable, this can not be confirmed.

The discussion that follows deals with each of the variables found to be significant predictors of physical and mental well-being and self rated health and whether the proposed hypotheses have been supported.

4.3 Significant Findings

4.3.1 Hypothesis 1: Circadian Typology

The first hypothesis, that evening type individuals will have better physical well-being, higher self rated health, and better mental well-being than individuals who are morning oriented is not supported. Instead, findings in the present research suggest that morning type individuals have better physical well-being and higher self rated health than evening type individuals. In addition, circadian typology is not found to significantly predict mental well-being. The finding that morning type individuals have better physical health and higher self rated health than evening type individuals is contrary to the findings of many previous researchers, who suggest that evening type individuals find it easier to tolerate shiftwork than morning type individuals (Akerstedt & Torsvall, 1981; Kerkhof, 1985a; Monk & Folkard, 1985; Monk, 1988). However, none of these previous studies have been undertaken in an ATS environment.

As outlined previously, morningness is thought to be a powerful inter-individual difference in circadian rhythms, that appears to be related to biological, behavioural and attitudinal differences among people (Kerkhof, 1985a). Morningness has been considered a potential tool for selecting and placing workers into shiftwork since evening individuals are believed to find shiftwork easier to tolerate. This is thought to

be because evening individuals find zeitgeber influences less potent, they find it easier to sleep during the morning resulting in less sleep deprivation, and they are believed to have longer free running periods than morning individuals which is an advantage in forward rotating shift cycles.

Several weaknesses have been identified in the previous research that has identified evening individuals as more tolerant to shiftwork. Firstly, there has been a tendency to consider the effects of individual factors on shiftworker health and well-being as if they act independently of each other. Secondly, few of the studies which have related circadian typology to physiological differences have sound methodology. These studies investigated the relationship between morningness and the cycle of body temperature, yet few researchers took measurements over an entire 24 hour period (Vidacek, Kaliterna, Radosevic-Vidacek, & Folkard, 1988). Most studies took measurements only within the normal waking period. Taking this into account, only one study from a group of twelve (Breithaupt et al, 1980) is able state that there was a phase difference of 1.5 hours between morning and evening type individuals on a normal diurnal routine. Finally, studies of morningness have seldom included performance measures and have instead relied on subjective ratings of alertness, times of sleep onset and offset, or body temperature differences to differentiate between morning and evening types.

Bohle and Tilley (1993) noted a surprising finding in their study concerned with the mood of night working nurses. They found evening typology strongly predicted high fatigue-inertia scores (a sub-scale of the Profile of Mood States). In addition, Iskra-Golec, Marek and Noworol (1995) investigated the interactive effects of a number of individual factors on nurses health and sleep. Morningness was not found to be predictive of health, fatigue or sleep disturbances and it was also found that when morningness was added to the interactions of neuroticism with languidity and extroversion with flexibility of sleep, it did not significantly improve the predictions of the above mentioned dependent variables. Akerstedt (1980) found morningness accounted for very little variance in psycho-somatic complaints, sleep complaints and sleep length and Vidacek et al (1988) found morningness to be predictive of oral temperature and subjective ratings of alertness but not of heart rate or reaction time.

The findings of these studies suggest that morningness may not necessarily be a good predictor of mood, health, sleep disturbances and possibly performance.

It is important to note that only a very small proportion of the present sample can be considered true evening type individuals according to criteria set by Smith et al (1989). Smith et al (1989) based their cut off scores on the 10th and 90th percentiles in their sample. In the present study, less than 5% of Air Traffic staff are true evening individuals, while over 13% are true morning type individuals. It would be expected from the findings of previous research that in a group of long term shiftworkers there would be a greater proportion of evening individuals and few morning type individuals, since it is believed that morning individuals are more likely to transfer to day work (Akerstedt & Torsvall, 1981).

One of the reasons evening type individuals are believed to be more tolerant to shiftwork than morning individuals is because their longer free running rhythms make it easier for them to adapt to phase advances, such as is required for forward rotating shift cycles. In the present study, all the Air Traffic staff worked on backward rotating cycles. Such backward rotating cycles are the norm in New Zealand and Australia and are liked by staff because of the compacted work week and the longer time off between shift cycles than in a forward rotating cycle. It is possible, that just as longer free running periods are advantageous in forward rotating cycles they serve as a disadvantage in backward rotating cycles where the shorter free running periods of morning individuals may be more suited. Indeed, if morning types do find this shift cycle easier to tolerate than evening types then it would be expected for there to be a greater proportion of them in the working population than evening types and as previously noted this is the case in the present research.

One interesting finding with regard to circadian typology is the relationship between morningness and the level of perceived support from an individual's spouse or partner. Although difficult to explain, morning individuals rate their spouse or partner as being more supportive of them working shifts than evening type individuals. It may be that individuals who prefer to rise early have time in the morning to help with household tasks and child care which could in turn lead to greater domestic harmony and hence greater support for working shifts. To determine

if the level of spouse support influences the effect of circadian typology on physical well-being or self rated health further research would be necessary. However, even if there is an interaction between the level of spouse support and morningness, it must be remembered that morningness is found to be a significant predictor of physical well-being and self rated health while controlling for other variables in the regression equation. This is because standard regression analysis determines the standardised beta coefficients for each independent variable while statistically keeping all other independent variables constant, so although variables found to significantly predict the dependent variable may interact with other independent variables they are also proven to significantly contribute to the regression equation on their own.

In summary, the present finding that morning type individuals have better physical well-being and higher self rated health than evening individuals is in contrast to the proposed hypothesis. This may be for several reasons. Firstly, there are weaknesses in the research on which this hypothesis is based. Secondly, several studies have found morningness not to contribute to predictions of physical health and sleep disturbances, and for evening typology to predict fatigue scores. Thirdly, being an evening type person is believed to be an advantage in forward rotating shift systems, yet Air Traffic staff work on backward rotating systems where being more morning oriented may be an advantage. The relatively large number of morning individuals in this population also shows the advantage of this circadian type.

4.3.2 Hypothesis 2 and 3: Social and Domestic Variables

The second hypothesis that, the less shiftwork is perceived to have an effect on, and cause difficulties with, social life and domestic life the better an individual's physical well-being and better mental well-being, and the higher their self rated health, is partially supported. A single domestic variable, the extent to which an individual perceives shiftwork to cause domestic problems, significantly predicts physical and mental well-being but it does not contribute to self rated health. Walker (1985) suggests an individual's body may be able to adjust to shiftwork but their ability to cope still depends greatly on domestic factors. Previous studies have overwhelmingly found shiftwork to cause domestic difficulties (Mott et al, 1965; Khalaque & Rahman, 1984; Shamir, 1983). This is particularly so for rotating shiftworkers, such as those in the present sample. Rotating shiftworkers experience both the disadvantages and advantages of all shifts but one of the most common and unique problems faced by rotating shiftworkers is that of working at weekends. This means greater difficulty in spending time with a working spouse and school aged children. Individuals working non-standard schedules have a similar problem and Staines and Pleck (1984) found that such individuals spent significantly less time with their children.

The third hypothesis that, individuals with fewer domestic commitments and greater spousal support will have better physical well-being, higher self rated health, and better mental well-being than individuals with greater domestic commitments and less spousal support is also only partially supported. Spousal support does not significantly contribute to predicting any of the dependent variables and only self rated health was significantly predicted by having children. Air Traffic staff with children rated their health as poorer than individuals without children. With an understanding of the role of domestic life in coping with shiftwork this finding is not unanticipated. It is well known that shiftwork makes it considerably more difficult for an individual to fulfil family roles and to find child care. However, there is another possible explanation for this finding and that is that having children contributes to lower ratings of health regardless of whether an individual works shifts or not. The comparison of Air Traffic staff with a group of day workers would be necessary to clarify this point.

What is interesting is that although a domestic variable in each regression analysis significantly predicts the dependent variable, none of the social variables do. It is widely realised that shiftworkers find it more difficult to socialise than day workers and in general report less involvement in community and sporting organisations and have fewer friends (Colligan & Rosa, 1990; Herbert, 1983; Walker, 1985). Despite an individual's social life being disrupted by shiftwork it is possible that it is an issue that is more easily dealt with and subsequently has less consequence on physical and mental well-being than disruption to domestic life. Sufficient social support may be gained from shift working friends and family members. A number of Air Traffic staff commented that they only socialised with fellow workers because of the difficulties of staying in contact with people on day shift. The fact that shiftworkers realise this is an inherent problem of shiftwork may lead them to develop closer social relations with other shiftworkers and hence still gain the social support necessary. Consequently, the difficulties associated with social life are not excessive and therefore do not manifest themselves in health related problems.

4.3.3 Hypothesis 4 and 5: Exposure to Shiftwork and Work Schedules

The fourth and fifth hypothesis are both partially supported and are discussed together. The number of months on the current shift cycle significantly contributes to the prediction of physical well-being. The reason for the number of months on the current shift cycle being significant is unclear. If this variable was purely a reflection of the length of exposure to shiftwork or the actual shift cycle worked then it would have been expected that the number of years in Air Services, the number of years spent in the present work position and the current shift cycle variable would also be significant. It may therefore be that the combination of these factors is important and it is neither the length of exposure to shift work or the actual shift cycle worked but the interaction of these factors that is the key. Other factors contributing to the effects of the number of months on the current shift cycle can be suggested by investigating bivariate analyses. Longer periods of time on the current shift cycle is related to less support for working shifts from an individual's spouse or partner and with greater satisfaction with the job as a whole.

The fourth hypothesis is also partially supported by the finding that an absence from Air Services significantly predicts self rated health. This absence from Air Services was for other than normal sick leave, annual leave or training courses. Only a relatively small proportion of the sample had been absent from Air Services and reasons ranged widely including maternity leave, family issues due to shiftwork, long service leave, running a business, needing a change and travel.

This is an interesting finding and possibly suggests that having a break from shiftwork results in better health. It is also possible that individuals who take such a break do so because they realise the benefits, or that after having such a break people feel better and attempt to maintain their improved health. This finding has practical implications in that individuals who have leave which is owing should be encouraged to take it.

The significance of preferred shift rather than actual shift worked in contributing to self rated health is, to say the least unusual, and difficult to explain. It was found that individuals who would prefer to work on a 4 on / 2 off shift cycle have poorer self rated health than individuals who would prefer to work on a 5 on / 2 off, 5 on / 3 off shift cycle or on some other shift cycle. Presently, the majority of individuals work on a 4 on / 2 off shift cycle and interestingly twice as many individuals would prefer to work on a 5 on / 2 off, 5 on / 3 off shift cycle than the number who currently do.

