

Restorative Sleep: Energizing and Restoring the Body for People Living with Diabetes

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**IMPROVING SLEEP QUALITY
TO ENHANCE DIABETIC
HEALTH AND WELLBEING**



Financial Disclosure

- I, David Earl, do **NOT** have any financial relationships with any commercial interests that create a conflict of interest affecting the content of this presentation regarding products or services.

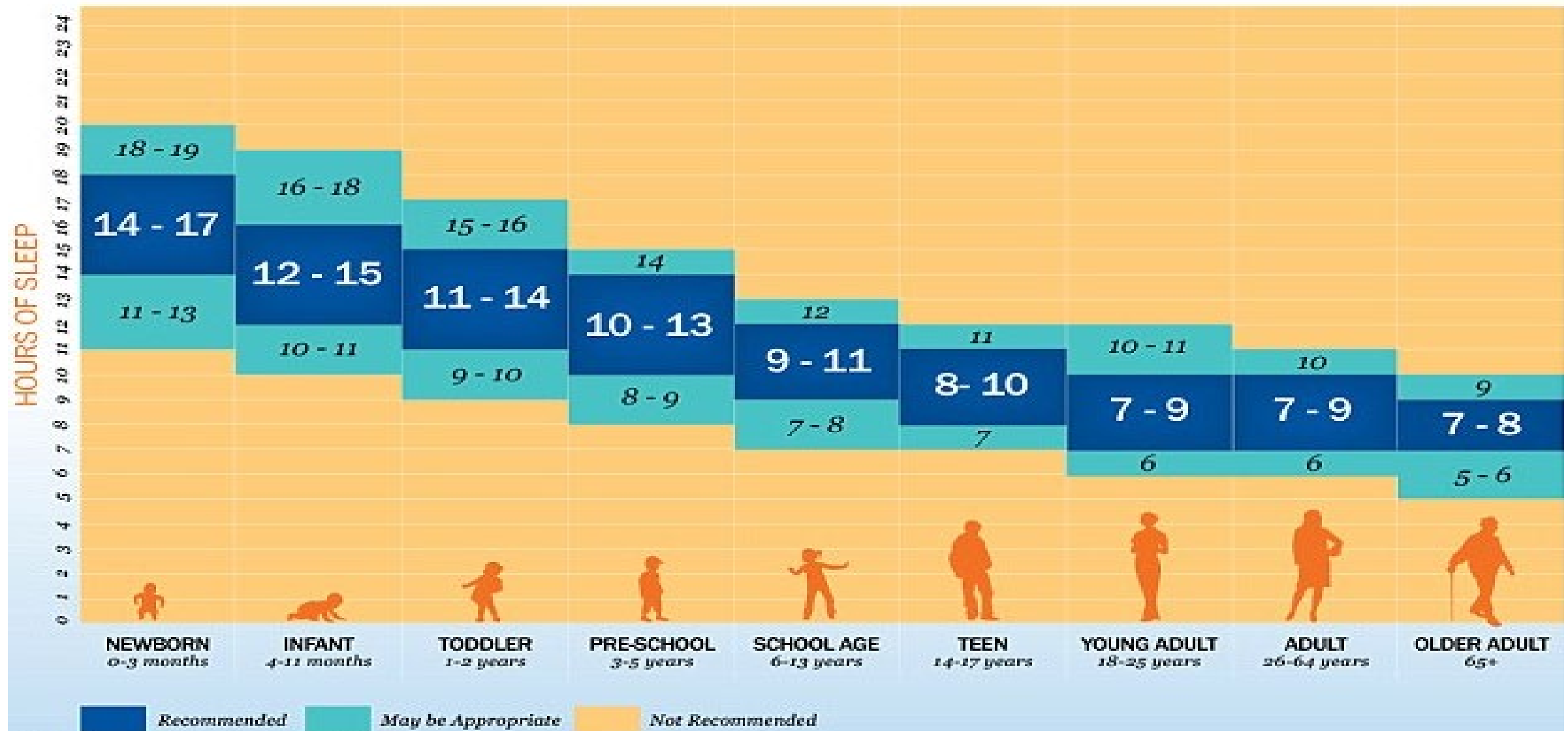
Key Topics on Sleep and Diabetes



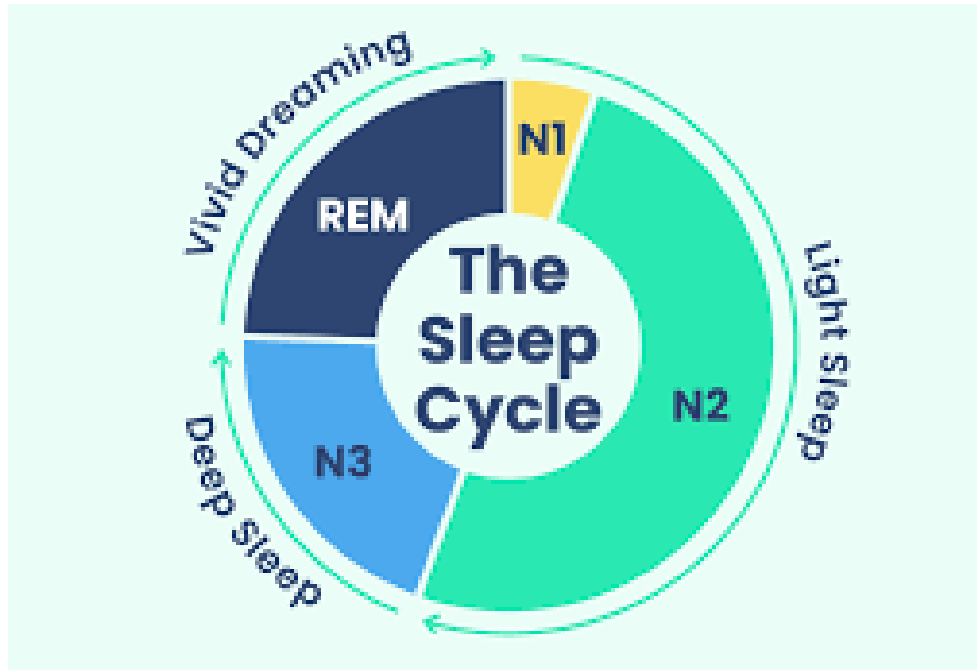
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- **Physiological and Psychological Impacts of Sleep on People with Diabetes**
- **The Bidirectional Relationship Between Sleep and Diabetes Management**
- **Practical Strategies** to Promote Restorative, High-Quality Sleep
- **Warning Signs** Indicating Need for Specialized Sleep Care
- **Accessing Resources to Support Restorative Sleep** in Diabetes

