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Research Article

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A Study of Postprandial Plasma Glucose Changes, Including Glucose Fluctuations, among three Time Periods Using GH-Method: Math-Physical Medicine (No. 439)

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Abstract

The author uses a continuous glucose monitoring sensor device (CGMS) to collect his glucose data at 15-minute time intervals from 5/5/2018 to 4/21/2021 which contains 1,074 breakfasts. He selects three similar time periods with equal number of breakfasts of 164 for each period. The first period is Case A from 11/8/2018 to 4/20/2019, and without any fasting days. The second period is Case B from 11/8/2019 to 4/20/2020, and also without any fasting days. The third period is Case C from 11/8/2020 to 4/20/2021, but with 115 fasting days (70% of intermittent fasting, drinking tea only as his breakfast). The first two non-fasting periods, Case A and Case B have normal breakfasts.

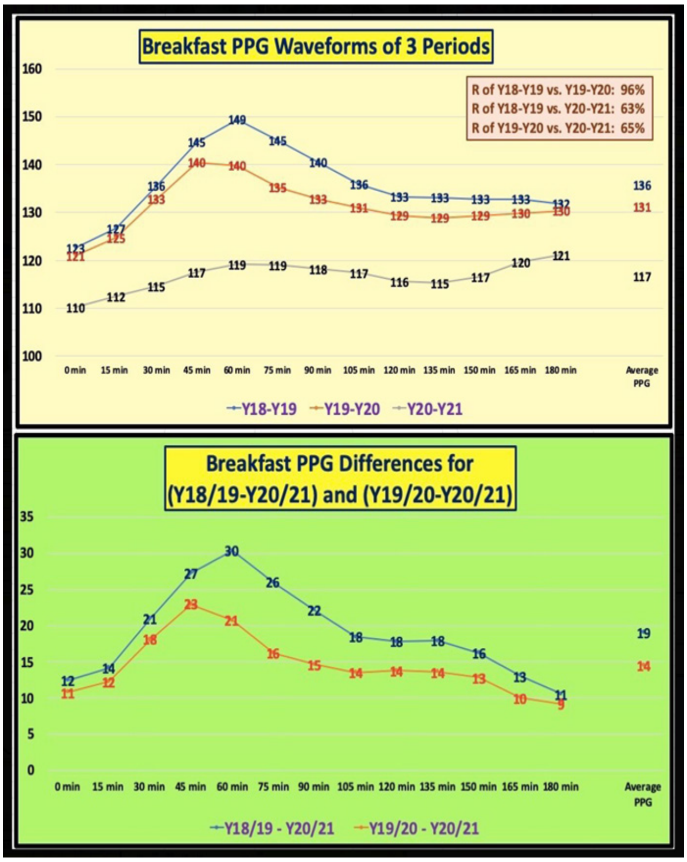
This specific study includes two investigations. The first part examines the changes on his postprandial plasma glucoses (PPG). The second part analyzes PPG wave fluctuations i.e., glycemic variability (GV) or glucose fluctuations (GF).

The objective of this study is to explore any significant differences on his PPG magnitude, and his GF between Case C versus both Case A and Case B.

The key conclusion is that the Case C (with 70% of IF influences) has indeed shown significant differences versus those two selected non-IF Case A and Case B in regard to breakfast PPG, daily PPG, daily glucose (eAG), and body weight. Even the averaged breakfast glucose fluctuation of Case C (11 mg/dL) is significantly less than those two Non-IF cases (19 mg/dL for Case B and 27 mg/dL for Case A). However, in terms of Case C's daily glucose GF (~95 mg/dL) and PPG GF (~44 mg/dL), the Case C has demonstrated comparable GF values as both Case A and Case B.

His previous conclusion from his paper No. 438 (Reference 33) was that the IF case did not show any significant differences from the two selected non-IF cases in regard to PPG, daily glucose, and body weight. But now inserting above findings from this particular study's paper No. 439, his combined and modified conclusions are that the If effect on our body, both Glucose, Weight, and internal organ impact, is a "longer-term" concerning factor. We ought to be ultra-careful about drawing any conclusion quickly from a short time period with a limited amount of data. In addition, the overall lifestyles has a direct impact on medical conditions which out to be included in the IF study as well. For example, in comparison, Case A has the worst outcomes and Case C has the best outcomes while Case B is in the middle. This observation can be verified through his carbs/sugar intake amounts and body weights.

