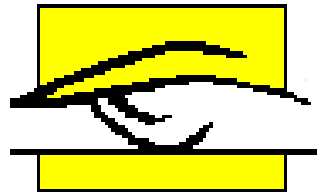


***SLEEPINESS AND THE HEALTH AND  
PERFORMANCE OF ADOLESCENT  
STUDENTS***



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**An Initiative of Sleep/Wake Disorders Canada**

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## EXECUTIVE SUMMARY

Sleep affects a third of our lives. Despite this, there is a serious lack of awareness of the prevalence of sleep deprivation and sleepiness in children and adolescents. The reasons for inadequate sleep are multifactorial and include chronobiological changes of puberty, sleep disorders, comorbid conditions, lifestyle choices and part-time work hours. Regardless of the cause, inadequate sleep is associated with decreased academic achievement, impaired performance, behavioural problems, accidents and it impacts on quality of life. There are 2 million Canadians in the age group 14-18 years.

Adolescence is a period of human development with great turmoil affecting health at many levels. At this workshop the participants identified the following:

- 1) During adolescence, sleep and its daily timing undergo significant shifts that result in significant maladjustments, including those leading to sleep deprivation.
- 2) These are commonly accompanied by daily symptoms, such as daytime sleepiness, and as a result more severe sleep disorders may be masked and thus go undiagnosed.
- 3) Sleep maladjustment and sleep disorders have a significant impact on performance at school and on extracurricular activities.
- 4) There are potential remedial interventions.

Studies have shown that;

- Adolescents require 8 ½ or more hours of sleep
- Approximately 48% of adolescent students have less than 8 hours weeknight sleep
- As many as 24% of adolescent students reported lower grades due to sleepiness
- Students reporting lower grades had 25-30 minutes less weeknight sleep than their peers
- 18% of adolescent students reported involvement in fewer extracurricular activities because of sleepiness
- 60 - 70% of adolescent students reported their sleepest time of day was 8-10 A.M.
- There is an association between part-time work over 15-20 hours per week and decreased sleep time, performance and use of alcohol and marijuana
- 6% of adolescent students may have an unrecognized sleep disorder
- Sleep deprivation may be a precursor of depression in adolescents
- Sleep deprivation affects memory, cognition, behaviour and development of social competence in adolescents
- There is early evidence that certain cognitive/behavioral interventions or system - modifications may be effective in increasing sleep quantity and performance

The school systems in Canada have been under severe financial pressure. Any new initiatives, such as a focus on sleep, would require very strong evidence that a significant problem existed. In this initiative, partners in education, policy makers, educators, teachers, parents and students were directly involved with researchers and clinicians to identify the needs and directions for research as well as its planning and implementation through a workshop dealing with;

- an overview of the current state of knowledge about adolescent sleep
- the obstacles/opportunities in addressing sleep problems in the education system
- the relevant gaps in sleep research
- the necessity, opportunities and strategies for knowledge transfer

## **RECOMMENDATIONS:**

As a result of the deliberations of the workshop participants, initial approaches were identified that were felt to be feasible to provide significant new information towards addressing the problem of inadequate sleep in students.

### **Knowledge Transfer:**

Knowledge transfer was identified as a major priority. There was a consensus that there is a sufficient body of reliable evidence to warrant concerted efforts to increase the awareness of the problem of inadequate sleep in multiple constituencies. The initial efforts should be directed to the education system, including clientele with special needs.

### **Cognitive/Memory Research:**

The recent advances in techniques using brain imaging (functional MIR, PET scanning) and multiple channel recording of EEG and event related potential (ERP) offer an exciting opportunity to identify sleep effects on specific central nervous system function associated with cognition (memory, learning, attention).

### **Intervention Studies:**

It is very difficult to dissect out the individual influence of the several determinants of sleep problems. The common denominator, however, is inadequate sleep. The initial approach recommended is to develop a strategy to improve sleep. There is at least one model that has had pilot testing in the United States. It is felt that a strategy should be developed in Canada that would be designed and implemented by classroom teachers, students and parents as well as the sleep researchers.

A second possibility for an intervention would involve a partnership with residential schools. The students in these schools are more vulnerable to the effects of inadequate sleep. There would likely be more flexibility in altering school start times and timing of curriculum presentation to coincide with circadian cycles of alertness. This process would also be a beginning to a study of comorbidity.

### **Longitudinal Studies:**

Red flags associated with students with sleep problems have been identified in cross-sectional studies. The effectiveness of using these to identify students with difficulties with sleep needs to be tested in a longitudinal study.

Longitudinal studies are required to define the long term effects of sleep deprivation.

### **Prevalence Studies:**

The prevalence of sleep disorders in adolescents in Canada is unclear. The results of the Ontario survey need to be replicated in other Provinces.

### **Call for Proposals:**

Given the available evidence of sleep problems in adolescent students, CIHR might consider a call for proposals on sleepiness as it affects children and adolescents in school.

# **SLEEPINESS AND THE HEALTH AND PERFORMANCE OF ADOLESCENT STUDENTS**

## **INTRODUCTION:**

### **Objective:**

To develop a multidisciplinary research strategy involving researchers, educators, students and parents that will address the problems related to sleep deprivation and sleep disorders in adolescent students.

### **Introduction:**

One of the five strategic research priorities for the Institute of Population and Public Health is “Understanding and Addressing the Impacts of Physical and Social Environments on Health”. One of the vulnerable stages in development is adolescence. During this phase of life individuals need to attain social competence and to acquire the skills and knowledge necessary to become self-sufficient members of society. Socioeconomic status, in turn, is a major determinant of health. The school is a critical environment in which that development can succeed or fail. The school environment is not only a focus for learning but also for social and physical maturation. In order to succeed, the adolescent needs to bring to this milieu a willingness and ability to learn.

Steinberg (1) states in a review of the education system in the United States “No curricular overhaul, no instructional innovation, no change in school organization, no toughening of standards, no rethinking or teacher training or compensation will succeed if students do not come to school interested in, and committed to learning”. His research identified several important factors for the disturbing findings of decreased commitment to learning. However, there is another ubiquitous and largely unrecognized reason, sleep deprivation. There is now evidence that sleep deprivation in adolescents is common and has a significant negative effect on cognition, memory, learning and behaviour.

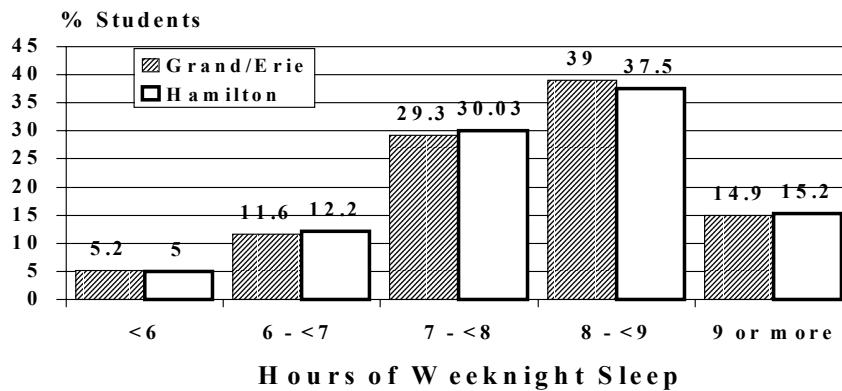
Epidemiological and clinical research of sleep in adolescence has been limited but significant. Wolfson and Carskadon (2,3) have shown adolescents need 8.5-9.25 hours sleep per night. The same researchers, in a survey of 3,120 high school students, found those who reported grades as C, D or F had 25 minutes less sleep on week nights than those reporting A or B grades.

Dahl (4) states “the empiric data to directly assess the effects of sleep loss or disruption on children’s cognitive function are quite sparse, however a wide range of clinical and observational data support a general picture that inadequate sleep results in tiredness, difficulties with focussed attention, low threshold to express negative affect (irritability and easy frustration), and difficulty modulating impulses and emotions. In some cases these symptoms may resemble attention deficit hyperactivity disorder.