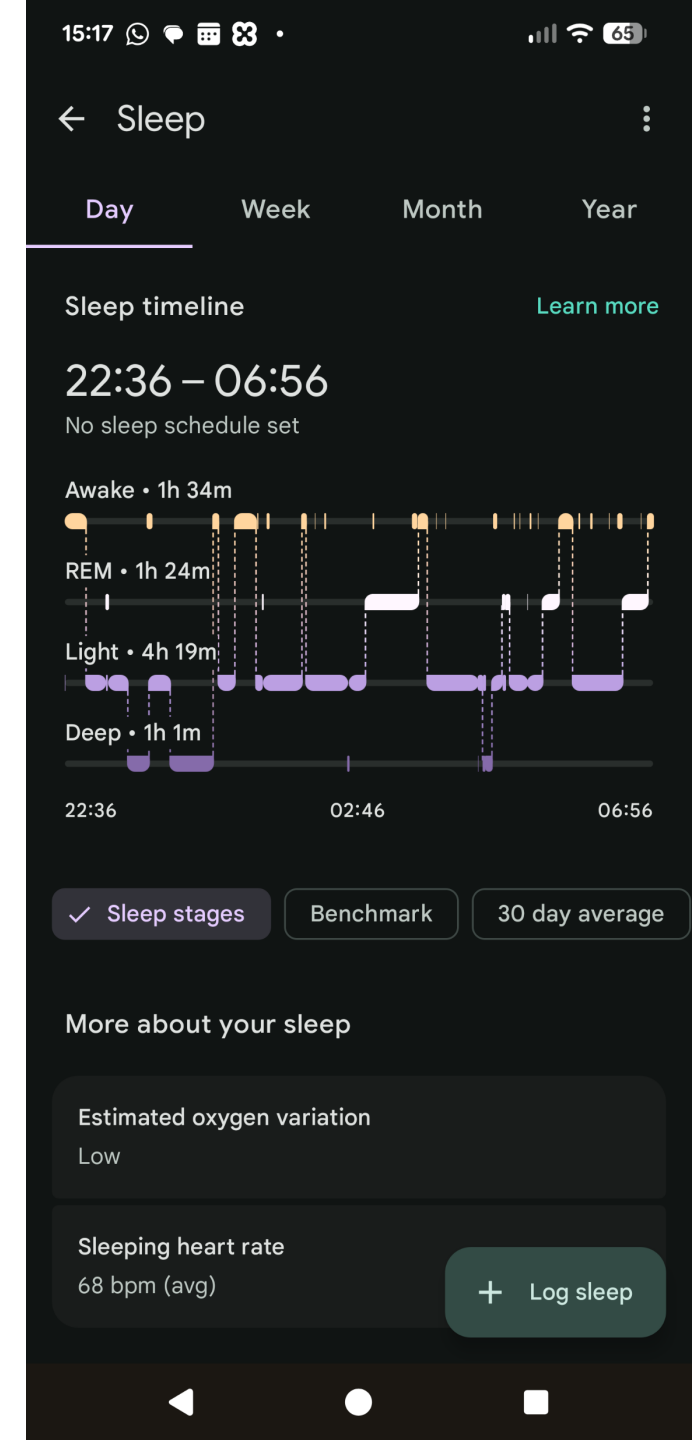
SLEEP DURATION RECOMMENDATIONS



A Note About **Wearable Information**



<https://www.sleepfoundation.org/stages-of-sleep/nrem-sleep>



Physiological and Psychological Impacts of Sleep on People with Diabetes



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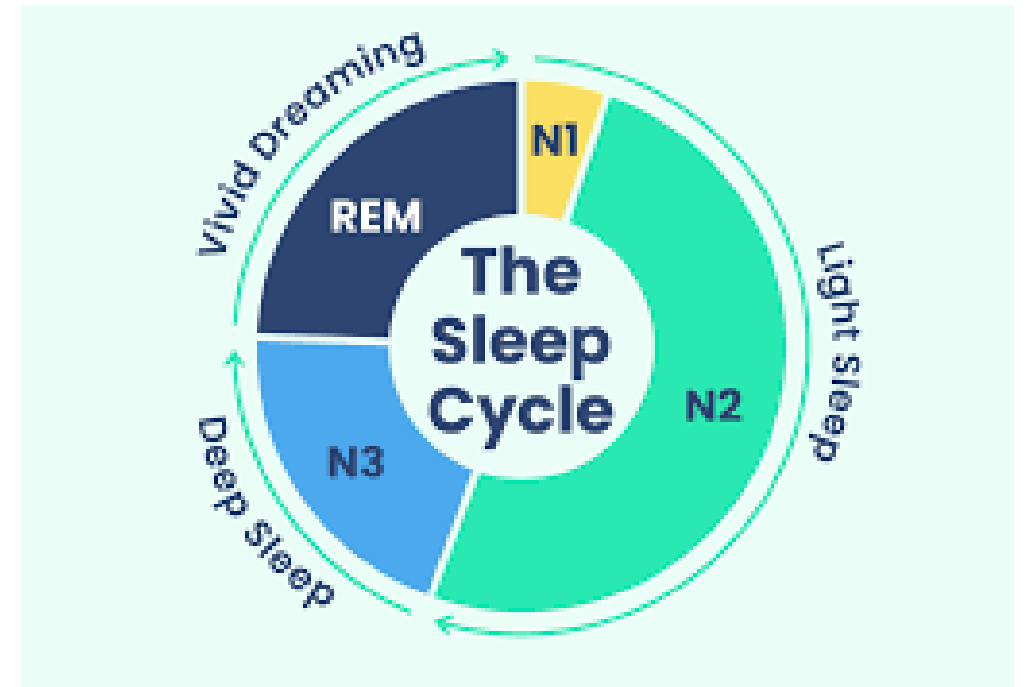
Sleep: Physiology and Clinical Importance

Sleep Architecture: NREM/REM cycles, restorative functions.

Cognitive & Emotional Health: Sleep supports **memory consolidation**, **executive function**, and **mood regulation**.

Immune & Endocrine Effects: Sleep modulates **immune response** and hormonal balance (cortisol, growth hormone, appetite hormones).

Metabolic Health: Adequate sleep is **essential for glucose homeostasis and energy regulation**.



<https://www.sleepfoundation.org/stages-of-sleep/nrem-sleep>

Effects of Sleep on Energy Levels and Daily Functioning



https://commons.wikimedia.org/wiki/File:A_Cartoon_Man_Sleeping_At_Work.svg

Importance of Quality Sleep

Adequate and quality sleep is essential for **BOOSTING ENERGY** and maintaining optimal daily functioning.

Consequences of Poor Sleep

Poor sleep causes **FATIGUE and DECREASED PRODUCTIVITY**, impairing daily performance and well-being.

Impact on Glucose Metabolism

POOR SLEEP IMPAIRS GLUCOSE METABOLISM, posing challenges especially for individuals with diabetes.

