Type 1 Diabetes: Navigating Nutrition Trends

November 9, 2019
Friends for Life Canada
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Disclosures

- Employee, Animas Canada (RIP)

- Always consult your diabetes care team before making any changes to your insulin dosing or management regimen.

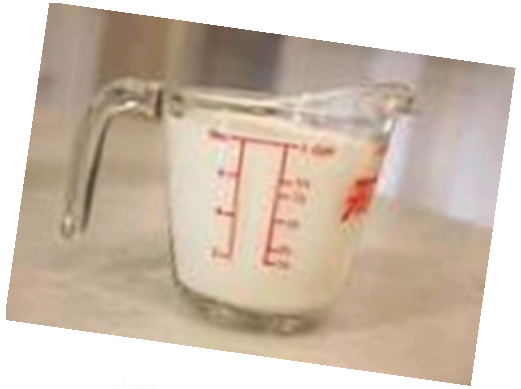
Today's Objective

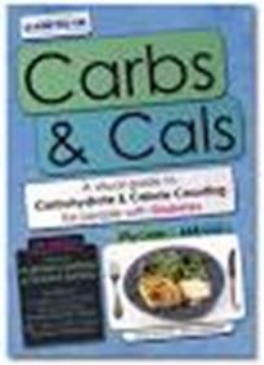
- Discuss the benefits and risks of current nutrition trends including low carb eating, ketogenic diets, food order and intermittent fasting diets in type 1 diabetes.

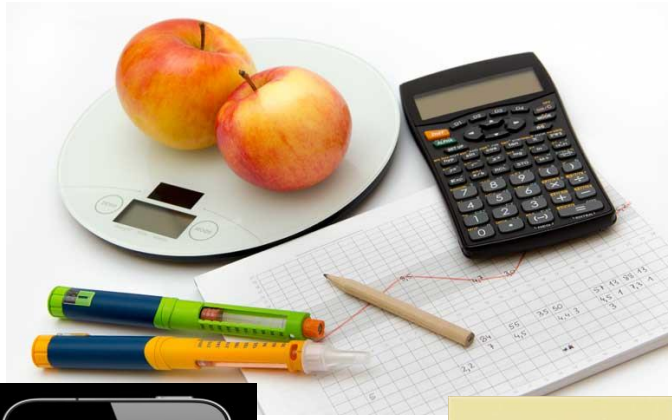
Every meal is a test….

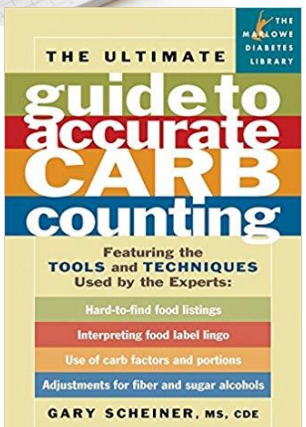
???

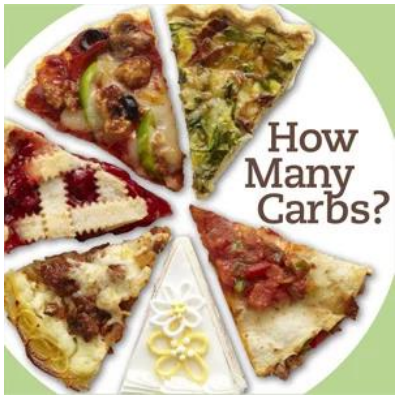
You use all of the tools….







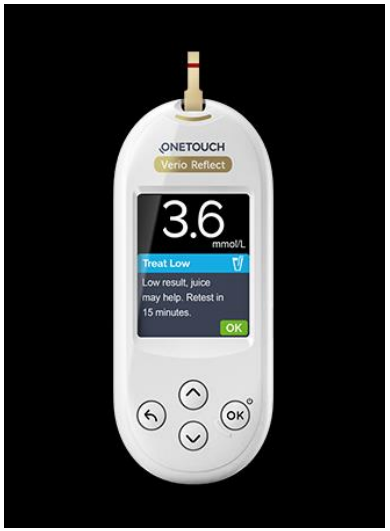




And then…


22:23
Ends in 13 days
6.2
mmol/L
14:00
18:00
22:00
FreeStyle Libre


Share
13.9
mmol/L
High Glucose Alert
Your sensor glucose reading is high.
OK


ONETOUCH
Verio Reflect
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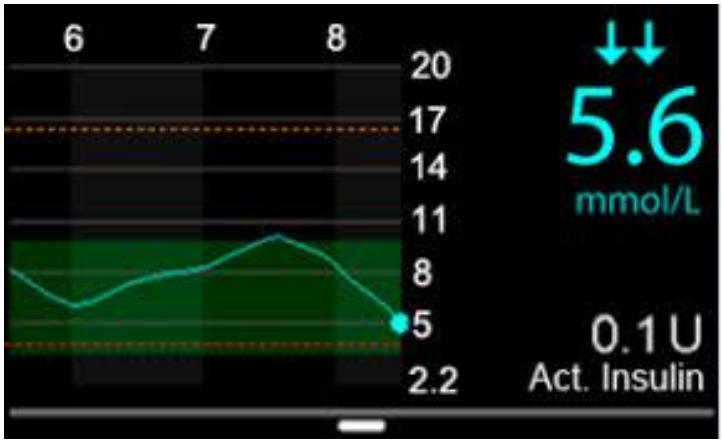
Treat Low
Low result, juice may help. Retest in 15 minutes.
OK


18.8


6
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2.2
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mmol/L
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Act. Insulin


11.2
mmol/L


3:18
AM
1
2
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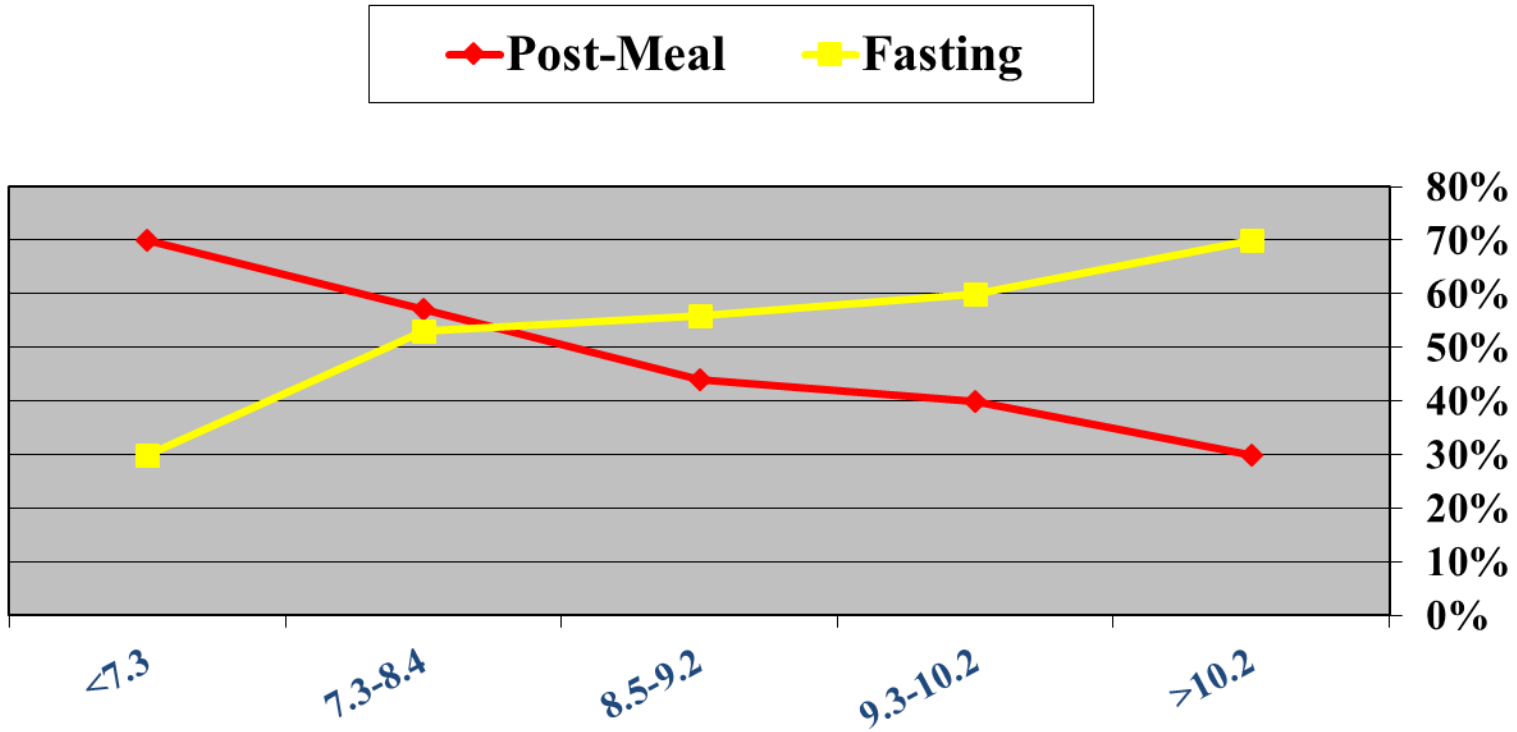
mmol/L
Act Ins.
0.10 u
Bolus
Basal

