



Fasting Can Reverse Type 2 Diabetes

The world's oldest dietary intervention

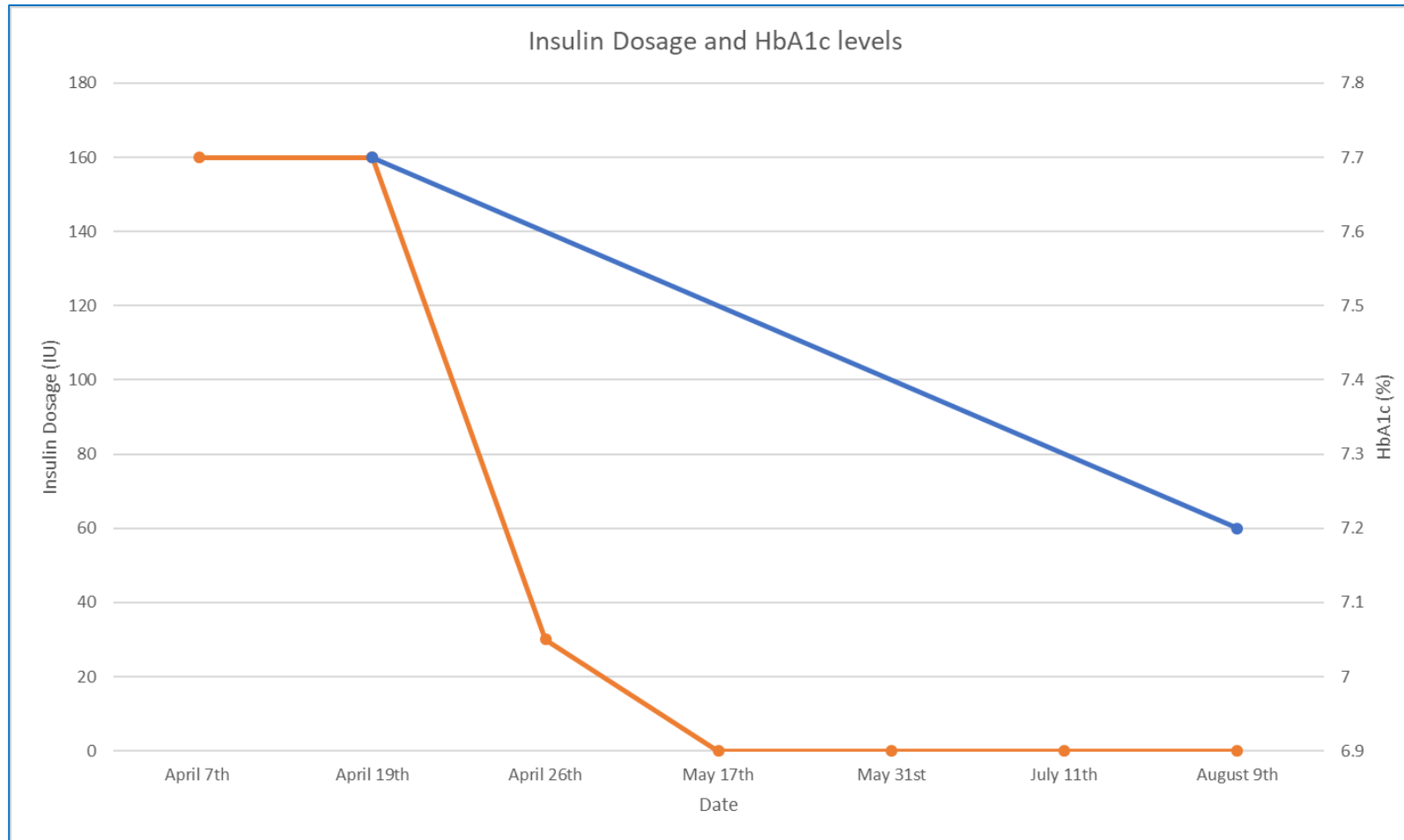
Hippocrates (460-370 BC)