Sleep's Influence on Mood and Decision-Making

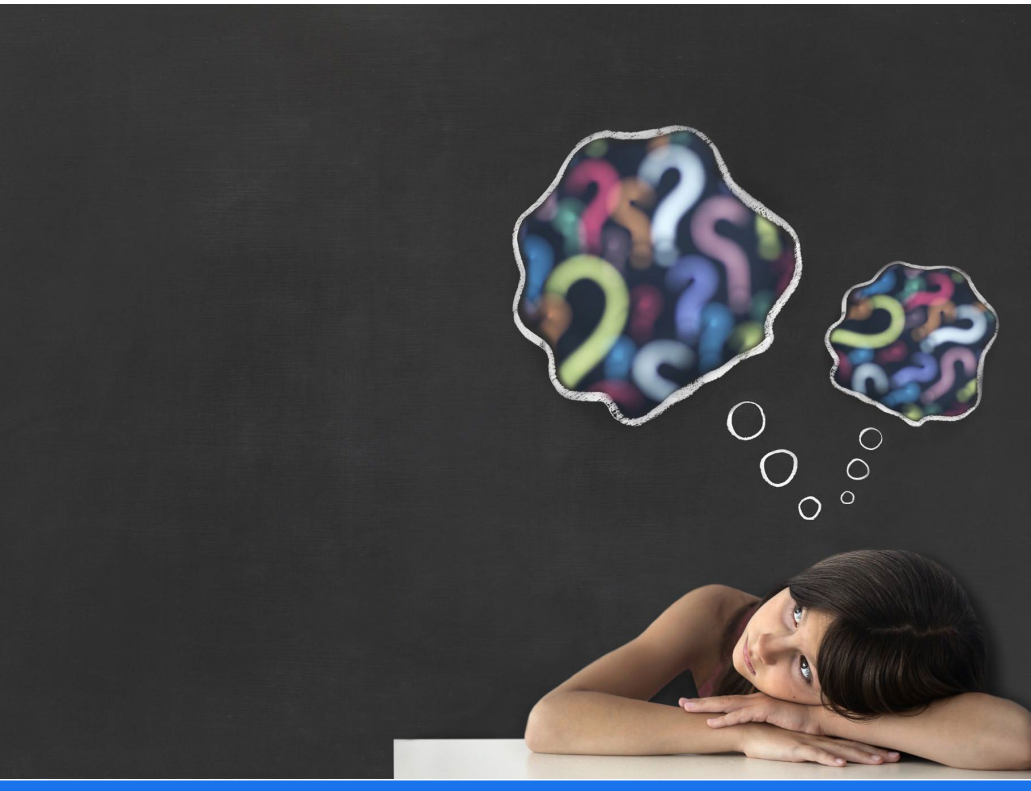


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Emotional Regulation

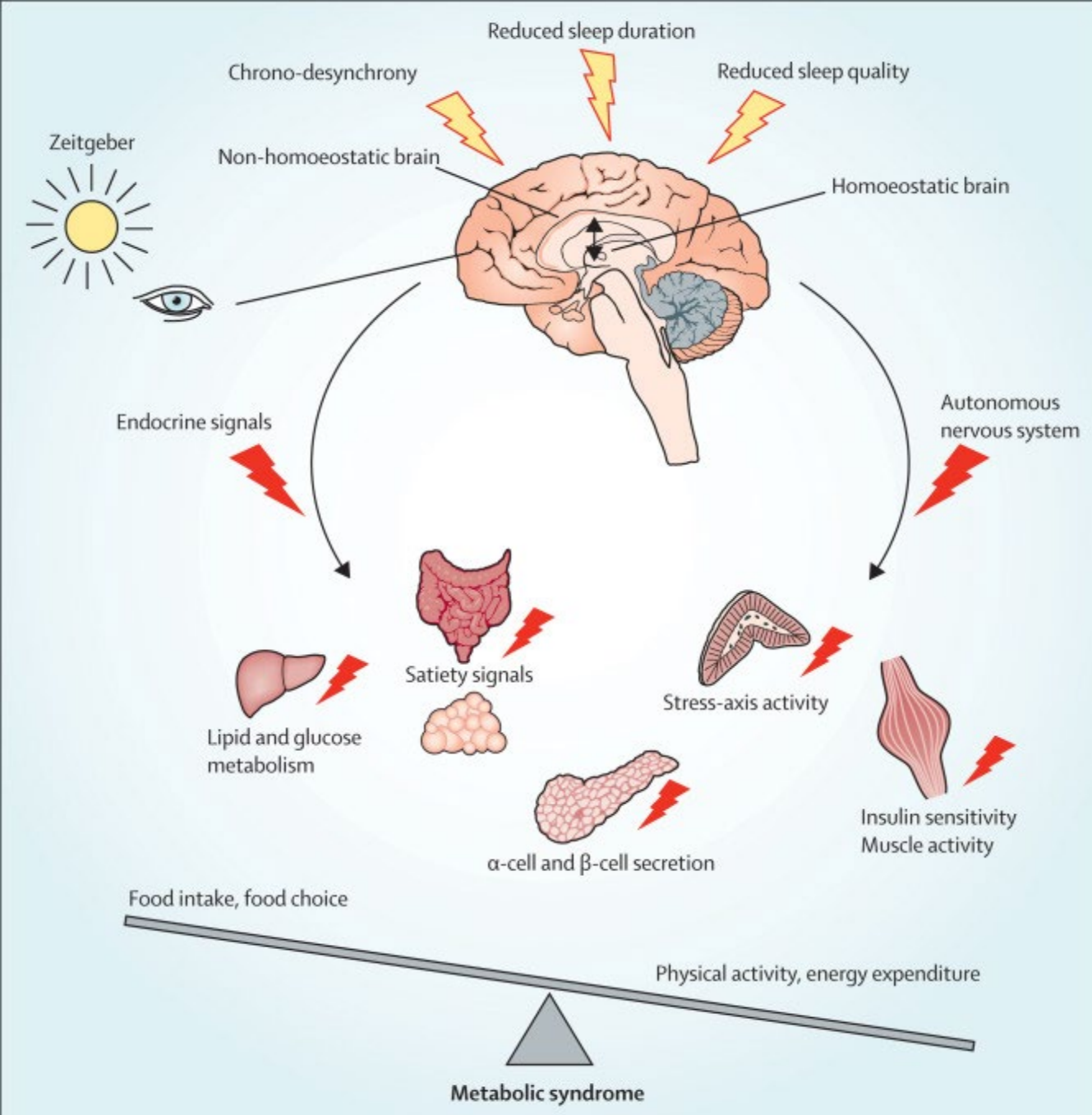
Adequate sleep supports emotional stability and reduces irritability and anxiety.

Cognitive Function

Sleep is essential for cognitive functions, impacting focus and judgment.

Decision-Making Impact

Lack of sleep **impairs decision-making, influencing diabetes self-care and lifestyle choices.**



Impact of Sleep on Chronic Conditions, with Emphasis on Diabetes

Sleep and Immune Function

Poor sleep negatively impacts immune system function, increasing vulnerability to illness in chronic conditions.

Sleep and Glucose Control

Sleep disturbances disrupt glucose metabolism, worsening blood sugar regulation in diabetes patients.

Diabetes Complications and Sleep

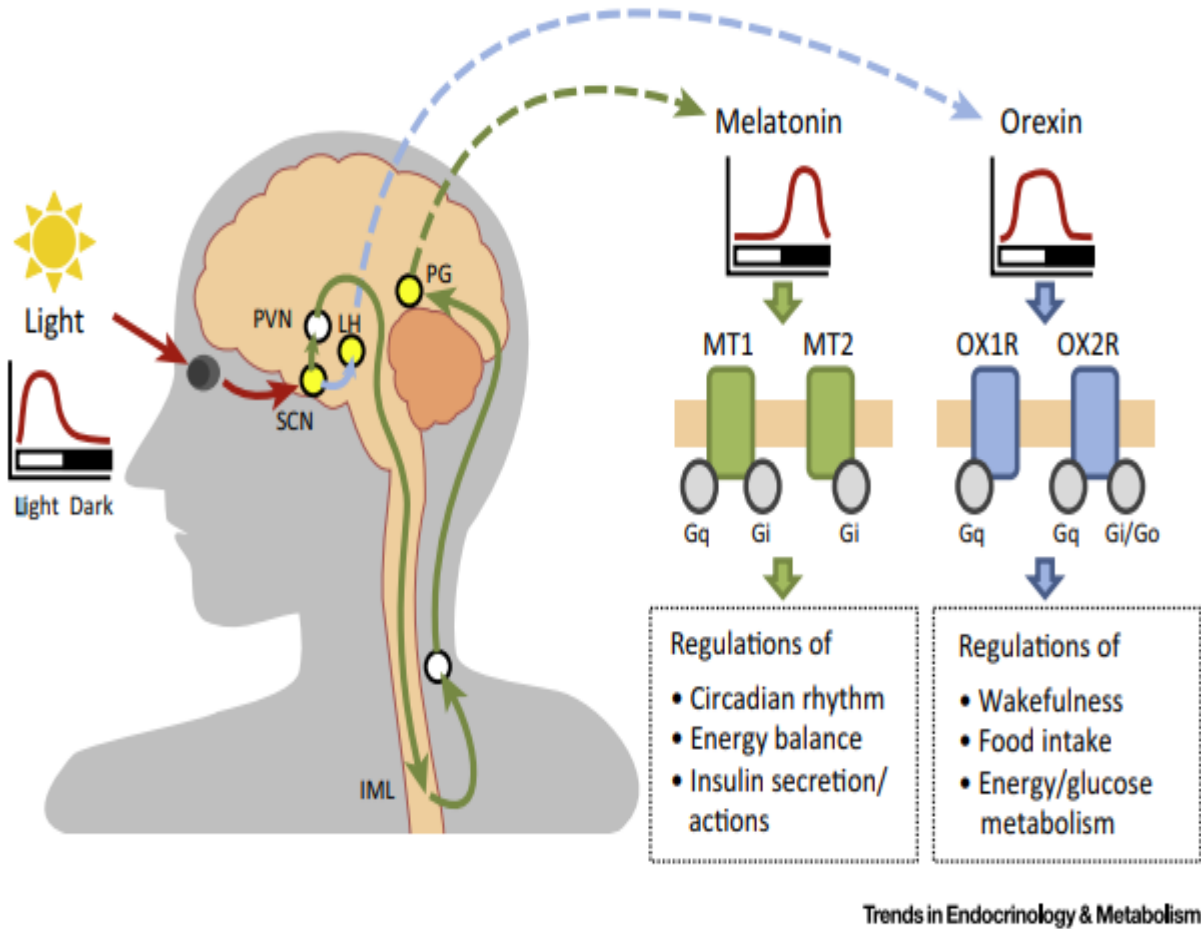
Poor sleep can exacerbate diabetes symptoms and increase risks of complications associated with the disease.