It is possible that individuals who currently rate their health more highly, and hence have greater tolerance to shiftwork, are more aware of the factors that influence their ability to cope with shiftwork. One of the factors that is important in coping with shiftwork is time off in order to be with family and socialise. The 4 on / 2 off shift cycle is a seven week cycle (repeating every seven weeks) and results in a normal weekend off once every seven weeks. The 5 on / 2 off, 5 on / 3 off shift cycle is a 17 week cycle, with three normal weekends off every 17 weeks. This equates to one weekend off every 5.5 weeks. Importantly though, it allows three weekends off in a row every 17 weeks and these weekends off may be an important attraction of this shift cycle. In addition, the 5 on / 2 off, 5 on / 3 off shift cycle may be perceived by individuals as a more predictable and stable cycle since it reflects a more normal work

week than the 4 on / 2 off cycle. In explaining this finding it is of course also likely that there is another reason, unrelated to shiftwork, that has not been considered here.

This finding is interesting in that it implies some shiftworkers are very aware of factors that influence their ability to tolerate shiftwork, while other workers are not. Because of its relationship to an individuals perception of their health, it is well worth investigating further in order to try and gain an understanding of why it has such an influence on self rated health.

4.3.4 Hypothesis 6: Satisfaction with Shift Cycle

The sixth hypothesis that, individuals who experience fewer difficulties with their performance due to shiftwork, have fewer problems with the organisation, and report greater satisfaction with their work will have better physical well-being, higher self rated health, and better mental well-being than individuals who find shiftwork causes performance problems, believes the organisation has difficulties, and reports less satisfaction with their work, is partially supported. Only an individual's satisfaction with their shift cycle is found to relate to physical well-being. Greater satisfaction with the shift cycle worked predicts better physical well-being. Neither self rated health or mental well-being are predicted by satisfaction with work or the shift cycle.

Satisfaction with a shift cycle may reflect an individuals ability to cope with the effect of their shift cycle on their sleep patterns and circadian rhythms. Therefore, if an individual finds their sleep and body rhythms are disrupted due to their work patterns they may also experience poorer physical health. It should be noted that items in the physical well-being scale deal with sleep complaints and gastrointestinal problems, two areas which would be expected to be adversely affected if an individual was not tolerating the shift cycle they were working on.

Bivariate analyses may also help to explain the significance of satisfaction with shift cycle in predicting physical well-being. Greater satisfaction with the shift cycle worked relates to fewer reported sleep, performance and organisational problems. There is also a positive correlation between satisfaction with shift cycle and

satisfaction with the hours worked. Such relationships may indicate that satisfaction with shift cycle also reflects a general ability to tolerate the effects of the shift cycle worked on other aspects of an individuals life. But like the other relationships found in the present study further investigation is required in order to determine causality.

The primary duties of an individual were found to significantly predict both physical well-being and self rated health and this finding partially supports the sixth hypothesis. In the regression equation for physical well-being it is found that Flight Service and Flight Data workers are in the best physical health, followed by Air Traffic Controllers. Those individuals who have additional responsibilities, such as supervisors, instructors, team leaders and stream specialists, have the poorest health. In the regression for self rated health, Air Traffic Controllers are found to have significantly higher ratings of health than both Flight Service/Flight Data and individuals with additional responsibilities. No significant difference is found between Flight Service/Flight Data and individuals with additional responsibilities.

There are a number of possible explanations for individuals who have additional responsibilities having poorer health. Firstly, being in a position of responsibility may mean that an individual feels obliged to work longer hours, fill shifts for absent workers, and experience greater difficulty in swapping shifts since the positions of responsibility are shared between a relatively small group of individuals (21% of the present sample). In addition, Air Traffic staff who have additional responsibilities are likely to have worked their way through the Air Traffic system and would therefore be older and have been exposed to shiftwork for a longer period of time.

An alternative explanation is that such positions are more stressful than other jobs in Air Services and the effect of having greater responsibility is not directly related to working shifts but instead lower levels of well-being are caused by other workplace stressors. For example, the findings of the present study suggest that a large majority of staff perceive that there are organisational problems in the work place (eg: the way work is organised, staffing is arranged or management decision are implemented) and although individuals with additional responsibilities may not make management

decisions they may be perceived as management by other staff and are therefore exposed to complaints and comments regarding management practices.

4.3.5 Hypothesis 7: Sleep Problems

The seventh hypothesis that, individuals who experience few sleep related difficulties will have better physical well-being, higher self rated health, and better mental well-being than individuals who experience problems with sleep is partially supported. The extent to which shiftwork caused sleep problems is a significant predictor of physical well-being. This is a slightly surprising finding because it was expected that sleep problems would be important in predicting all dependent variables. One of the most recognised problems encountered by shiftworkers is the disturbance of the sleep-wake cycle and as such, Knauth (1983) found that complaints of disturbed sleep were the most frequent made by shiftworkers.

One possible explanation is that for Air Traffic staff, other factors are more important in determining tolerance to shiftwork and sleep problems are less of an issue for them. Another, more likely, explanation is that the measures of sleep problems used in the present study did not adequately capture the extent of the problem. As has been discussed in some detail, many of the sleep variables were found to be unreliable and subsequently could not be used in the remainder of the study. This means that important data could have been missed. In addition, sleep items dealt with sleep length and continuity but not sleep quality. Future studies need to include more reliable measure of sleep length and possibly measures concerned with the quality of sleep.

4.3.6 Hypothesis 8: The Use of Engagement and Disengagement Strategies

The most consistent finding in the present study is that the use of engagement and disengagement strategies in coping with shiftwork is important in predicting physical and mental well-being and self rated health. This supports the eighth hypothesis. Previous research has shown this relationship, but only for mental well-being (Spelten et al, 1993).

The use of engagement strategies in coping with shiftwork involves actively managing or changing factors that cause an individual stress. The more frequent use of these types of strategies is found, in the present study, to be related to better physical and mental well-being and higher self rated health. As previously mentioned, individuals were asked the frequency with which they used these strategies in dealing with sleep, social, domestic and work problems caused by working shifts.

Monk (1994) argues that the ability to tolerate shiftwork depends on the interaction of three areas; circadian rhythms, sleep, and social and family life. Tolerance to shiftwork is dependant on problems or difficulties in *all* these areas being addressed. The findings of the present study also suggest that these three areas are consequential in determining the health and well-being of shiftworkers but in addition the use of engagement strategies in dealing with work place problems is identified as important.

The use of engagement strategies possibly shows a greater commitment to shiftwork through the willingness to make lifestyle changes and the more disciplined management of time. Previous literature has suggested that because several aspects of an individual's life are important in coping with shiftwork, it is necessary for the shiftworker to continually attempt to balance all these facets, so the result is no great impairment of any one area (Monk, 1994, Kogi, 1985). What is important about engagement strategies is that their use reflects efforts to *actively* deal with difficulties encountered through working shifts and this possibly identifies individuals who are prepared to continually attempt to balance each area that is affected by shiftwork.

The effect of using engagement strategies on the physical well-being of shiftworkers may be explained by the findings of Folkard et al (1978) who reported that nurses with a greater lifestyle commitment to night work had circadian rhythms that were more adjusted to their work/sleep schedules than nurses who had less of a commitment to night work. Therefore it may be, that Air Services staff who are active and willing in their efforts to adjust their lives to their work patterns may suffer less physiological disruption and hence experience fewer health problems.

The use of disengagement strategies in coping with shiftwork is related to poor physical and mental well-being and lower self rated health. Disengagement strategies are at the opposite end of the continuum from engagement strategies, in that they reflect a desire to avoid or ignore dealing with difficulties created by shiftwork. Therefore, their relationship to poorer health and well-being may be because an individual eventually experiences greater stress through ignoring problems caused by shiftwork. In addition, an individual's disregard for the physiological effects of shiftwork may result in a greater incidence of health problems.

Spelten et al (1993) suggest that individuals disengage as a result of their inability to cope with shiftwork. They believe that this is supported by the finding that individuals who used both engagement and disengagement strategies showed better psychological health than individuals who only used disengagement strategies. The present study did not investigate the interaction of these two forms of coping so results can not confirm or refute these previous findings. Despite the use of disengagement strategies being related to poorer health and well-being, causality can not be determined. Therefore, it must also be considered that poor physical and mental well-being results in individuals using disengagement strategies.

Spelten et al (1993) also noted that the use of disengagement strategies is dichotomous, in that these strategies were either used frequently or not at all. In the present study, the initially skewed distribution of scores on the disengagement sub-scale suggests that they are generally not used by many individuals, although a few individuals use them frequently reflecting a similar dichotomous split. This finding may indicate that individuals only switch to using this type of strategy when their problems become severe.

On the whole the finding that the use of engagement and disengagement strategies are related to physical and mental well-being and self rated health confirms that coping is an important part of tolerating the effects of shiftwork. The definitive nature of these relationships is unclear and further investigation in a longitudinal study would be of benefit. This would allow any change in the use of these strategies to be detected and

compared with changes in tolerance to shiftwork. The interaction of the two styles of coping also requires further study since it is possible the effects of disengaging may be moderated by the use of engagement strategies.

4.4 Limitations of the Present Study and Suggestions for Future Research

4.4.1 Ratio of Cases to Independent Variables

Because of the large number of independent variables (42) used in the present study, the ratio of cases to independent variables is slightly below that recommended by Tabachnick and Fidell (1989) for multiple regression analyses. The result of this lower than preferred ratio is a large degrees of freedom in relation to the number of cases considered and hence reduced statistical power of the regression analyses. There is also a slight increase in the possibility of making a type II error. The strategy of further combining independent variables was not considered a feasible option. Variables that could be combined had been and additional composite independent variables would be meaningless. Previous research on coping with shiftwork has tended to consider only one or two of the variables thought to be important in predicting shiftworker well-being. It is therefore important that future research considers a broad range of variables in order to better understand tolerance to shiftwork, such as the present study has attempted to do. However, in order to overcome the limitation of the ratio of cases to independent variables, future studies must have a large number of cases.

4.4.2 Limitations of Regression Analysis

A regression analysis allows the assessment of the relationship between a set of independent variables and one dependent variable. The degree of association between the independent variables and the dependent variable can be determined but the identification of a relationship does not imply cause and effect. The findings of the present study suggest that there are a number of relationships that require further investigation. Because of the progressive nature of health outcomes a longitudinal study is warranted in order to investigate causal relationships.

4.4.3 Self Reported Data

Caution must be noted in interpreting some results, given that all data presented are self reported and hence there is the potential bias in responding that may be associated with this methodology. For example, it could be argued that the associations between domestic problems, sleep problems, satisfaction with the shift cycle and the dependent variables may in fact indicate an artefact ie: a tendency to complain.

4.5 Practical Implications

In conclusion, the findings of the present research indicate that an individuals ability to tolerate shiftwork is dependent on a range of factors including circadian typology, work place factors, social and domestic factors, sleep factors, and coping factors. Further longitudinal research is required for causality to be determined but the current findings do have some practical implications. The first of these is that shiftworkers must be educated about the effects of shiftwork on their health and well-being. Without being informed there is no way they can be expected to begin the develop effective coping strategies. The second implication is that an organisation must support the coping strategies of their shiftworkers. Shiftworkers need to be supported in sleep, safety, free time, health, social life and their careers. By doing this, it is more likely that an individual can continually balance their life so that they can continue for some time on a rapidly rotating shift system.