Smith (5), from his research on sleep and cognition, states “children often do not sleep long enough or suffer from poor sleep for various reasons. Parents should be warned that progress in school, sports and other activities such as music might suffer as a result. Improving sleep quality will improve learning ability.”

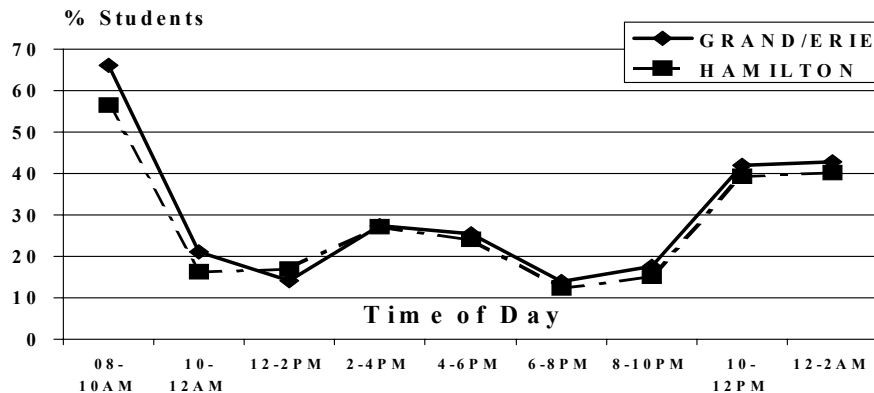
A survey of 3400 Ontario high school students in three boards, Hamilton-Wentworth, Grand-Erie and a rural board (results included in HW), Gibson et al (6), showed; 47.3% of students had less than 8 hours sleep on week nights and only 20% more than the 8.5 hours recommended for adolescents (fig. 1).

**Fig. 1 % students in each weeknight sleep period**



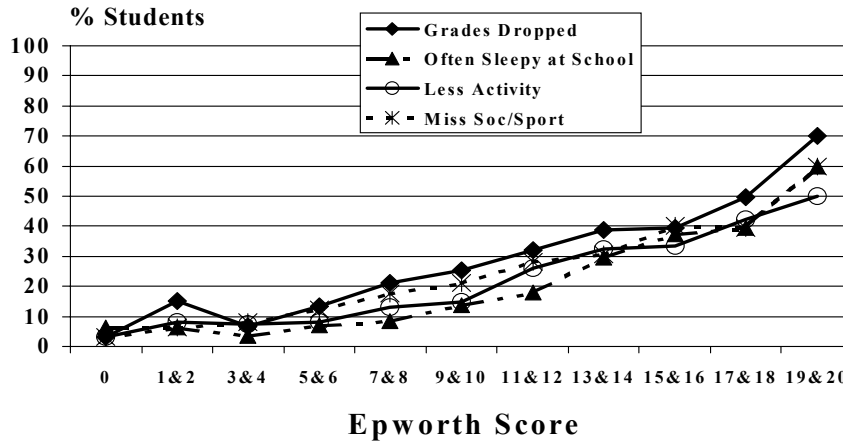
60-70 % reported that they were often very sleepy between 8 - 10 A.M., raising concern about school start time and academic scheduling (fig.2).

**Fig. 2 % students “very sleepy” at different time periods**



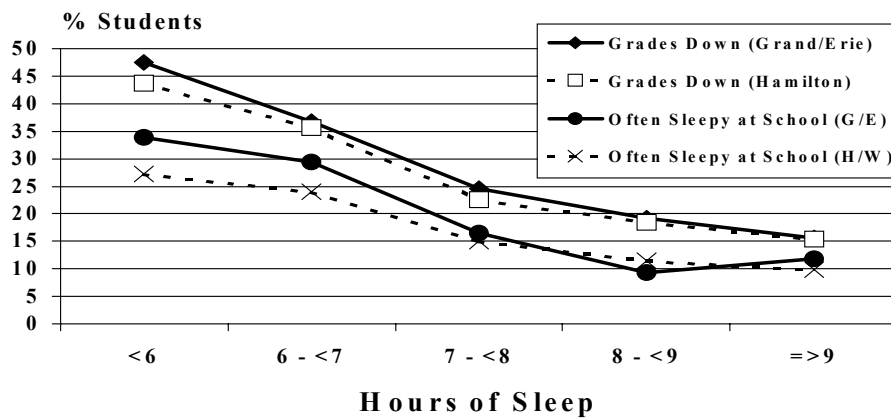
There was a positive linear relationship between increased daytime “sleepiness” (Epworth Score) and decreased academic and extracurricular performance (Fig. 3).

**Fig. 3 As daytime sleepiness (Epworth Score) increases performance decreases**



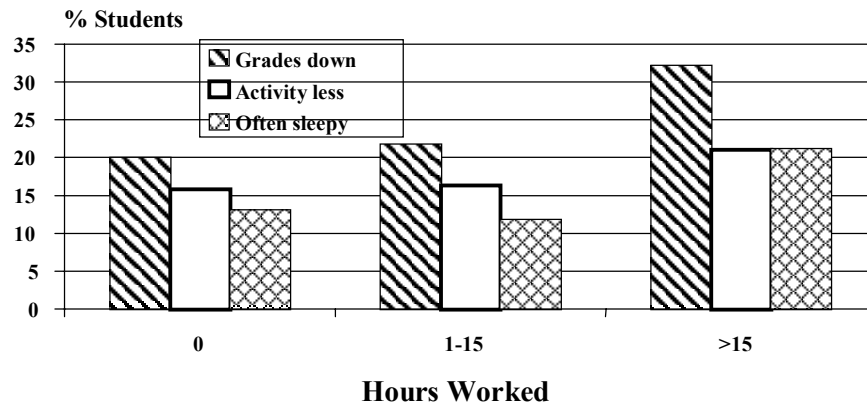
24% of the students felt their grades had dropped because of sleepiness and averaged 26-32 minutes less sleep per weeknight than their peers. 18% stated they were involved in fewer extracurricular activities because of sleepiness. There was a direct and significant relationship between hours of sleep and performance (Fig 4).

**Fig.4 As weeknight sleep increases, performance increases**



Other factors associated with decreased performance were poor “sleep hygiene”, working part time more than 15 hours per week (fig. 5) and use of alcohol or marijuana once a week or more.

**Fig.5 Working over 15 hours associated with decreased performance**



7% of the students answered the questionnaire in a manner strongly suggesting the presence of a primary sleep disorder. Only 15% of this 7% gave any indication that the condition had been recognized. A large number of adolescents may have a significant unrecognized health problem.

If these findings can be validated and generalized they indicate a potentially significant health problem and impact on educational achievement in Canada. There are approximately 2 million Canadians aged 14-18, the survey results would suggest there could be as many as 115,000 adolescents with unrecognized medical sleep disorders and at least 975,000 with significant sleep deprivation. These individuals are very likely not achieving their full potential.

The Ontario survey included focus groups of students, teachers and parents. Two clear themes emerged. First, there were gaps in research about adolescent sleep that needed to be addressed. Second, there was far more knowledge available about sleep, sleep deprivation and sleep disorders in this age group than was recognized or being used by the school system, parents, students and clinicians. It was felt appropriate use of the knowledge now available could make a significant difference in the quality of life and performance of adolescent students.

There is some evidence that interventions can be effective. Danner (7) found that delaying school start time by one hour in one school district was associated with an average increase in adolescent sleep time of 50 minutes. Automobile crash rates decreased by 8-23% across the 16-18 year age groups affected. Wahlstrom (8) followed 50,000 students in Minnesota when their high school start times were changed from 7:15

to 8:40 A.M. in 1997-1998. A review in 2001 showed average sleep times increased by one hour. Daily attendance improved, drop-out rates decreased. Students reported improved behaviour and less depression. There was a slight, but not statistically significant, improvement in grades.