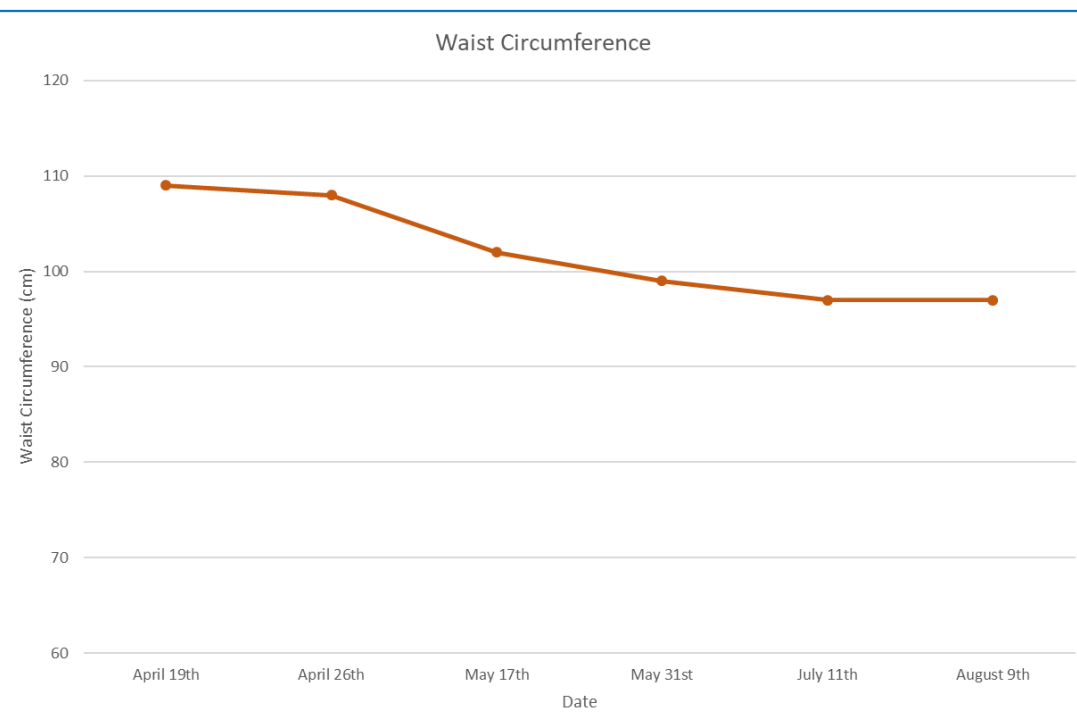
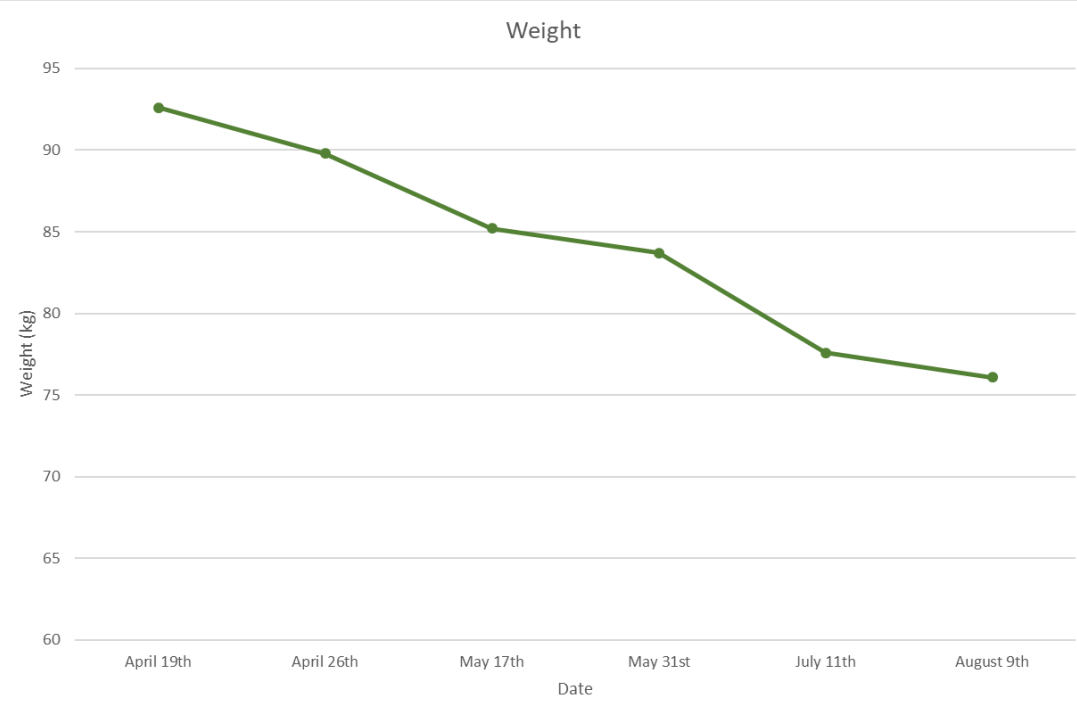
Case Report

- 69 year old man with 35 year history of type 2 diabetes, on insulin for 11 years
- Taking 160 units of insulin + metformin
- Body Mass Index 28.4 at baseline
- Started on intermittent fasting 24-36 hours 2-3 times per week with adjustment of medications