Optimizing Postprandial Glycemia

Why ?

Relative Influence on A1C



Monnier et al, Diabetes Care, 26, 3/03, 881-885

T1D – How are we doing?

Canadian data (T1/T2) 2017

- A1C 7.0 – 8.5% ≈ 30%
- A1C > 8.5% ≈ 15%

U.S. Type 1 Diabetes Exchange data 2019

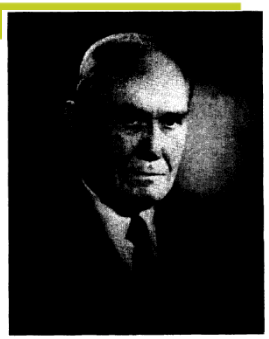
- A1C <7.5% for youth ≈ 17%
- A1C < 7.0% for adults ≈ 21%
- Pump use increased from 57% to 63%
- CGM use increased from 7% to 30%

Coons, MJ et al. BMJ Open Diabetes Res Care 2017;5:e000316
.T1D Exchange Clinic Network. Diab Tech Ther 2019; 21 (2): 1-7.

Food and Diabetes: Going back in time….

- Before the discovery of insulin
  - Life expectancy was measured in months
  - The most “successful” dietary strategy of the time **The Allen Starvation Diet** was a semi-starvation diet, which was low carb, minimal fat and protein

Frederick Madison Allen's "Starvation Diet"


FREDERICK MADISON ALLEN
1879–1964

"For forty-eight hours after admission to the hospital the patient is kept on an ordinary diet, to determine the severity of his diabetes. Then he is starved, and no food allowed save whiskey and black coffee. The whiskey is given in the coffee: 1 ounce of whiskey every two hours, from 7am until 7pm. The whiskey is not an essential part of treatment; it merely furnishes a few calories and keeps the patient more comfortable while he is being starved."

Starvation (Allen) Treatment of Diabetes (1915).

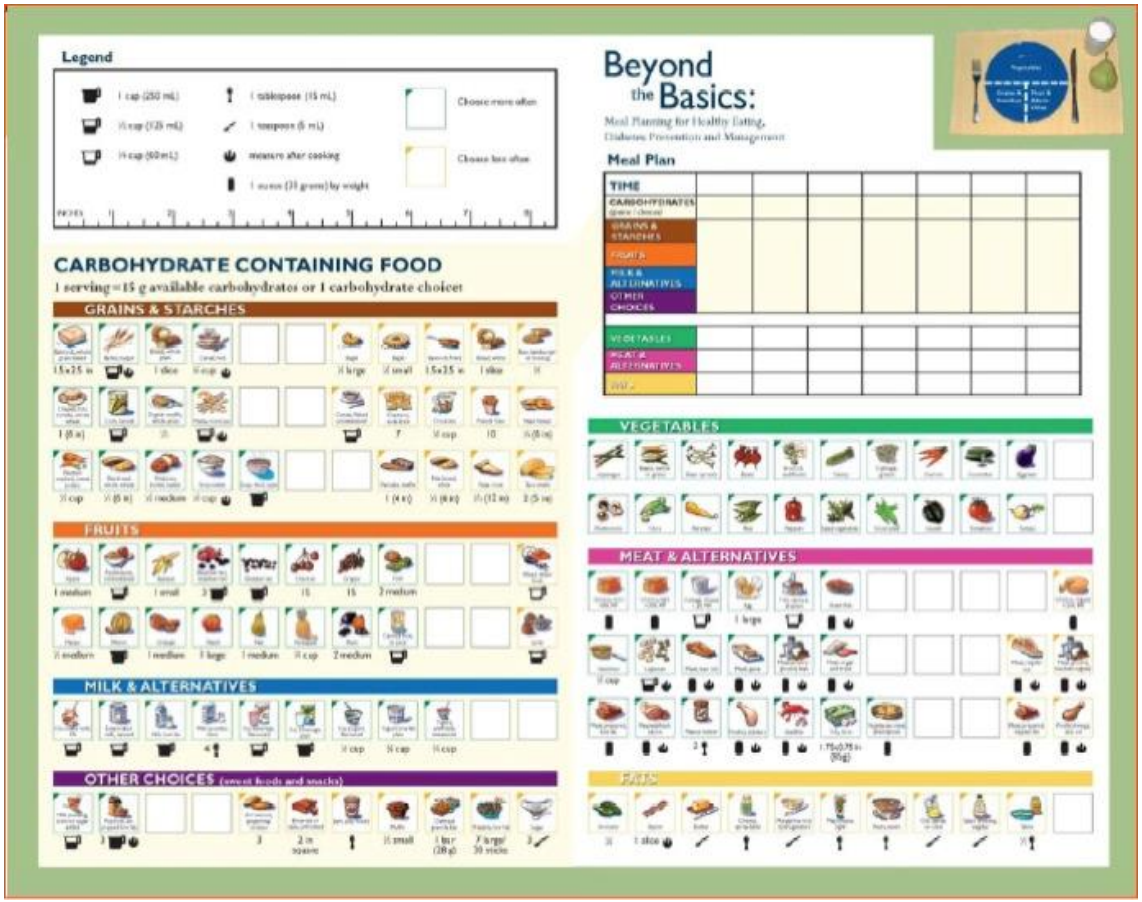
Food and Diabetes: Going back in time….

- 1922 – when insulin was discovered, the low carbohydrate diet remained as the main dietary strategy incorporating Allen's Starvation Diet
- After 1922 the recommended % of calories from carbohydrate gradually increased but restrictions on sugar persisted.
- "Exchange Diets" were developed and strict meal plans calculated (usually based on energy ie. a 7500 kJ or 1800 kcal "diabetic diet")

“Diabetic diets”

Carbohydrate Counting

- Beyond the Basics - 15g carbohydrate exchanges



In recent years

- 1990's to now – evolution of carb counting from exchange diets
- Increased dietary flexibility as fixed carb regimens replaced by insulin:carb ratio
- Recognition of impact of fat and protein on BG
- Have we focused too much on carb counting?

Carbohydrate

- Greatest impact on blood glucose (time and magnitude)
- However, carbohydrates don't affect blood glucose equally
- Some of the potential variables effecting glycemic impact:
  - Type and amount of starch (i.e. Basmati rice vs. short grain)
  - Fiber (soluble vs. insoluble)
  - Physical form of the food
  - Acidity
  - Temperature
  - Processing
  - Ripeness of fruit
  - Cooking method – degree of gelatinization i.e. al dente pasta
  - Others?

Franz M. *Carbohydrate and Diabetes: Is the Source or the Amount of More Importance?* Current Diabetes Reports 2001. 1:177-186.