This is a multifaceted problem in education and in public health which touches the fields of sleep, behaviour, addiction, work, child development and education. There is a need for concerted effort by the stakeholders to clearly define its extent and impact and to develop strategies to address it.

Roberts (9) has succinctly expressed the crux of the problem; “given the growing evidence for a relation between disturbed sleep and impaired adolescent function; more attention needs to be directed to identifying causal pathways and possible strategies for intervention”.

A key overview of sleep in adolescents is provided by Carskadon (10).

### **OVERVIEW OF RELEVANT CURRENT KNOWLEDGE:**

#### **Architecture of Sleep:**

##### **Circadian Rhythm:**

This is a cyclical alteration in the sleep/wake state, controlled by the suprachiasmatic nucleus in the brain and closely associated with body temperature. Body temperature, and alertness, rise across the day to early evening, then decrease, reaching a low point between 2 and 4 A.M. Onset of sleep is associated with secretion of the hormone melatonin by the pineal gland. Light has a significant effect on circadian timing.

##### **Stages of Sleep:**

Sleep is cyclical. There are 90-minute cycles throughout the sleep period and each cycle has 5 stages. Stages relate to falling asleep (1,2) and staying asleep (3,4). Stage 4, the deepest sleep (slow wave sleep, SWS), is longest in the early hours of sleep and gradually decreases over the sleep period. SWS is associated with somatic functions such as growth hormone secretion and immune response activation. Near the end of each cycle, there is an arousal, almost to waking; at this point there is onset of rapid eye movement (REM) sleep (stage 5). This sleep stage is associated with maintenance of neurocognitive function. REM sleep is also associated with dreaming. The length of REM sleep gradually increases over the sleep cycle and is longest at the end.

#### **Sleep Needs:**

Adolescents require 8.5 –9.25 hours of sleep. Surveys have shown that less than 25% achieve this (fig. 3).

### **Sleep-wake homeostasis and circadian timing:**

There are alterations in the sleep-wake homeostasis and circadian timing mechanism from pre-puberty to puberty (Carskadon, Acebo (11)). There is a trend that favours evening alertness, adolescents showing a phase delay in circadian timing, i.e., normal sleep onset and wakening is delayed. There is a resultant decrease in morning alertness. This phase delay is associated with delayed onset of melatonin production.

Adolescents decrease weeknight sleep time by about an hour during the period age 14 to 18. There are corresponding later weeknight bedtimes. Longer sleep times on weekends are characterized by later bed and rise times. This reinforces the circadian cycle trend toward further phase delay.

Early rise times, as dictated by school start times, force the body to act as if it was alert when in fact it is in a “sleep” mode. This has implications for ability to learn as well as ability to safely operate a motor vehicle.

In a large survey (6), 60-70% of adolescent students indicated that they were often very sleepy between 8 and 10 A.M (Fig.2).

### **Performance:**

There is consistent evidence for an inverse relationship between sleep time and performance. As many as 24% of adolescent students report their grades have dropped because of sleepiness (6). When school performance measures taken from files are matched with reported total sleep time, it was found that students who have C, D or F grades average 25-30 minutes less weeknight sleep than their peers with better grades (3).

### **Social Factors:**

Early school start times restrict total sleep time. Wahlstrom identified 50,000 students in Minnesota when their high school start times were changed from 7:15 to 8:40 A.M. in 1997-1998. Three years later, Wahlstrom found that average sleep times increased by one hour (8). Daily attendance improved, dropout rates decreased. Students reported improved behaviour and less depression. There was a slight, but not statistically significant, improvement in grades.

There are multiple factors that maximize adolescents phase-delayed bedtime behaviours, including Internet, TV, socializing with peers, and work. These should be taken into account when assessing the situation.

### **Work:**

Working part-time over 15-20 hours per week (6,12) has been shown to be associated with decreased sleep time, decreased achievement (Fig.5) and increased smoking, alcohol and drug use. In an American study, 56% of adolescent students were working more than 20 hours a week, in the Ontario survey, of the 50 % who worked 38-42% worked more than 15 hours a week. In certain States (ie. Michigan), child labour laws

forbid employing students for more than 15 hours per week. To our knowledge there are no such laws in Canada.

### **Behaviour:**

Sleep and regulation of affect show a complex bi-directional relationship across many clinical and epidemiological and controlled studies.

Adolescents identified as having sleep problems show higher rates of behavioural and emotional problems – particularly mood problems and depressive disorders.

Adolescents identified as having depression (clinical and epidemiological samples) report elevated rates of sleep problems-especially difficulties going to sleep and daytime sleepiness.

Stress and emotional arousal can directly interfere with sleep, leading to sleepiness and sleep deficits in both direct and indirect ways.

Sleep disruption and inadequate sleep can interfere with mood and affect regulation.

Sleep deprivation is associated with several effects on performance. This can range from overt sleep episodes in the classroom to microsleeps to “tiredness”. Tiredness, even if one manages to stay awake, decreases the ability to be motivated towards goals. There is also an important negative synergy with alcohol; the effects of sleep deprivation on cognitive performance and alcohol are more than additive (13). This is a major issue with adolescents who are learning to drive, are chronically sleep deprived and are experimenting with alcohol.

Recent research indicates that brain development in early puberty may have a significant effect on behaviour. Explicit learning reaches adult levels very quickly, implicit learning lags into late adolescence. It is implicit learning that is important in navigating emotional situations, attaining social competence. Cognitive and emotional processing are sensitive to sleep deprivation. There is a vicious negative cycle with sleep deprivation impairing cognitive-emotional regulation; impaired cognitive-emotional regulation leading to increased stress and arousal, further interfering with sleep; which leads to further impairments in affective regulation and emotional well-being.

### **Nutrition:**

In one of the Ontario school boards studied, a health survey (14) found that 50% of the students were not eating breakfast regularly. Phase delay could be a contributing factor; their bodies may be still in a “sleep” phase and not be ready to eat. The result of inadequate intake could affect learning ability.

Caffeine or alcohol intake in the evening is associated with poor quality sleep.

## **Basic knowledge of sleep function and sleep disorders:**

### **Memory/Learning:**

Sleep is critical to the consolidation of memory. Research is beginning to identify the stages of sleep specific to each type of learning.

### **Two main types of learning:**

There are two basic kinds of learning, declarative and procedural. Declarative material (rote memorizing) is usually explicitly (consciously) learned, while procedural material (learning a novel cognitive or motor task) is usually implicitly (unconsciously) acquired. Students encounter both types of learning in the school system. While the declarative material does not seem very sensitive to sleep loss, the procedural material is very sensitive to sleep loss. Deficits in memory for procedural material in experimental sleep loss situations have been shown to be at least 20-30%. Further it seems clear that emotionally charged material is also sleep sensitive and the ability to adjust to daily stresses is also impaired by sleep deprivation.

**declarative** learning is the acquisition of factual material, students know they are memorizing something and can verbally reproduce it

**procedural** learning is the acquisition of techniques, strategies or skills

cognitive procedural memory is the memory for certain ways of doing things or solving problems

motor procedural memory is the memory of how to make specific motor movements

### **Memory and sleep stages;**

REM sleep is involved with the efficient memory processing of cognitive procedural material, but not declarative material

the length of the NREM(non-REM)-REM sleep cycle may be important for declarative memory

stage 2 sleep may be involved with the memory for motor procedural but not cognitive procedural tasks

It is important for sleep research to capitalize on advancements in memory research by choosing tasks that represent special memory systems and examining their relationship to sleep states.

### **New Investigative Techniques:**

Recent developments in brain imaging are enabling researchers to correlate sleep deprivation and specific brain functions related to cognition (memory, learning, attention). The specific techniques used are brain imaging (positron emission tomography (PET scans), functional magnetic resonance imaging (fMRI), and multiple channel recording of electroencephalography (EEG) and event related potentials (ERP). These techniques allow investigators to explore what brain regions are compromised during varying levels of sleepiness and will lead to better understanding of the types of performance deficits associated with sleep loss.