KU, Michael; RAMOS, Megan J.; FUNG, Jason. Therapeutic fasting as a potential effective treatment for type 2 diabetes: A 4-month case study. **Journal of Insulin Resistance**, [S.l.], v. 2, n. 1, p. 5

Case Report





Feeding

Insulin Inhibits Lipolysis

(Glycogen Synthesis)
Body Fat
(De Novo Lipogenesis)



Store It

Insulin



Metabolism
Exercise



Burn It

Fasting – Hormonal Change

Glycogenolysis
Lipolysis



Store It



Metabolism



Burn It

Effect of an Intermittent Calorie-restricted Diet on Type 2 Diabetes Remission: A Randomized Controlled Trial

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Xiao Yang, Jiali Zhou, Huige Shao, Bi Huang, Xincong Kang, Ruiyu Wu, Fangzhou Bian, Minghai Hu ✉, Dongbo Liu ✉

The Journal of Clinical Endocrinology & Metabolism, dgac661,
<https://doi.org/10.1210/clinem/dgac661>

Published: 14 December 2022 **Article history** ▼

Results: On completing the 3-month intervention plus 3-month follow-up, 47.2% (17/36) of participants achieved diabetes remission in the CMNT group, whereas only 2.8% (1/36) of individuals achieved remission in the control group (odds ratio 31.32; 95% CI, 2.39-121.07; $P < 0.0001$). The mean body weight of participants in the CMNT group was reduced by 5.93 kg (SD 2.47) compared to 0.27 kg (1.43) in the

47.2% vs 2.8% REMISSION



Efficacy and Safety of Intermittent Fasting in People With Insulin-Treated Type 2 Diabetes (INTERFAST-2)—A Randomized Controlled Trial

<https://doi.org/10.2337/dc22-1622>

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Type 2 diabetes remission 8 patients vs 0 patients