The Controversy – Fad or Fiction?

Could a low-carb diet shorten your life?

10 Health Benefits of Low-Carb and Ketogenic Diets

Ignore the low-carb cult: eating lots of fat won't really make you slim

'No One Should Be Doing Keto Diet' Says Leading Cardiologist

7 Reasons You NEED to Eat Carbs

Low-Carbohydrate, High-Fat: A Controversial Diet And The Start Of A Food War

Food Pattern "Definitions"- What is low carb?

- Ketogenic: < 20 - 50 g/day
- Very low carb: 20 - 70 g/day (Atkins, South Beach)
- Low Carb: < 130 g/day (Paleo, Zone)
- Moderate Carb: 130 – 225g/day (Mediterranean, DASH)
- High Carb: > 225 g/day (Asian, vegetarian/vegan)

Feinman et al. Nutrition. 2015;31(1):1-13.

The Controversy

Diabetes is Frustrating – Kerri Sparling

Six Until Me. Posted: 07 Mar 2012 07:10 AM PST

Monday morning, I woke up at a blood sugar of 4.6mmol/L. I had a cup of coffee, half of a banana, and two scrambled eggs for breakfast. I took 2 units of Humalog insulin to cover my meal, and then spent the morning playing with Birdy and doing some writing. Two hours after eating, I was at 7.9 mmol/L.

Tuesday morning, I woke up at a blood sugar of 5.4 mmol/L. I had a cup of coffee, half of a banana, and two fried eggs for breakfast. I took 2 units of Humalog insulin to cover my meal, and then spent the morning playing with the Birdzone and answering emails. Two hours after eating, I was 15.8 mmol/L.

What. The. Eff?

Albert Einstein once said, "The definition of insanity is doing the same thing over and over again and expecting different results."

I think the definition of diabetes is doing the same thing, over and over again, and waiting to see which way the wind is blowing that day. Or maybe the definition of "insanity" is "diabetes." ;)

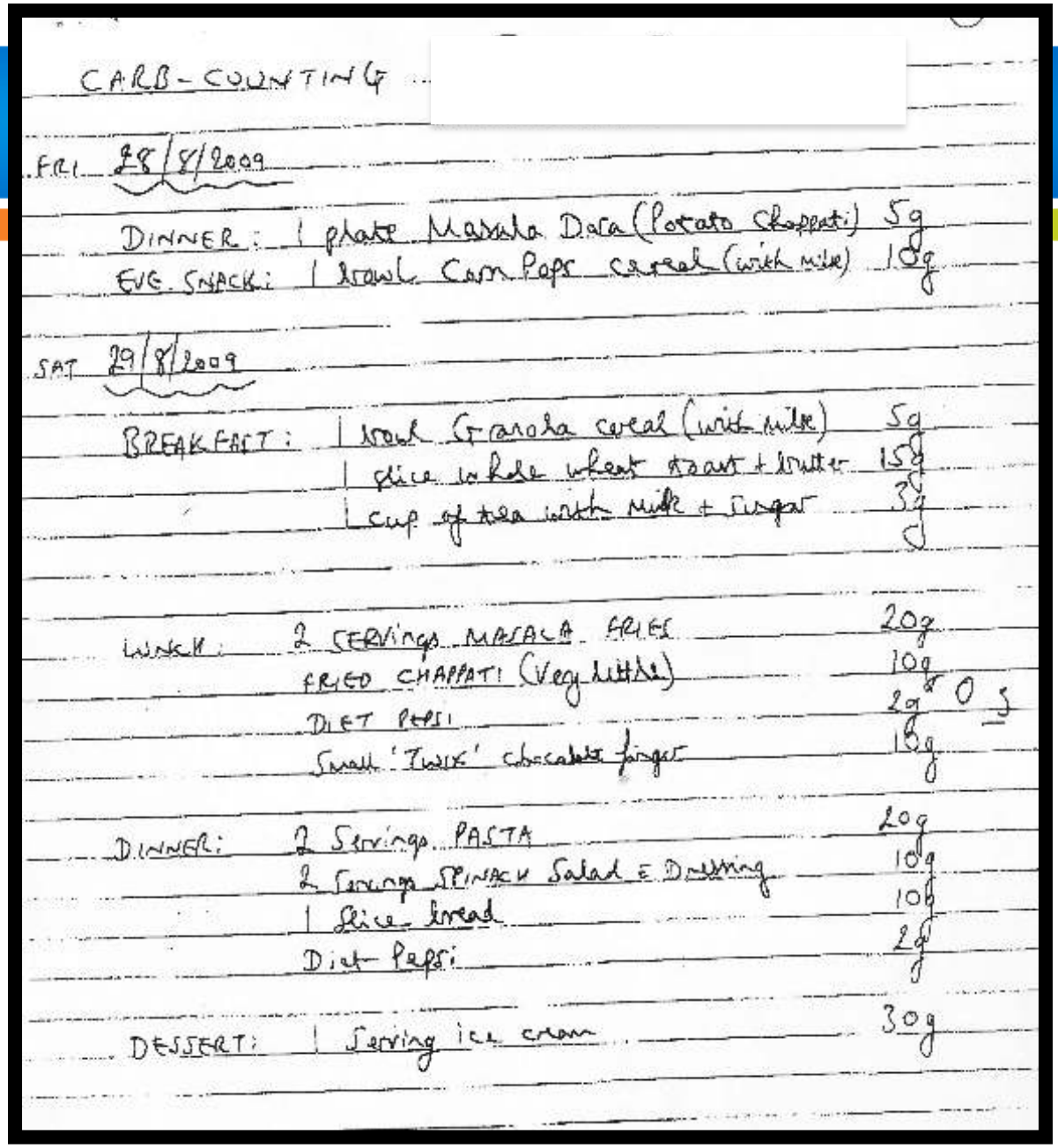
Potential Benefits of Low Carb in T1D

1. The Math – plain and simple.
   - "Big inputs make big mistakes; small inputs make small mistakes." Kanji Ishikawa, oldest surviving type 1 in Japan.

Carb Counting – How easy is it?

- Brazeau et al – 50 adults with type 1
  - Mean error of carb estimates per meal is **20%**.
  - Mean error in carb estimate was 15.4 +/- 7.8 g per meal.
  - Average carb content was 72.4 +/-34.7 g per meal
  - 63% of meals were underestimated, underestimation was more common with larger meals
  - Least errors occurred for breakfast
    - Smallest meal and most consistent

Brazeau et al. Carbohydrate counting accuracy and blood glucose variability in adults with type 1 diabetes. 2013. Diab Res Clin Prac. 99; 19-23.



CARB-COUNTING

FRI 28/8/2009

DINNER: 1 plate Masala Dosa (Potato Chappati) 5g
EVE. SNACK: 1 bowl Corn Pops cereal (with milk) 10g

SAT 29/8/2009

BREAKFAST: 1 bowl Granola cereal (with milk) 5g
1 slice whole wheat toast + butter 15g
1 cup of tea with milk + sugar 3g
0

LUNCH: 2 SERVINGS MASALA FRIES 20g
FRIED CHAPPATI (Veg Little) 10g
DIET PEPSI 2g 0 5
Small 'Twix' chocolate finger 15g

DINNER: 2 Servings PASTA 20g
2 Servings SPINACH Salad & Dressing 10g
1 Slice bread 10g
Diet Pepsi 2g

DESSERT: 1 Serving ice cream 30g

CARB COUNTING IS HARD!

Courtesy of Dr. Amish Parikh

Carbohydrate Counting

- Two “inputs” when determining meal insulin dose, both have risk of error
  - Carb counting/label accuracy[1].
    - Analysis of 11 loaves of bread revealed that the CHO content of a slice can vary up to 45% of label.
  - BG (meter/CGM accuracy)

- PLUS variability in insulin absorption, adjustment for premeal BG, activity (↑↓), alcohol, stress, high fat, high protein meals, etc.