## **SLEEP DISORDERS:**

Sleep maladjustment is accompanied by daily symptoms that can result in more severe sleep disorders going undiagnosed since both sleep deprivation and primary sleep disorders may have comparable, additive effects. The workshop participants were made aware of this important issue and the nosology of sleep disorders and typical case-studies were presented.

The prevalence of sleep disorders in adolescents has not been clearly established. Extrapolations based on adult prevalence may be misleading. While there are over 80 sleep disorders recognized, the five major ones in adolescence are phase delay syndrome, insomnia, restless legs – periodic limb movement in sleep, obstructive sleep apnoea – upper airway resistance syndrome and narcolepsy. Estimates of the prevalence of these disorders, even in adults, are variable. For insomnia, Ohayon (15 ) states “lack of a systematic assessment of insomnia has led to a large variation in its prevalence”. In a subsequent review of 50 prevalence studies (16) he notes the prevalence of insomnia in adults ranges from 6 to 33% based on the definition of insomnia and in adolescents 25% had insomnia symptoms and 4% had a DSM-IV insomnia disorder (17). Obstructive sleep apnoea prevalences are more consistently reported as between 2 and 4% (18), with prevalences in children less clear, but in a few studies ranging from 0.7 to 1.9% (19-21). The most extensive population survey (22 ) found a prevalence of 5.5% for restless legs syndrome. Narcolepsy prevalence is reported between 0.03 and 0.06% in adults (23-25). Unfortunately many of the sleep disorders are not diagnosed and treated until many years after onset of symptoms. It is probable that prevalence estimates for sleep disorders are underestimated because of lack of recognition by both patients and clinicians. In a review of 208 consecutive patients admitted to a general medical ward Namen (26) found any reference to sleep in only 9% of the admissions. For example, sleep apnoea has been relatively recently recognized as a major health problem, insomnia is the most prevalent of the disorders. In an analysis of the National Ambulatory Care Survey in the United States, Namen (27) found that between 1990 and 1998 there was a 12-fold increase in diagnosis of sleep apnoea in outpatients and a four-fold increase in diagnosis of insomnia. Punjabi (28) reviewed the diagnoses from 19 regional sleep centres in the United States. He noted the prevalence of diagnoses were 67.8% for obstructive sleep apnea, 4.9% for narcolepsy and 3.2% for restless legs syndrome. It is likely that the less well known sleep disorders continue to be underdiagnosed. In addition to the primary sleep disorders, many other illnesses or disabilities are associated with, or significantly affected by sleep problems. Examples would be depression, Tourette’s Syndrome, Attention Deficit Hyperactivity Disorders and Autism.

### **Narcolepsy:**

Narcolepsy is often missed in this age group. This condition is characterized by irresistible urges for sleep, cataplexy, sleep paralysis and hypnagogic hallucinations (associated with the rapid onset of REM sleep in narcolepsy). In children it has been

misdiagnosed as schizophrenia. Characteristically a student will often fall asleep in class, will appear less attentive, his/her academic standing will decrease, he/she will tend to become isolated, and homework and projects will be missed or poorly completed. Students with narcolepsy are often labeled as lazy and inattentive. These students are less likely to participate in extracurricular activities.

**Sleep Disordered Breathing:**

**Obstructive Sleep Apnoea (OSA).** As with narcolepsy, these students will be “tired” at school, grades will tend to drop, homework and projects will tend to be less well done or late and they will tend to decrease their participation in extracurricular activities. They may also seem depressed. Typical OSA is characterized by snoring at night with episodes of cessation of breathing followed by the “snore” or struggle to get breath. These multiple episodes throughout the night severely restrict restorative sleep due to sleep fragmentation. OSA may reduce oxygen in the blood and may be associated with increased incidence of cardiovascular disease. It has also been shown that brain hypoxia that may accompany OSA is associated with severe cognitive deficits, some of which may not be reversible by treatment (29).

**Upper Airway Resistance Syndrome.** This is a second type of apnoea, and these patients do not usually desaturate the blood of oxygen, so they would not have an oxygen deficit typical of OSA. In these individuals there is restriction of the airway but it is not complete as in obstructive apnoea. The result is a disturbance of sleep, often without snoring. Sleep studies may in fact be relatively normal. These patients are helped by use of continuous positive airway pressure machines or mandibular advancement devices.

In adolescents, who often sleep in their own bedrooms, the sign of snoring may be missed as compared to younger children who are more likely to be monitored by parents, and adults who are likely to have a bed partner.

**Restless Legs Syndrome/Periodic Limb Movements in Sleep (PLMS):**

This is a neurological movement disorder characterized by an urge to move the limbs (usually the legs) which is relieved by movement, it often associated with a creeping or crawling feeling. Symptoms are worse in the evening and night. In younger children the leg symptoms are often dismissed as growing pains. The urge to move may be attributed to ADHD in younger children. PLMS results in disturbed sleep with decreased restorative sleep. The disturbed sleep will result in excessive daytime sleepiness.

**Insomnia:**

Insomnia is the commonest of the sleep disorders. The prevalence in adolescents is not well defined, but is thought to be similar to that of adults. It is characterized by difficulty getting to sleep and staying asleep. Recent research indicates a strong association between insomnia in adolescents and depression, with insomnia as a predecessor of the depression.

**Phase Delay Syndrome:**

Physiological changes at puberty, such as the secretion of melatonin at a later hour in the evening, tend to delay sleep onset. This delayed sleep onset, in conjunction with waking times constrained by school start times, results in weeknight sleep times that are less

than optimal. These adolescents typically are those that are difficult to wake in the morning and stay up late at night or into the early morning. Attempts to make up for sleep on weekends characteristically are associated with longer sleep times, but unfortunately with later bed times as well. This tends to reinforce the phase delay.

**Substance Use:**

There is a strong association between substance use (drugs, alcohol, smoking), sleep deprivation, hours of part-time work and academic performance.

**Associated diseases:**

It was emphasized that conditions such as migraine and asthma can be specifically induced or worsened by sleep, will cause fragmented sleep/ sleep deprivation and are bound to induce daytime malfunctioning.

**Adolescents with special needs:**

The workshop also focussed on the issue of sleep disorders associated with other medical/psychological conditions that are prevalent in adolescents. These can be divided into two categories: mental health disorders and neurological disorders.

**Mental health:**

The prevalence of anxiety and depression in adolescence is likely underestimated and studies show that both conditions are comorbid. Anxiety disorders and depression can be associated with severe insomnia and it has been observed that in certain cases insomnia can worsen or even precedes a severe relapse. For example recent longitudinal studies show a strong association between insomnia and subsequent development of depression or of relapse of depression. The reverse can also be true; adolescents with marked phase delay have been misdiagnosed as being depressed. It is important that this interaction between sleep problems and anxiety/depression be recognized and addressed.

**Neurological Disorders:**

Conditions such as Attention Deficit Hyperactivity Disorders, Autism, Epilepsy, Rett's Syndrome, Down's Syndrome, Tourette's Syndrome are accompanied by sleep disorders compatible with daytime signs and symptoms including excessive daytime sleepiness, irritability, and poor cognitive performance. Two factors are fragmented sleep, with or without sleep apnoea, and chronobiological disorders of the sleep-wake schedule. Poor sleep has a substantial negative effect on the behaviour or learning ability of adolescents with these problems.

## **WORKSHOP FOCUS:**

The school system in Ontario, and likely in the other Canadian Provinces, has been under severe financial pressure. With increasingly limited resources, any new initiatives such as a focus on sleep, would require very strong evidence that a significant problem existed. Further, it would require the existence of a strategy or strategies that would be effective in addressing the problem. At this time the only study identified to define the extent of sleep problems in adolescent students in Canada is the Ontario survey. While the Ontario evidence mirrors that in the United States, further studies are necessary. However there is limited evidence for strategies to effectively address the problem. There is also a very clear need to support the exchange of knowledge to engage the relevant sectors, in particular education and health.