REFERENCES

Aanonsen, A. (1964). *Shiftwork and Health*. Oslo: Universitetsforlaget.

Adams, J., Folkard, S., & Young, M. (1986). Coping strategies used by nurses on night duty. *Ergonomics, 29*, 185-196.

Akerstedt, T. (1980). Interindividual differences in adjustment to shiftwork. In W. P. Colquhoun and J. Rutenfraz (Eds.), *Studies of Shiftwork* (pp. 121-130). London: Taylor & Francis.

Akerstedt, T., Alfredsson, L., & Theorell, T. (1987). Work hours and disease: An analysis with aggregated data. *Stressforskningsrapporter*, 190.

Akerstedt, T., & Gillberg, M. (1981). Sleep disturbances and shift work. In A. Reinberg, N. Vieux, & P. Andlauer (Eds*.), Night and shift work: Biological and social aspects* (pp. 127-135). Oxford, England: Pergamon Press.

Akerstedt, T., & Torsvall, L. (1981). Shift dependent well-being and individual differences. *Ergonomics, 24*, 265-273.

Akerstedt, T., Torsvall, L., & Gillberg, M. (1989). Shift work and napping. In D. F. Dinges & R. J. Broughton (Eds.), *Sleep and alertness: Chronobiological, behavioral, and medical aspects of napping* (pp. 205-220). New York: Raven Press.

Anastasi, A. (1988). Psychological Testing (6th ed.). New York: MacMillan.

Armstrong, D. (1982). *An evaluation of the influence of experience on permanent day and permanent night shift workers*. Unpublished master's thesis. Illinois Institute of Technology: Chicago.

Arvey, R. D., Carter, G. W., & Buerkly, D. K. (1991). Job satisfaction: dispositional and situational influences. In C. L. Cooper & I. T. Robertson (Eds.), *International Review of Industrial and Organizational Psychology, 6*, 359-383.

Banks, O. (1959). Continuous shiftwork: The attitude of wives. *Occupational Psychology, 30*, 68-69.

Barton, J., & Folkard, S. (1993). Advancing versus delaying shift systems. *Ergonomics, 36*, 59-64.

Barton, J., Smith, L., Totterdell, P., Spelten, E., & Folkard, S. (1993). Does individual choice determine shift system acceptability? *Ergonomics, 36*, 93-99.

Barton, J., Spelten, E., Totterdell, P., Smith, L., Folkard, S., & Costa, G. (1995). The Standard Shiftwork Index: a battery of questionnaires for assessing shiftwork-related problems. *Work & Stress, 9*, 4-30.

Bloom, F. E., & Lazerson, A. (1988). *Brain, Mind, and Behaviour* (2nd ed.). New York: W. H. Freeman and Company.

Bohle, P., & Tilley, A. J. (1989). The impact of night work on psychological well-being. *Ergonomics, 32*, 1089-1099.

Bohle, P., & Tilley, A. J. (1993). Predicting mood change on night shift. *Ergonomics, 36*, 125-133.

Booze, C. F. (1978). *The morbidity experience of air traffic control personnel* (Report no. FAA-AM-78-21).Washington, DC: Federal Aviation Administration.

Booze, C. F. (1982). Blood pressures of active pilots compared with those of air traffic controllers. Preprints *Aerospace Medical Association*.

Breithaupt, H., Hidlebrandt, G., Dohre, D., Josch, R., Sieber U., & Werner, M. (1980). Tolerance to Shift of Sleep, as Related to the Individual's Circadian Phase Position. In W. P. Colquhoun and J. Rutenfraz (Eds.), *Studies of Shiftwork* (pp. 177-188). London: Taylor & Francis.

Chadwick-Jones, J. K. (1969). *Automation and Behaviour: A Social Psychological Study*. London: John Wiley.

Cobb, S., & Rose, R. M. (1973). Hypertension, peptic ulcer and diabetes in air traffic controllers. *Journal of the American Medical Association, 224*, 498-492.

Cohen, S. (1988). Psychosocial models of the role of social support in the etiology of physical disease. *Health Psychology, 7*, 269-297.

Colligan, M. J., & Rosa, R. R. (1990). Shiftwork effects on Social and Family Life. In A. Scott (Ed.), *Occupational Medicine: State of the Art Reviews* (Vol. 5, pp. 315-322). Philadelphia: Hanley & Belfus Inc.

Colquhoun, W.P., & Rutenfranz, J. (1980). *Studies of Shiftwork*. London: Taylor & Francis.

Committee on the Regulation of Air Traffic Controller's Hours (1990*). Report of a Committee on Regulation of Air Traffic Controller's Hours to the Civil Aviation Authority*. Cheltenham: Civil Aviation Authority.

Costa, G. (1993). Evaluation of workload in air traffic controllers. *Ergonomics, 36*, 1111-1120.

Costa, G., Apostoli, P., D'Andrea, F., & Gaffuri, E. (1981). Gastrointestinal and neurotic disorders in textile shift workers. In A. Reinberg, N. Vieux, & P.

Andlauer (Eds.), *Night and Shift work: Biological and Social Aspects* (pp.) Oxford: Pergamon Press.

Costa, G., Lievore, F., Ferrari, P., & Gaffuri, E. (1987). Usual meal times in realtion to age, sex, work activity and morning-eveningness. *Chronobiologia, 14*, 383-391.

Costa, G., Schallenberg, G., Ferracin, A., & Gaffuri, E. (1995). Psychophysical conditions of air traffic controllers evaluated by the standard shiftwork index. *Work & Stress, 9*, 281-288.

Cruz, C., & Della-Rocco, P. (1995). Investigation of sleep patterns among air traffic specialists as a function of time off between shifts in rapidly rotating work schedules. In R. S. Jensen and L. A. Rakovan (Eds.), *Proceedings of the Eighth International Symposium on Aviation Psychology* (Vol. 2, pp. 974-979). Ohio: Ohio State University.

Dahlgren, K. (1981). Adjustment of Circadian Rhythms to Rapidly Rotating Shift Work - A Feild Study of Two Shift Systems. In A. Reinberg, N. Vieux, & P. Andlauer (Eds.), *Night and Shift work: Biological and Social Aspects* (pp. 357-364). Oxford: Pergamon Press.

Daniel, J., Potasova, A. (1989). Oral temperature in 8 h and 12 h shifts. *Ergonomics, 32*, 698-696.

Dekker, D. K., Paley, M. J., Popkin, S. M., & Tepas, D. I. (1993). Locomotive engineers and their spouses: Coffee consumption, mood, and sleep reports. *Ergonomics, 36*, 233-238.

De la Mare, G., & Walker, J. (1968). Factors influencing the choice of shift rotation. *Occupational Psychology, 42*, 1-21.

Dougherty, J. D. (1967). Cardiovascular findings in air traffic controllers. *Aerospace Medicine, 38*, 26-30.

Dougherty, J. D., Trites, D. K., & Dille, J. R. (1965). Self-reported stress-related symptoms among air traffic control specialists (ACTS) and non-ACTS personnel. *Aerospace Medicine, 36*, 956-960.

Ehert, C. F. (1981). New approaches to chronohygiene for the shift worker in the nuclear power industry. In A. Reinberg, N. Vieux, & P. Andlauer (Eds.), Night and Shift Work: Biological and Social Aspects (pp. 263-270). Oxford: Pergamon Press.

Ely, D. L., & Mastardi, R. A. (1986). The effects of recent life events stress, life assets and temperament pattern on cardiovascular risk factors for Akron City police officers. *Journal of Human Stress, 12*, 77-91.

Folkard, S. (1990). Circadian performance rhythms: Some practical and theoretical implications. In D. E. Broadbent, J. Reason, & A. Baddeley (Eds.), *Human Factors in Hazardous Situations* (Vol. 327-B, pp. 543-553). London: Philosophical Transcript Royal Society of London.

Folkard, S., & Barton, J. (1992). Do sleep gates influence early shift duration? *Proceedings of the 10th International Symposium on Night and Shift Work*. Sheffield.

Folkard, S., & Condon, R. (1987). Night shift paralysis in air traffic control officers. *Ergonomics, 30*, 1353-1363.

Folkard, S., Minors, D. S., & Waterhouse, J. M. (1985). Chronobiology and Shiftwork: Current issues and trends. *Chronobiologia, 12*, 31-54.

Folkard, S., & Monk, T.H. (1979). Shiftwork and Performance. *Human Factors, 21*, 483-492.

Folkard, S., Monk, T. H., & Lobban, M. (1978). Short- and long-term adjustment of circadian rhythms in 'permanent' night nurses. *Ergonomics, 21*, 785-799.

Folkard, S., & Totterdell, P. (1992, July). Circadian variations in performance: Implications for abnormal work hours. *Abstracts: International Symposium "Shiftwork and Job Demands* (pp. 10-14). Paris.

Folkman, S. (1984). Personal control and stress and coping processes: A theoretical analysis. *Journal of Personality and Social Psychology, 46*, 839-852.

Frese, M., & Okenek, K. (1984). Reasons to leave shiftwork and psychological and psychosomatic complaints of former shiftworkers. *Journal of Applied Psychology, 69*, 509-541.

Frese, M., & Semmer, N. (1986). Shiftwork, stress and psychosomatic complaints: A comparison between workers in different shiftwork schedules, non-shiftworkers, and former shiftworkers. *Ergonomics, 29*, 99-114.

Froberg, J. E. (1985). Sleep Deprivation and Prolonged Working Hours. In S. Folkard & T. H. Monk (Eds.), *Hours of Work: Temporal Factors in Work Scheduling* (pp. 67-75). New York: John Wiley and Sons.

Frost, P. J., & Jamal, M. (1979). Shift work, attitudes, and reported behavior: Some associations between individual characteristics and hours of work and leisure. *Journal of Applied Psychology, 64*, 66-70.

Gadbois, C. (1981). Women on night shift: Interdependence of sleep and off-the-job activities. In A. Reinberg, N. Vieux, & P. Andlauer (Eds.), *Night and shift work: Biological and social aspects* (pp. 223-227). Oxford, England: Pergamon Press.

Gander, P. H., Myhre, G., Graeber, R. C., Anderson, H. T., & Lauber, J. K. (1985). *Crew Factors in Flight Operations: I. Effects of 9-hour time-zone changes on Fatigue and the Circadian Rhythms of Sleep/Wake and Core Temperature* (Technical Report No. 88197). Moffett Field, California: National Aeronautics and Space Administration.

Gersten, A. H. (1987). *Adaption in rotating shift workers: A six year follow-up study*. Unpublished doctoral dissertation. Illinois Institute of Technology: Chicago.

Goldberg, D. P. (1972). *The Detection of Psychiatric Illness by Questionnaire*. Oxford: Oxford University Press.