Interfast2 Study
<https://doi.org/10.2337/dc22-1622>

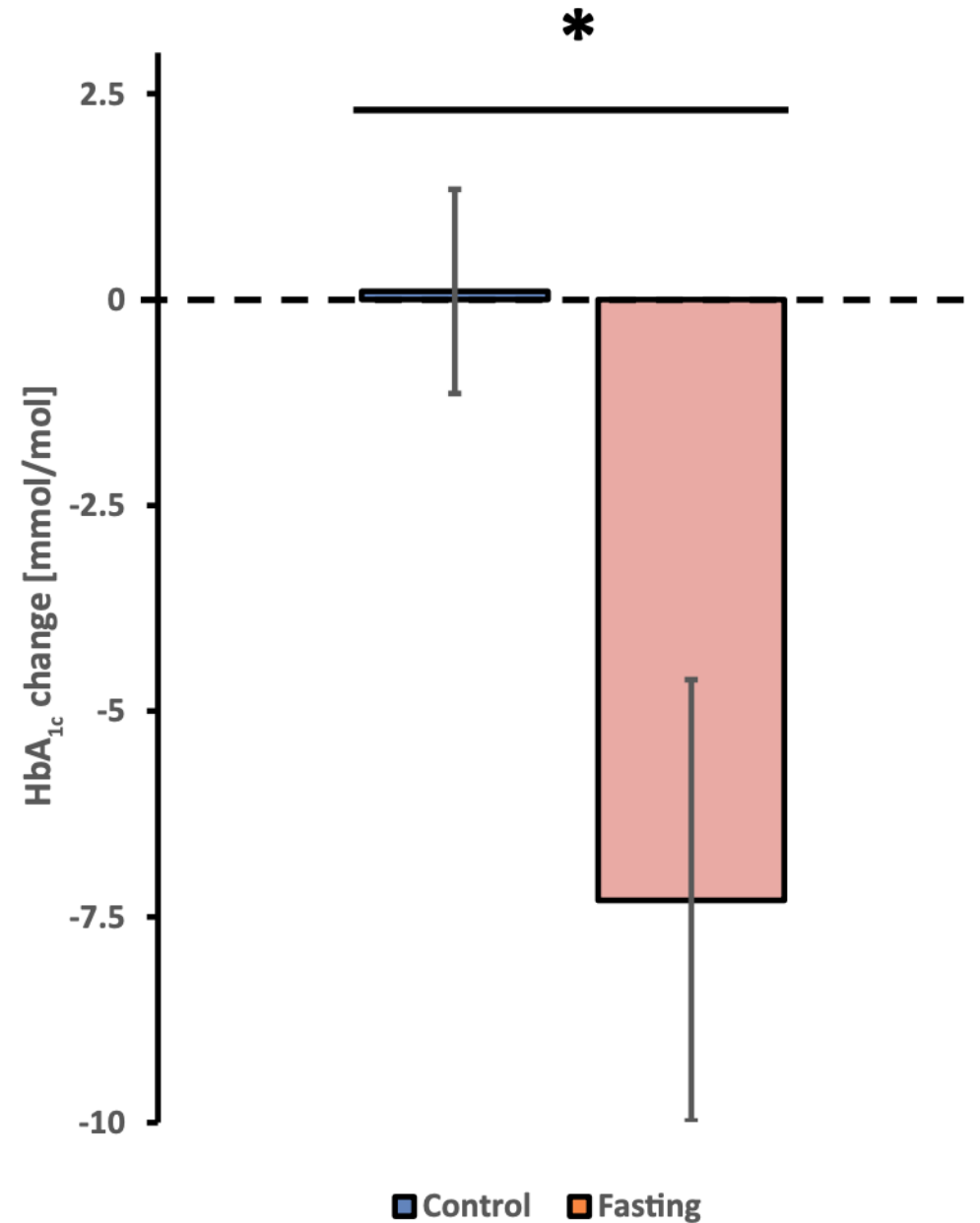


Figure 2—Change in HbA_{1c} from baseline to 12 weeks in control and IF group. Data are displayed as mean \pm SEM. * $P = 0.012$.