It was evident that to progress in an effective and relevant manner it was essential that the partners in education, the policy makers, educators, teachers, parents and students would need to be directly involved with the researchers and clinicians in identifying the needs and directions for research as well as its planning and implementation. The workshop was to be a first step in this process.

The participants were chosen to represent the partners in education at the levels of the ministry of education, school board, school administration, teachers, parents, students and counselors. The health professionals were chosen to represent sleep research, sleep clinical practice, public health and addiction research.

The workshop was structured to provide the participants with an overview of the current state of knowledge about adolescent sleep presented by leading researchers and clinicians in the field. This was followed by interactive sessions dealing with the following issues;

- the necessity, opportunities and strategies for knowledge transfer (there is a need to support the exchange of knowledge, to engage the relevant sectors, in particular education and health)
- the priorities for research in the education system
- the obstacles/opportunities in addressing sleep problems in the education system
- the relevant gaps in sleep research
- the top priorities for a multidisciplinary research strategy likely to improve the performance and quality of life of adolescent students

## **DELIBERATIONS OF THE WORKSHOP PARTICIPANTS:**

The participants addressed the objectives of the workshop in several interactive sessions.

### **THE PROBLEMS IN THE CLASSROOM:**

The workshop used the experience of two students with sleep disorders, one with narcolepsy (N), one with obstructive sleep apnoea (SA). This provided insight into areas that need to be addressed and suggested some strategies for dealing with them. Although both disorders are different, the experience of both students was remarkably similar both at school and in the community.

#### **Early Onset:**

N remembers at afternoon naps at age 4 to 5 of seeing colourful snakes or flying down the stairs in a flowing white dress (hypnagogic hallucinations associated with REM sleep). SA remembers in Grade 2 that her teacher would regularly allow her to have a nap in the middle of class.

#### **Personal Awareness:**

N in about grade 10 noticed an increase in sleepiness; she was unable to stay awake to watch some of her favourite TV and couldn't understand why her friends were able to stay awake. She had to have several "naps" when doing her homework, but felt this was normal. By grade 12 she was regularly falling asleep in English, Math and Science. She had discovered that activity helped and she took 12 credits in phys ed. All the while she had no inkling that she might have a sleep disorder.

SA felt that when her grades dropped that it was because she was "stupid" or that this was compatible with more difficult work in high school. Falling asleep in class was attributed to a boring subject or teacher. By grade 10 she fell asleep in all but three of her History and English classes in one semester. Eventually this impacted on her self-esteem.

#### **Parental Awareness:**

In both cases parents were aware of the sleepiness, but attributed it to other factors. With N, a very active individual who worked hard at school and had a part time job it was attributed to these activities. With SA, although recognizing the sleepiness, attributed it to not getting enough sleep and felt it was not a serious problem.

#### **School:**

In both students there was ample evidence of the impact of sleepiness at school. N found she had to be very active to stay alert. Fortunately in elementary school she had a teacher, who kept her very busy, running errands and performing classroom chores. N is currently a teacher and feels that in today's classroom she would have been labeled as having ADHD. In high school she fell asleep regularly in class, she made all sorts of attempts to stay awake, she sat in the front row in class, went to bed early, was very active in school activities, took extra phys ed classes because she realized activity kept her awake. The most disconcerting experience was going from top of the class in

mathematics in grade 10, to failing grades in grade 12. In grade 12 she was now falling asleep in English, Science and Math, in fact in all situations where there was no physical activity.

SA had relatively good grades until grade 8 when she began to notice a change. She was falling asleep in school a lot, but assumed it was because of a boring teacher. Her grades actually fell from As and Bs to Cs and Ds. When she reached high school, her grades became even worse. Again, she attributed this to being “stupid” and assuming that high school was that much harder. She slept through all but three of her English and History classes in Grade 10. She began to hear other students saying, “there goes that girl that sleeps all the time”.

### **Teachers:**

There were many episodes at school that might have led teachers to inquire further. For N, the hyperactivity in the elementary school was quite evident, although it could have been mistaken for ADHD. As high school progressed, she fell asleep in class with increasing frequency. Teachers would note this and comment “are you feeling a little tired today”. On one occasion she fell asleep while standing talking to the librarian. When her marks in math dropped precipitately she approached the teacher to drop the subject so it would not affect her transcript for University entrance. There was no further inquiry as to reasons for the drop in her grades.

In SA’s case, her grades went from A and B, to C and D, and eventually failing a history credit because she slept through most of the classes. Her mother actually took the report cards to the math teacher to show him the marked difference in grades. The teacher acknowledged there might be a problem, but at a later visit attributed it to a change in the math curriculum.

In both cases there was a lack of communication from the teachers to the parents about any problems with sleepiness in the classroom or of concern for the falling marks.

### **Diagnosis:**

With N, the diagnosis was made when a physician doing her entrance medical for University asked her about her sleep patterns. With SA, concern by her parents and herself led them to convince their family practitioner that the sleepiness was significantly affecting her life and her school work and needed to be investigated.

### **Summary:**

The factors common to both students were;

- lack of personal awareness of the reasons for their difficulties;
- lack of awareness of the parents of the extent and reason for the problem;
- lack of awareness of the teachers of the possible reasons for the obvious “sleepiness” of the students;
- lack of investigation of the reasons for a sudden drop in academic achievement;
- lack of communication between the school and the parents;
- a gap of several years between the onset of symptoms or difficulties and recognition of the problem;
- a significant effect on the psyche and success of one student, and a potential one on the other that was fortuitously avoided.

The clinicians in the workshop felt that these stories, unfortunately, were typical and common. There are many anecdotal references to delay in diagnosis of sleep disorders of 10-20 years, however little was identified in the literature to confirm this. One study, Kryger (30), compared a group of patients with a confirmed diagnosis of narcolepsy to matched controls. In the year preceding formal evaluation in a sleep laboratory only 38% of the patients had a provisional diagnosis of narcolepsy. Ronald (31) found patients diagnosed with obstructive sleep apnea were twice as likely to utilize health care resources than matched controls in the 10 years prior to diagnosis.

The education system makes it difficult to identify adolescent students with sleep problems:

- class sizes increase from elementary to secondary school;
- students are exposed to many different teachers in secondary versus primary school;
- in secondary schools teachers may see over 90 students per day who they expect to take responsibility for their own learning (especially in senior grades) and may not pursue or investigate the reasons for changes in achievement;
- there are fewer social workers and support staff due to financial constraints;
- teachers are preoccupied with meeting curriculum requirements.

### **Conclusions:**

Sleep disorders are “missed” by students, teachers and parents for a number of reasons:

- lack of awareness of the meaning of symptoms and signs
- attribution of symptoms and signs to lifestyle and biological changes of puberty
- lack of communication between teachers and parents

Red flags or warning signs have been identified:

- regular falling asleep in class
- sudden drop in grades
- lates (of the 25% of students late more than 2 times in the previous month; 40% reported drop in grades, and 31 minutes less weekday sleep than those who were not late) (6).
- behavioural changes

Intervention strategies need to recognize:

- the red flags
- teachers are interested in helping their students achieve – a crucial message is that sleep problems impact on achievement and behaviour
- early onset of symptoms suggests that identification and intervention strategies should be considered in elementary school
- family physicians often pay little attention to, or fail to ask about, sleep problems

Emphasis should be on increasing awareness about “sleep”, strategies to identify whether it is a problem, to assess the need for further investigation and to provide a protocol for dealing with suspected sleep problems.

Trying to educate about individual disorders was felt unlikely to have impact.