Goldberg, D. P. (1987) The General Health Questionnaire. In I. McDowell and C. Newell (Eds.), *Measuring Health: A Guide to Rating Scales and Questionnaires*. New York: Oxford University Press.

Goldberg, D. P., Rickels, K., Downing, R., & Hesbacher, P. (1976). A comparison of two psychiatric screening tests. *British Journal of Psychiatry*, *129*, 61-67.

Gordon, N. P., Clearly, P. D., Parker, C. E., & Czeisler, C. A. (1986). The prevalence and health impact of shiftwork. *American Journal of Public Health, 76*, 1225-1228.

Greenwood, K.M. (1994). Long-term stability and psychometric properties of the Composite Scale of Morningness. *Ergonomics*, *37*, 377-383.

Haider, M., Kundi, M., & Koller, M. (1981). Methodological issues and problems in shift work research. In L. C. Johnson, D. I. Tepas, W. P. Colquhoun, & M. J. Colligan (Eds.), *Biological rhythms, sleep, and shiftwork* (pp. 145-163). New York: Spectrum.

Hakkinen, S. (1969). Adapdability to shift work. *Studia Laboris et Salutis*, *4*, 68-80.

Harrington, J. M. (1978). *Shiftwork and Health. A Critical Review of the Literature*. London: HMSO.

Hauty, G. T., Trites, D. K., & Berkley, W. J. (1965). *Biomedical Survey of ATC Facilities: 2. Experience and Age* (Report No. FAA-AM-65-6).Washington, DC.: Federal Aviation Administration Office of Aviation Medicine.

Haw, M. A. (1982). Women, work and stress: A review and agenda for the future. *Journal of Health and Social Behavior, 23*, 132-144.

Herbert, A. (1983). The influence of shiftwork on leisure activities: A study with repeated measurement. *Ergonomics*, *26*, 565-574.

Heslegrave, R. J., Rhodes, W., Szlaptis, I., Ujimoto, V., Hahn, K., & Moldofsky, H. (1995). Impact of Shiftwork and Overtime on Air Traffic Controllers: Subjective Estimates of Performance Deficits as a Function of Shift,

Chronobiological Type and Age. In M. H. Chase, L. D. Rosenthal & C. O'Connor (Eds.), *Sleep Research* (Vol. 24, pp. 93). UCLA, Los Angeles: Brain Information Service/Brain Research Institute.

Hopkin, V. D. (1995). *Human Factors in Air Traffic Control.* London: Taylor & Francis.

Horne, J. A., & Ostsberg, O. (1976). A self-assessment questionnaire to determine morningness in human circadian rhythms. *International Journal of Chronobiology, 4,* 97-110.

Idler, E. L., & Angel, R. J. (1990). Self-Rated Health and Mortality in the NHANES-I Epidemiologic Follow-up Study. *American Journal of Public Health, 80,* 446-452.

Idler, E. L., & Kasl, S. (1991). Health Perceptions and Survival: Do Global Evaluations of Health Status Really Predict Mortality?, *Journal Of Gerontology, 46,* S55-65.

International Labour Office. (1978). *Management of working time in industrialised countries.* Geneva: International Labour Office.

Iskra-Golec, I., Marek. T., & Noworol, C. (1995). Interactive effect of individual factors on nurses' health and sleep. *Work & Stress, 9,* 256-261.

Jahar, P., & Weller, M. P. I. (1982). Psychiatric morbidity and time zone changes: A study of patients from Heathrow Airport. *British Journal of Psychiatry, 140,* 231-235.

Jamal, M., & Jamal, S. M. (1982). Work and non-work experiences of fixed and rotating shifts: An empirical assessment. *Journal of Vocational Behaviour, 20,* 282-293.

Johnson, L. C. (1982). Sleep deprivation and Performance. In W. B. Webb (Ed.), *Biological rhythms, sleep and performance*. New York: Wiley.

Jones, L. (1982). *Management and Employee Relationships Within the Federal Aviation Administration* (Contract no. DTFAO1-82-C-300006). Washington, DC.: Federal Avaition Administration.

Joyce, W. F., & Slocum, J. W. (1984). Collective climate: Agreement as a basis for defining aggregate climates in organizations. *Academy of Managment Journal, 27,* 721-742.

Kalat, J. W. (1992). *Biological Psychology* (4th ed.). Belmont, California: Wadsworth.

Kavanagh, M. J., Hurst, M. W. & Rose, R. (1981). The relationship between job satisfaction and psychiatric health symptoms for air traffic controllers. *Personnel Psychology, 34*, 691-707.

Kelly, R. J., & Schneider, M. F. (1982). The twelve-hour shift revisited: Recent trends in the electric power industry. *Journal of Human Ergology, 11* (Suppl.), 369-384.

Kerkhof, G. (1984). A Dutch questionnaire for the selection of morning- and evening-type persons. *Nederlands Tijdschrift voor de Psychologie en Haar Grensgebieden, 39*, 281-294.

Kerkhof, G. (1985a). Inter-individual differences in the human circadian system: A review. *Biological Psychology, 20*, 83-112.

Kerkhof, G. (1985b). Individual differences in circadian rhythms. In S. Folkard, & T. H. Monk (Eds.), *Hours of Work: Temporal Factors in Work Scheduling* (pp. 29-35). New York: John Wiley and Sons.

Khaleque, A. & Rahman, A. (1984). Shiftworker's attitudes towards shiftwork and perception of quality of life. *International Archives of Occupational and Environmental Health, 53*, 291-297.

Knauth, P. (1983). Analysis of 120 shift systems of the police in the Federal Republic of Germany. *Applied Ergonomics, 14*, 133-137.

Knauth, P. (1993). The design of shift systems. *Ergonomics, 36*, 15-28.

Knauth, P., Kieswetter, E. (1987). A change from weekly to quicker shift rotations: A field study of discontinuous three-shift workers. *Ergonomics, 30*, 1311-1321.

Knutsson, A., Akerstedt, T., Jonsson, B. G., Orth-Gomer, K. (1986). Increased risk of ischaemic heart disease in shift workers. *Lancet, July*, 89-92.

Koen, S. (1984). *Shiftwork: How To Cope*. New Hampshire: Community Health Network Inc.

Kogi, K. (1985). Introduction to the Problems of Shiftwork. In S. Folkard, & T. H. Monk (Eds.), *Hours of Work: Temporal Factors in Work Scheduling* (pp. 165-184). New York: John Wiley and Sons.

Kolgi, K. (1982). Sleep problems in night and shiftwork. *Journal of Human Ergology, 11* (Suppl.), 217-231.

Koller, M., Kundi, M., & Cervinka, R. (1978). Field studies of shift work at an Australian oil refinery: I Health and psychosocial well being of workers who drop out of shiftwork. *Ergonomics, 21*, 835-847.

Krieger, D. T. (1988). Abnormalities in circadian periodicity in depression. In D. J. Kupfer, T. H. Monk, & J. D. Barchas (Eds.), *Biological Rhythms and Mental Disorders* (pp. 177-196). New York: The Guilford Press.

Kronauer, R. E. (1994). Circadian rhythms. In R. Cooper (Ed.), *Sleep* (pp. 97-134). London: Chapman & Hall Medical.

Kurumatani, N., Koda, S., Nakagiri, S., Hisashige, A., Saki, K., Saito, Y., Aoyama, H., Dejima, M., & Moriyama, T. (1994). The effects of frequently rotating shiftwork on sleep and the family life of hospital nurses. *Ergonomics*, *37* (6), 995-1007.

Landy, F.J. (1989). *Psychology of Work Behavior* (4th ed.). California: Brookes/Cole.

Lauber, J. K., & Kayten, P. J. (1988). Keynote Address: Sleepiness, circadian dysrythmia, and fatigue in transportation system accidents. *Sleep, 11*, 503-512.

Lavie, P,. Chillag, N., Epstein, R., Tzischinsky, O., Givon, R., Fuchs, S., & Shahal, B. (1989). Sleep disturbances in shift-workers: A marker for maladaption syndrome. *Work & Stress, 3*, 33-40.

Lazarus, R. S. (1966*). Psychological Stress and the Coping Process*. New York: McGraw-Hill.

Luna, T. D., French, J., Mitcha, J. L., & Neville, K. J. (1992*). Forward rapid rotation shiftwork in USAF air traffic controllers: Sleep, activity, fatigue and mood analyses* (Technical Report No. AL/CF-TR-1994-0156). Brooks Air Force Base, Texas.

McBride, A., Lance, W., & Freeman, S. (1979). The psychosocial impact of a labour dispute. *Occupational Psychology, 54*, 125-134.

MacLennan, R. N., & Peebles, J. W. E. (1996). Survey of Health Problems and Personality in Air Traffic Controllers. *The International Journal of Aviation Psychology, 61*, 43-55.

Melton, C. E. (1982). *Physiological stress in air traffic controllers: A review* (Technical Report No. FAA-AM-82-17). Washington, DC.: Federal Aviation Administration.

Melton, C. E., Smith, R. C., McKenzie, J. M., Saldivar, J. T., Hoffman, S. M., & Fowler, P. R. (1975). *Stress in Air Traffic Controllers: Comparison of Two Air Route Traffic Control Centers on Different Shift Rotation Patterns* (Technical Report No. FAA-AM-75-7). Washington, DC.: Federal Aviation Administration.

Minors, D. S., Healy, D., & Waterhouse, J. M. (1994). The attitudes and general health of student nurses before and immediately after their first eight weeks of nightwork. *Ergonomics, 37*, 1355-1362.

Minors, D. S., & Waterhouse, J. M. (1990). Circadian Rhythms in General. In A. Scott (Ed.), *Occupational Medicine: State of the Art Reviews*, (Vol. 5, pp. 165-182). Philadelphia: Hanley & Belfus Inc.

Monk, T. H. (1988). *The relationship of chronobiology to sleep demands*. Paper presented at the 32nd Annual Meeting of the Human Factors Society, Anaheim, California.

Monk, T. H. (1994). Shift work. In M. H. Kryger, T. Roth, & W. C. Dement (Eds.), *Principles and Practice of Sleep Medicine* (2nd ed.) (pp. 471-476). Philadelphia: W. B. Saunders Company.

Monk, T. H., & Folkard, S. (1985). Individual differences in shiftwork adjustment. In S. Folkard & T. H. Monk (Eds.), *Hours of Work: Temporal Factors in Work Scheduling* (pp. 227-236). New York: John Wiley and Sons.

Monk, T. H., & Folkard, S. (1992). *Making Shiftwork Tolerable*. London: Taylor & Francis.

Mott, P. E., Mann, F. C., McLoughlin, Q., & Warwick, D. P. (1965). *Shiftwork: The Social, Psychological and Physical Consequences*. Ann Arbor: University of Michigan Press

Nachreiner, F. (1990). Towards Standardisation of Methodology in Shift Work Research. In G. Costa, G. Cesana, K. Kogi, & A. Wedderburn (Eds.), *Shiftwork: Health, Sleep and Performance* (pp. 165-172). Franfurtam Main: Peter Lang.