1. Smart et al. Nutr Dietet. 2011. 68. 227-230.

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Factors That Affect BG

Food

- ↑↑ 1. Carbohydrate quantity
- →↑ 2. Carbohydrate type
- →↑ 3. Fat
- →↑ 4. Protein
- →↑ 5. Caffeine
- ↓↑ 6. Alcohol
- ↓↑ 7. Meal timing
- ↑ 8. Dehydration
- ? 9. Personal microbiome

Medication

- →↓ 10. Medication dose
- ↓↑ 11. Medication timing
- ↓↑ 12. Medication interactions
- ↑↑ 13. Steroid administration
- ↑ 14. Niacin (Vitamin B3)

Activity

- →↓ 15. Light exercise
- ↓↑ 16. High-intensity and moderate exercise
- →↓ 17. Level of fitness/training
- ↓↑ 18. Time of day
- ↓↑ 19. Food and insulin timing

Biological

- ↑ 20. Insufficient sleep
- ↑ 21. Stress and illness
- ↓ 22. Recent hypoglycemia
- →↑ 23. During-sleep blood sugars
- ↑ 24. Dawn phenomenon
- ↑ 25. Infusion set issues
- ↑ 26. Scar tissue and lipodystrophy
- ↓↓ 27. Intramuscular insulin delivery
- ↑ 28. Allergies
- ↑ 29. A higher glucose level
- ↓↑ 30. Periods (menstruation)
- ↑↑ 31. Puberty
- ↓ 32. Celiac disease
- ↑ 33. Smoking

Environmental

- ↑ 34. Expired insulin
- ↑ 35. Inaccurate BG reading
- ↓↑ 36. Outside temperature
- ↑ 37. Sunburn
- ? 38. Altitude

Behavioral & Decision Making

- ↓ 39. Frequency of glucose checks
- ↓↑ 40. Default options and choices
- ↓↑ 41. Decision-making biases
- ↓↑ 42. Family relationships and social pressures

diaTribe®

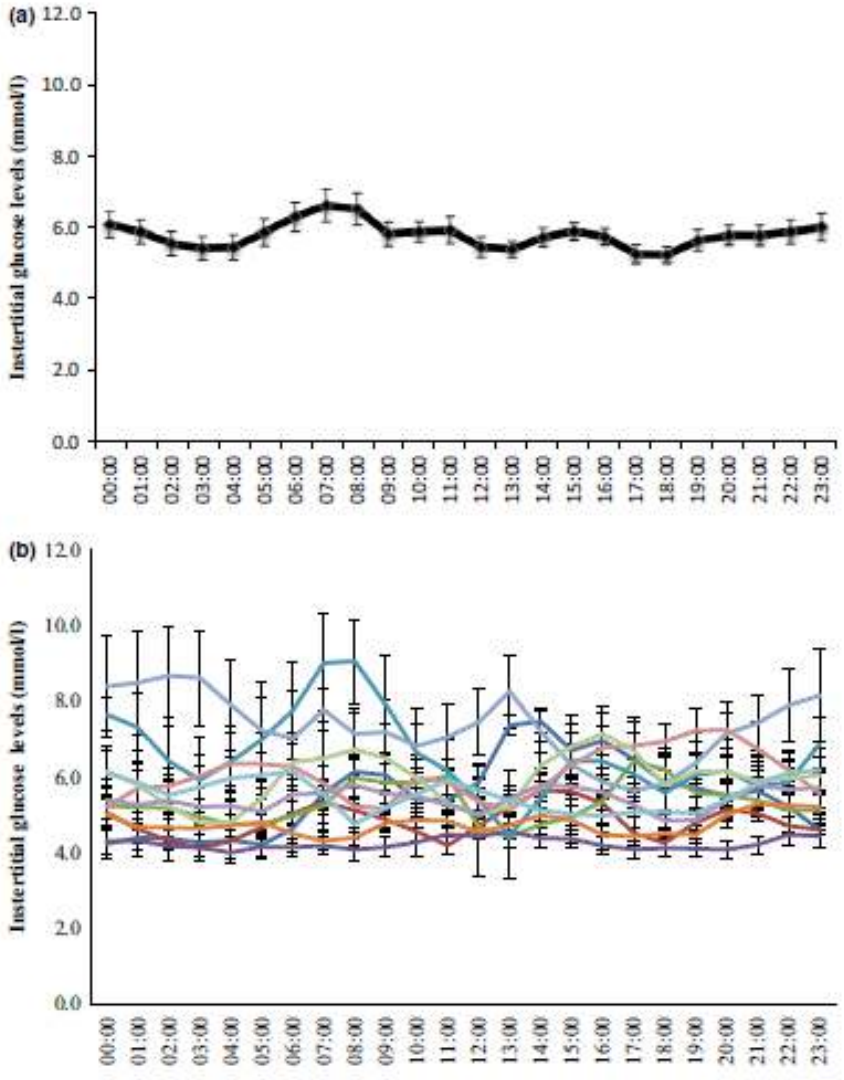
Brown, A. https://diatribe.org/42factors

Potential Benefits of Low Carb in T1D

1. "Big inputs make big mistakes; small inputs make small mistakes." Kanji Ishikawa, oldest surviving type 1 in Japan.
   - Less hypoglycemia, less hyperglycemia, more time in range
     - 20% carb counting error rate means:
       - 75g carb meal= range of 60 – 90 g carb
       - 20g carb meal = range of 16 – 24g carb

Bernstein, R.K. Dr. Bernstein's Diabetes Solution. 1997.

In Pursuit of a Smooth Line - < 55 g/day



Leows, Z et al. Diab Med. 35, 1258-63. 2018

Potential Benefits of Low Carb in T1D

1. The Math – plain and simple.
   - "Big inputs make big mistakes; small inputs make small mistakes." [1] Kanji Ishikawa, oldest surviving type 1 in Japan.
   - Less hypoglycemia, less hyperglycemia, more time in range, less variability.
2. Less insulin – YES[2]
3. Weight loss – maybe

[1] Bernstein, R.K. Dr. Bernstein's Diabetes Solution. 1997.
[2] Turton, J.L et al. (2018). PLoS ONE 13(3): e0194987

T1D and Very Low Carb Diet

- **Observational** study published *Pediatrics*, May 2018.
- Online survey of participants in TypeOne Grit (online FB group) of t1d who follow VLCD.
- 316 respondents
  - 42% were parents of a t1 child
  - Mean time following diet 2.2 +/- 3.9 yrs
  - Mean carb intake of 36 g +/- 15 g/day
  - **Mean participant A1C = 5.67 +/- 0.66%**

Lennerz, B. et al. 2018. Pediatrics; 141(6):e20173349

T1D and Very Low Carb Diet - Other findings

- Participant reported adverse events were low.
  - Low incidence of hypo
- High levels of overall health and satisfaction with diabetes management reported.
- 62% had elevated blood cholesterol.
- *27% did not discuss with health care team
- Additional research is needed.

Lennerz, B. et al. 2018. Pediatrics; 141(6):e20173349

Potential Risks of Low Carb Diets in T1D

1. **Hypoglycemia** if insulin doses are not adjusted.

Hypoglycemia

- Lower % of time <3.9 on low carb vs high carb diet
- Lower incidence of pt reported hypo however a median of 0.9 daily episodes on CGM has been reported.

- Of note, recent study compared low carb diet (<50 g/day) on response to glucagon rescue → Concluded that low carb diet impaired ability of glucagon to raise BG vs high carb diet

Seckold, R et al. Diab Med. 00: 1-9. 2018.