Introduction



The author uses a continuous glucose monitoring sensor device (CGMS) to collect his glucose data at 15-minute time intervals from 5/5/2018 to 4/21/2021 which contains 1,074 breakfasts. He selects three similar time periods with equal number of breakfasts of 164 for each period. The first period is Case A from 11/8/2018 to 4/20/2019, and without any fasting days. The second period is Case B from 11/8/2019 to 4/20/2020, and also without any fasting days. The third period is Case C from 11/8/2020 to 4/20/2021, but with 115 fasting days (70% of intermittent fasting, drinking tea only as his breakfast). The first two non-fasting periods, Case A and Case B have normal breakfasts.

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Methods and Results

MPM Background

To learn more about his developed GH-Method: math-physical medicine (MPM) methodology, readers can read the following three papers selected from the published 400+ medical papers.

The first paper, No. 386 (Reference 1) describes his MPM methodology in a general conceptual format. The second paper, No. 387 (Reference 2) outlines the history of his personalized diabetes research, various application tools, and the differences between biochemical medicine (BCM) approach versus the MPM approach. The third paper, No. 397 (Reference 3) depicts a general flow diagram containing ~10 key MPM research methods and different tools.

Input Data for This Study

During the total period from 5/5/2018 to 4/20/2021, he further segregated his collected glucose data into three specific separate groups:

Case A (Non-IF):
164 days between 11/8/2018 and 4/20/2019
Case B (Non-IF):
163 days between 11/8/2019 and 4/20/2020
Case C (70% of IF):
164 days between 11/8/2020 and 4/20/2021

It should be pointed out that his Case C includes lower body weight and glucoses through a more stringent lifestyle management program.

He has modified his computer software program to aggregate his data collection in a variety of ways according to his research needs. In this way, it will be easier for him to conduct many "what-if" analysis. Once collected, the data always stay put in a cloud server and because of the capability of the software, it can extract and analyze them in correct ways.

Graphic Results

In Figure 1, the data table shows the number of breakfasts, carbs/sugar intake, post-breakfast walking steps, sensor collected average PPG, daily glucose, body weight in the morning, and GF for breakfast PPG, daily POG, and daily glucose.

4/22/2021 & IF meals ratio:	0%	0%	70%
Breakfast	Y18-Y19	Y19-Y20	Y20-Y21
Starting Date	11/8/18	11/8/19	11/8/20
Ending Date	4/20/19	4/20/20	4/20/21
No. of Breakfasts	164	163	164
Avg. Carbs	*12.8*	*8.8*	*3.0*
Avg. K-Steps	4.1	4.7	4.1
Finger PPG	117	113	110
Sensor Avg. PPG	*136*	*131*	*117*
Start PPG	123	121	110
Close PPG	132	130	121
Max PP	149	140	121
Min PPG	123	121	110
Bkfst PPG GF	*27*	*19*	*11*
K-chart Max	160	155	131
K-chart Min	114	114	105
Breakfast K-chart GF	*46*	*41*	*26*
K-chart start	123	121	110
K-chart close	132	131	121
K-chart avg	136	131	117
Weight	*171*	*171*	*167*
Sensor Daily Glucose	*129*	*128*	*117*
Sensor PPG	*134*	*131*	*120*
Daily Glucose GF	*95*	*95*	*97*
PPG GF	*48*	*45*	*42*

Figure 1: Data table of input data and calculated GF

Figure 2 depicts the comparison of his weight among Case A (171 lbs.), Case B (171 lbs.) and Case C (167 lbs.). After Case B period ended on 4/20/2020, he has gone through an extra effort to bring his body weight down and reach to <170 lbs. His body weight has been maintained slightly >170 lbs. since 2015 . The weight impact resulted from IF effort is a much slower process which takes a longer period of time to observe a desired weight reduction. This figure also shows his declined Carbs/sugar intake amount from 12.8 grams of Case A through 8.8 grams of Case B to 3.0 grams of Case C. Actually, Case C contains 70%

of IF influences which has 0.4 gram of carbs intake from drinking tea only as his breakfast combining with a total of 16 hours of fasting each fasting day. If without fasting influence, during the same period with non-fasting normal breakfast (usually eggs only), his averaged carbs/sugar intake should be >5.0 grams per meal. It should be pointed out that his averaged list-meal walking k-steps are always around >4K steps, with or without fasting.

