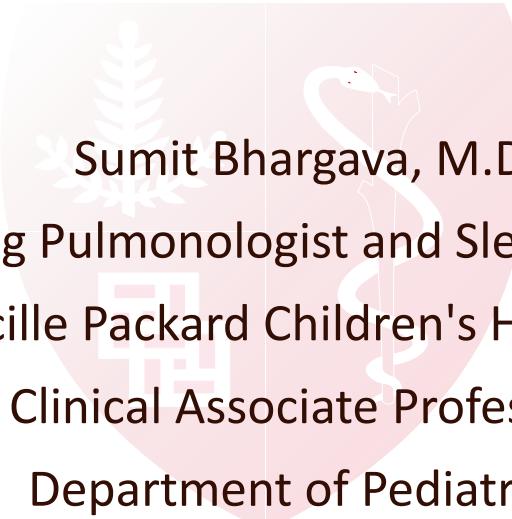


# **LOSING SLEEP OVER CYSTIC FIBROSIS: SLEEP AND THE ADOLESCENT WITH CYSTIC FIBROSIS**



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# Learning Objectives

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- Learn about sleep in adolescents.
- Learn about the relationship between sleep and respiratory function in adolescents with cystic fibrosis
- Learn about what to do if your adolescent has sleep problems
- Learn how to help your adolescent sleep better.



# SLEEP AND THE ADOLESCENT

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# Sleep in America 2006

- The average adolescent gets 7.6 hours of sleep/night.
- 45% of adolescents get less than 8 hours of sleep/night.
- 9<sup>th</sup>-12<sup>th</sup> grade adolescents get less sleep than 6-8<sup>th</sup> grade adolescents. Only 1 in 10 (9%) gets an adequate amount of sleep.
- An adequate amount of sleep for most adolescents is between 9-10 hours per night.



# Why are adolescents not sleeping enough?

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- Nature: A physiologic “phase delay” occurs at the time of puberty due to pubertal/hormonal influences on the circadian rhythm and altered secretion of melatonin.
- Nurture: Environmental factors and lifestyle/social demands significantly impact sleep cycles resulting in later and later bedtimes. Early start time of high school results in premature wake times and daytime sleepiness.
- Significant variability in sleep wake patterns from weekdays to weekends.



# Prevalence and Impact of Adolescent Sleep Problems

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- Prevalence of sleep problems is as high as 20% across adolescents and may be higher in those with chronic medical conditions or psychiatric problems.
- Sleep problems are associated with:
  - Significant declines in school/work and occupational performance.
  - Use of caffeine and stimulant medications.
  - Increased risk taking behaviors.
  - Drowsy driving



# Sleep and the Adolescent with cystic fibrosis

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- Affect on sleep quality.
- Affect on respiratory function.
- Affect on appetite.
- Affect on glucose control.



# Sleep Quality in Cystic Fibrosis

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- Sleep quality is poor in children with cystic fibrosis due to respiratory symptoms such as cough, upper airway obstruction with nasal polyps and chronic infection, lower airway obstruction and low levels of oxygen at night.
- The more severe the lung disease the greater the impact on sleep.
- Frequent awakenings and decreased time in REM sleep were noted with overall increased sleep fragmentation, even in stable patients.



# Sleep and Respiratory Function in Cystic Fibrosis

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- In patients with severe lung disease, the normal small decrease in ventilation is exaggerated during sleep, resulting in low oxygen levels and elevated levels of carbon dioxide.
- The volume of the breath changes with sleep with lower volumes of air inspired in REM sleep as compared to NREM sleep.
- Key features: low oxygen saturation of the blood and elevated levels of carbon dioxide.



# Sleep and Appetite

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# Sleep Loss & Appetite Regulation

- Appetite is regulated by the interaction between metabolic and hormonal signals and neural mechanisms.
- Primary hormones:
  - Leptin: Appetite inhibiting
  - Ghrelin: Appetite stimulating.



# Leptin, Ghrelin & Partial Sleep Deprivation

- In a study that looked at partial sleep deprivation over 2 days with 2 days of recovery sleep, the impact on leptin, ghrelin, hunger and appetite was measured.
- Overall, leptin levels decreased and ghrelin levels increased.
- Hunger increased and so did the appetite for nutrient dense high calorie foods.