Potential Risks of Low Carb Diets in T1D

1. Hypoglycemia if insulin doses are not adjusted.
2. **Potential for nutrient deficiency**
    1. **Bone health**

Bones and T1D

- Type 1 diabetes appears to affect the structure of bone by decreasing bone mineral density[1]
- Nearly 20% of T1D's between the ages of 20–56 yrs meet the criteria for being osteoporotic.
- Women with type 1 diabetes were 12.25 times more likely to report an incident hip fracture than women without diabetes.[2]
- The ketogenic diet data for epilepsy raises definite concerns
- Requires full evaluation and monitoring

[1]Ther Adv Musculoskelet Dis. Diabetes and Bone Health: latest evidence and clinical implications. 2017 Mar; 9(3): 67–74. 2Nicodemus and Folsom, Diabetes care 2001. Data provided by Dr. Martin de Bock 2018

Potential Risks of Low Carb Diets in T1D

1. Hypoglycemia if insulin doses are not adjusted.
2. Potential for nutrient deficiency
    1. Bone health
    2. **Vitamins/minerals**

Vitamins & Minerals

- High risk of nutrient deficiency
- One study showed that in order to meet 100% of the RDI of 27 micronutrients on Atkins diet, need to eat **37,500** calories.
- Nutrients of greatest concern:
  - Thiamine, Folic acid, Vitamin C, IRON*

→ Need for vitamin/mineral supplementation.

Carlton, J of Int Soc of Sports Nutrition 2010, 7; 24.

Iron

- High-fat diet can cause iron deficiency[1]
- 3 out of 7 men on VLCD had low hemoglobin[2]

1. Sonnweber et al, J Nutr Biochem 2012
2. Leow et al, Diabetic medicine 2018

Potential Risks of Low Carb Diets in T1D

1. Hypoglycemia if insulin doses are not adjusted.
2. Potential for nutrient deficiency
    1. Bone health
    2. Vitamins/minerals
    3. Iron
3. **Cholesterol**

Cholesterol

- Western Australian adults (n=11)
- Raised total cholesterol 82%
- Raised LDL cholesterol 82%
- Raised total cholesterol/HDL ratio 64%
- Raised TGs 27%
- BUT….???

Leow et al, Diabetic medicine 2018

Potential Risks of Low Carb Diets in T1D

1. Hypoglycemia if insulin doses are not adjusted.
2. Potential for nutrient deficiency
    1. Bone health
    2. Vitamins/minerals
    3. Iron
3. Cholesterol
4. **Long term adherence may be a challenge**

Can it be followed long term?

- Studies rely on self- reported data!

- Few studies report on actual intake vs adherence
  - 1 study of 50-75g/d → actual intake at 12 wks was 103g (motivated group, intensive support by team)
- 1 long term study reported a 52% drop out rate after 2 years on very low carb diet

Seckold, R et al. Diab Med. 00: 1-9. 2018.
Neilson, J et al. Diab & Met Syn 2012, 4:23.

Potential Risks of Low Carb Diets in T1D

1. Hypoglycemia if insulin doses are not adjusted.
2. Potential for nutrient deficiency
    1. Bone health
    2. Vitamins/minerals
    3. Iron
3. Cholesterol
4. Long term adherence may be a challenge – 1 long term study reported a 52% drop out rate after 2 years on VLCD
5. **Pre-occupation with food**

Does this look familiar?

The “Dieting” Cycle

Results – Incidence of Eating Disorders

Psychiatric Disorder	Comparison Cohort N (6,192)	T1D Cohort N (1,282)	aHR (95% CI)
Affective disorders	163	92	2.95 (2.3,3.8)
Anxiety disorders	245	119	2.5 (2.0,3.1)
Eating disorders	13	13	5.06 (2.3,10.9)
Personality and behaviour disorders	36	17	2.43 (1.4,4.3
Schizophrenia and psychosis disorders	58	9	0.81 (0.4,1.6)
Substance dependence disorders	54	12	1.15 (0.6,2.2)
Any of the above	**400**	**187**	**2.46 (2.1,2.9)**

aHR – Adjusted Hazard Ratio (95% Confidence Interval)

from right censored Cox proportional hazard model additionally adjusted for birth year

Cooper et al, Pediatric Diabetes 2016

What is a Ketogenic Diet?

- A dietary pattern that induces the metabolic state of ketosis.

- **Ketosis:** normal metabolic process whereby the body uses fat for energy instead of carbohydrates.

  - Induced by:
    - Low dietary carbohydrates (typically <50 g/day)
    - Prolonged exercise
    - Fasting

Kanikarla-Marie, P. et al. Hyperketonemia and ketosis increase the risk of complications in type 1 diabetes. Free Rad Biol Med. 2016; 95: 268-277.

Blood levels during a Normal diet, Ketogenic diet and Diabetic Ketoacidosis (DKA)

Blood Levels	Normal Diet	Ketogenic Diet	Diabetic Ketoacidosis
Glucose (mmol/L)	4.0 – 7.0	3.6 – 4.4	> 16.7
Ketones (mmol/L)	0.1	1.5 – 3.0 – early stages 6.0 – 8.0 – later stages	> 25
pH	7.4	7.4	< 7.3

Adapted from: Paoli, A. et al. EJ Cl Nutr. 2013. 67, 789 -796.

What are the Potential Risks specific to T1 and KD?

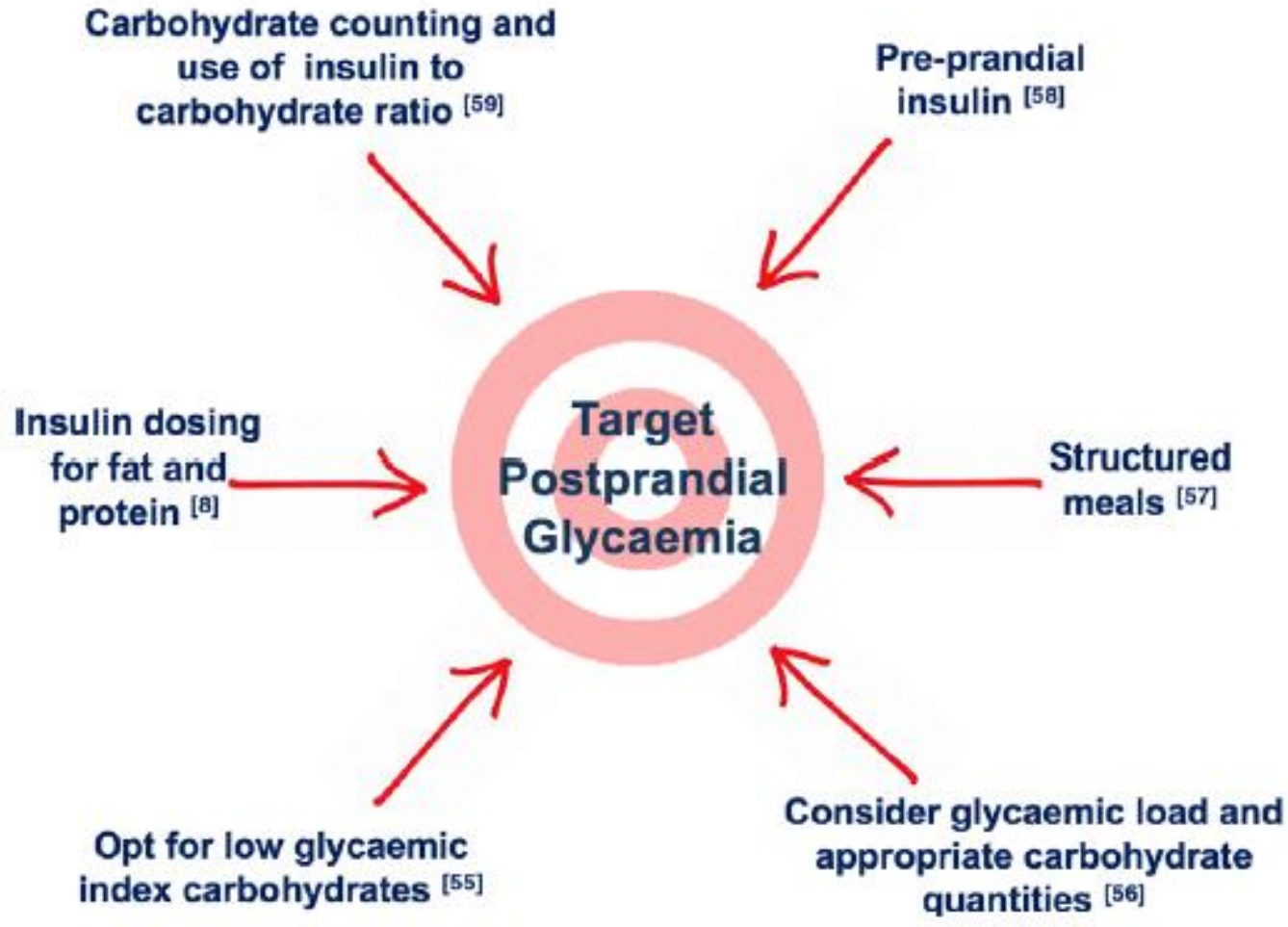
- In addition to the risks already discussed with respect to low carb diets:
  1. **Risk of DKA** – illness, dehydration, insulin sensitive.
  2. Diabetes complications
  3. Others not specific to T1

Kanikarla-Marie, P. et al. Hyperketonemia and ketosis increase the risk of complications in type 1 diabetes. Free Rad Biol Med. 2016; 95: 268-277.