The Bidirectional Relationship Between Sleep and Diabetes Management

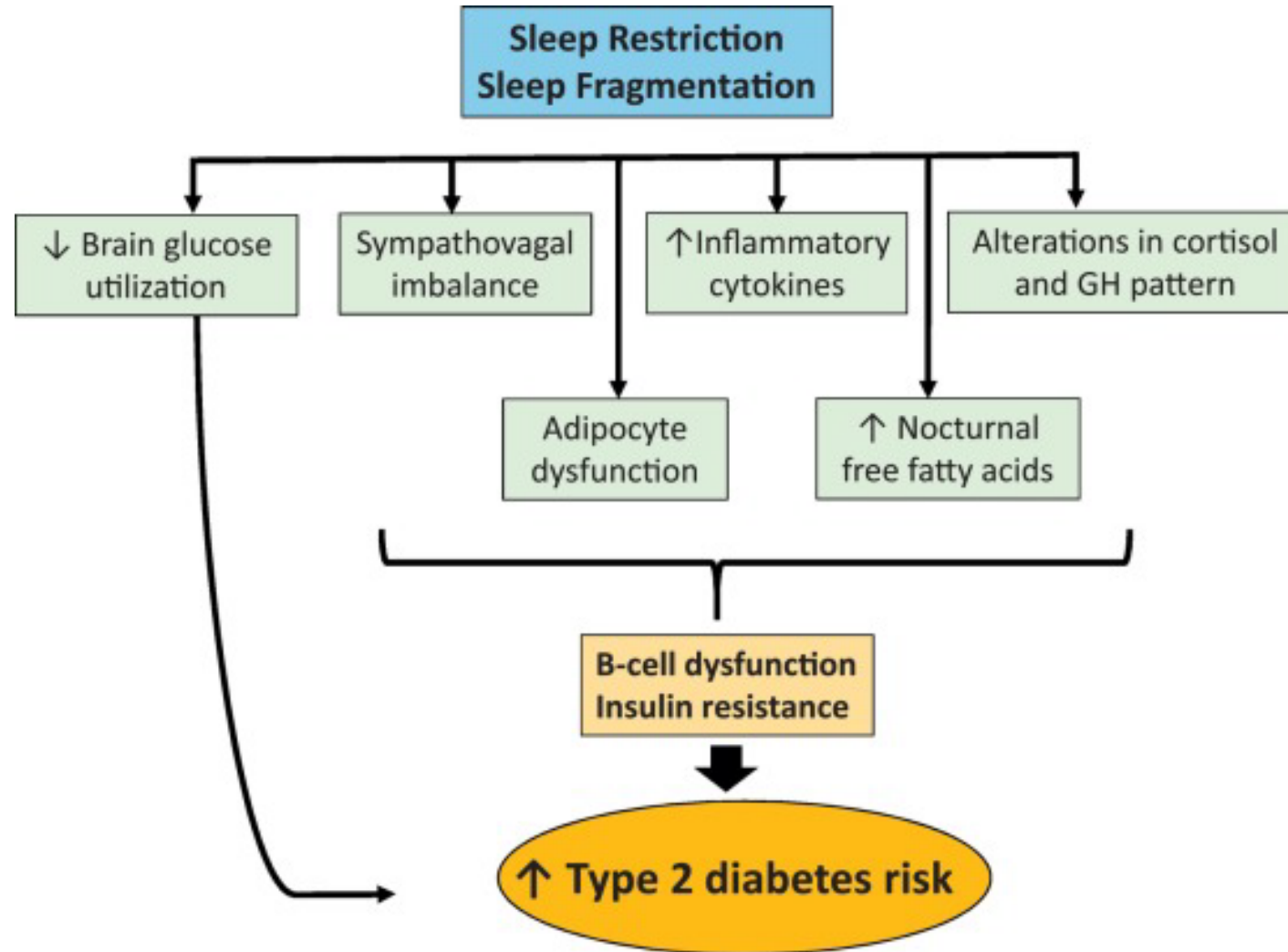
G-Protein Coupled Receptors and Sleep

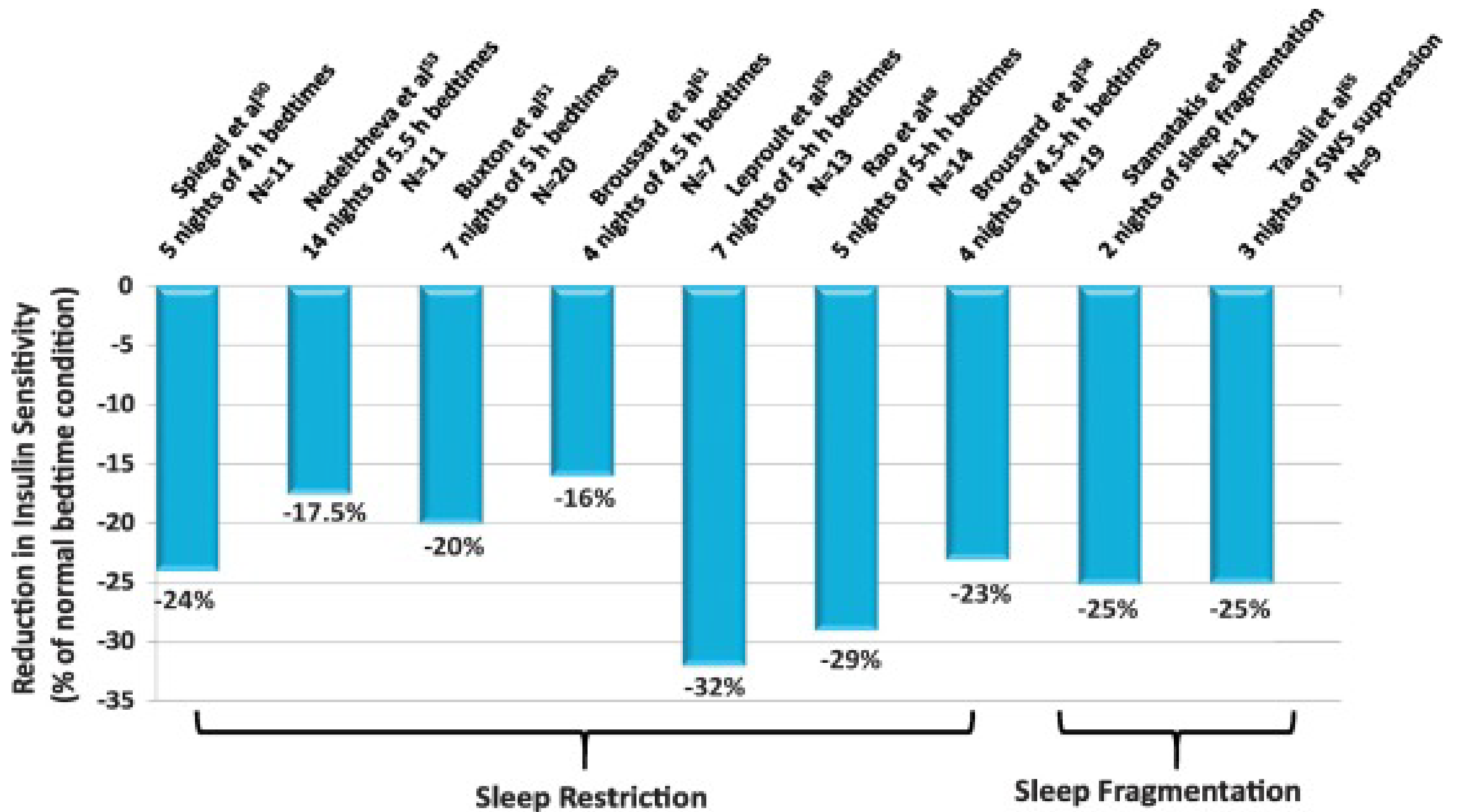
GPCR-mediated pathways link sleep physiology to metabolic outcomes, underscoring the **bidirectional relationship between sleep quality and glucose homeostasis**

Sleep deprivation or fragmentation leads to **insulin resistance and impaired glucose metabolism**, partly through altered signaling in GPCR pathways



Poor Sleep → Increased Risk of T2DM!!