Norusis, M. J. (1988). *SPSS/PC+ Advanced Statistics V2.0*. Chicago: McGraw-Hill.

Olsson, K., Klandolin, I., & Kauppinen-Toropainen, K. (1990). Stress and coping strategies of three-shift workers. *Le Travail humain, 53*, 175-188.

Orth-Gomer, K. (1983). Intervention on coronary risk factors by adapting a shiftwork schedule to biologic rhythmicity. *Psychosomatic Medicine, 45*, 407-415.

Ottoman, W., Karvonen, M. J., Schmidt, K. H., Knauth, P., & Rutenfraz, J. (1989). Subjective health status of day and shift working policemen. *Ergonomics, 32*, 847-854.

Presser, H.B. (1988). Shift work and child care among young dual-earner American parents. *Journal of Marriage and the Family, 50,* 133-148.

Price, W.J., & Holley, D. C. (1990). Shiftwork and Safety in Aviation. In A. Scott (Ed.), *Occupational Medicine: State of the Art Reviews* (Vol. 5, pp. 343-377). Philadelphia: Hanley & Belfus Inc.

Reason, J. (1990). The contribution of latent human failures to the breakdown of complex human systems. In D. E. Broadbent, J. Reason, & A. Baddeley (Eds.), *Human Factors in Hazardous Situations* (Vol. B-327, pp. 475-484). London: Philosophical Transactions of the Royal Society of London.

Rhodes, W., Szlaptis, I., Hahn, K,. Heslegrave, R., & Ujimoto, K.V. (1994). *A Study of the Impact of Shiftwork & Overtime on Air Traffic Controllers* (Technical Report No. TP 12257E). Canada: Transport Canada.

Rice, R. W. (1984). Organisational work and the overall quality of life. *Applied Social Psychology Annual, 5*,155-178.

Rosa, R. R., Colligan, M. J., & Lewis, P. (1989). Extended workdays: Effects of 8-hour and 12-hour rotating shift schedules on performance, subjective alertness, sleep patterns, and psychosocial variables. *Work & Stress, 3*, 21-32.

Rose, R. M., Jenkins, C. D., & Hurst, M. W. (1978). *Air traffic controller health change study* (Technical Report No. FAA-AM-78-39). Washington, DC: Federal Aviation Administration.

Rosenzweig, M.R., & Leiman, A.L. (1982). *Physiological Psychology*. Lexington, Massachusetts: D.C Heath and Company.

Rutenfranz, J., Colquhoun, W. P., Knauth, P, & Ghata, J. N. (1977). Biomedical and psychosocial aspects of shiftwork: A review. *Scandanvian Journal of Work Environment and Health, 3*, 165-182.

Rutenfranz, J., Haider, M., & Koller, M. (1985). Occupational health measures for night workers and shiftworkers. In S. Folkard, & T. H. Monk (Eds.), *Hours of Work: Temporal Factors in Work Scheduling* (pp. 199-210). New York: John Wiley and Sons.

Saldivar, J. T., Hoffman, S. M., & Melton, C. E. (1977). *Sleep in air traffic controllers* (Technical Report No. FAA-AM-77-5). Washington, DC.: Federal Aviation Administration.

Sauter, S. L., Murphy, L. R., & Hurrell, J. J. (1990). Prevention of work related psychological disorders: A national strategy proposed by the National Institute for Occupational Safety and Health (NIOSH). *American Psychologist, 45*, 1146-1158.

Scheier, M., Weintraub, J., & Carver, C. (1986). Appraisal, avoidance and coping with stress. *American Psychologist, 7,* 813-819.

Scherrer, J. (1981). Man's work and circadian rhythm throught the ages. In A. Reinberg, N. Vieux, & P. Andlauer (Eds.), *Night and shift work: Biological and social aspects* (pp. 1-10). Oxford, England: Pergamon Press.

Schmieder, R. A., & Smith, C. S. (1996). Moderating effects of social support in shiftworking and non-shiftworking nurses. *Work & Stress, 10,* 128-140.

Shamir, B. (1983). Some antecedentsof work-nonwork conflict. *Journal of Vocational Behavior, 23,* 98-111.

Shouksmith, G., & Burrough, S. (1988). Job Stress Factors for New Zealand and Canadian Air Traffic Controllers. *Applied Psychology: An International Review, 37,* 263-270.

Singal, M., Smith, M., Hurrell, J. J., Bender, J., Kramkowski, R. S., & Salisbury, S. A. (1977). *Hazard evaluation and technical assistance report: O'Hare International Airport* (Report no. TA 77-67). Cincinatti: National Institute for Occupational Safety and Health.

Smith, R. C. (1973). Comparison of the job attitudes of personnel in three air traffic control specialities. *Aerospace Medicine, 44,* 918-927.

Smith, R. C. (1978). *Communication Concerning Partial Summary of Medical Disqualifications at Level 5 Terminals -- 1972-1977*. Washington, DC.: Federal Aviation Administration Aeromedical Services Division.

Smith, R. C. (1980). *Stress, Anxiety and the Air Traffic Control Specialist: Some Conclusions From a Decade of Research* (Report no. FAA-AM-80-14). Washington, DC.: Federal Aviation Administration Office of Aviation Medicine.

Smith, R. C., & Folkard, S. (1993). The impact of shiftwork on personnel at a nuclear power plant: an exploratory survey study. *Work & Stress, 7,* 341-350.

Smith, R.C., Melton, C.E., & McKenzie, J.M. (1971). *Affect Adjective Checklist Assessment of Mood Variations in Air Traffic Controllers* (Technical Report No. FAA-AM-71-21). Washington, DC: Federal Aviation Administration, Office of Aviation Medicine.

Smith, C. S., Reilly, C. & Midkiff, K. (1989). Evaluation of Three Circadian Rhythm Questionnaires With Suggestions for an Improved Measure of Morningness. *Journal of Applied Psychology, 74,* 728-738.

Spelten, E., Smith, L., Totterdell, P., Barton, J., Folkard S., & Bohle, P. (1993). The relationship between coping strategies and GHQ-scores in nurses. *Ergonomics, 36,* 227-232.

Staines, G. L., & Pleck, J. H. (1984). Nonstandard work schedules and family life. *Journal of Applied Psychology, 69*, 515-523.

Suvanto, S., Partinen, M., Harma, M., & Ilmarinen, J. (1990). Flight attendants desynchronosis after rapid time zone changes. *Aviation Space and Environmental Medicine, 61*, 543-547.

Tabachnick, B. G., & Fidell, L. S. (1989). *Using Multivariate Statistics* (2nd ed.). New York: Harper & Row.

Tattersall, A. J. & Farmer, E. W. (1995). The Regulation of Work Demands and Strain. In S. L. Sauter & L. R. Murphy (Eds.), Organizational risk factors for job stress (pp. 139-156). Washington, DC.: American Psychological Association.

Tattersall, A. J. & Farmer, E. W., & Belyavin, A. J. (1991). Stress and workload managment in air traffic control. In J. A. Wise, V. D. Hopkin and M. L. Smith (Eds.), *Automation and Systems Issues in Air Traffic Control* (NATO ASI Series Vol. F73, pp. 255-266). Berlin: Springer-Verlag.

Taylor, P. J., & Pocock, S. J. (1972). Mortality of shift and day workers 1956-1968. *British Journal of Individual Medicine, 29*, 201-207.

Tepas, D. I. (1982a). Work/sleep time schedules and performance. In W. Webb (Ed.), *Biological rhythms, sleep, and performance* (pp. 87-107). Chichester, England: Wiley.

Tepas, D. I. (1982b). Adaption to shiftwork: Fact or fallacy? *Journal of Human Ergology, 11* (Suppl.), 1-12.

Tepas, D. I. (1985c). Flexitime, compressed work weeks, and other alternative work schedules. In S. Folkard, & T. H. Monk (Eds.), *Hours of Work-Temporal Factors in Work Scheduling* (pp. 147-164). New York: John Wiley and Sons.

Tepas, D. I., & Carvalhais, A. B. (1990). Sleep patterns of shiftworkers. In A. Scott (Ed.), *Occupational medicine: State of the art reviews* (Vol. 5, pp. 199-208). Philadelphia: Hanley & Belfus.

Tepas, D.I., Duchon, J.C., & Gersten, A.H. (1993). Shiftwork and the Older Worker. *Experimental Aging Research, 19*, 295-320.

Tepas, D. I., & Monk, T. H. (1987). Work Schedules. In G. Salvendy (Ed.), *Handbook of Human Factors* (pp. 819-843). New York: Wiley.

Tepas, D. I., Walsh, J. K., & Armstrong, D. R. (1981). Comprehensive study of the sleep of shiftworkers. In L. C. Johnson, D. I. Tepas, W. P. Colquhoun, & M. J. Colligan (Eds.), *Biological rhythms, sleep, and shiftwork* (pp. 347-356). New York: Spectrum.

Thierry, H., & Meijman, T. (1994). Time and behavior at work. In H. C. Triandis, M. D. Dunnette and L. M. Hough (Eds.*), Handbook of Industrial and Organisational Psychology* (Vol. 4, pp. 341-413). Palo Alto, CA: Consulting Psychologists Press.

Tobin, D. L., Holroyd, K. A., & Reynolds, R. V. C. (1984*). User's Manual for the Coping Strategies Inventory*. Ohio: Ohio University.

Torsvall, L., & Akerstedt, T. (1980). A diurnal type scale. *Scandanavian Journal of Work and Environmental Health*, *6*, 283-290.

Verhaegan, P., Dirkx, I., Maasen, A., & Meers, A. (1986). Subjective health after twelve years of shiftwork. In M. Haider, M. Koller and R. Cervinka (Eds.), *Night and Shiftwork: Long term Effects and their Prevention* (pp. 67-74). Verlag: Peter Lang.

Vidacek, S., Kaliterna, L., & Radosevic-Vidacek, B. (1987). Predictive validity of individual difference measures for health problems in shiftworkers. In A. Oginski, J. Pokorski and J. Rutenfraz (Eds.), *Contemporary Advances in Shiftwork Research* (pp. 99-106). Krakow: Medical Academy.

Vidacek, S., Kaliterna, L., Radosevic-Vidacek, B., & Folkard, S. (1988). Personality differences in the phase of circadian rhythms: a comparison of morningness and extraversion. *Ergonomics, 31*, 873-888.

Walker, J (1985). Social problems of shiftwork. In S. Folkard, & T. H. Monk (Eds.), *Hours of Work-Temporal Factors in Work Scheduling* (pp. 211-225). New York: John Wiley and Sons.

Warr, P. B. (1987). Job characteristics and mental health. In P. Warr (Ed.), *Psychology at Work*. Harmondsworth: Penguin.