The Bottom Line

- T1D: Back to the Future?
- PUT **SAFETY** FIRST
  - Involve your health care team
  - Insulin doses will likely need adjustment
  - Ensure proper monitoring is done
  - Discuss potential need for supplementation
  - Any time you feel unwell, check ketones
- We need **RESEARCH** in this area.

Strategies to Minimize Postmeal Spikes



Seckold, R et al. Diab Med. 00: 1-9. 2018.

What about Fat and Protein?

Impact of Fat & Protein

Fat[1,2]	Protein[3]
• Reduces *early* postmeal responses • Delays stomach emptying • Decreases insulin sensitivity • Minimal fat converted to glucose (<10%) • May last for hours after eating	• In large amounts, causes a late & sustained rise in BG Possible mechanisms: • Increased glucagon secretion • Gluconeogenesis
Result: delayed hyperglycemia	

1. Bell et al. J Diabetes Complication. 2015; 29(8): 1323–1329.
2. Wolpert et al. Diabetes Care. 2013; 36: 810-816.
3. Paterson, M.A. et al. Diabet Med. 2015 Oct 26.

ORIGINAL ARTICLE

Dietary Fat Acutely Increases Glucose Concentrations and Insulin Requirements in Patients With Type 1 Diabetes

Implications for carbohydrate-based bolus dose calculation and intensive diabetes management

HOWARD A. WOLPERT, MD[1,2]
ASTRID ATAKOV-CASTILLO, BA[1]
STEPHANIE A. SMITH, MPH[1]
GARRY M. STEIL, PHD[2,3]

OBJECTIVE—Current guidelines for intensive treatment of type 1 diabetes base the mealtime insulin bolus calculation exclusively on carbohydrate counting. There is strong evidence that free fatty acids impair insulin sensitivity. We hypothesized that patients with type 1 diabetes would require more insulin coverage for higher-fat meals than lower-fat meals with identical carbohydrate content.

RESEARCH DESIGN AND METHODS—We used a crossover design comparing two 18-h periods of closed-loop glucose control after high-fat (HF) dinner compared with low-fat (LF) dinner. Each dinner had identical carbohydrate and protein content, but different fat content (60 vs. 10 g).

RESULTS—Seven patients with type 1 diabetes (age, 55 ± 12 years; A1C 7.2 ± 0.8%) successfully completed the protocol. HF dinner required more insulin than LF dinner (12.6 ± 1.9 units vs. 9.0 ± 1.3 units; $P = 0.01$) and, despite the additional insulin, caused more hyperglycemia (area under the curve >120 mg/dL = 16,967 ± 2,778 vs. 8,350 ± 1,907 mg/dL·min; $P < 0001$). Carbohydrate-to-insulin ratio for HF dinner was significantly lower (9 ± 2 vs. 13 ± 3 g/unit; $P = 0.01$). There were marked interindividual differences in the effect of dietary fat on insulin requirements (percent increase significantly correlated with daily insulin requirement; $R^2 = 0.64$;

patients with type 1 and type 2 diabetes have shown that dietary fat delays gastric emptying, leading to a lag in glucose absorption (7,8). Although there has been considerable interest in the role of dietary fat and circulating FFAs in the pathogenesis of type 2 diabetes (9,10), relatively little attention has been given to the possible implications of FFA-induced insulin resistance for the treatment of type 1 diabetes. Review of continuous glucose monitoring and food log data from our adult patients with type 1 diabetes led to the observation that, contrary to the current treatment recommendations, higher-fat meals usually require more insulin coverage than lower-fat meals with similar carbohydrate content.

Pizza is widely recognized to cause

Dietary fat and T1D

- HF dinner increased mean insulin requirement 42% (n=7)
- Marked inter-individual responses (-17% to 108%)
- Dietary fat intake is an IMPORTANT consideration for type 1's striving for tight control.

Wolpert et al. *Diabetes Care.* April 2013; 36: 810-816.

Both Dietary Protein and Fat Increase Postprandial Glucose Excursions in Children With Type 1 Diabetes, and the Effect Is Additive

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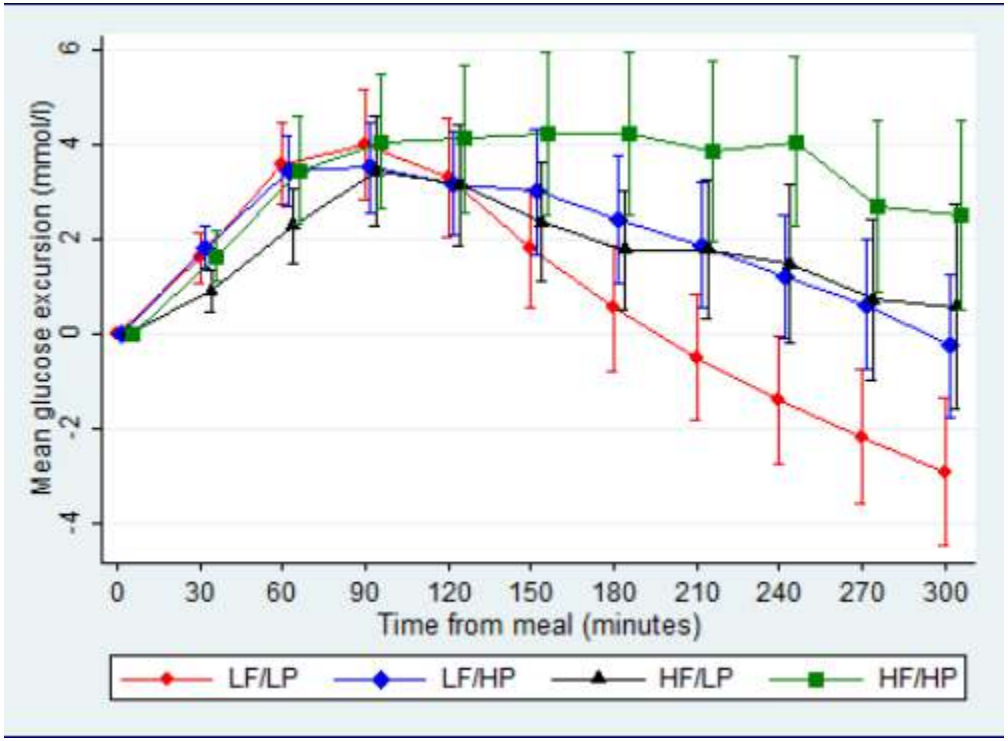
Elizabeth A. Davis, MD, PHD[3,4,6]
Bruce R. King, MD, PHD[3,5]



High fat, high protein

High fat, low protein

Low fat, high protein

Low fat, low protein

The 'Warsaw School of Insulin Pump Therapy Program' for dosing mealtime insulin

"Fat and Protein Unit (FPU)":

- 1 FPU = 100 kcal of fat and/or protein = 10 g "carb equivalents"