# CF & Leptin/Ghrelin

- CF patients have consistently been demonstrated to have higher leptin levels than controls , DESPITE lower body fat. This implies that they feel less hungry and have increased energy expenditure as compared to controls.
- Only 1 study has measured Ghrelin levels in CF patients and found the levels to be low. This implies less food intake and increased energy expenditure.



# Sleep and Glucose Control

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# Glucose Metabolism & Sleep

- Sleep exerts major modulatory effects on glucose tolerance.
- Glucose tolerance is at its minimum in the middle of the night.
- Overall glucose utilization is maximum during stage wake and lowest in NREM sleep.
- Intermediate levels are noted in REM sleep.



# Partial Sleep Deprivation and Glucose metabolism

- Healthy young men were subjected to 6 nights of 4h in bed followed by 7 nights of 12 h in bed.
- An intravenous ivGTT was performed and the results were analyzed using a model of glucose homeostasis.
- It was discovered that:
  - In the sleep debt phase as compared to the sleep recovery phase, the rate of glucose clearance was 40% lower, glucose effectiveness was 30% lower and acute insulin response to glucose was 30% lower.



# Sleep disordered breathing and impaired glucose tolerance in CF

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- Lower oxyhemoglobin saturation is associated with worse glucose regulation in children with CF.
- No correlation found with sleep duration, arousal index or wake time after sleep onset.
- Study compromised by small sample set and no measurement of sleep in adolescent controls.



# Importance of detecting sleep disordered breathing in Cystic Fibrosis

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- Prevention of heart disease: Pulmonary hypertension can be reduced by detecting low levels of oxygen while asleep and providing supplemental oxygen.
- Prevent deterioration in neurocognitive dysfunction and daytime functioning.



# Who is at risk?

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- Resting daytime oxygen saturation is a good predictor of nocturnal hypoxemia. Levels less than 94% appear to be significant.
- FEV1 less than 65%.
- Symptoms:
  - Headache on awakening
  - Excessive daytime sleepiness
  - High hemoglobin or heart problems



# Diagnosis of Sleep Disordered breathing in Cystic Fibrosis

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- Overnight Polysomnography is the gold standard.
- Overnight pulse oximetry can be used as a screening test.
- Symptomatic patients with negative pulse oximetry studies still require an attended overnight PSG.
- Advantages of PSG: It allows for sleep staging and the effective correlation of sleep stage with hypoxemia.
- It allows for effective titration of supplemental oxygen
- It allows for the accurate diagnosis of obstructive sleep apnea, a possible co morbidity.



# Treatment of sleep disordered breathing in CF

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- Supplemental oxygen
- Non invasive ventilatory support.



# Oxygen therapy

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- Low flow oxygen supplementation improves oxyhemoglobin saturation during sleep.
- However, use of low flow oxygen therapy has not been shown to change the quality of sleep, daytime function or survival.
- Further investigations are necessary.



# Non Invasive Ventilation

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- Use of NIV has led to improvement in awake arterial blood gases, respiratory muscle strength, a lessening of shortness of breath and a subjective improvement in the quality of sleep and the level of daily activities.
- NIV can improve oxygenation and decrease CO<sub>2</sub> retention more effectively as compared to supplemental oxygen therapy.
- Current use is as a ‘bridge to transplant’.
- Earlier intervention may be more beneficial.



# What can you do?

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- Recognize that sleep is essential to good health and daytime functioning.
- Help your child to maintain a sleep routine that maximizes the chance to sleep 8-9 hours/night.
- Regular bedtime and wake time, avoidance of caffeine, avoidance of TV set/computers in bedroom
- Avoid discrepant weekday and weekend schedules.
- Discuss the dangers of drowsy driving.
- Address manifestations of sleep disordered breathing or inadequate sleep with your CF team.



# Conclusions

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- Nocturnal oxygen desaturation and modification to sleep quality occur in patients with CF and moderate to severe lung disease.
- Sleep loss can have important consequences on the quality of life, appetite and possibly glucose control
- It is not known when these abnormalities first commence.
- Talk about sleep with your child and with your CF team