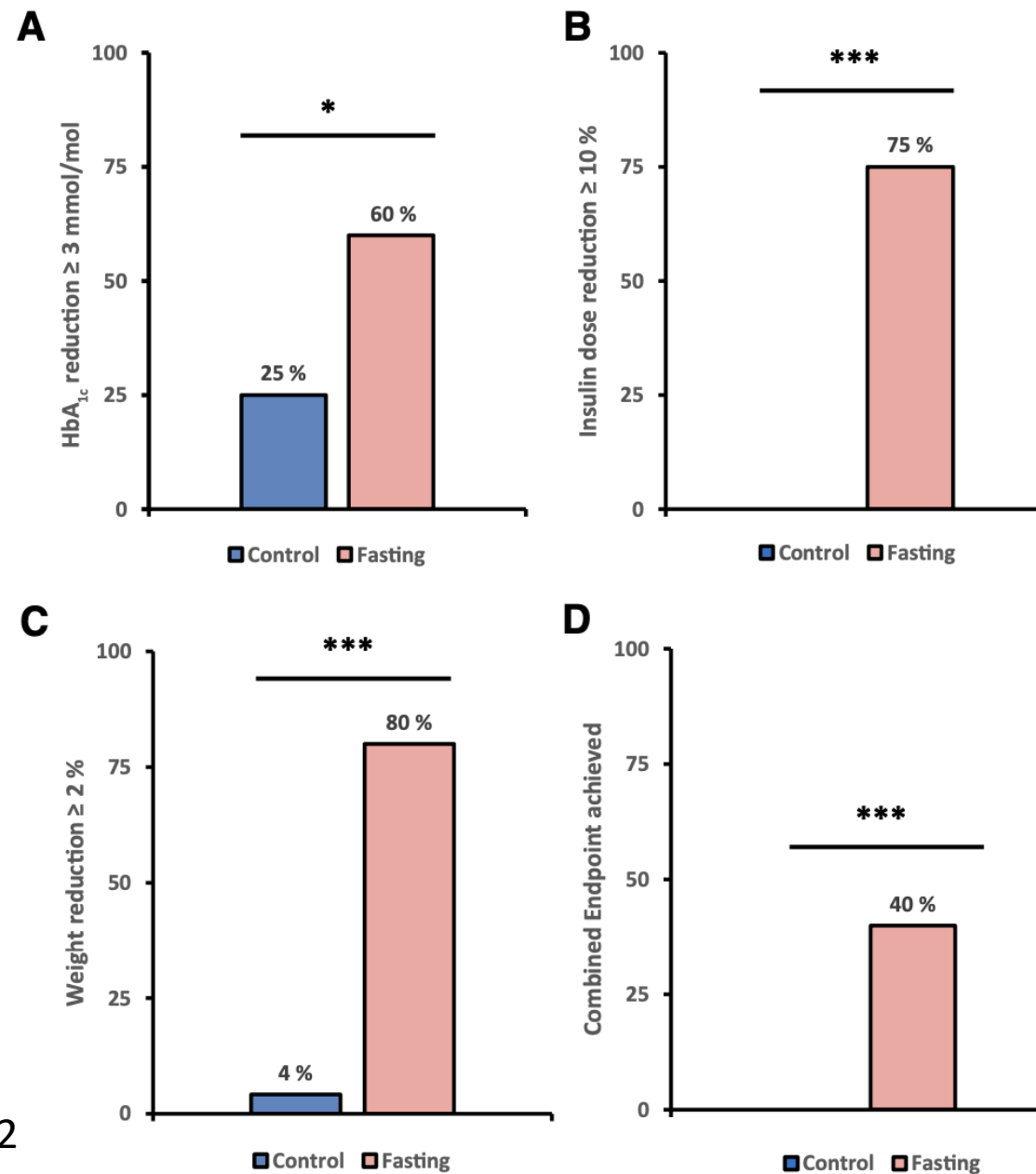


Figure 3—Coprimary end point; percentage of participants achieving each individual aspect and the combined coprimary end point. * $P < 0.05$, *** $P < 0.001$.

Intermittent fasting plus early time-restricted eating versus calorie restriction and standard care in adults at risk of type 2 diabetes: a randomized controlled trial