## **OBSTACLE AND OPPORTUNITIES IN ADDRESSING SLEEP PROBLEMS IN THE EDUCATION SYSTEM:**

### **Opportunities:**

- There is a body of research dealing specifically with sleep problems in adolescent students. The problem is sufficiently significant to warrant intervention.
- The partners in education, students, teachers, parents, support staff, administrators are accessible through the school. There are many opportunities for partnering, such as with student council, parent council, special education etc.
- Teachers are interested in improving achievement for their students – there is a clear relationship between sleep difficulties and lowered achievement. Understanding this, and knowing how to deal with it, is a way in which teachers can be of significant help to their students.
- Teachers in Ontario are required to attend Professional Learning Programs (PLP) through the Ontario College of Teachers. One of these 10-hour programs could have a sleep-related curriculum.
- Sleep could be included in the health curriculum.
- The National Physical Education Curriculum, although directed only to Grade 9, could be a vehicle to increase awareness.
- There are Provincial Schools in Ontario whose focus is education of children with disabilities. These students are likely more significantly affected by sleep problems than their peers are. These institutions might be more amenable to considering systematic changes to improve achievement and the quality of life of their students than is possible in the general public system.
- With the clear relationship between sleep deprivation, alcohol and learning a new skill, sleep should be a component of driver education programs.
- Currently there is an increased focus on mental health problems in the schools. This might be an opportunity to work with this initiative rather than initiate a new one. The relationship between sleep deprivation and adolescent development and behaviour has significant potential to drive research in mental health.
- There is a public health presence in the schools, the public health nurse. In-service for these individuals would not only raise awareness in the schools, but just as importantly, in the public health system.
- There are educational journals that might be used as access to principals, teachers, special education teacher's etc.
- There are four key provincial ministries who should have an interest in this subject, education, health, transportation and labour.
- There may be other research projects involving this population that might be expanded to include aspects of sleep.
- The key to making change is the teacher and community health professionals.**

### **Obstacles:**

- Competing interests. There are many organizations and groups vying for attention in the education system.

Lack of community awareness and general lack of interest in “sleep”. Sleep is not on anyone’s priority list.

Demands on teachers’ time is increasing. An example is the current emphasis on assessment in the system requiring much time to meet the demands of these programs.

Systemic changes, such as altering school start time, timing of subject matter throughout the day, or changing the curriculum are perceived to be extremely difficult and costly to accomplish.

There are many demands on parents. Changing teenager’s behaviour, with regard to “sleep hygiene”, would be difficult.

Perception of “sleep” as a parenting, not an academic responsibility.

There is problem in many geographic areas of access to expertise in dealing with sleep problems. Overall in Canada there is a shortage of health professionals and diagnostic facilities with expertise in sleep problems.

Funding is a problem. Professional development time must be paid for, research projects in the schools have many hidden costs, both financial and opportunity cost.

There is an argument as to whether research in schools should be funded by “education” or by “health”.

### **Conclusions:**

It is very evident from these deliberations that effective and relevant research must have active involvement of all the partners in education. The education system should be seen as a partner that needs to be actively engaged through two-way exchange of knowledge. For example the strategies to develop in order to effect desirable change

The major obstacle is a lack of awareness at all levels of the community, including health professionals, of the impact of sleep deprivation and sleep disorders on performance.

The major opportunity is that there is research evidence for a direct relationship between adequate sleep and achievement, behaviour and development. This is the message the education system needs to understand in order to support the development of strategies to address the problem in the classroom and the home and to facilitate further evaluation and research.

There are many opportunities and many obstacles to attaining a goal of alert adolescent students prepared to learn and to achieve their full potential. These must be carefully considered in the development of research questions and protocols.

The classroom teacher is the key to effective change.

**Considerable attention needs to be given in the development of research protocols to strategies that utilize the time of educators in an efficient and effective manner.**

## **RELEVANT GAPS IN SLEEP RESEARCH:**

Consensus of the participants was that there was already sufficient information available to warrant intervention studies and implementation of knowledge transfer strategies, but that there were gaps in sleep research that needed to be addressed.

### **I. Longitudinal Studies:**

Most of the research data to date has been cross-sectional (assessment at one point in time). There needs to be longitudinal studies (observation over time) in order to identify:

- the long term consequences of sleep deprivation
- normal developmental change in adolescent sleep
- risk factors for sleep deprivation
- the relationship between mental health (e.g. depression) and insomnia in adolescence

### **II. Intervention Studies:**

The common denominator for adolescents with sleep problems or sleep disorders is sleep deprivation. Sleep deprivation can be the result of sleep fragmentation, chronobiological disorders, lifestyle choices. There is a paucity of data about interventions and their effectiveness. Other than the studies of Wahlstrom, Danner and Rossi no intervention studies were identified specifically related to improving sleep in adolescents. Most intervention studies relate to the effectiveness of cognitive behavioural interventions for insomnia in adults or to specific interventions such as CPAP for sleep apnoea.

#### **Improved Sleep:**

Because of the difficulty of isolating the effects of individual factors such as lifestyle, work, drugs, etc. an approach could be taken that is directed simply to getting better sleep. Such a program would be cognitive/ behavioural and could be modeled on a pilot project initiated by Wolfson and Rossi (32), called Sleep Smart.

Sleep Smart was designed to increase the total sleep time for 7<sup>th</sup> grade students, to improve schedule regularity and sleep hygiene efficacy. There were weekly 45 minute classes over a 7-week period. As compared to a randomly selected control class, these students increased school night sleep times, had earlier weekend bedtimes and decreased reported weekend daytime sleepiness.

#### **System/Policy Changes:**

The evidence shows that the early morning hours are times of maximum sleepiness for adolescent students and their ability to learn and retain information is probably limited. The educators in the workshop felt that making changes such as school start time, timing of subject presentation and curriculum changes would be realistically impossible in the current public education system. An alternative was suggested.

In Ontario there are three residential schools for children with various physical and mental problems. These children are a group that are particularly vulnerable to sleep deprivation. The operation of these schools is such that systemic changes such as start times and timing of subject presentation could be made without major disruptions. It would also allow for a comparison with a control school.

There are gaps in knowledge about some of the determinants of adequate sleep in adolescents that will require surveys to establish baselines:

- national survey of school start times and scheduling and implementing knowledge about sleep
- review of labour laws in Canada regarding allowable hours of work for teen age students.

### **III. Social/Environmental Determinants:**

Rural versus urban comparisons

Parents as role models

The findings in the Ontario and other surveys of the association of drug and alcohol use with sleep problems and decreased performance warrants further cooperative research with those in the addiction and public health research fields. There is evidence that part-time work over 15-20 hours per week is associated with decreased performance and academic achievement and increased alcohol and drug use.

### **IV. Comorbidity:**

Poor or inadequate sleep as a determinant of the performance of children with medical, developmental, or mental problems has not been adequately clarified. ADHD is a very common diagnosis in school age children. The contribution of sleep problems to the functioning of these children has not been well established. There is early evidence that as many as 20-30% of children diagnosed with ADHD may in fact have a primary sleep disorder, Chervin (33,34), Pichietti (35). Sleep problems interfere with the functioning of children with a number of other disorders such as Tourette's syndrome, autism, asthma and epilepsy. Obstructive sleep apnoea is frequently present in children with Down's Syndrome.

### **V. Identification of Current Relevant Research Projects Which Could Accommodate Sleep Research:**

It might be possible to answer some of the questions posed in the context of ongoing or proposed research projects involving this age group.

### **VI. Cognitive Neuroscience Techniques:**

There have been exciting advances in research techniques to identify specific central nervous system function associated with learning and memory and how it is affected by sleep. The specific techniques used are brain imaging (positron emission tomography (PET scans), functional magnetic resonance imaging

(fMRI), and multiple channel recording of electroencephalography (EEG) and event related potentials (ERP).

These techniques are just recently being used to investigate brain functioning as it relates to sleep deprivation and cognition and memory.

It is important for sleep research to capitalize on advancements in memory research by choosing tasks that represent special memory systems and examining their relationship to sleep states.