<6 Hours of Sleep is Hazardous!

- Chronic sleep restriction (<6 hours/night) is associated with a 30–40% increased risk of metabolic syndrome and type 2 diabetes (Noga et al, JAMA Netw Open, 2024).



Habitual Short Sleep Duration, Diet, and Development of Type 2 Diabetes in Adults

Diana Aline Nôga, PhD; Elisa de Mello e Souza Meth, BSc; André Pekkola Pacheco, MD; Xiao Tan, PhD; Jonathan Cedernaes, MD, PhD; Lieve Thecla van Egmond, PhD; Pei Xue, MD, PhD; Christian Benedict, PhD

Abstract

IMPORTANCE Understanding the interplay between sleep duration, dietary habits, and the risk of developing type 2 diabetes (T2D) is crucial for public health and diabetes prevention strategies.

OBJECTIVE To investigate the associations of type of diet and duration of sleep with the development of T2D.

DESIGN, SETTING, AND PARTICIPANTS Data derived from the UK Biobank baseline investigation (2006-2010) were analyzed for this cohort study between May 1 and September 30, 2023. The association between sleep duration and healthy dietary patterns with the risk of T2D was investigated during a median (IQR) follow-up of 12.5 (11.8-13.2) years (end of follow-up, September 30, 2021).

EXPOSURE For the analysis, 247 867 participants were categorized into 4 sleep duration groups: normal (7-8 hours per day), mild short (6 hours per day), moderate short (5 hours per day), and extreme short (3-4 hours per day). Their dietary habits were evaluated based on population-specific consumption of red meat, processed meat, fruits, vegetables, and fish, resulting in a healthy diet score ranging from 0 (unhealthiest) to 5 (healthiest).

MAIN OUTCOMES AND MEASURES Cox proportional hazards regression analysis was used to calculate hazard ratios (HRs) and 95% CIs for the development of T2D across various sleep duration groups and healthy diet scores.

RESULTS The cohort comprised 247 867 participants with a mean [SD] age of 55.9 [8.1] years, of whom 52.3% were female. During the follow-up, 3.2% of participants were diagnosed with T2D based on hospital registry data. Cox regression analysis, adjusted for confounding variables, indicated a significant increase in the risk of T2D among participants with 5 hours or less of daily sleep. Individuals sleeping 5 hours per day exhibited a 1.16 adjusted HR (95% CI, 1.05-1.28), and individuals sleeping 3 to 4 hours per day exhibited a 1.41 adjusted HR (95% CI, 1.19-1.68) compared with individuals with normal sleep duration. Furthermore, individuals with the healthiest dietary patterns had a reduced risk of T2D (HR, 0.75 [95% CI, 0.63-0.88]). The association between short sleep duration and increased risk of T2D persisted even for individuals following a healthy diet, but there was no multiplicative interaction between sleep duration and healthy diet score.

Key Points

Question Is there an association between adherence to healthy diet, sleep duration, and risk of developing type 2 diabetes (T2D) in adults?

Findings This cohort study analyzing data from 247 867 adults in the UK Biobank found that individuals sleeping less than 6 hours daily had a notably higher risk of developing T2D compared with those with 7 to 8 hours of sleep. Despite the association between healthier diets and reduced T2D risk, the increased risk associated with short sleep duration persisted even among adults with healthy eating habits.

Meaning These findings suggest that adopting a healthy diet may not reduce the risk of developing T2D among those with habitual short sleep duration.

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

Sleep Affects on Blood Glucose Control in T1DM

Impact of Poor Sleep

Poor sleep disrupts hormonal balance, affecting insulin sensitivity and blood glucose control.

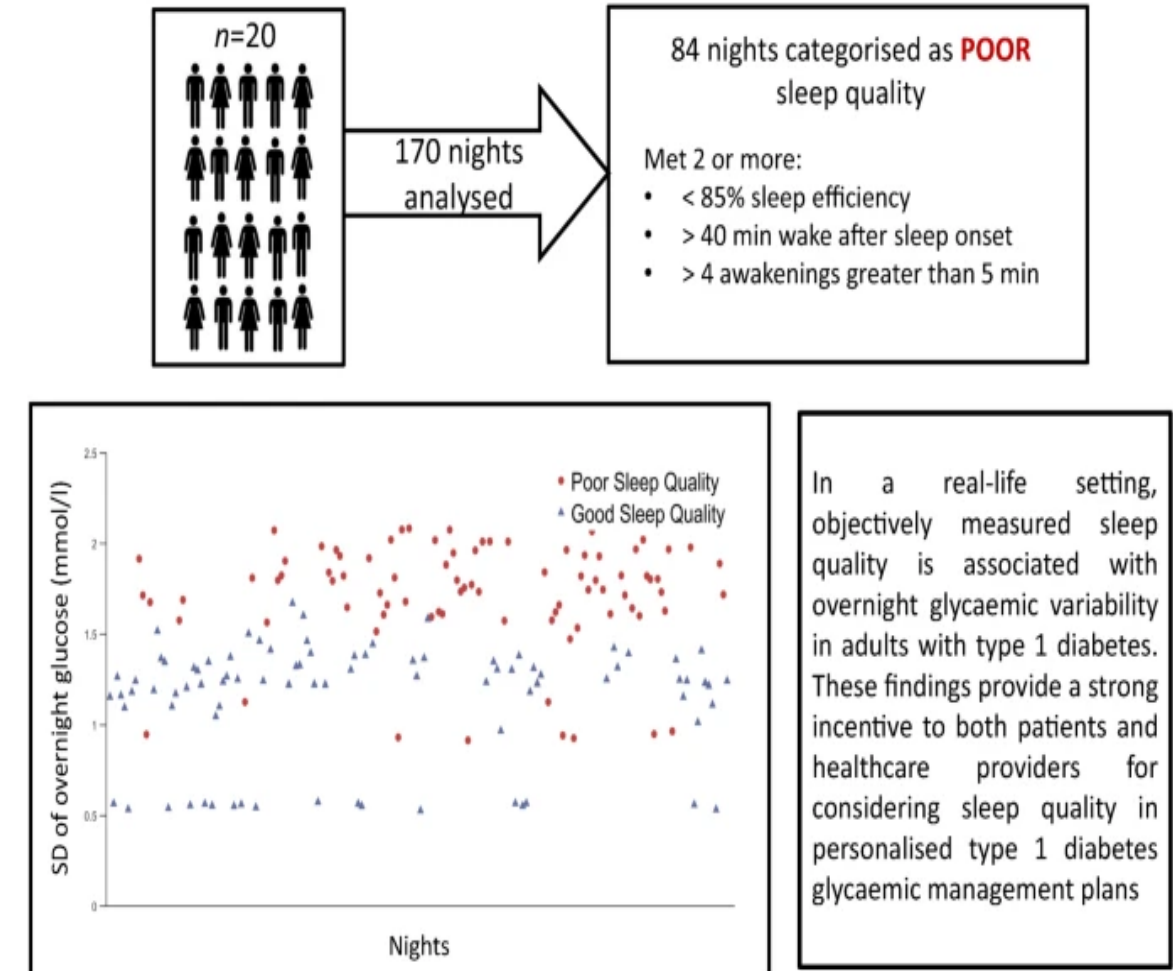
Blood Glucose Instability

Unstable blood glucose levels result from impaired insulin sensitivity due to poor sleep quality and duration.