Waterhouse, J. M., Folkard, S., & Minors, D. S. (1992). *Shiftwork, Health and Safety: An Overview of the Scientific Literature 1978-1990*. London: HMSO.

Wedderburn, A. A. I. (1978). Some suggestions for increasing the usefulness of psychological and sociological studies of shiftwork. *Ergonomics, 21*, 827-833.

Wedderburn, A. A. I. (1991). *Giudelines for shiftworkers*. BEST, No. 3.

Wedderburn, A. A. I. (1995). Men and women who like continuous shiftwork are more 'hardy': but what does it mean?. *Work & Stress, 9*, 206-210.

Wilkinson, R. T. (1992). How fast should the night shift rotate? *Ergonomics, 35*, 1425-1446.

Zeier, H. (1994). Workload and psychosocial stress reactions in air traffic controllers. *Ergonomics, 37*, 525-539.

Appendix A

RELIABILITY STUDY

Aim

A small survey was carried out to determine the reliability of the questionnaire to be used in the main study. This also permitted the acceptability of the questions to be tested and for any anomalies in questions to be detected.

Method

Participants:

Data from Air Traffic Controllers employed by Airways Corporation of New Zealand at Ohakea Air Force Base, New Zealand was included in this portion of the study. Air traffic services at this centre include tower control for military aerodrome traffic, and area and terminal radar services for the surrounding airspace (approximately one third of the North Island). Radar services control a combination of military traffic, commercial civilian aircraft and training traffic.

Initially 33 Air Traffic Controllers were approached at this centre and asked to participate in the study. Sixteen responses were eligible to be used, giving a response rate of 48%.

Measures:

A description of the measures used in the reliability study can be found on page 64. Because of differences in the terms used to describe job responsibilities by New Zealand and Australian Air Traffic Service organisations, questions regarding the type of job, and primary duties were worded slightly differently. The New Zealand centre also ran one additional shift schedule that was not used in Australia and this was included in the questionnaire for the reliability study.

Procedure:

Air Traffic Controllers received the questionnaire through their internal mailing system. The manager of ATS at Ohakea Centre held a list of all Air Traffic Controllers' names along with the corresponding identification numbers from the questionnaires; this allowed the second questionnaire to be distributed to the correct individual. The Centre manger was not involved in collecting the questionnaires. Return was via a postal box located in the Air Traffic Controllers' workplace. The second issue of the questionnaire followed exactly the same format as the first with a time interval of 4 weeks between the first and second administrations.

Information to participants outlined the method of distribution and collection since there was concern over anonymity being maintained. This concern was heightened because of current industrial relations which were strained due to ongoing contract negotiations. Many Air Traffic Controllers were reluctant to participate because they felt 'management' might use the results to their disadvantage.

The information sheet handed out to Air Traffic Controllers with the questionnaire can be found in Appendix C. Twenty two of the first questionnaires were returned but only 10 of the second questionnaire were initially returned. In order to encourage further returns a reminder letter was sent to all Air Traffic Controllers (see Appendix C) this resulted in a further six responses.

Results

An overview of demographic data for participants involved in the reliability study can be found in Table A1. Work related data is summarised in Table A2. The means and standard deviations for all continuous variables are shown in Table A3. Good variability was found on most variables.

Table A1: Demographic Variables for the Reliability Study

Variable	Frequency	Percentage
Gender	16	
Male	14	87.5
Female	2	12.5
Ethnicity	16	
European	11	68.8
New Zealander	3	18.8
Other	2	12.5
Education	16	
No formal school qualification	1	6.3
Formal school qualification	9	56.3
Trade certificate, professional certificate or diploma	4	25
University degree, diploma or certificate	2	12.5
Marital status	16	
Never married	3	18.8
Married	12	75
Living with partner	1	6.3
Have children	16	
Yes	9	56.3
No	7	43.8
Have other dependents	16	
Yes	1	6.3
No	15	93.8
Number of hours worked by spouse	13	
less than 10	5	31.3
11-15	1	6.3
16-25	1	6.3
26-35	2	12.5
36-45	1	6.3
over 45	3	18.8

Table A2: Work Related Variables in the Reliability Study

Variable	Frequency	Percentage
Type of work	16	
Area radar	1	6.3
Terminal radar	9	56.3
Tower	6	37.5
Primary duties	16	
Operational Controller	11	68.8
Other	5	31.3
Current shift cycle	15	
4 on / 2 off	6	37.5
5 on / 2 off, 5 on / 3 off	4	25.0
other cycle	5	31.3
Current shift schedule	16	
AADM	2	12.5
EADM	3	18.8
no fixed schedule	7	43.8
other schedule	4	25.0
Preferred shift cycle	16	
4 on / 2 off	14	87.5
5 on / 2 off, 5 on / 3 off	1	6.3
other shift cycle	1	6.3
Preferred shift schedule	15	
Permanent fixed shifts	6	37.5
Rotating shifts	9	56.3
Worked in another country	16	
Yes	8	50
No	8	50
Absent from Airways	16	
Yes	3	18.8
No	13	81.3
Fallen asleep on the way to or from work	16	
Yes	2	12.5
No	14	87.5

Table A2 continued...

Variable	Frequency	Percentage
Sleep continuity on morning shift	14	
Split	3	18.8
Continuous	11	68.8
Sleep continuity on day shift	15	
Split	1	6.3
Continuous	14	87.5
Sleep continuity on afternoon shift	15	
Split	0	0
Continuous	15	93.8
Sleep continuity on evening shift	14	
Split	1	6.3
Continuous	13	81.3
Sleep continuity on night shift	6	
Split	2	12.5
Continuous	4	25.0
Sleep continuity on days off	15	
Split	1	6.3
Continuous	14	87.5

Table A3: Means and Standard Deviations for Continuous Variables in the Reliability Study

Variable	N	Mean	SD	Range
Age	16	40.62	7.60	28-57
Circadian variable				
Morningness	14	38.36	6.07	28-47
Sleep variables				
Sleep problems	16	3.06	1.00	2-5
Sleep length on morning shift	15	6.87	1.06	5-9
Sleep length on day shift	16	7.69	.87	6-9
Sleep length afternoon shift	16	8.00	.97	6-9
Sleep length on evening shift	15	7.47	1.25	6-9
Sleep length on night shift	6	6.67	1.21	5-8
Sleep length on days off	16	8.06	1.00	6-10
Social and domestic variables				
Spouse support	13	2.54	1.61	1-6
The affect of shiftwork on social life	16	20.88	4.59	13-33
Social problems	16	3.00	.97	2-5
Domestic problems	16	2.75	1.24	1-5
Shift cycle and family	14	3.79	1.53	1-6
Shift schedule and family	14	3.86	1.46	2-6
Overtime and family	14	3.93	1.54	1-6
Work place variables				
Number of years in Airways	16	16.63	8.34	1-32
Number of years in current work area	16	10.5	7.64	1-28
Number of months on current cycle	16	13.75	11.49	0-36
Number of short changes	15	1.93	1.1	1-4
Maximum number of days	16	6.19	.75	5-7
Maximum number of nights	15	0	0	0
Frequency of changing shifts	16	2.13	.89	1-3
Overtime in normal conditions	16	7.25	5.63	0-20
Overtime in peak conditions	16	10.69	7.15	0-20
Sufficient breaks	6	16.5	2.51	14-21
Average travel time	5	93.2	32.45	63-147
Performance problems	16	2.25	.78	1-4
Organisational problems	16	3.13	1.25	1-5
Satisfaction with work tasks	16	1.63	.72	1-3
Satisfaction with job	16	2.63	1.36	1-6
Satisfaction with shift	16	2.50	.89	2-5
Satisfaction with hours	16	2.45	.89	2-5

Table A3 continued...

Variable	N	Mean	SD	Range
Coping variables				
Coping with organisational problems	16	2.63	1.15	1-5
Coping with increasing age	16	3.25	.93	2-5
Engagement	16	43.50	7.77	30-56
Disengagement	16	29.63	9.01	16-52
Dependent variables				
General Health Questionnaire	16	12.19	4.55	6-19
Self Rated Health	16	5.06	.77	4-6
Physical Well-being	7	56.29	12.85	43-78

Test-retest reliability was determined by computing Pearson correlation coefficients for each variable. These are reported in Table A4. Anastasi (1988) suggests that ideally reliability coefficients should be above .80. In this reliability study there was a very low number of participants, therefore depending on the construct being measured, acceptable reliability varies slightly. Variables with poor or unproven reliability were excluded from further use.

Morningness was found to have good reliability (r = .86). Several sleep variables had reliability coefficients of 1.0, these included falling asleep on the way to or from work, sleep continuity on day shift, and sleep continuity on night shift. Sleep length on day shift and sleep length on afternoon shift had moderate reliability with r = .74 and r = .78 respectively. Pearson's r for sleep problems was relatively low, but acceptable at .65.

The remaining sleep variables showed poor reliability with sleep length on morning shift, sleep length on days off, sleep continuity on morning shift, sleep continuity on evening shift and sleep continuity on days off all having reliability coefficients of less than .60. Pearson's r for sleep length on night shift was .65, but was not found to be significant. A correlation coefficient could not be calculated for sleep continuity on afternoon shifts because there were an insufficient number of cases. All these variables were excluded from the remainder of the study due to unproven or poor reliability. This indicates that subjective estimates of sleep length and continuity are probably not a good means of measuring this variable.

The exsistence of social problems also had a reasonably low reliability coefficient, r = .66, but this was considered sufficient to retain the variable. All other social and domestic variables had moderate to high reliability coefficients, ranging between .74 and .96.

Preferred shift cycle and preferred shift schedule had moderate reliability with r = .77 and r = .73 respectively. The frequency of short change shifts had acceptable reliability of .87, as did the maximum number of days worked in the last six months (r = .84). There were insufficient cases to compute the maximum number of night shifts worked in the last six months. This variable was therefore not used in the remainder of the study due to its unproven reliability. Pearson's r for the frequency with which shifts were changed was .74. The reliability coefficient for the sufficiency of breaks was also .74 but was not significant. This variable was therefore not used in the remainder of the study.

Both reliability coefficients for overtime under normal conditions and overtime under peak conditions were very low. Pearson's r was .14 and .24 respectively, hence these variables were not considered in the remainder of the study. From this result it is suggested that subjective estimates of overtime are too variable and that in the future more objective data should be gathered from work records. In addition to this a number of participants made comments regarding overtime. The majority of these comments stated that there was no difference between overtime under normal and peak conditions, since understaffing was considered normal.

The average time to get to work had a high reliability of r = .99. The extent to which shiftwork caused performance problems had a reasonably low, but still acceptable, reliability of .63, while for organisational problems reliability was acceptable at .75.

Satisfaction with the kind of work, the job as a whole and shift cycle all had moderate to high reliability coefficients, ranging between .70 and .81. The reliability coefficient for satisfaction with work hours was low at .58, but significant. It was

therefore decided to include this variable in the remainder of the study, since this rating could vary depending on the shift an individual was currently working.