How to dose insulin:

1. Normal bolus for carb using ICR +
2. Square wave/extended bolus for FPU using ICR

1 FPU	3 hrs
2 FPU	4 hrs
3 FPU	5 hrs
4 + FPU	8 hrs

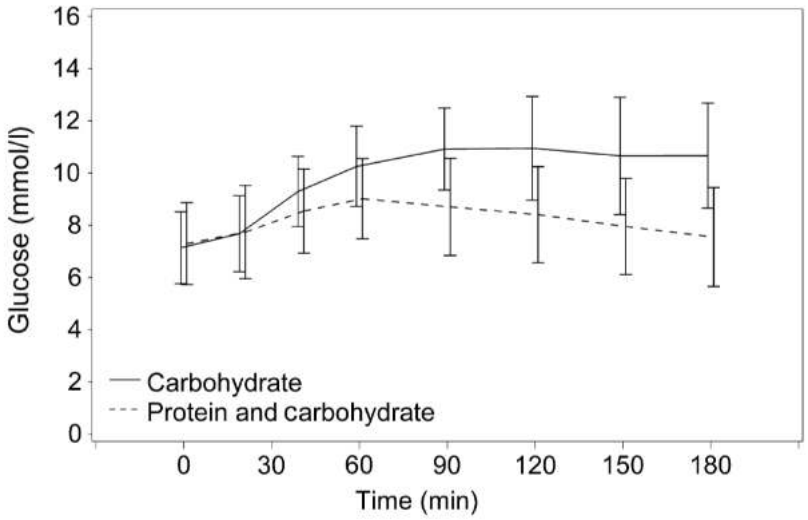
Example. Hot dog: 30 g CHO, 16 g PRO, 28 g FAT, ICR = 1:10g

- 30g CHO/10 (ICR) = 3U normal bolus
- 16g protein x 4 kcal/g = 64 kcal
- 28g fat x 9 kcal/g = 252 kcal
- = 316 kcal from fat/pro

- 316 kcal = 3 FPU's = 30 g "carb"
- 30g/10 (ICR) – 3U square wave/extended bolus over 5 hrs.

Pankowska et al. *Pediatric Diabetes.* 2009; 10(5): 298-308.

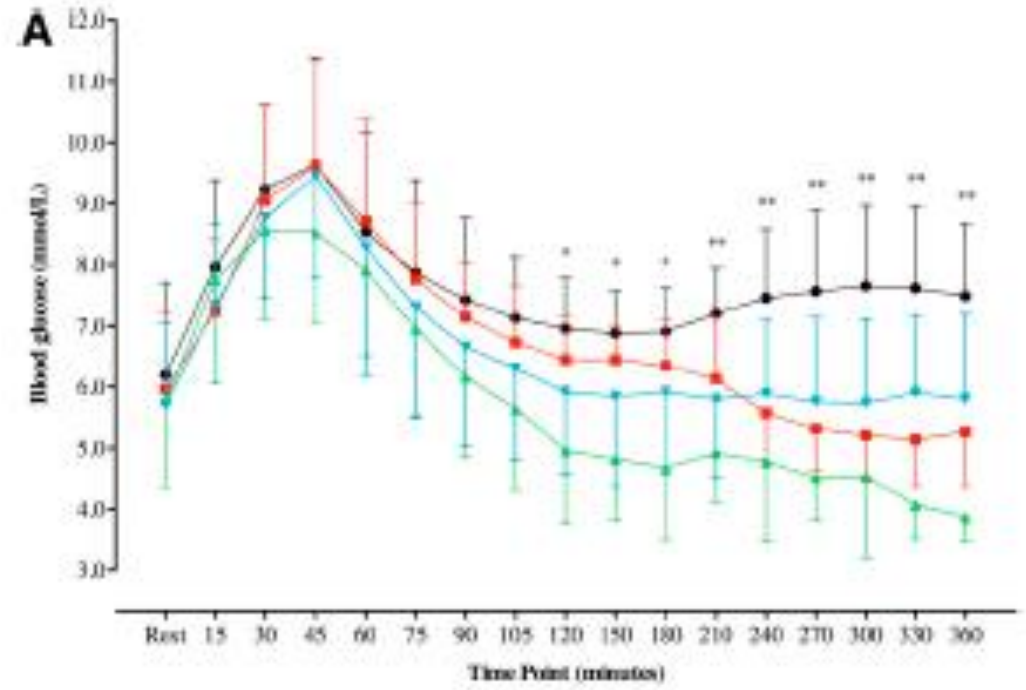
Using an Insulin:Protein Ratio for Low Carb Diet



- 16 t1d on pump/MDI
- LCD (<100g/d)
- Milkshake 14g carb, 2g fat, 40g pro
- Gave bolus based on 1) carb counting OR 2) carb plus pro counting
- Pro ratio calculated as ½ ICR (ie. if ICR = 1:10g then I:PRO = 1:20g)

Krebs, J et al. Diabetes Obes Metab. 2018;20:2486-2489.

MDI Dosing Strategies for High Fat Meals



Black = High Fat 100%

Blue = Low Fat 100%

Red = High Fat Split

Green = High Fat 130%

Campbell, M et al. Diabetes Care 2016;39:e141-e142

Where to Start with Dosing for Higher Fat Meals:

1. Calculate insulin dose based on carb and I:C ratio. Then add + 20 - 30%.
2. Deliver over 2-3 hours.
3. Distribution of bolus, depends on carb type. If pizza/pasta: start with 30% up front.
4. Consider dose reduction if exercise preceding higher fat meal or alcohol with meal.
5. Re-evaluate, re-evaluate, re-evaluate.

Wolpert, H. 2017 AADE Insulin dosing for fat and protein in type 1 diabetes.

Proposed Strategies for Fat and Protein Dosing

1. Fat Protein Units (100 kcal ≈ 10 g “carb” – extended)
   - Hypoglycemia?
2. Protein Counting and Dosing using ½ I:C ratio
3. Regular Insulin?
4. Closed Loop control

Food Order and Children with Type 1

- 20 kids, age 7-17yrs.
- Standard meal: **54g carb, 22g protein, 9g fat** consisting of 2 slices brown bread, 1 T jam, cheese, turkey breast and 150mL of OJ.
- Two visits – 2nd visit with cheese/turkey first, 15 min later carb foods.
- Insulin given 10 min prior to meal for both meals.

Faber et al. Pediatr Diabetes. 2018; 19: 809-815.

Food Order and Children with Type 1

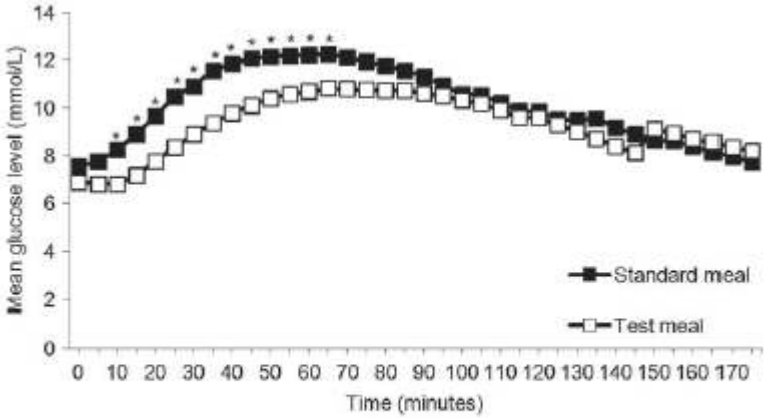


FIGURE 2 Mean glucose levels at 5-minute intervals for standard and test meals. *$P < .05$

- Mean glucose levels 1 mmol/L lower after test meal.
- Less time BG > 10 mmol/L and > 12 mmol/L
- Mean BG 1.5 mmol/L lower at 30 min.

- Rise in gut hormone GLP-1 with protein/fat preload
  - ↓ glucagon response
- Delayed gastric emptying
- GLP-1 levels in t1d did not differ from healthy control subjects
- Time between insulin dose and end of meal > test meal
- **Simple and no safety risks or side effects!**

Faber et al. Pediatr Diabetes. 2018; 19: 809-815.