Diabetes Management Challenges

Poor sleep complicates diabetes management by making blood glucose levels harder to regulate.

Sleep Quality and Glycaemic Variability in a Real-Life Setting in Adults with Type 1 Diabetes



Practical Strategies to Promote Restorative, High- Quality Sleep

Establishing Healthy Bedtime Routines

Consistent Sleep Schedule

Maintaining a **regular bedtime and wake-up time** regulates the body's internal clock for better sleep quality.

Calming Pre-Sleep Rituals

Engaging in **relaxing activities before bed** helps ease the transition to sleep and improves sleep onset.



Image source: Microsoft 365 content library

Optimizing the Sleep Environment

Cool Bedroom Temperature

Maintaining a cool bedroom temperature helps regulate body heat, promoting deeper and more restful sleep.

Dark Sleep Environment

A dark bedroom minimizes light exposure, enhancing melatonin production for better sleep quality.

Quiet Surroundings

Reducing noise in the bedroom creates a peaceful atmosphere conducive to uninterrupted sleep.

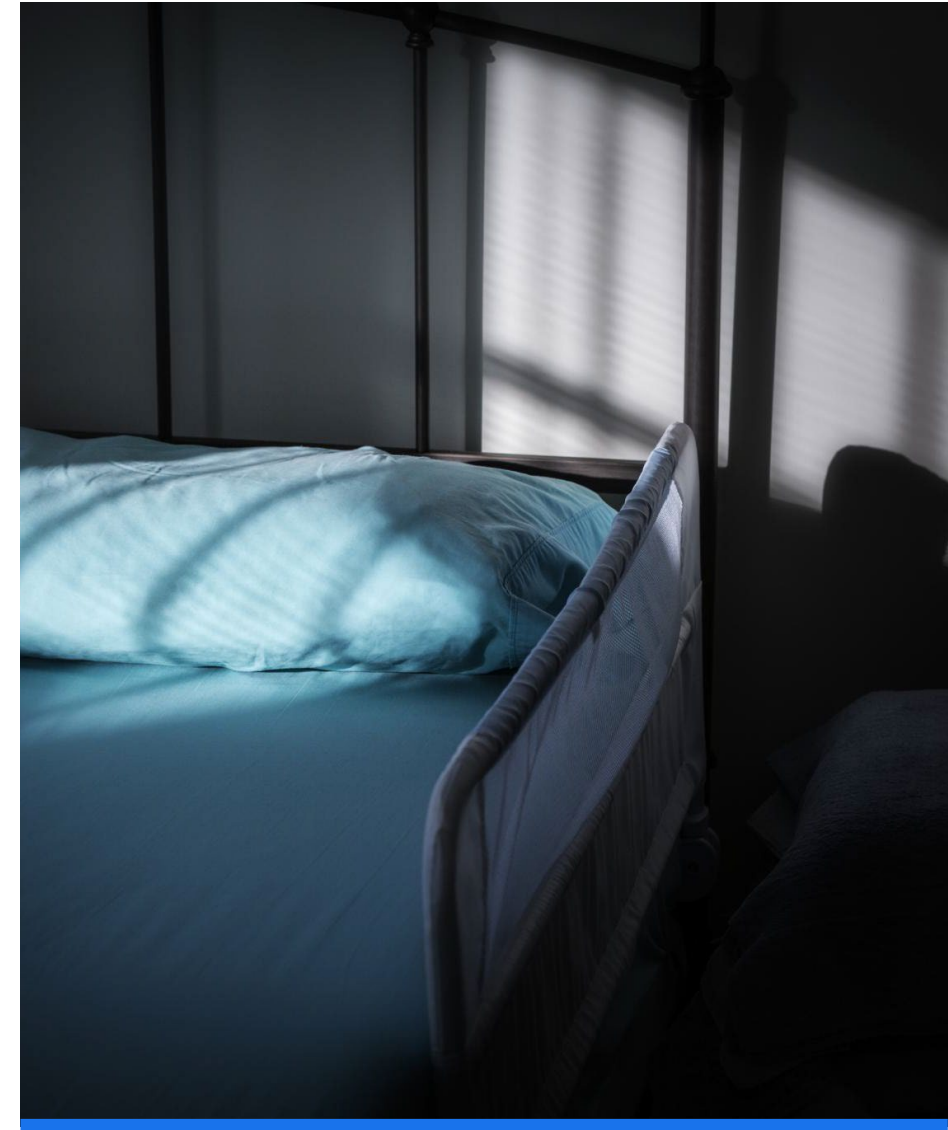
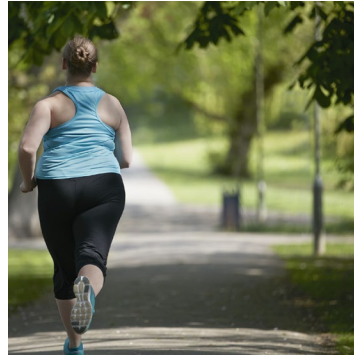


Image source: Microsoft 365 content library

Lifestyle Modifications to Enhance Sleep Quality



Regular Exercise Benefits

Regular physical activity promotes better sleep quality and aids in managing diabetes effectively.



Mindful Eating Habits

Eating balanced meals and avoiding heavy or late-night eating supports improved sleep patterns.



Limit Caffeine and Screens

Reducing caffeine intake and screen exposure before bedtime enhances sleep quality and diabetes control.

Image sources:
Microsoft 365 content
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Tips for Getting a Good Night's Sleep



Practice healthy habits during the day:

- Go to bed and wake up at the same time each day.
- Try to get at least 30 minutes of sunlight.
- Exercise regularly, but not within 2-3 hours before bedtime.
- Don't take naps after 3 p.m.
- Avoid caffeine and nicotine.
- Avoid alcoholic drinks before bed.
- Avoid large meals and drinks late at night.
- Avoid medicines that delay or disrupt your sleep, if possible.



Create a good sleeping environment:

- Have a comfortable mattress and pillow.
- Keep the room temperature cool.
- Avoid distractions such as noises, bright lights, clocks, TVs, and computers.



Take time to relax before going to bed:

- Read a book or listen to music, and turn off the TV and electronic devices.
- Take a hot bath, which will adjust your body temperature and help you relax.

If you are awake for more than **20 minutes**, get up and do something relaxing.
If you continue to have trouble sleeping, **talk to your doctor about it.**



For more information, visit www.nhlbi.nih.gov/sleep.

Warning Signs Indicating Need for Specialized Sleep Care



Referral to Sleep Medicine

- **Obstructive Sleep Apnea**

- Loud snoring
- Witnessed apneas
- Daytime sleepiness
- Morning Headaches
- Hypertension
- Diabetes (~50% prevalence)

- **Complex Insomnia**

- Difficulty falling asleep (>30 minutes in an appropriate environment)
- Difficulty staying asleep
- Non-restorative sleep
- Daytime Impairment

- **Complex Movements During Sleep**

- Odd behaviors/sleep walking
- Dream enactment- yelling, screaming, swatting/kicking, falling out of bed

- **Hypersomnia (e.g. narcolepsy, etc)**

- Sleep attacks
- Sleep paralysis and/or hallucinations
- Paralysis with emotions



Knowing when to Refer for Sleep Studies or Specialist Evaluation

Persistent Sleep Disturbances

Ongoing sleep problems that adversely affect health require timely medical evaluation to avoid complications.

Referral to Specialists

Referral to sleep specialists enables accurate diagnosis and personalized treatment plans for better health outcomes.



