

Effects of Patient-Driven Lifestyle Modification Using Intermittently Scanned Continuous Glucose Monitoring in Patients With Type 2 Diabetes

An Analysis of the PDF Study | Diabetes Care 2022

Cited by 67

MOTIVATION & RESEARCH CONTEXT



The Complexity of MNT

Medical Nutrition Therapy (MNT) lacks a "one-size-fits-all" pattern. Individual variability in postprandial glucose (PPG) responses is immense, even for the same meals. (Identical meals produce different glucose responses across individuals)



Informatics Opportunity

While ML models (e.g., Zeevi et al.) can predict PPG using gut microbiota and diet, they are hard to implement in real-world clinical settings. (CGM provides rich physiological information)

Clinical Problem

Type 2 diabetes management depends heavily on:

- Diet, exercise, medication, and glucose monitoring

Traditional monitoring (finger-prick BGM):

- sparse measurements, painful, and cannot capture post-meal glucose dynamics

Continuous Glucose Monitoring (CGM):

- provides continuous glucose profiles, enabling personalized treatment

Issue:

- Patients often do not know how to convert CGM data into lifestyle decisions.

This is exactly the gap addressed by this paper.

Study Goal & Hypothesis

Investigating if isCGM-guided self-evaluation improves glycemic control.

Research Question:

Does patient-driven lifestyle modification using intermittently scanned CGM (isCGM) improve glycemic control more than standard blood glucose monitoring?

Subquestions:

1. Does it reduce HbA1c?
2. Does it improve body weight?
3. Does it improve fasting glucose?
4. Does it improve diabetes self-care?
5. Is it safe?

HYPOTHESIS & CORE NOVELTY



The SEOUL (Self-Evaluation Of Unhealthy foods by Looking at postprandial glucose) Algorithm

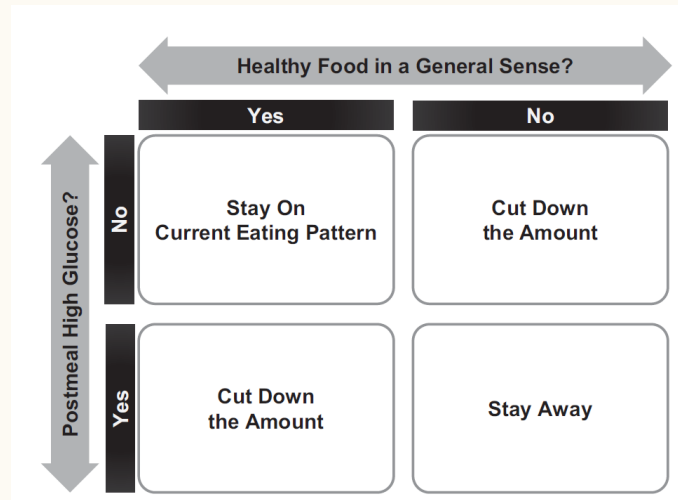
Hypothesis: Personalized lifestyle modification based on individual postprandial glucose responses will produce better glycemic outcomes than conventional diabetes education.

Novelty: The study introduces the *SEOUL Algorithm*: a simplified 2×2 matrix for patients to self-adjust behavior based on isCGM spikes without needing complex data modeling. First randomized trial combining: isCGM, structured education, personalized nutrition, and patient-driven decisions

Summary: To determine whether patient-driven lifestyle modification, supported by isCGM and the SEOUL algorithm, can achieve better diabetes outcomes than conventional blood glucose monitoring and routine diabetes education.

Framework and SEOUL Algorithm

They developed a new framework called SEOUL Algorithm
(Self-Evaluation Of Unhealthy foods by Looking at postprandial glucose)



The SEOUL algorithm guides personalized dietary decisions by combining perceived food healthiness with postprandial glucose responses. Patients are encouraged to continue healthy meals with normal glucose responses, reduce portion sizes when hyperglycemia occurs, and avoid or limit unhealthy foods, enabling individualized lifestyle modification.

Instead of
Doctor reviews CGM
↓
Patient changes diet

The workflow becomes
CGM
↓
Patient interprets glucose
↓
Patient changes diet immediately

THE SEOUL ALGORITHM MATRIX

Postmeal High Glucose?	Healthy Food (General Sense)?	Recommended Action
No	Yes	Stay On Current Pattern
No	No	Cut Down the Amount
Yes	Yes	Cut Down the Amount
Yes	No	Stay Away (Avoid)

THE RCT STUDY DESIGN

RCT (Randomized Controlled Trial): A gold-standard study design where participants are randomly assigned to groups to compare effectiveness.

Duration: 12 weeks, Open-label, Multicenter, 3 hospitals, 126 patients, Randomization 1:1



Intervention Group

63 Patients

Structured Education + **isCGM Device** + SEOUL Algorithm usage.

