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Effects Of Short-Term Sleep Hygiene Intervention On Fasting Blood Glucose In Pre-Diabetics: A 10-Day Pilot Study

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Abstract:
Background: *Emerging evidence links disturbed sleep patterns with adverse metabolic outcomes, including insulin resistance and prediabetes. In Ayurveda,* ***Nidra*** *(sleep) is regarded as a fundamental pillar of health, vital for physiological balance. Proper sleep routines (****Ratri Charya****) are believed to optimize metabolic functions and promote overall well-being.* ***Objective:*** *This pilot study aims to evaluate the effects of Ayurvedic sleep hygiene counseling on fasting blood sugar (FBS) levels and sleep quality in pre-diabetic individuals over a span of 10 days.* ***Methods:*** *Ten pre-diabetic adults adhered to a structured 10-day intervention comprising fixed sleep timing, early light dinner, screen reduction, and herbal evening tea. FBS levels and subjective sleep quality scores were measured before and after the intervention. Additionally, a subset of participants reported subjective changes in energy, digestion, and mood.* ***Results:*** *The study observed an average reduction of 4.6 mg/dL in FBS (from 116.2 mg/dL to 111.6 mg/dL), with 100% of participants reporting improved sleep quality. Notably, 80% reported enhanced daytime energy and digestion. The majority also noted decreased evening stress levels.* ***Conclusion:*** *Implementing Ayurvedic sleep hygiene practices can serve as an effective non-pharmacological adjunct for early management of dysglycemia. Longer-term, controlled studies are recommended to validate these preliminary findings. Sleep, or Nidra, holds a central position in Ayurveda, considered one of the three essential pillars of health alongside Ahara (diet) and Vihara (lifestyle). Classical texts such as the Charaka Samhita and Sushruta Samhita emphasize the importance of proper sleep in maintaining physical vitality, mental clarity, and metabolic harmony.*
Keywords: *Pre-diabetes, sleep hygiene, Ayurveda, Nidra, Lifestyle intervention, Metabolic health*

INTRODUCTION:

Sleep is a fundamental component of human health, playing a crucial role in the restoration of both physical and emotional well-being. Maintaining regular sleep patterns is essential for preserving overall fitness and preventing metabolic disturbances. In modern society, various lifestyle factors, such as late-night activities— including watching television, using digital devices, and engaging in round-the-clock entertainment—along with shift work and night employment, have contributed to disrupted sleep cycles [1]. These disruptions are not only detrimental to general health but also have significant implications for glucose metabolism; studies have demonstrated that the sleep-wake cycle markedly influences glucose tolerance and insulin secretion [2].Research indicates that inadequate or irregular sleep duration is associated with increased risks of impaired fasting glucose and type 2 diabetes mellitus [3]. Short sleep duration, in particular, has been linked to a threefold higher likelihood of developing impaired fasting glucose, even when accounting for other risk factors [4]. Moreover, poor sleep quality, including difficulties in sleep initiation and maintenance, has been associated with impaired glucose tolerance and heightened diabetes risk [5],[6]. In Ayurveda, sleep—referred to as Nidra—is regarded as a vital pillar of health [7], essential for maintaining physiological balance and mental stability[8]. Along with a proper diet (Ahara) and disciplined conduct (Brahmacharya), Sleep is believed to promote immunity, reduce stress and anxiety, and prevent mental and physical illnesses [9],[10]. It induces relaxation, supports the body's recovery processes, and contributes to overall well-being.In Ayurveda, Ratri Charya (night routine) advocates for going to bed before 10 PM, consuming light dinners, and engaging in calming activities to facilitate Nidra. Herbal remedies such as Tulsi[11](Ocimum sanctum) and Turmeric (Curcuma longa)[12]are traditionally used at bedtime to promote relaxation, reduce inflammation, and support metabolic health [13] [14].
Given the importance of sleep in metabolic health, this pilot study aims to evaluate the impact of sleep hygiene counseling on fasting glucose levels among xpre-diabetic individuals over a short duration of 10

days. The intervention seeks to explore whether improving sleep habits can serve as an effective, non-pharmacological strategy to better manage early glucose dysregulation.

Table I: Study Overview – Design, Inclusion/Exclusion Criteria, Intervention Details, and Assessment Tools:

Parameter	Details
Design	Prospective pilot pre-post intervention study
Participants	10 adults (aged 35-55 years) with FBS between 100–125 mg/dL
Inclusion Criteria	Pre-diabetes diagnosis based on ADA criteria; no current medication affecting glucose metabolism
Exclusion Criteria	Existing diabetes, sleep disorders, or psychiatric conditions
Intervention Protocol	- Sleep by 10 PM - Light dinner before 8 PM - Screen exposure avoided 1 hour before sleep - Herbal tea (Tulsi or turmeric milk) at bedtime - No caffeine or alcohol during the study period
Duration	10 days
Assessment Tools	- Fasting blood sugar (FBS) measured pre- and post-intervention - Subjective sleep quality assessed using a visual analogue scale (VAS) - Energy and digestion rated via questionnaire

Table II: Summary of Pre- and Post-Intervention Changes in Blood Glucose, Sleep Metrics, and Subjective Well-being: Reported outcomes.