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Recognizing Symptoms of Sleep Apnea

Loud Snoring

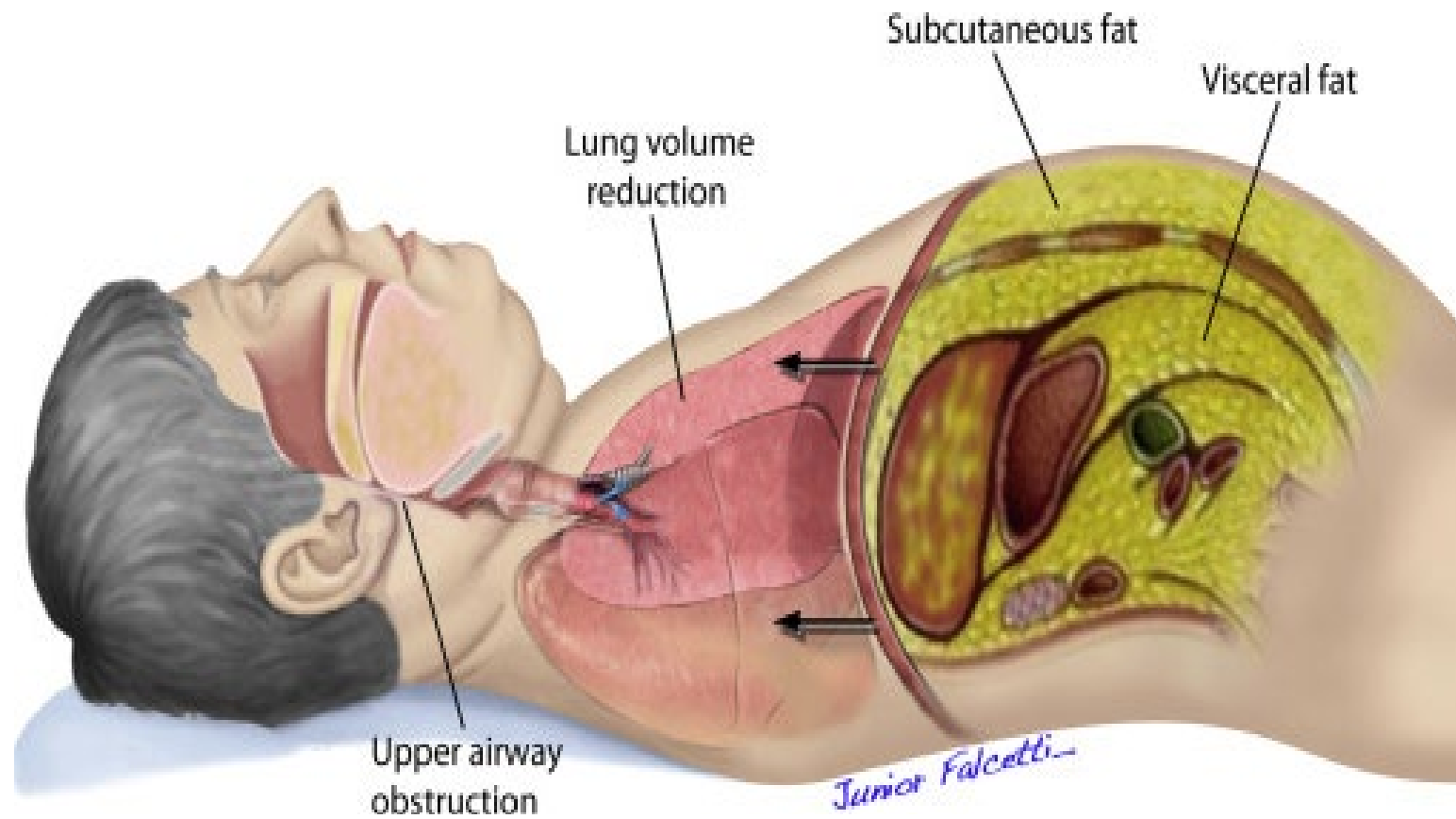
Loud snoring is a common symptom indicating possible sleep apnea and disturbed breathing during sleep.

Choking During Sleep

Episodes of choking or gasping during sleep are warning signs of sleep apnea requiring medical evaluation.

Daytime Sleepiness

Excessive daytime sleepiness is a major symptom of sleep apnea often impacting daily function and alertness.



Luciano F. Drager, Sônia M. Togeiro, Vsevolod Y. Polotsky, Geraldo Lorenzi-Filho, Obstructive Sleep Apnea: A Cardiometabolic Risk in Obesity and the Metabolic Syndrome, Journal of the American College of Cardiology, Volume 62, Issue 7, 2013, Pages 569-576, ISSN 0735-1097, <https://doi.org/10.1016/j.jacc.2013.05.045>.

Sleep Apnea Treatments

- **auto-PAP Therapy** (e.g. auto-CPAP, BiPAP, etc): Gold standard for OSA, but adherence remains a challenge in some.
- **Lifestyle Modification & Weight Loss:**
 - Caloric restriction, Mediterranean diet, increased physical activity.
 - Even 5–10% weight loss can significantly reduce AHI (apnea-hypopnea index).
- **Adjuncts/Alternatives:**
 - Oral appliances (for mild/moderate OSA).
 - Bariatric surgery (for severe obesity/OSA).
 - Hypoglossal Nerve Stimulation