Received: 19 September 2022

A list of authors and their affiliations appears at the end of the paper

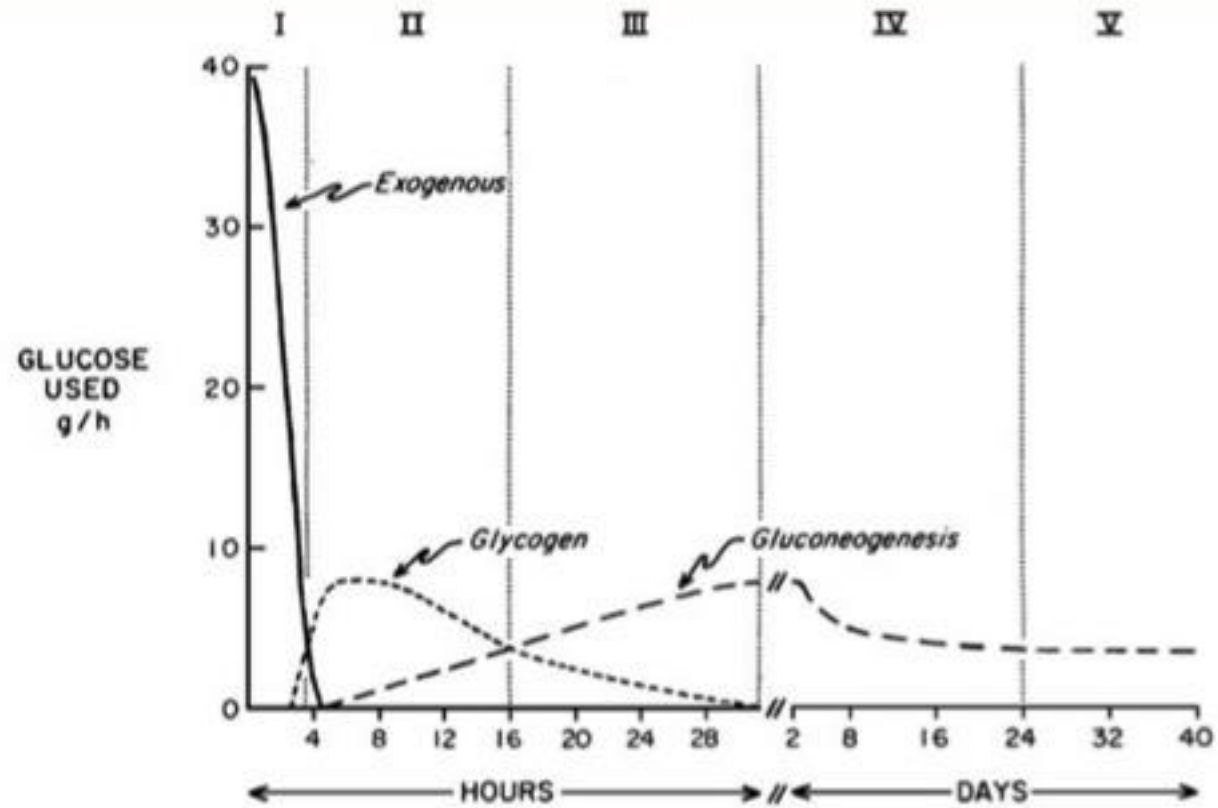
Accepted: 2 March 2023

Published online: 06 April 2023

Intermittent fasting appears an equivalent alternative to calorie restriction

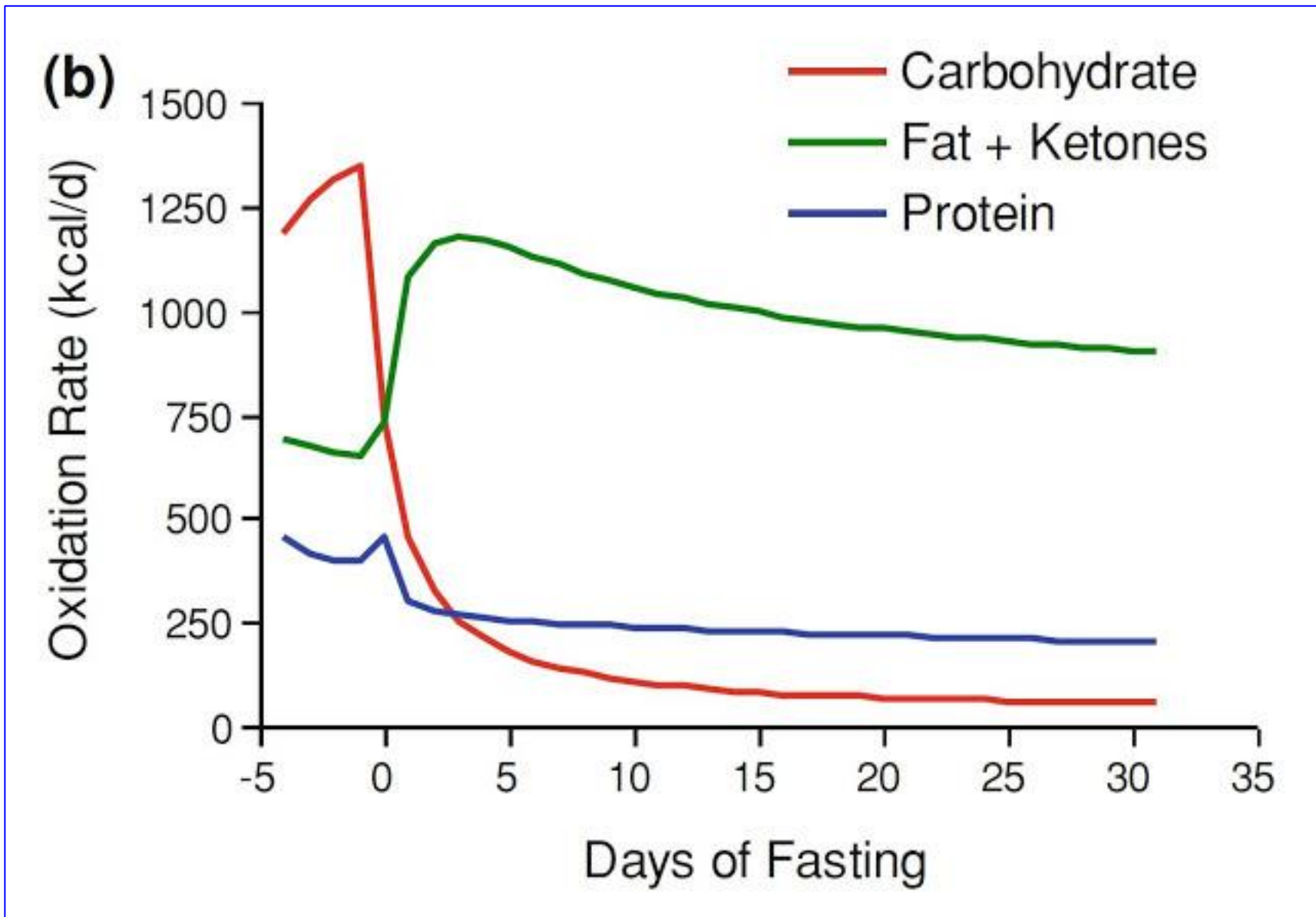
with an additional 12-month follow-up. The primary outcome was change in glucose area under the curve in response to a mixed-meal tolerance test at month 6 in iTRE versus CR. **Glucose tolerance was improved to a greater extent in iTRE compared with CR (−10.10 (95% confidence interval −14.08, −6.11) versus −3.57 (95% confidence interval −7.72, 0.57) mg dl^{−1} min^{−1}; *P* = 0.03) at**

Fasting Physiology



| | (I) | (II) | (III) | (IV) | (V) |
|-------------------------|-----------|---|---|---|--|
| ORIGIN OF BLOOD GLUCOSE | Exogenous | Glycogen Hepatic gluconeogenesis | Hepatic gluconeogenesis Glycogen | Gluconeogenesis, hepatic and renal | Gluconeogenesis, hepatic and renal |
| TISSUES USING GLUCOSE | All | All except liver. Muscle and adipose tissue at diminished rates | All except liver. Muscle and adipose tissue at rates intermediate between II and IV | Brain, rbc's, renal medulla. Small amount by muscle | Brain at a diminished rate, rbc's, renal medulla |
| MAJOR FUEL OF BRAIN | Glucose | Glucose | Glucose | Glucose, ketone bodies | Ketone bodies, glucose |

Figure 1 The five metabolic stages between the postabsorptive state and the near-steady state of prolonged starvation (62).



