

A Pilot on the Endocrine Effects of Hormonal Replacement Therapy on Menopausal T1 Diabetics Using Wearable Sensors

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Menopause: an under-reported and under-researched life stage for women with T1D

- ▶ Menopause is associated with metabolic dysfunction leading to weight gain, impaired insulin sensitivity, hypertension and hypercholesterolemia, which diminishes longevity for women living with diabetes.
- ▶ The vasomotor symptoms of hot-flushes/night-sweats, mood swings, anxiety, depression and sexual dysfunction make it difficult to differentiate between symptoms of menopause and hypoglycemia.
- ▶ While it is recognised that transitioning through menopause increases the potential for developing diabetes, yet there are no recommendations on managing glucose variability or insulin resistance for women with pre-existing diabetes.
- ▶ Women using glucose sensor technologies have self-identified increased glucose variability in their data. The generated data, collected in real-time from women outside traditional research settings, would have been unimaginable 20 years ago.

Research Aims

- ▶ Women highlighting the knowledge deficit are driven to learn and share more about menopause. Their requests for clinician support about the impact of hormone replacement therapies (HRT) on glycemic variability, and the associated risk of developing additional comorbidities illustrates the importance of this subject.
- ▶ This work uses wearable sensor datasets to inform an understanding of the collective perimenopause and menopause journeys of women with T1D. Self-management and peer support is bridging the research void, which is why more research is needed.

Problem: Knowledge gaps identified by women

need more research

very difficult to find out about side-effects and how diet/food plays a part in that

What effect does oestrogen have on blood sugars?

re-learning things about diabetes again, sugar levels, food/diet.

Didn't know it was the menopause - I had anxiety attacks, burning tongue, but didn't realise as there weren't hot flushes

What's missing when it comes to support? guidance in general but specifically in effect on BG; mental health support; information; openness to talk about it

Looping is brilliant but total disregard for us

Using CGM and menopause. Noticed blood sugar and hot flushes ran parallel

Good to start HRT? When hormone levels change

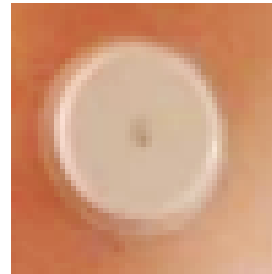
Participant Demographics

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The participants:

- ▶ were recruited from an online community.
- ▶ have lived with Type One Diabetes for 30-45 years.
- ▶ are well educated, professional women with an active interest in health literacy and technology.
- ▶ have previously experienced pregnancy and contributed to research studies in this area.
- ▶ are in their early 50's.
- ▶ are in a cohort of ~6000 people with T1D using DIY artificial pancreas systems. These off-label systems use open source software, developed and updated by the T1D community, to regulate blood glucose levels.

Resources



Sensor Data

Log

nightscout reporter 3.0.2

28/04/2022 until 24/07/2022

| Time | mmol/L | Change | Tuesday, 12/07/2022 |
|-------|--------|--------|--|
| 03:13 | 8.6 | | ab 23:22: neuer Wert 8.00 ab 23:52: neuer Wert 4.62 |
| 03:14 | 8.6 | | temp. Basal 0.72 / 5 min |
| 03:18 | 8.8 | | Pump unreachable |
| 03:19 | 8.8 | | temp. Basal 1.56 / 10 min |
| 03:29 | 8.8 | | temp. Basal 2.02 / 30 min |
| 03:53 | 8.4 | | Pump unreachable |
| 03:59 | 8.3 | | temp. Basal 0.00 / 15 min |
| 04:14 | 7.2 | | temp. Basal 0.00 / 60 min |
| 04:23 | 6.4 | | Pump unreachable |
| 05:08 | 5.7 | | Pump unreachable |
| 05:14 | 5.5 | | temp. Basal 0 / 0 min |
| 05:14 | 5.5 | | temp. Basal 1.05 / 0 min |
| 05:14 | 5.5 | | temp. Basal 0.55 / 10 min |
| 05:24 | 5.2 | | temp. Basal 0.20 / 5 min |
| 05:29 | 4.9 | | temp. Basal 0.00 / 5 min |
| 05:34 | 4.7 | | temp. Basal 0.00 / 5 min |
| 05:39 | 4.4 | | temp. Basal 0.00 / 30 min |
| 05:43 | 4.3 | | Pump unreachable |
| 05:59 | 4.0 | | temp target 5 mmol/L for 90 min, reason: Automation |
| 06:09 | 4.3 | | SMB 0.1 U |
| 06:09 | 4.3 | | temp. Basal 1.17 / 10 min |
| 06:20 | 4.4 | | temp. Basal 0.78 / 5 min |
| 06:23 | 4.2 | | Pump unreachable |
| 06:25 | 4.2 | | temp. Basal 0.07 / 5 min |
| 06:30 | 4.0 | | temp. Basal 0.00 / 10 min |
| 06:39 | 4.2 | | temp. Basal 0.72 / 5 min |
| 06:44 | 4.6 | | SMB 0.2 U |
| 06:45 | 4.6 | | temp. Basal 1.82 / 15 min |
| 06:49 | 5.0 | | SMB 0.2 U |
| 06:54 | 5.4 | | SMB 0.2 U |
| 07:00 | 5.6 | | temp. Basal 0.78 / 5 min |
| 07:03 | 5.4 | | Pump unreachable |
| 07:05 | 5.4 | | temp. Basal 0.00 / 45 min |