Coping with organisational problems had a high reliability (r = .83), and the difficulty of coping with shiftwork with increasing age had acceptable reliability at .73. Pearson's r for both engagement and disengagement were acceptable, with r = .79 and r = .89 respectively.

Scores on the General Health Questionnaire had low reliability with r = .50. This was to be expected since the scale refers to the previous few weeks. Self rated health also had low reliability, r = .44, while Pearson's r for well being was high at .81.

Table A4: Pearson's Correlation Coefficients for all Variables in the Reliability Study.

Variable	Pearson's *r*
Circadian variable	
Morningness	.86***
Sleep variables	
Sleep problems	.65***
Fallen asleep on the way to or from work	1.0***
Sleep length on morning shift	.51
Sleep length on day shift	.74***
Sleep length afternoon shift	.78***
Sleep length on evening shift	.65*
Sleep length on night shift	.65
Sleep length on days off	.53*
Sleep continuity on morning shift	-.16
Sleep continuity on day shift	1.0***
Sleep continuity on afternoon shift	insufficient cases to compute
Sleep continuity on evening shift	.52
Sleep continuity on night shift	1.0***
Sleep continuity on days off	.43
Social and domestic variables	
Spouse support	.74***
Number of hours worked by spouse	.96***
The effect of shiftwork on social life	.81***
Social problems	.66***
Domestic problems	.83***
The effect of shiftwork on family life	.92***
Work variables	
Preferred shift cycle	.77***
Preferred shift schedule	.73***
Number of short changes	.87***
Maximum number of days	.84***
Maximum number of nights	insufficient cases to compute
Frequency of changing shifts	.74***
Overtime in normal conditions	-.14
Overtime in peak conditions	.24
Adequacy of breaks	.74
Average time to get to work	.99*
Performance problems	.63***
Organisational problems	.75***

* $p < 0.05$, ** $p < 0.01$, *** $P < 0.001$

Table A4 continued...

Variable	Pearson's r
Satisfaction with work tasks	.70***
Satisfaction with job	.73***
Satisfaction with shift	.81***
Satisfaction with hours	.58*
Coping variables	
Coping with organisational problems	.83***
Coping with increasing age	.73***
Engagement	.79***
Disengagement	.89***
Dependent variables	
General Health Questionnaire	.50*
Self Rated Health	.44
Physical Well-being	.81*

* $p < 0.05$, ** $p < 0.01$, *** $P < 0.001$

Appendix B

ADDITIONAL TABLES AND FIGURES

Table B1: Frequencies of the Average Time to get to and from Work on all Shifts.

Time to get to and from work (minutes)	Frequency	Percentage
less than 10	4	2.2
11-15	11	6
16-20	19	10.4
21-25	18	9.8
26-30	26	14.2
31-35	27	14.8
36-40	21	11.5
41-45	12	6.6
46-50	6	3.3
51-55	2	1.1
56-60	0	0
over 60	8	4.4

Table B2: Frequencies and Percentages of Scores on the General Health Questionnaire

GHQ Score	Frequency	Percentage
less than 2	1	.5
3-4	3	1.6
5-6	12	6.6
7-8	35	18.2
9-10	24	13.1
11-12	28	15.3
13-14	31	17
15-16	6	3.2
17-18	17	9.3
19-20	9	4.9
21-22	8	4.4
23-24	1	.5
25-26	2	1
27-28	2	1
29-30	0	0
31-32	1	.5

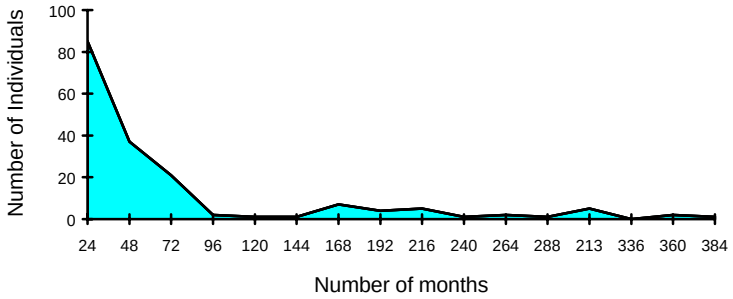

Figure B1: Number of Months on Current Shift Cycle

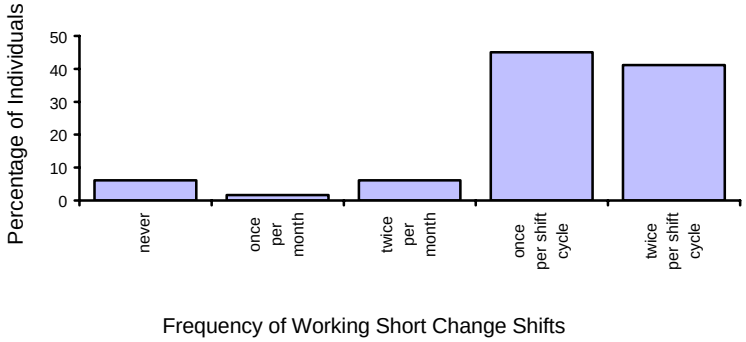

Figure B2: Frequency of Working Short Change Shifts

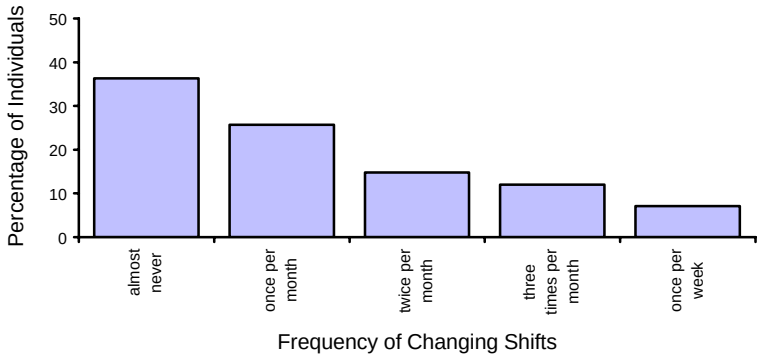

Figure B3: Frequency of Changing Shifts to Accommodate Other Activities

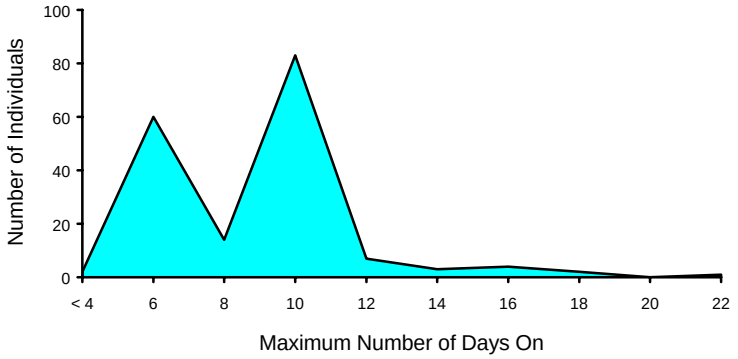

Figure B4: Maximum Number of Days Worked Consecutively in the Last Six Months

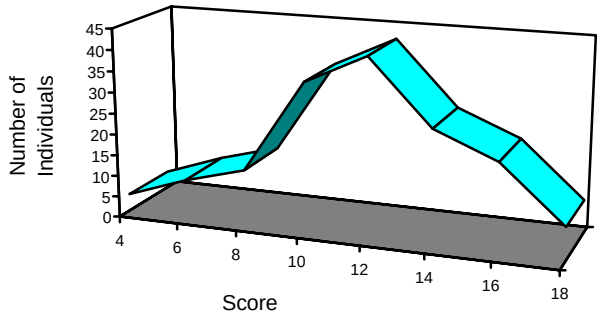

Figure B5: Frequency of Scores for the Effect of Shiftwork on Family Life

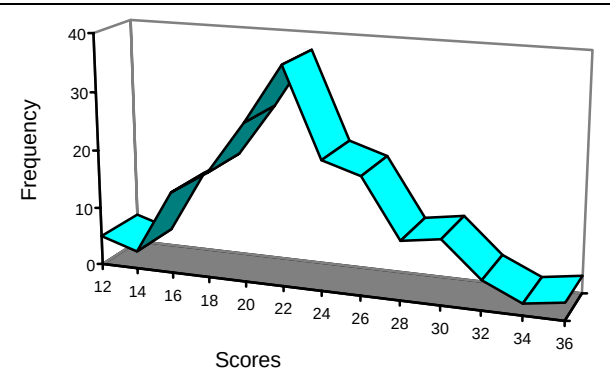

Figure B6: Scores for the Effect of Shiftwork on Off-work Activities and Personal Relationships