What is Intermittent Fasting?

- An “eating pattern” that cycles between periods of fasting and eating.
  - Doesn’t specify WHAT you should eat just WHEN
  - Various forms (ie. 5:2, 16/8, eat-stop-eat)
- Health benefits have been found in type 2’s who manage without diabetes medication.
  - Weight loss though non-superior
  - Improvements in insulin sensitivity
  - No clinical trials on CVD, observational studies have shown risk reductions

What is Intermittent Fasting?

- Risks → Hypoglycemia if on meds, protein/vit/min malnutrition, risk of dehydration, insufficient energy (nausea, dizziness, headache, weakness, hunger)
- Caution with any chronic disease esp diabetes
- No for pregnancy, young children, older adults, immunodeficiencies, ED, dementia, others +++

What about Intermittent Fasting and Type 1?

- Involve your health care team
- Insulin doses will need to be adjusted
  - Begin with 10% basal rate reduction on pump and adjust from there
  - May need 30-50% less basal on MDI
  - Meal boluses based on carb consumed

- Bottom Line → Few, small human studies to date.
- Benefits and risks not known and benefits may take months to years to be realized.

The day to day realities….

Received on Tuesday March 18th, 2016

"Hi Lorraine, Are you still coming to the Tues. April 29 meeting as our guest speaker on Pump Tips and Tricks? I was in Mississauga yesterday and saw _____ from the Trillium Centre. **Our group is going to the JDRF dinner at Boston Pizza in May. I never eat there...too many carbs, fats and calories!!!!** _____ said to go and enjoy. It's a treat dinner."

Boston Pizza Lasagna

FOOD ITEM	NOTE	GRAMS PER SERVING	CALORIES	TOTAL FAT	SATURATED FAT	TRANS FAT	CHOLESTEROL	SODIUM	CARBO HYDRATE	PROTEIN
BOSTON'S SMOKY MOUNTAIN SPAGHETTI AND MEATBALLS		1096g	1730	63g	29g	0.5g	150mg	2750mg	218g	78g
HOMESTYLE LASAGNA*		554g	890	49g	23g	0.5g	190mg	2170mg	62g	57g
BOSTON'S LASAGNA*	FULL ORDER	629g	760	23g	11g	0.4g	70mg	1930mg	104g	38g
	HALF ORDER	346g	370	13g	5g	0.2g	35mg	870mg	48g	17g
BAKED SEVEN CHEESE RAVIOLI	FULL ORDER	355g	490	27g	15g	0.5g	90mg	880mg	34g	29g
Does not include sauce	HALF ORDER	179g	140	4.5g	1.5g	0g	15mg	710mg	19g	7g
CHICKEN AND MUSHROOM FETTUCCINI	FULL ORDER	780g	1200	51g	19g	0.4g	140mg	1650mg	138g	50g
	HALF ORDER	411g	720	40g	12g	0.2g	70mg	820mg	70g	25g
JAMBALAYA FETTUCCINI	FULL ORDER	860g	1440	71g	16g	0.2g	160mg	3140mg	139g	62g
	HALF ORDER	452g	840	49g	10g	0.1g	80mg	2010mg	70g	31g
TUSCAN LINGUINI	FULL ORDER	780g	1060	29g	5g	0g	0mg	2690mg	170g	38g
Whole wheat pasta	HALF ORDER	404g	470	9g	1.5g	0g	0mg	980mg	82g	18g
BAKED CHIPOTLE BACON PENNE		760g	1430	88g	39g	1.5g	195mg	2760mg	114g	55g
PESTO CHICKEN PENNE		695g	1210	48g	12g	0.4g	135mg	3430mg	136g	68g
BAKED TACO BEEF PENNE		631g	810	22g	6g	0.4g	55mg	1820mg	119g	37g
SEAFOOD FETTUCCINI		956g	1060	26g	15g	0.5g	135mg	2070mg	147g	57g
SMOKED MEAT PASTA*		683g	870	16g	5g	0.1g	80mg	1960mg	139g	43g
Gourmet Pastas above served with:	GARLIC TOAST (1 SLICE)	56g	180	6g	2.5g	0g	10mg	330mg	27g	5g
POLLO POMODORO LINGUINI		456g	510	11g	2.5g	0g	25mg	820mg	73g	30g
Whole wheat pasta										

http://www.bostonpizza.com/assets/unmanaged/nutritional-information-en.pdf

Boston Pizza Lasagna

Susan has an I:C Ratio of **1:10g** and is having 1 order of the lasagna.

- CHO: 62g
- Fat: 49g x 9 kcal/g = 441 kcal
- Protein: 57g x 4 kcal/g = 228 kcal
- **TOTAL: 669 kcal → 6 FPUs** → equivalent to 60g additional 'carbs'

Insulin Dose:

- **Normal Bolus:** 62/10 → 6.2 units
- **Extended Bolus:** 60 /10 → 6.0 units over 8h

The Bottom Line

- Postmeal BG is an important component of diabetes management.
- Focus on strategies to minimize postmeal spikes.

The Bottom Line

- Focus on strategies to minimize post meal spikes
  - Choose lower GI, high quality carbs
  - Count carbs and use insulin to carbohydrate ratio
  - Pre-bolus and/or eat veg/protein first
  - Consider insulin dosing for protein and fat
  - Talk to your diabetes team about the best strategies for you and your diabetes.

The Bottom Line

- Postmeal BG is an important component of diabetes management.
- Focus on strategies to minimize postmeal spikes.
- Poor quality eating habits are not beneficial for health.
- Food is more than a collection of nutrients.
- We need research in this area.

CHOICE and T1D – Final Thoughts

- We don’t have a choice as to whether we take insulin or not.
- We DO have CHOICE when it comes to:
  - How we take insulin
  - How we monitor our blood glucose
  - How we choose to eat

- Everyone’s diabetes is DIFFERENT.

Thank you! Questions?

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416-303-0996

Suggested Monitoring for Children and VLCD

Theme	Specifics	Frequency
Counselling	Discuss any problematic hypoglycaemia*	Baseline, then 3-monthly*
	Identify potential psychosocial barriers to the use of very-low-carbohydrate diet	Baseline, then 3-monthly*
Nutritional evaluation (registered dietitian)	Weight, height and ideal weight for stature, height velocity, BMI.	Baseline, then 3-monthly*
	Review appropriateness of meal plan (calories, protein, fibre and fluid)	Baseline, then 3-monthly*
	Review need for vitamin and mineral supplementation (particularly iron, calcium, B vitamins) based on dietary reference intake guidelines	3 baseline, then monthly*
	Assess adherence to meal plan and management of social situations including school, parties and sleepovers as the child grows	3-monthly*
Medical evaluation (endocrinologist)	Glycaemia and insulin dosing*	Baseline, then 3-monthly*
	Efficacy of diet: is the very-low-carbohydrate diet meeting parental expectations?	3 monthly*
Laboratory assessment	Complete blood count with platelets	Baseline, then after 3 months, then annually*
	Electrolytes to include serum bicarbonate, total protein, calcium, magnesium and phosphate	Baseline, then after 3 months, then annually*
	Serum liver and kidney profile (including albumin, AST, ALT, blood urea nitrogen, creatinine)	Baseline, then after 3 months, then annually*
	Fasting lipid profile	Baseline, then after 3 months, then annually*
	Urine analysis	Baseline, then after 3 months, then annually*
	Urine calcium and creatinine	Baseline, then after 3 months, then annually*
Ancillary	Renal ultrasonography	Baseline, then annually*
	Bone mineral density (DEXA scan)	Baseline, then annually*

ALT, alanine aminotransferase; AST, aspartate aminotransferase; DEXA, Dual energy x-ray absorptiometry.
*Added to the original recommendation from Kossof *et al.* [54].

Seckold, R et al. Diab Med. 00: 1-9. 2018.