From: Kevin Hall

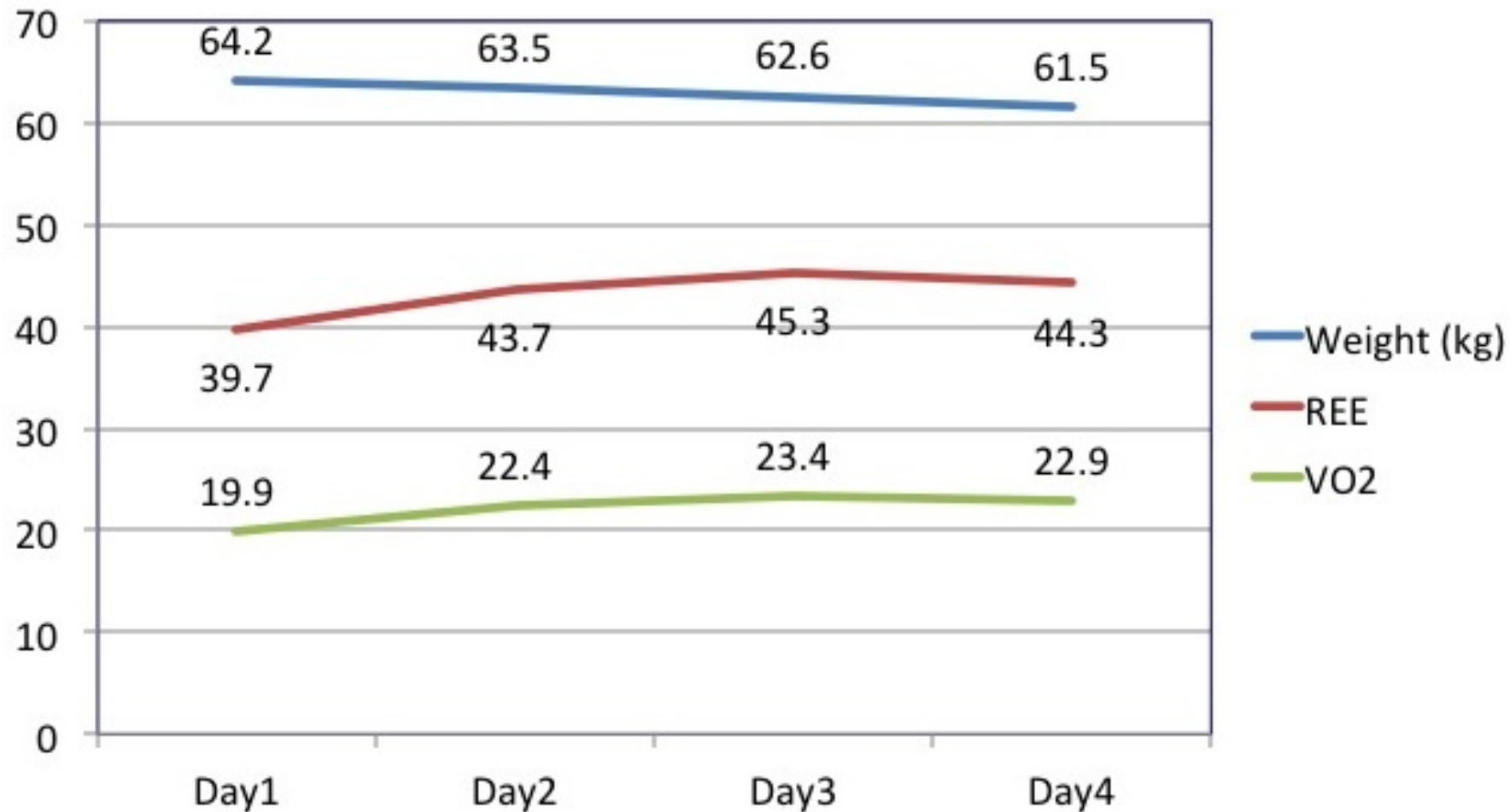
Counter-Regulatory Hormones

- Sympathetic Nervous System
- Adrenalin and Noradrenalin
- Growth Hormone
- Cortisol

Allows body to use stored energy (calories) by pushing glucose from stores into the blood (glycogenolysis)

Allows body to use body fat as energy (lipolysis)