Participant One: using HRT

Log

25/03/2022 until 16/07/2022

| Time | mmol/L | Change | Thursday, 28/04/2022 |
|-------|--------|--------|--|
| 20:36 | 4.3 | | SMB 0.5 U |
| 20:38 | 5.2 | | temp. Basal 2.03 / 14 min |
| 20:41 | 5.2 | | SMB 0.4 U |
| 20:49 | 7.0 | | Correction Bolus 2.1 U |
| 20:50 | 7.0 | | Correction Bolus 2 U |
| 20:50 | 7.0 | | The pump could not be reached. No bolus was given |
| 20:51 | 7.0 | | Carbs (20g) |
| 20:51 | 7.0 | | eCarbs: 30 g (1 h), delay: 0 m |
| 20:52 | 7.2 | | temp. Basal 0 / 0 min |
| 20:52 | 7.2 | | temp. Basal 6.24 / 1 min |
| 20:54 | 7.2 | | temp. Basal 0.00 / 2 min |
| 20:56 | 7.2 | | temp. Basal 0 / 0 min |
| 20:56 | 7.2 | | temp. Basal 6.24 / 2 min |
| 20:58 | 7.0 | | temp. Basal 1.25 / 5 min |
| 21:03 | 6.8 | | temp. Basal 0.00 / 5 min |
| 21:08 | 6.7 | | temp. Basal 0.00 / 5 min |
| 21:13 | 6.9 | | temp. Basal 1.40 / 15 min |
| 22:38 | 9.0 | | temp. Basal 1.22 / 10 min |
| 22:48 | 9.6 | | temp. Basal 1.22 / 10 min |
| 22:51 | 9.6 | | Correction Bolus 1 U |
| 22:58 | 9.5 | | temp. Basal 1.22 / 5 min |
| 23:03 | 9.3 | | temp. Basal 0.00 / 10 min |
| 23:13 | 8.9 | | temp. Basal 1.00 / 11 min |
| 23:21 | 8.7 | | Profileswitch - Start Aug 2020 => Lyumjev 3/22 (2/22 copy)(130%) for 60 Minutes Duration of insulin activity (DIA) 5.50 hours => 6.30 hours Target area ab 00:00 5 - 7.00 => 6 - 6.00 ab 07:00 neuer Bereich 5.50 - 5.50 ab 22:00 5 - 7.00 => 6 - 6.00 Basalrate ab 00:00: 0.90 => 1.18 ab 01:00: neuer Wert 1.18 ab 02:00: neuer Wert 1.26 ab 03:00: 1.15 => 1.37 ab 04:00: neuer Wert 1.44 ab 05:00: 1.60 => 1.69 ab 06:00: 2.00 => 1.99 ab 07:00: neuer Wert 2.41 ab 08:00: neuer Wert 2.69 |

Participant Two: not using HRT



Data collected using
Nightscout Reporter (zreptil.de)

Results

| Volunteer | Glucose Level First 30 Days | Glucose Level Second 30 Days | Fluctuations |
|-------------------|-----------------------------|------------------------------|-------------------------|
| HRT Volunteer | Mean: 7.29 STD: 2.75 | Mean: 7.41 STD: 2.79 | Mean: 0.12 STD: 0.04 |
| Non-HRT Volunteer | Mean: 7.53 STD: 2.63 | Mean: 7.50 STD: 2.58 | Mean: 0.03 STD: 0.05 |

- ▶ This study is the first to use combined data from wearable glucose sensors, insulin pumps and DIY artificial pancreas systems to identify changes in insulin sensitivity among menopausal women with Type One Diabetes. The data was collected retrospectively. There was no intervention from the research team, it is a free-living sample set.
- ▶ HRT is often used by women to balance the loss of key hormones oestrogen and progesterone, thus easing the transition to menopause. Although the sample size is small, there are notable changes in insulin sensitivity between the participants following the commencement of HRT.

- ▶ 60 days of data were analysed as 2 x 30 day segments, allowing for observations of glucose variability in the individual who commenced therapeutic HRT treatment - the 2nd volunteer is the control for this study.
- ▶ The mean glucose level of the participant using HRT increased, requiring additional insulin micro-boluses to maintain time in range. This may be due to the therapeutic hormones contributing to a sustained increase in glucose levels, similar to reported insulin resistance during menstruation. The STD values do not fluctuate significantly.
- ▶ The no HRT participant had a higher mean glucose level in the first half of the data. The marginal fluctuation in the second half of their data, implies a consistent lifestyle, with minimal changes to glucose variability and insulin requirements over this time. When compared with the volunteer using HRT, we see that HRT may contribute to increased glucose levels and reduced insulin sensitivity.

Limitations & Areas for future research

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- ▶ Sample size.
- ▶ This is a short sample period. Data submitted for analysis was collected over 60 days and split into segments of 30 days, which allowed for the observation of glucose variability pre and post the commencement of HRT.
- ▶ As this was a retrospective observational study it is unknown how other types of HRT may impact glucose variability, specifically alterations in insulin sensitivity.
- ▶ Subsequent work should involve the input of women with T1D in the design of studies.
- ▶ The recruitment of a larger cohort of patients using additional pharmacological therapies may enable researcher to robustly investigate this theoretical concept further.

Questions

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