Received:

- FreeStyle Libre isCGM
- Structured education
- SEOUL algorithm
- CGM diary
- Personalized meal decisions



Control Group

63 Patients

Standard Care + **Standard BGM** (Finger-prick monitoring twice daily).

Received:

- Standard finger-prick glucose meter
- usual diabetes education
- glucose logbook
- No CGM
- No SEOUL algorithm

PDF stands for: Patient-Driven lifestyle modification using FreeStyle Libre in patients with Type 2 Diabetes

Outcome Measures

Primary Outcome:

- Change in HbA1c

Secondary Outcomes

- fasting glucose
- body weight
- waist circumference
- blood pressure
- cholesterol
- diabetes self-care score (SDSCA-K)

Exploratory CGM Metrics

- Time in Range (TIR)
- Time Above Range (TAR)
- Time Below Range (TBR)
- Coefficient of Variation (CV) (Measures glucose variability)

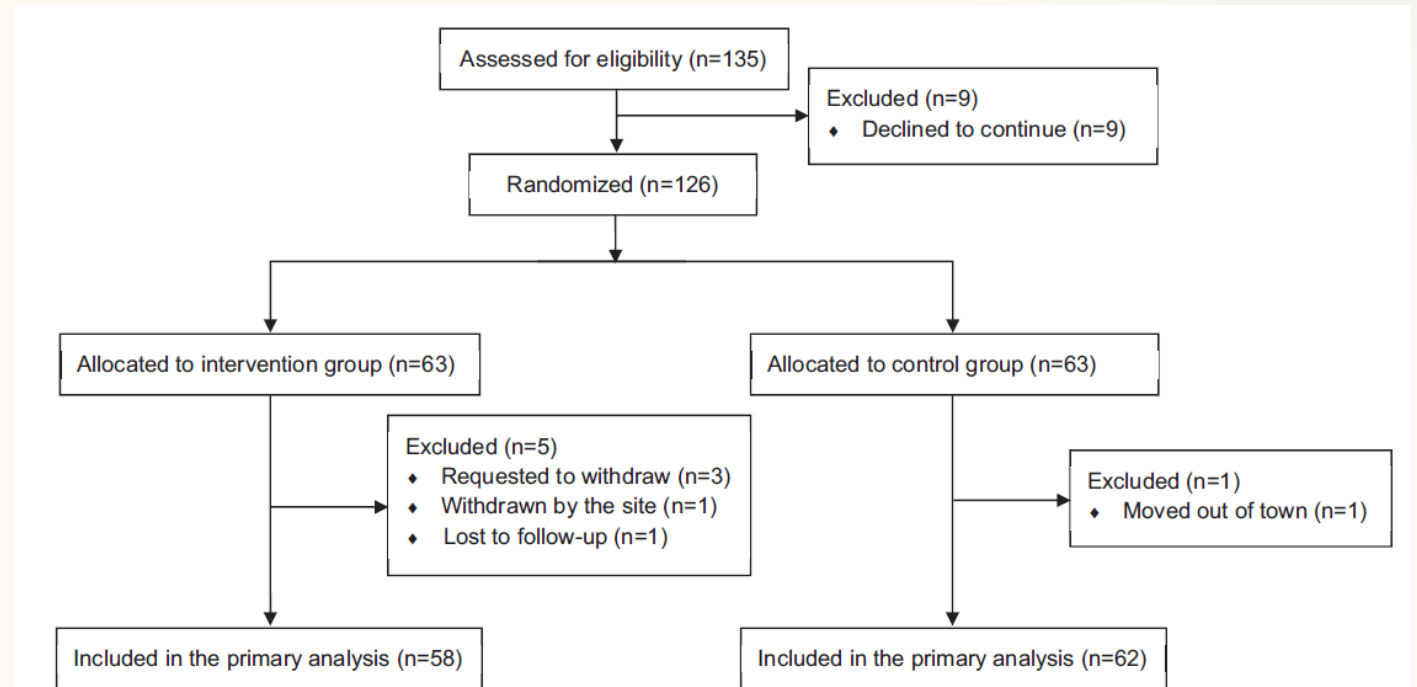


Figure 2—Consort diagram.

- Mean \pm SD age of the total study participants was 58.0 ± 11.9 years, and 48 (40.0%) were women.
- Mean HbA1c was $7.9 \pm 0.7\%$.
- Duration of T2D was 13.3 ± 7.8 years.
- 27.5% of the participants were receiving basal insulin therapy.

12-WEEK TESTING PROTOCOL



Screening (V1)

Baseline HbA1c (7-10%),
Randomization,
BGM/isCGM setup.



Weeks 1-2

Initial isCGM data
collection & SEOUL
education.



Weeks 3-11

Continuous self-
management & PDF diary
tracking.



Follow-up (V2)

Final HbA1c, Weight, &
SDSCA-K assessment.

What is the PDF Study?