#### **VII. Prevalence of sleep disorders in Adolescents:**

No data, other than the Ontario survey, could be identified to establish the prevalence of the major sleep disorders in adolescents in Canada.

#### **VIII. Costs of Sleep Problems:**

There has been no known attempt to assess the cost of sleep problems in this population. In a review of the cost implications of sleep disorders in adults, Hossain (36) concludes that sleep medicine education and availability of adequate diagnostic and therapeutic facilities will reduce the profound socioeconomic implications of untreated sleep disorders. Kapur (37) estimates the costs of untreated sleep apnea in the United States as 3.4 billion dollars.

#### **IX. Family Practitioner/Paediatrician Knowledge of Sleep:**

One of the reasons for continuing lack of identification of adolescents with sleep disorders was the failure of the primary care physician to ask about sleep and a general lack of knowledge about the sleep disorders. A recent survey by Owen (38) in the United States found that 44% of paediatricians did not routinely screen for sleep disorders in adolescents. We were unable to identify any similar studies in Canada.

#### **X. Accidents:**

This age group is over represented in motor vehicle accidents. There has been little research looking at the relationship between sleep deprivation and accidents in this age group.

#### **XI. Surveys:**

There are national health surveys which should be utilized to gather further information about the prevalence of sleep problems. A major example is the Canadian Community Health Survey. In Cycle 2.1, September 2002, there are four questions on sleep. **Unfortunately these sleep questions were optional and all health units elected to delete them.** While the number of questions is inadequate, responses would have given an estimate of the prevalence of sleep deprivation and insomnia in the Canadian population, and presumably the sub population of adolescents.

There needs to be a survey to identify basic trends across Canada with regard to school start times (because of busing, a more critical measure is the time students are expected to get on the bus) and curricula dealing with sleep.

## **KNOWLEDGE TRANSFER:**

Increasing awareness was identified as a major priority. There was consensus among the participants that there was sufficient knowledge available about sleep in adolescent students to warrant a concerted effort to identify and evaluate effective methods for knowledge transfer. **This report will be used as effectively as possible to initiate this process.**

The participants also felt that a further workshop devoted to knowledge transfer was indicated.

There should be consultation with experts in knowledge transfer, such as the Program in Policy Decision-Making at McMaster, Chair in Knowledge Transfer and Innovation, Université Laval, the Department of Knowledge Transfer and Exchange at the Institute for Work and Health and CIHR. It would be appropriate to follow the evidence based principles that are being established in transferring new research knowledge to decision-makers. (Lavis (39)).

- What should be transferred? – The message. Is it actionable?
- To whom should it be transferred? – The target audience
- By whom should it be transferred? – The messenger
- How should it be transferred? – The type of process and supporting communications infrastructure
- With what effect? – The evaluation of impact

**The participants began the process of identifying some of the components of this process.**

### The Message:

Inadequate sleep affects a large proportion of adolescent students. The reasons for inadequate sleep are multifactorial and include chronobiological changes of puberty, sleep disorders, comorbid conditions, lifestyle choices and part-time work hours. Regardless of the cause, inadequate sleep is associated with decreased academic achievement, impaired performance, behavioural problems, accidents and it impacts on quality of life. There is evidence that intervention can improve performance.

**The actionable component is that interventions need to be directed toward improving quantity and quality of sleep.**

### Target Audience:

The target audience is extensive, each with a slightly different focus for the message:

Education System [Focus – achievement, behaviour, identification];

Health System [Focus – identification, sleep expertise presence, quality of life, resources, policy];

Ministries of Labour [Focus – student work over 15-20 hours, legislation]

Ministries of Transportation [Focus – sleep deprivation and accidents]

CIHR [Focus – relevant directions for research]

Institute of Population and Public Health  
Institute of Neuroscience, Mental Health and Addiction  
Institute of Human Development, Child and Youth Health  
Institute of Health Services and Policy Research  
Institute for Work and Health [Focus – work and students]  
Canadian Sleep Society (the organization of clinical, research and technical sleep professionals)  
[Focus – coordination of research, sleep expertise]students

The Messenger:

The messenger will be determined by the target audience.

Process:

The report will be circulated to representatives of all the target audience. Realistically this is likely to have little impact in its own right. The initial focus has to be limited and the logical target is the education system.

**Conclusions:**

The initial focus for knowledge transfer is the education system. The education system should be seen as a partner that needs to be actively engaged through two-way exchanges of knowledge, for example, in order to effect desirable change.

The message is the need to improve the quantity and quality of sleep in order to improve performance. There is limited evidence that intervention can improve the quantity of sleep and improve performance.

**WORKSHOP RECOMMENDATIONS:**

Two million Canadians are in the 14 to 18 year age group. Forty-eight per cent of these may be sleep deprived to a greater or lesser degree. The reasons for inadequate sleep are multifactorial and include chronobiological changes of puberty, sleep disorders, comorbid conditions, lifestyle choices and part-time work hours. Regardless of the cause, inadequate sleep is associated with decreased academic achievement, impaired performance, behavioural problems, accidents and it impacts on quality of life.

In addition, primary sleep disorders are often not identified in this age group and the Ontario survey (6) suggests as many as 115,000 Canadian students may have unrecognized sleep disorders.

As a result of the deliberations of the workshop participants, six initial approaches were felt to be feasible and would provide significant new information towards addressing the problem of inadequate sleep in students.

**Knowledge Transfer:**

Knowledge transfer was identified as a major priority. There was a consensus that there is a sufficient body of reliable evidence to warrant concerted efforts to increase the awareness of the problem of inadequate sleep in multiple constituencies. The initial efforts should be directed to the education system. This is felt to be of sufficient importance to justify a further workshop or other collaborative initiative involving the partners in education (students, parents, teachers, administrators), sleep researchers, sleep clinicians and experts in knowledge transfer.

The education system should be seen as a partner that needs to be actively engaged through two-way exchanges of knowledge, for example, in order to effect desirable change.

**Intervention Studies:**

It is very difficult to dissect out the individual influence of the several determinants of sleep problems. The common denominator, however, is inadequate sleep. The initial approach recommended is to develop a strategy to improve sleep. There is at least one model that has had pilot testing in the United States (Sleep Smart (30)). It is felt that a strategy should be developed in Canada that would be designed and implemented by classroom teachers, students and parents as well as the sleep researchers. This approach would increase the probability of achieving an effective approach.

A second possibility for an intervention would involve a partnership with residential schools. The students in these schools are more vulnerable to the effects of inadequate sleep. There would likely be more flexibility in altering school start times and timing of curriculum presentation to coincide with circadian cycles of alertness. Since there is more than one school and they are geographically distant from one another, there is an opportunity to identify a control school for purposes of evaluation. This process would also be a beginning to a study of comorbidity.

**Longitudinal Studies:**

Red flags associated with students with sleep problems have been identified in cross-sectional studies. The effectiveness of using these to identify students with difficulties with sleep needs to be tested in a longitudinal study.

Longitudinal studies are required to define the long term effects of sleep deprivation.

**Prevalence Studies:**

The prevalence of sleep disorders in adolescents in Canada is unclear. The results of the Ontario survey need to be replicated in other Provinces.

**Cognitive/Memory Research:**

The recent advances in brain imaging using functional MRI, PET scanning and the use of multiple channel recording of EEG and event-related potentials (ERP), offer an exciting opportunity to identify specific central nervous system function associated with memory and learning. In Canada there are researchers with skills in this area that could contribute in a significant way to our understanding of the processes of learning and memory and their relationship to sleep.

**Call for Proposals:**

Given the available evidence of sleep problems in adolescent students, CIHR might consider a call for proposals on sleepiness as it affects children and adolescents in school.