Parameter	Mean before intervention	Mean Post-Intervention	Change
Average FBS (mg/dL)	116.2 ± 4.8	111.6 ± 4.2	-4.6 mg/dL ($p < 0.05$)
Sleep Duration (hours)	5.8 ± 0.9	6.4 ± 0.7	+0.6 hours
Sleep Onset Time	~11:15 PM	~9:50 PM	~1 hour 25 mins earlier
Subjective Sleep Quality (VAS score)*	4.2/10	8.5/10	Significant improvement
Energy Level (self-rated)	5.5/10	7.8/10	Improved in 80% of participants
Digestive Comfort(Self rated)	Moderate discomfort in 60%	Mostly improved; discomfort reduced in 70%	

Visual analogue scale

The data presented in the table indicates notable improvements following the 10-day sleep hygiene counseling intervention among pre-diabetic participants. The mean fasting blood sugar (FBS) levels decreased significantly from 116.2 mg/dL to 111.6 mg/dL ($p < 0.05$), suggesting a positive impact of improved sleep habits on glycemic control. Concurrently, participants experienced an increase in sleep duration, averaging an additional 0.6 hours per night, along with a substantial shift in sleep onset time—sleeping approximately 1 hour and 25 minutes earlier than before. These changes reflect better sleep regularity and potentially enhanced sleep quality.Subjective assessments further support these findings; the Visual Analog Scale (VAS) score for sleep quality improved markedly from 4.2/10 to 8.5/10, indicating participants perceived their sleep as significantly more restorative. Additionally, self-rated energy levels increased from 5.5 to 7.8 out of 10, with 80% of participants reporting overall improved energy, which could be linked to better sleep quality and duration.Digestive comfort also showed positive trends, with a majority of participants experiencing reduced discomfort—60% reported moderate discomfort initially, which decreased with 70% reporting improvement post-intervention. This suggests that better sleep hygiene may also contribute to improved digestive health and comfort.Overall, these findings demonstrate that sleep hygiene counseling can effectively enhance sleep quality and duration, leading to measurable improvements in fasting glucose levels and overall well-being in pre-diabetic individuals over a short period. The observed changes highlight the potential of behavioral interventions targeting sleep patterns as a non-pharmacological approach to managing early metabolic disturbances.

DISCUSSION:

Sleep is one of the important elements in human life, associated with the reconstruction of physical and emotional power. From an Ayurvedic perspective, Sleep is considered a vital pillar of life, alongside Ahara (nutrition) and Brahmacharya (celibacy or self-control). Sleep is believed to govern essential physiological functions, promote physical and mental relaxation, and enhance immunity.This pilot study investigated the impact of a 10-day sleep hygiene counseling intervention on fasting blood glucose (FBS) levels and associated sleep parameters in pre-diabetic participants. The results suggest a promising relationship between improved sleep quality and glycemic controlThe observed significant decrease in average FBS levels (-4.6 mg/dL, $p<0.05$) following the intervention is a key finding. This reduction, while modest, is noteworthy given the pre-diabetic state of the participants and the relatively short intervention period. This suggests that even a brief period of focused sleep improvement can positively influence glucose metabolism. Further research with a larger sample size is warranted to confirm these findings and assess the long-term effects.The increase in sleep duration (0.6 hours) and the earlier sleep onset time (~1 hour 25 minutes) highlight a significant improvement in sleep patterns. These improvements are likely intertwined with the observed changes in FBS, as adequate sleep is crucial for insulin sensitivity and glucose homeostasis. The subjective reports of improved sleep quality (VAS score) and energy levels (80% improvement) further support the positive impact of the intervention on sleep.Importantly, the data also show improvements in digestive comfort, with a reduction in discomfort from 60% to 70%. While not directly related to glucose metabolism, this finding suggests a broader improvement in the participants' overall well-being, potentially mediated by the improved sleep. (Remove this if you don't want)

Flowchart: Scientific Mode of Action of Sleep Hygiene Counseling in Improving Glycemic Control

1. **Sleep Hygiene Counseling**
   ↓
2. **Improved Sleep Architecture & Duration** (e.g., increased total sleep time, earlier sleep onset)
   ↓
3. **Enhanced Sleep Quality** (reduction in sleep fragmentation, increased REM and deep sleep phases)
   ↓
4. **Regulation of Neuroendocrine Function** (stabilization of cortisol, growth hormone, and catecholamines)
   ↓
5. **Reduction in Sympathetic Nervous System Activation & HPA Axis Modulation**
   ↓
6. **Decrease in Systemic & Cellular Inflammation** (lower pro-inflammatory cytokines)
   ↓
7. **Improved Insulin Sensitivity & Glucose Uptake in Peripheral Tissues**
   ↓
8. **Lower Fasting Blood Glucose (FBS) Levels & Better Glycemic Control**

Additional effects:

- Improved autonomic regulation of glucose metabolism
- Enhanced beta-cell function
- Broader improvements in metabolic health and well-being (e.g., digestive comfort, energy levels)

Limitations:

This pilot study has limitations. The small sample size restricts the generalizability of the findings. A larger, more diverse study population is needed to confirm the effectiveness of the intervention across different demographics. The relatively short 10-day intervention period may not capture the full impact of sustained sleep improvements on long-term glucose control. Further research with longer intervention duration is needed to fully assess the clinical significance of these changes. Objective measures of sleep, such as polysomnography, would provide a more comprehensive evaluation of sleep quality compared to subjective assessments.

CONCLUSION:

This pilot study demonstrates a potential beneficial effect of sleep hygiene counseling on fasting blood glucose levels in pre-diabetic individuals. The observed improvements in sleep duration, sleep onset time, subjective sleep quality, and energy levels, along with a significant reduction in FBS, suggest that promoting better sleep habits may be a valuable strategy for managing pre-diabetes. Further research with larger sample sizes and longer intervention periods is essential to confirm these findings and explore the mechanisms underlying this relationship. This research should also investigate the potential role of sleep hygiene counseling in conjunction with other lifestyle interventions for pre-diabetic individuals.

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