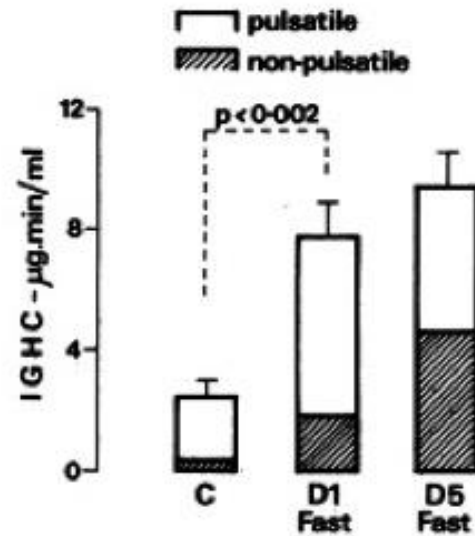
Metabolic Changes over 4 days of fasting



Zaunfer C *Am J Clin Nutr* 2000;71:1511-5.

Growth Hormone

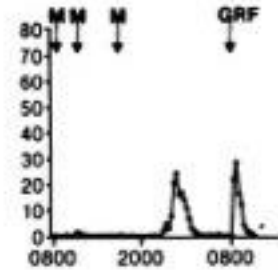
Integrated GH concentration



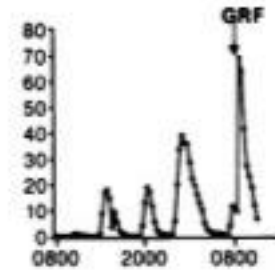
J Clin Invest. 1988 April; 81(4): 968-975
Ho KY

Fasting increases Growth Hormone

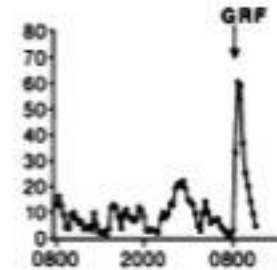
CONTROL



DAY 1



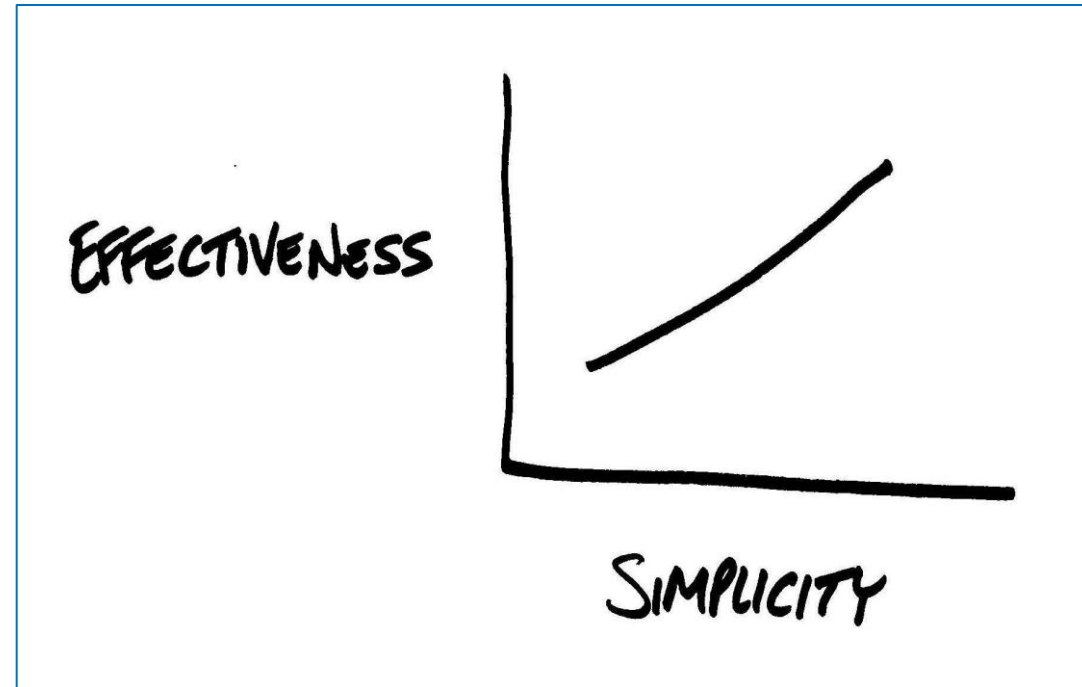
DAY 5



J Clin Invest. 1988 April; 81(4): 968-975 Ho KY

Fasting Advantages

- **Flexibility**
- **Convenience**
- **Free**
- **Simplicity**
- **Add to Any Diet**



Fasting - Conclusions



When you eat, you store energy (calories)



When you don't eat, you burn energy (calories)