- A 12-week multicenter randomized controlled trial
- Compared CGM-guided personalized lifestyle modification with standard diabetes care
- Evaluated whether empowering patients with real-time glucose feedback improves glycemic control and diabetes self-management

PRIMARY RESULT: HBA1C REDUCTION

Intervention (isCGM)

-0.6% Change

Control (Standard)

-0.1% Change

Risk-Adjusted Difference: -0.50% ($P < 0.001$).

The intervention group showed significantly greater improvement in glycemic control compared to standard BGM care.

SECONDARY METABOLIC RESULTS

-16.5

Fasting Glucose (mg/dL)

Significant reduction in morning levels.

-1.5

Body Weight (kg)

Superior weight loss vs control.

-0.5%

HA1c

Significant reduction in morning levels.

SEOUL algorithm + isCGM compared with standard care:

HA1c:

Adjusted difference: -0.50% 95% CI: -0.74 to -0.26 P < 0.001

Fasting blood glucose

Adjusted difference: -16.5 mg/dL 95% CI: -30.0 to -3.0 P = 0.017

DISCUSSION & GROUP COMPARISON

Why Intervention Won?

- **Feedback Loop:** Immediate awareness of meal impact (SEOUL algorithm).
- **Adherence:** High scanning frequency correlated with better outcomes.
- **Precision:** Moving from "average calories" to "personal response."

Control Group Limits

- BGM (Finger pricks) only captures snapshots, missing postprandial peaks.
- Pain and inconvenience leads to lower monitoring frequency.

Critical Discussion

Strengths:

- Excellent clinical trial design
- Simple algorithm
- High clinical applicability
- Good patient engagement

Weaknesses:

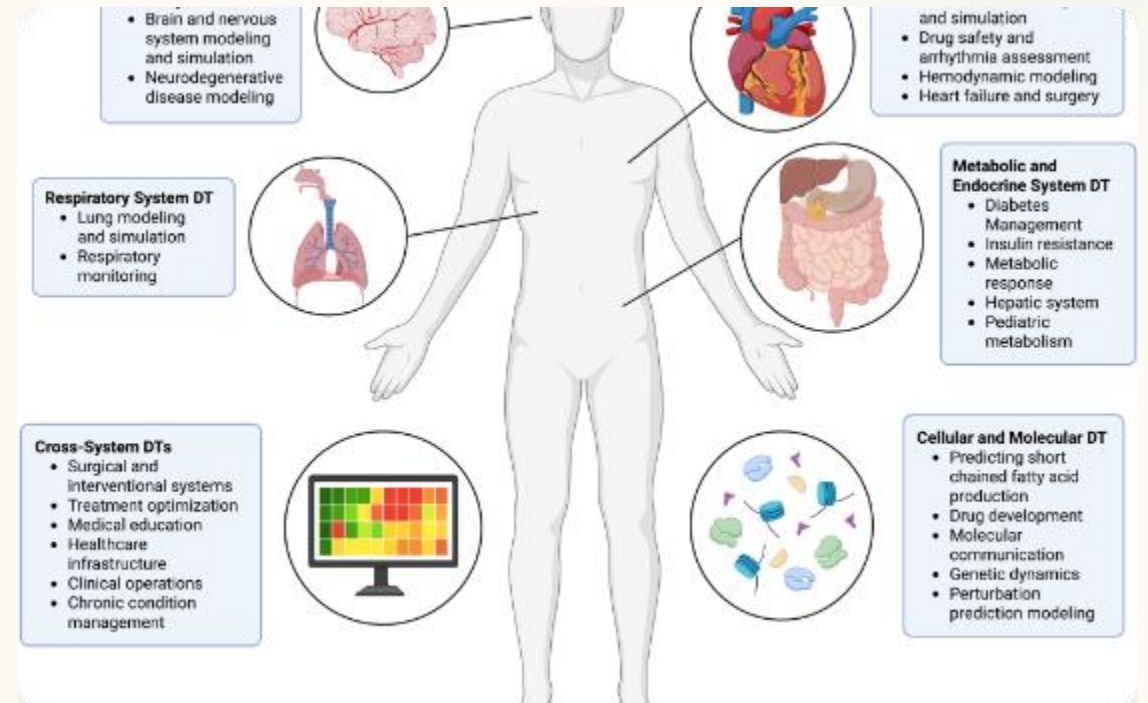
- The SEOUL algorithm is **rule-based**, not adaptive.
- It does not use AI or predictive analytics.
- It only reacts to observed postprandial glucose instead of forecasting future glucose.
- The intervention lasts only 12 weeks, so long-term adherence is unknown.
- There is no personalization beyond simple glucose thresholds; patient-specific factors (sleep, stress, activity, medications) are not integrated.

INFORMATICS & DIGITAL TWINS

Future Research Links

How this paper supports our work:

- **Forecasting:** Proves that human-driven "algorithms" work, suggesting a baseline for Digital Twin accuracy.
- **Personalization:** Validates the need for individual-specific metabolic models.
- **Digital Twins:** We can move from the 2×2 matrix to a virtual "simulated meal" before the patient eats.



Questions?