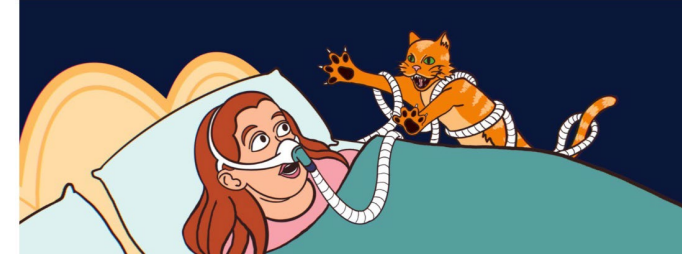


Figure 7



Figure 8



Figure 9



Figure 10

Sleep & Health Outcomes

Insomnia Symptoms

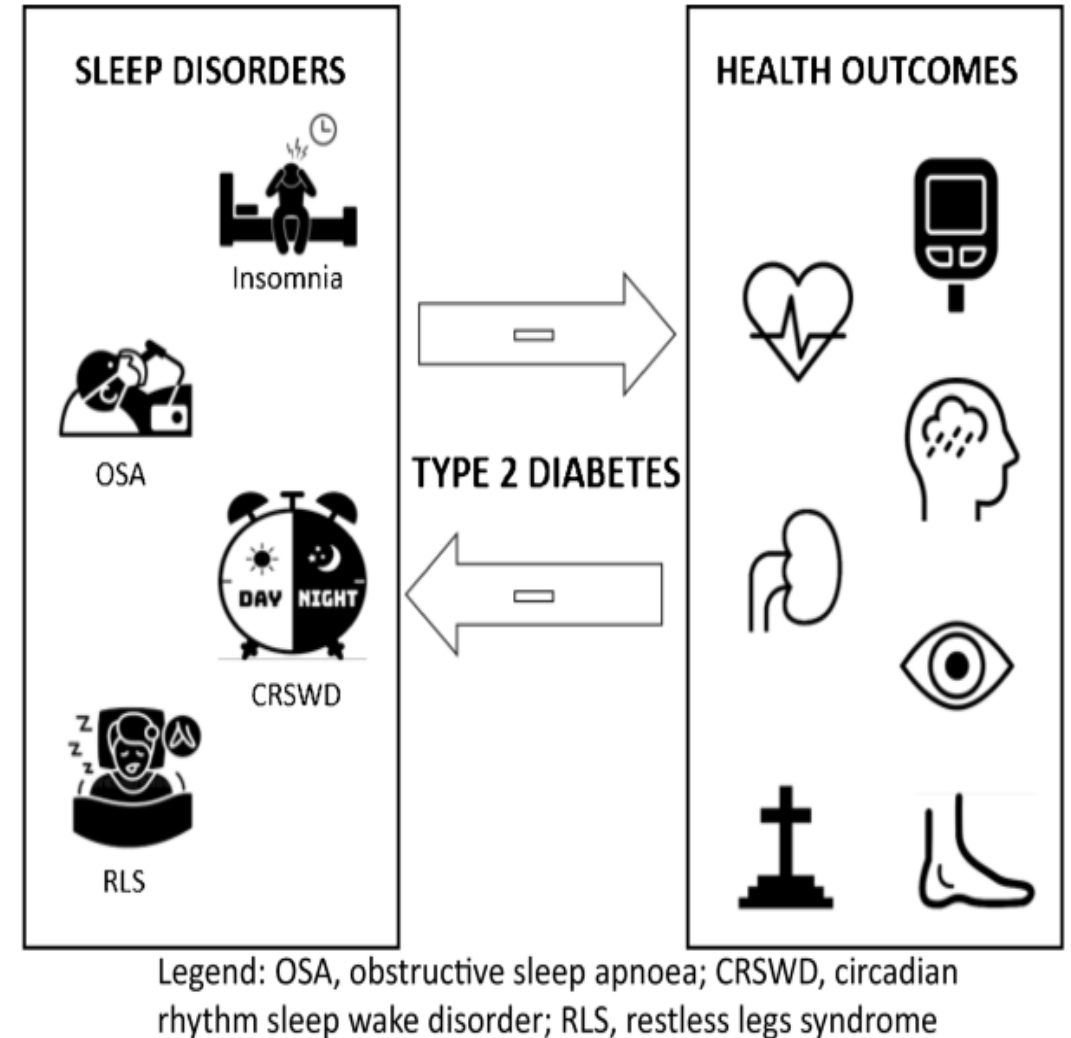
Difficulty falling asleep or staying asleep frequently **disrupts rest** and overall health.

Restless Leg Sensations

Uncomfortable leg sensations cause frequent leg movements that **disturb sleep quality**.

Impact on Diabetes

Optimized sleep can **improve diabetes control!**



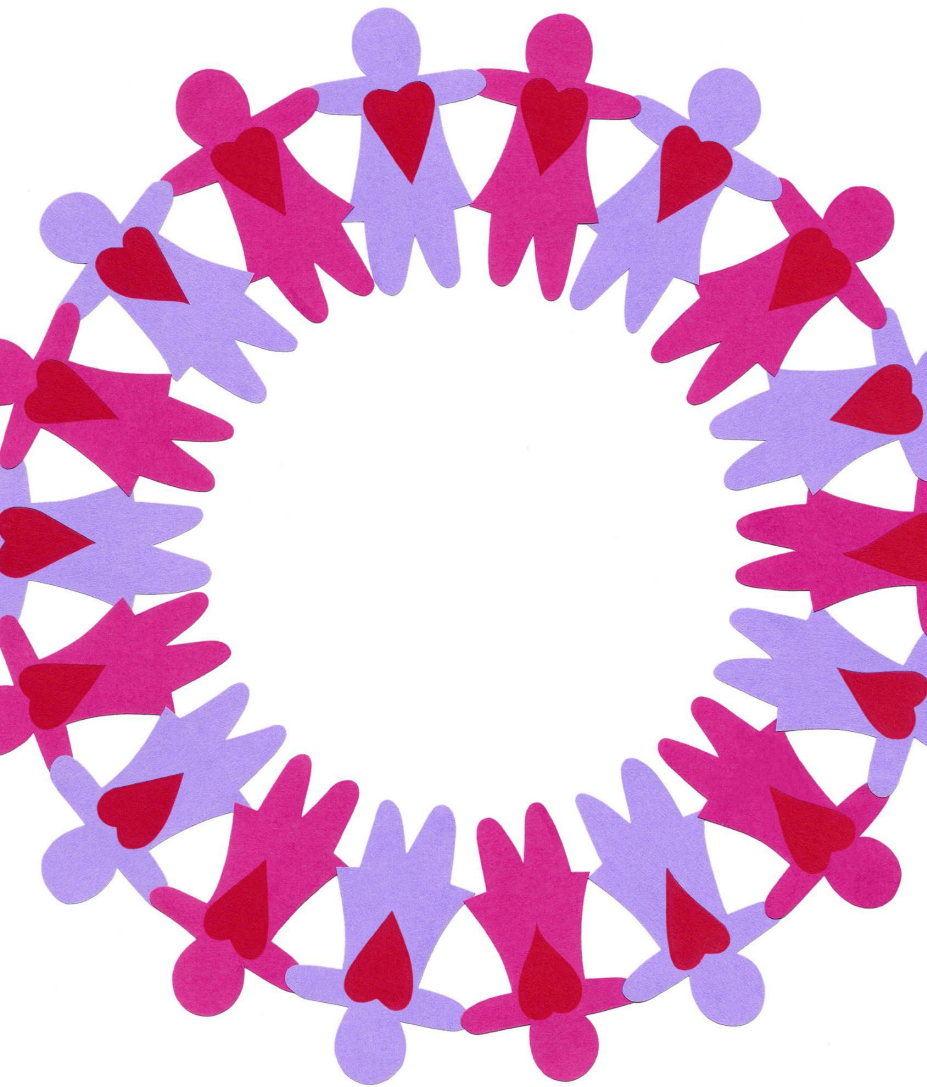
Summary of the literature on the association between sleep disorders, health outcomes, and quality of life in people with type 2 diabetes

Sleep problem	HbA _{1c} 	Retinopathy 	Nephropathy 	Neuropathy 	Macrovascular 	Depression 	Mortality 	Quality of Life 
Insomnia 	↑	↑	?	?	?	↑	↑	↓
OSA 	↑	↑	↑	↑	↑	?	↑	↓
RLS 	=	↑	↑	↑	↑	↑	?	↓
CRSWDs 	↑	=	=	↑	?	↑	↑	?

Summary of the possible pharmacological and non-pharmacological treatment options for sleep disorders highly prevalent in people with type 2 diabetes

Sleep disorder	Type of therapy	Treatment
Insomnia 	Pharmacological	Orexin receptor antagonist Low-dose antidepressants Antipsychotics Melatonin
	Non-pharmacological	CBT and sleep education
OSA 	Pharmacological	None reported
	Non-pharmacological	CPAP Mandibular devices Weight loss
RLS 	Pharmacological	Dopamine agonists
	Non-pharmacological	None reported
CRSWDs 	Pharmacological	None reported
	Non-pharmacological	None reported

Accessing Resources to Support Restorative Sleep in Diabetes



Educational Tools and Patient Support Programs

Sleep Hygiene Guidance

Programs provide essential tips on improving sleep patterns, promoting better overall health and well-being.

Diabetes Education

Educational programs help patients manage diabetes effectively through diet, medication, and lifestyle awareness.

Coping Strategies Support

Support programs teach coping techniques to handle chronic illness challenges, boosting patient confidence and resilience.



Utilizing Technology and Community Resources

Digital Sleep Apps

Digital apps help monitor sleep patterns and provide personalized insights to improve sleep quality.

Wearable Devices

Wearable devices track physiological data to motivate users toward better sleep habits.

Community Support Groups

Community groups offer peer support and motivation to sustain healthy sleep behaviors.

Conclusion: Prioritizing Restorative Sleep Enhances Diabetes Care

Importance of Restorative Sleep

Restorative sleep plays a crucial role in managing diabetes by supporting metabolic health and insulin regulation.

Adopting Healthy Sleep Habits

Establishing consistent sleep routines and environments enhances sleep quality and diabetes management outcomes.

Recognizing Warning Signs

Identifying symptoms of poor sleep helps in early intervention and better diabetes care.

Leveraging Support Resources

Using healthcare guidance and educational resources empowers people with diabetes to improve their sleep and health.

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