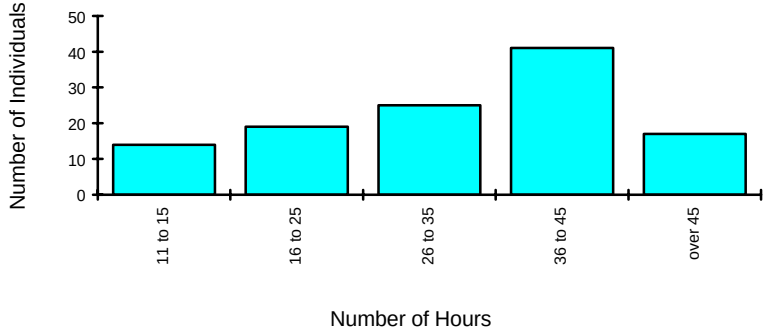

Figure B7: Number of Hours Worked per Week by Spouse

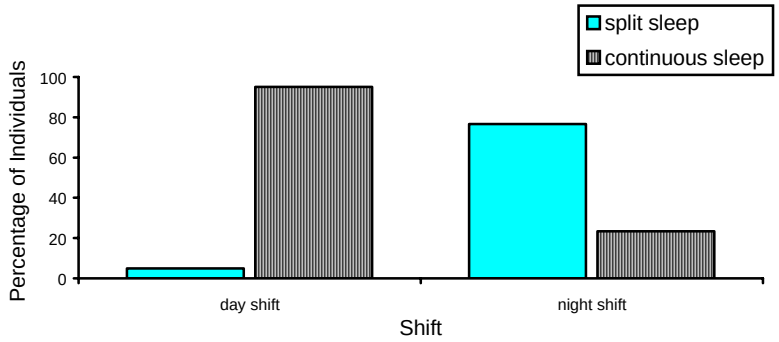

Figure B8: Sleep Patterns on Day Shift and Night Shift

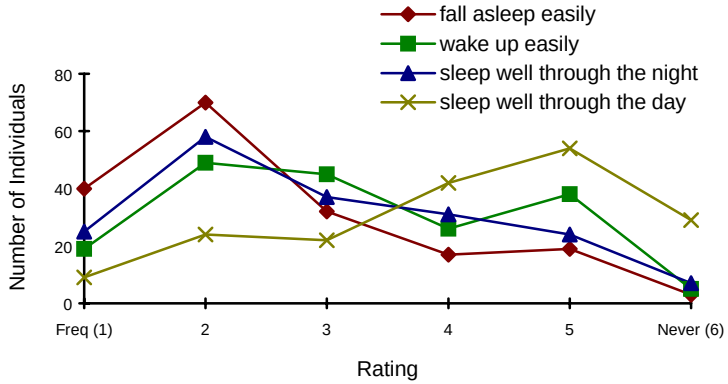

Figure B9: Ratings on Sleep Variables

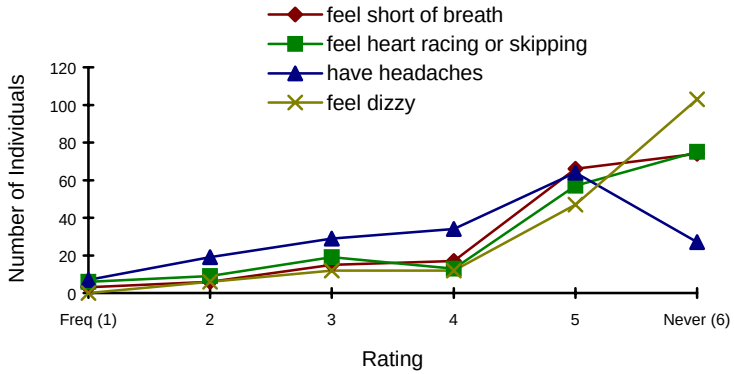

Figure B11: Ratings for Health Symptoms

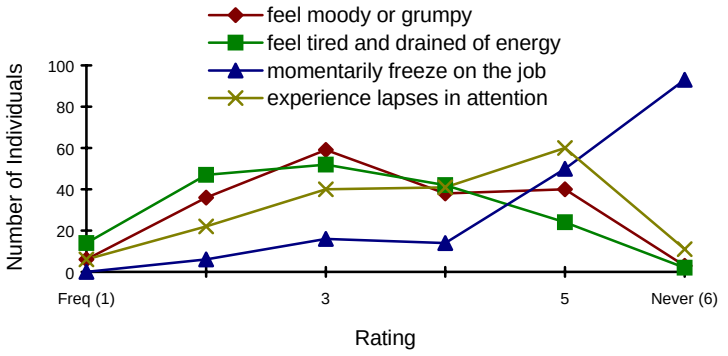

Figure B10: Ratings on Fatigue Variables

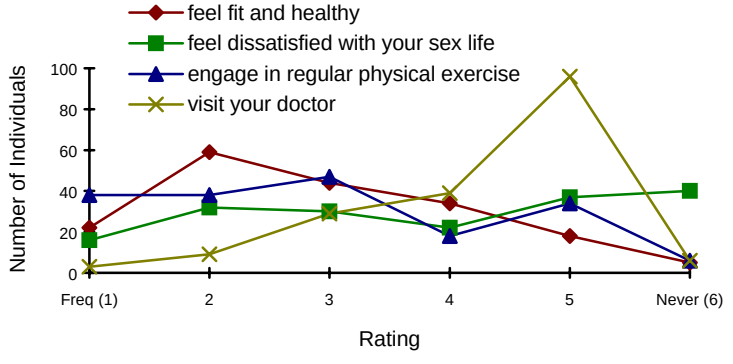

Figure B12: Ratings on General Well-being Variables

Figure B13: Ratings of Gastrointestinal Complaints and Dietary Habits

Appendix C

INFORMATION TO PARTICIPANTS IN THE RELIABILITY STUDY

MASSEY UNIVERSITY SCHOOL OF AVIATION

THE IMPLICATIONS OF SHIFTWORK FOR AIR TRAFFIC CONTROLLERS

Information Sheet

The purpose of this research is to determine the extent to which shiftwork influences an individual's physical and mental well being. Information from the study may provide Air Traffic Controllers with ideas and ways of better coping with changing shift cycles.

You are being invited to participate in this study and complete a questionnaire. The questionnaire includes questions about yourself, your work and how you feel about different aspects of shiftwork. It should take about thirty minutes to complete.

This study is being carried out by Leigh Signal, as part of the requirements for a Masters degree. She is being supervised by Dr Anne Isaac and Professor Nigel Long. If you have any questions regarding the study, they can be contacted at the following addresses.

Leigh Signal	School of Aviation Massey University Private Bag 11222 Palmerston North ph: (06) 350 3221 fax: (06) 350 3200
Dr Anne Isaac	School of Aviation Massey University Private Bag 11222 Palmerston North ph: (06) 350 3227 fax: (06) 350 3200
Professor Nigel Long	Psychology Department Massey University Private Bag 11222 Palmerston North ph: (06) 350 5229

The inital phase of this study involves the construction of a questionnaire on a variety of shiftwork related factors in Air Traffic Controlling. In order to determine if the

questionnaire will be useful in answering these questions we are asking Air Traffic Controllers at Ohakea Centre to complete the questionnaire at **TWO DIFFERENT** points in time. You will be asked to complete the questionnaire now and then again in 4 weeks.

To ensure confidentiality your questionnaire will be given a code number, therefore no names are required and you can be assured of anonymity. Dave Rollo will have a list of code numbers with the corresponding names. He will not have access to completed questionnaires, as they will be returned direct to the researchers.

Once the study is completed you will have access to a copy of a report outlining the findings of the study.

If you choose to take part, you have the right to:

- Refuse to answer any particular question, and to withdraw from the study at any time

- Ask further questions about the questionnaire that occur to you during your participation

- Provide information on the understanding that it is completely confidential to the researchers. All information will be collected anonymously, and it will not be possible to identify you in any reports that are prepared from the study

- Be given access to a summary of the findings from the study when it is concluded.

Please note that filling out the questionnaire implies consent to participate in the study.

Once you have completed the questionnaire please put in the envelope provided and place it in the box provided in the crew room.

If you require any more information please do not hesitate to contact Leigh, Anne or Nigel at the above mentioned addresses.

PLEASE ENSURE THIS COMPLETED QUESTIONNAIRE IS PLACED IN THE BOX IN THE CREW ROOM BY <u>14 JULY</u> TO BE INCLUDED IN THE STUDY.

Your participation in this study is greatly appreciated.

Leigh Signal

MASSEY UNIVERSITY SCHOOL OF AVIATION

SHIFTWORK STUDY

As part of the study being conducted on the implications of shiftwork for Air Traffic Controllers a **second** shiftwork questionnaire was handed out recently. The use of two questionnaires was to determine if the questions were useful in asking about shiftwork for Air Traffic Controllers. Since there are only a small number of controllers at Ohakea centre the maximum number of responses is important in achieving useful results.

If you have forgotten to return your completed questionnaire then it is not to late to do so. If you have misplaced the questionnaire or had not filled it out and are still willing to fill in a second questionnaire it would be greatly appreciated. An additional copy of the questionnaire is attached.

Please place the completed questionnaire in the box provided in the radar room by **31st August.**

If you have any queries regarding the questionnaire please do not hesitate to contact Leigh Signal or Anne Isaac at the below address.

School of Aviation
Massey University
Private Bag 11222
Palmerston North
ph: 350 3221
fax: 350 3200
e-mail: T.L.Signal@massey.ac.nz

Your participation in this study is greatly appreciated

Leigh Signal

Appendix D

QUESTIONNAIRE AND INFORMATION TO PARTICIPANTS IN THE MAIN STUDY

MASSEY UNIVERSITY SCHOOL OF AVIATION

THE IMPLICATIONS OF SHIFTWORK FOR AIR TRAFFIC CONTROLLERS

Information Sheet

The purpose of this research is to determine the extent to which shiftwork influences an individual's physical and mental well being. Information from the study may provide Air Traffic Controllers with ideas and ways of better coping with changing shift cycles.

You are being invited to participate in this study and complete a questionnaire. The questionnaire includes questions about yourself, your work and how you feel about different aspects of shiftwork. It should take about thirty minutes to complete.

This study is being carried out by Leigh Signal, as part of the requirements for a Masters degree. She is being supervised by Dr Anne Isaac and Professor Nigel Long. If you have any questions regarding the study, they can be contacted at the following addresses.

Leigh Signal
School of Aviation
Massey University
Private Bag 11222
Palmerston North
ph: (06) 350 3221
fax: (06) 350 3200

Dr Anne Isaac
School of Aviation
Massey University
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Professor Nigel Long
Psychology Department
Massey University
Private Bag 11222
Palmerston North
ph: (06) 350 5229

To ensure confidentiality your questionnaire will be given a code number, therefore no names are required and you can be assured of anonymity.

Once the study is completed you will have access to a copy of a report outlining the findings of the study.

If you choose to take part, you have the right to:

- Refuse to answer any particular question, and to withdraw from the study at any time

- Ask further questions about the questionnaire that occur to you during your participation

- Provide information on the understanding that it is completely confidential to the researchers. All information will be collected anonymously, and it will not be possible to identify you in any reports that are prepared from the study

- Be given access to a summary of the findings from the study when it is concluded.

Please note that filling out the questionnaire implies consent to participate in the study.

Once you have completed the questionnaire please put in the envelope provided and place it in the box provided in the crew room.

If you require any more information please do not hesitate to contact Leigh, Anne or Nigel at the above mentioned addresses.

PLEASE ENSURE THIS COMPLETED QUESTIONNAIRE IS PLACED IN THE BOX IN THE CREW ROOM BY SUNDAY 22nd SEPTEMBER TO BE INCLUDED IN THE STUDY.

YOUR PARTICIPATION IN THIS STUDY IS GREATLY APPRECIATED.

Leigh Signal

MASSEY UNIVERSITY SCHOOL OF AVIATION

SHIFTWORK QUESTIONNAIRE

Your participation in this research is important in helping us determine the implications of shiftwork for Air Traffic Controllers. The information collected through this questionnaire will allow us to understand the relationship between the hours you work, and your social, domestic, psychological and physical well-being.

We know that people react differently to shiftwork. Some experience no difficulties at all. Others, however, do have problems, but develop strategies for coping with them. It would be helpful for us to know what you are experiencing and what you do to cope with any difficulties. Your participation in this study is extremely important in providing us with a realistic understanding of the issues.

Please note that filling out this questionnaire implies consent to participate in the study. You also have the right to refuse to answer any question.

The short time you spend filling out this questionnaire is greatly appreciated.

Once you have completed the questionnaire please place it in the envelope provided and then in the box provided before the 22nd September.

Please note that the questionnaire uses the following terminology:

A **Morning shift** - a shift starting between 0500 and 0759
A **Day shift** - a shift starting between 0800 and 1000
An **Afternoon shift** - a shift starting between 1200 and 1459
An **Evening shift** - a shift starting between 1500 and 1959
A **Night shift** - a shift starting between 2000 and 2400

Thank you for taking the time to complete this questionnaire