**Acknowledgements:**

It is clear from this workshop that there has been relatively little effort expended in Canada to understand and to address the problems of sleep deprivation and sleep disorders in adolescents. The interest and enthusiasm of the workshop participants to identify and address the issues related to adolescent students is gratefully acknowledged. There has been an important sequence of events leading up to this workshop. The commitment of the volunteers and staff of the former National Voluntary Health Organization, Sleep/Wake Disorders Canada, to the well being of individuals with sleep problems, combined with the support of Health Canada, led to the initial survey of Ontario adolescent students. The survey, in turn, would not have been possible without the support of the students, teachers, parents and administrative staff of the seven secondary schools involved and the Hamilton Wentworth District School Board, Near North District School Board and the Grand Erie District School Board.

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## Agenda - Sheraton Hamilton Hotel – 8,9 Nov 2003

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### Friday, November 8

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12:00 – 1:00	Luncheon - Tonic Lounge 2 <sup>nd</sup> Floor
	<b>Meeting Room – Ballroom South 2<sup>nd</sup> Floor</b>
1:00	Welcome and Introduction
1:30 - 2:30	Keynote Address – Dr. Amy Wolfson - “Sleep and Adolescence”
2:30 - 3:15	Overview – Sleep Disorders in Adolescents - Drs. Powles, Shapiro, Godbout
3:15 - 3:30	Break
3:30 – 5:00	Overview - Sleep Deprivation – Cognition/Memory/Behaviour – Drs. Smith, Dahl, Cote.
5:00 – 5:30	Dr. Gibson – Results of the Ontario adolescent student survey
7:00	Dinner – get to know each other

### Saturday, November 9

#### Meeting Room – Ballroom West

8:00 – 8:30	Continental breakfast – Ballroom West Foyer
8:30 - 9:00	Overview – Lifestyle – Sleep/Drugs/Work – Drs. Adlaf, Breslin, Stevens.
9:00 – 10:00	Small group sessions – What are the relevant gaps in sleep research?
10:00 – 10:30	Break
10:30 – 11:00	Summary and discussion – Chair Dr. Morin – How can the gaps in sleep research be addressed?
11:00 – 12:00	The problem in the classroom – a case study – Cozzarin, Collins, O’Brien, Sincerbox, Radford, Glenny-Burke, DeLong Reaction panel and general discussion
12:00 – 1:00	Lunch – Ballroom South Small group sessions – What are the obstacles/opportunities in addressing sleep problems in the education system?
1:00 – 2:00	Summary and discussion – Chair Dr. DeLong – What are the priorities for addressing sleep problems in the education system?
2:00 – 2:30	Small group sessions – What strategies might be effective in increasing awareness among the stakeholders?
2:30 – 3:15	Break
3:15 – 3:30	Summary and discussion – Chair Dr. Reimer – Knowledge translation strategies that should be implemented/tested.
3:30 – 4:00	Bringing it together – Dr. D. Andreae, facilitator – Outline the top priorities for a multidisciplinary sleep research strategy likely to improve the performance and quality of life of adolescent students? Who, what, where and when.

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Appendix A.

Appendix B.

**WORKSHOP PARTICIPANTS**

Andreae, Dr. Dan - Facilitator

Collins, Angela – Teacher/Student

Cote, Dr. Kimberly, Assistant Professor, Department of Psychology, Brock University

Cozzarin, Stephanie – Student

Cozzarin, Mr and Mrs L. - Parents

Dahl, Dr. R.E., Professor of Psychiatry and Pediatrics, University of Pittsburgh Medical Center

Delong, Dr. Jackie – Superintendent, Grand Erie District School Board

♣♦Gibson, Dr. E.S., Clinical Professor, Department of Clinical Epidemiology and Biostatistics, McMaster University. President Sleep/Wake Disorders Canada

Glenny-Burke, Gail – Social Worker, Hamilton-Wentworth District School Board

♦Godbout, Dr. Roger – Professor, Department of Psychiatry, Université de Montréal

Kayumov, Dr. Leonid – Assistant Professor, Department of Psychiatry, University of Toronto. Director, Sleep Research Laboratory, Toronto Western Hospital

Morin, Dr. Charles – Professeur agrege, Ecole de psychologie, Université Laval, Québec, President, Canadian Sleep Society.

Murray, Irene – Ontario Parent Council

♦O'Brien, Mrs. Susan – Vice-Principal, Ancaster High School, Hamilton Wentworth District School Board

♦Powles, Dr. Peter – Professor of Medicine, University of Toronto

Radford, Ms Susan, Social Worker, Hamilton-Wentworth District School Board

♦Reimer, Dr. Marlene – Associate Professor and Associate Dean, Research and Graduate Programs, Faculty of Nursing, University of Calgary

◆ Shapiro, Dr. Colin – Professor of Psychiatry, University of Toronto  
Director, Sleep and Alertness Clinic, Toronto Western Hospital

Sincerbox, Scott – Principal, Hillcrest Middle School  
Hamilton Wentworth District School Board

Smith, Dr. Carlyle – Professor of Psychology, Trent University, Peterborough ON

Stevens, Adam – Epidemiologist, Brant County Health Unit

Thomas, Wayne – Education Officer, Coordinated Services Unit  
Special Education Project Branch, Ontario Ministry of Education

Wheelock, Mrs. Maggie – Executive Director, Sleep/Wake Disorders Canada

Wolfson, Dr. Amy – Associate Professor, Clinical Psychology, College of the Holy  
Cross Worcester MA

Workshop Coordinator – Ms Lynda Marsh

Workshop Administration – Department of Clinical Epidemiology and Biostatistics,  
McMaster University – Ms Debbie Billings

#### PARTICIPANTS UNABLE TO ATTEND THE WORKSHOP

The following had input into the workshop but were unable to attend;

Dr. Edward Adlaf – Centre for Addiction and Mental Health, Department of Public  
Health Sciences, University of Toronto

Mrs. Judith Bishop – Chair, Hamilton Wentworth District School Board

Dr. Curtis Breslin – Institute for Work and Health, Toronto

Mr. Peter Moffat – Director of Education, Grand Erie District School Board

Dr. Dan Offord – Professor emeritus, Psychiatry and Neurosciences, McMaster  
University.

♣ Convenor

◆ Planning Committee

## **Appendix C.**

### **Approach to Knowledge Transfer in the Education System**

#### Basic Information:

##### Professional media;

Professionally Speaking (Ontario) – teachers

OPC Register (Ontario) – principals

similar publications in the other Provinces will need to be identified

##### Professional Organizations

Ontario College of Teachers

Ontario Principals Council

Ontario School Counselors Association

similar organizations in the other Provinces will need to be identified

##### Ontario Parent Council

similar organizations in the other Provinces will need to be identified

##### Provincial Ministries of Education

#### Demonstration Project:

A demonstration project or intervention introduced to a few schools to establish a workable strategy for knowledge transfer, with an evaluation component, to serve as a model for further utilization by other schools. This step is felt to be essential to establish credibility and resultant action in a system that is critically short of personnel and finances.

#### Potential for Knowledge Transfer to Specific Groups:

A presentation on adolescent sleep was made to a group involved in special education.

Regional Special Education Workshop – Thu 6 Feb 03 – London ON

The participants represented;

18 school boards

4 faculties of education

1 Ministry of Education

1 Provincial School

1 demonstration school

1 RSEC coordinator

There are multiple levels in the education system involved;

the classroom - students, parents, teachers, counselors, school administration

the Board - administration

- trustees

the Ministry of Education

The message and the messenger will need to be specific to each level of the system.

primary care physicians, public health units, Ministries of Health.

**Correspondence**

**Dr. Edward S. Gibson  
52 Silverbirch Blvd.  
RR1 Mount Hope ON L0R 1W0  
e-mail [edgibson@sympatico.ca](mailto:edgibson@sympatico.ca)**

**Dr. A.C.P. Powles  
Sunnyside West Room 236, St. Joseph's Health Centre  
30 The Queensway, Toronto ON M6R 1B5  
e-mail [powlep@stjoe.on.ca](mailto:powlep@stjoe.on.ca)**