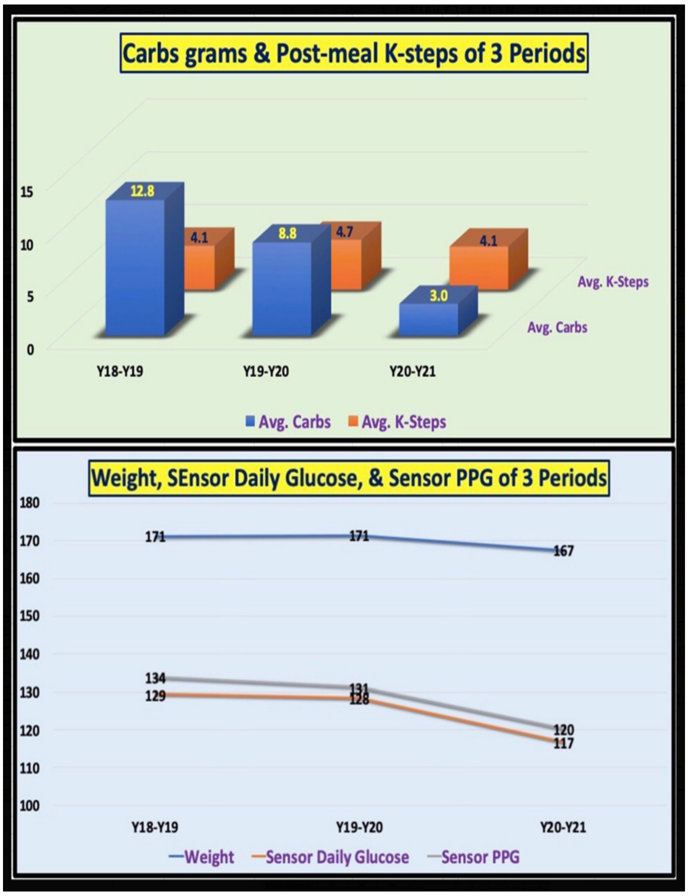
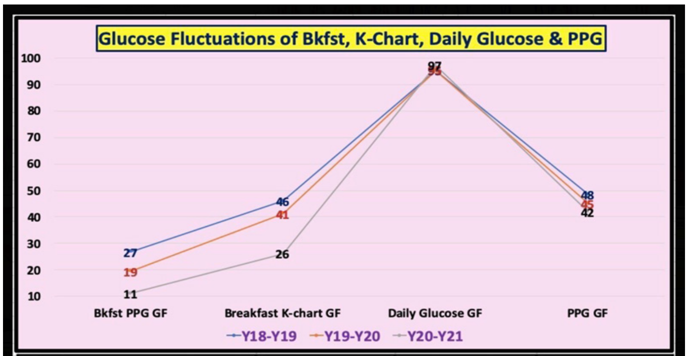


Figure 2: Carbs grams, post-meal walking k-steps, weight, eAG, and sensor PPG of 3 periods

Above described lifestyle inputs have resulted into his Daily PPG and daily glucoses being the lowest for Case C in comparison with both Case A and Case B.

Figure 3 shows the comparison of glucose fluctuations ("GF equals to the Maximum glucose minus the Minimum glucose") of breakfast PPG (from both waveform model and candlestick K-line model), daily PPG, and daily glucose. The results show that only significant influence by IF on breakfast PPG GF can be seen. Both of daily PPG and daily glucose do not show any significant benefit from the IF effort. This is due to the breakfast only contributes 33% (1/3) of the daily PPG and the PPG only contributes 38% (9/24) of the daily glucose value. This has demonstrated that, at least during the fasting period, the glucose wave would not generate extra energy from the glucose fluctuations.



4/22/2021 & IF meals ratio:	0%	0%	70%
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Avg. K-Steps	4.1	4.7	4.1
Breakfast	Y18-Y19	Y19-Y20	Y20-Y21
Weight	*171*	*171*	*167*
Sensor Daily Glucose	*129*	*128*	*117*
Sensor PPG	*134*	*131*	*120*
Breakfast	Y18-Y19	Y19-Y20	Y20-Y21
Bkfst PPG GF	*27*	*19*	*11*
Breakfast K-chart GF	*46*	*41*	*26*
Daily Glucose GF	*95*	*95*	*97*
PPG GF	*48*	*45*	*42*

Figure 3: Comparison of glucose fluctuations (GF = Max-Min) of 3 periods

Figure 4 shows a direct comparison of three PPG waveforms of these three cases. At first, all of the correlation coefficients among these 3 curves are very high (65% to 96%) which explains why these three curves have similar wave shapes. Second, checking the magnitudes of these three waveforms, the distance of peak PPG values is 30 mg/dL between Case A and Case C and 23 mg/dL between Case B and Case C. Furthermore, the distance of averaged breakfast PPG values is 19 mg/dL between Case A and Case C and 14 mg/dL between Case B and Case C. This has demonstrated that IF has indeed contributed on PPG reduction, at least during the fasting period.

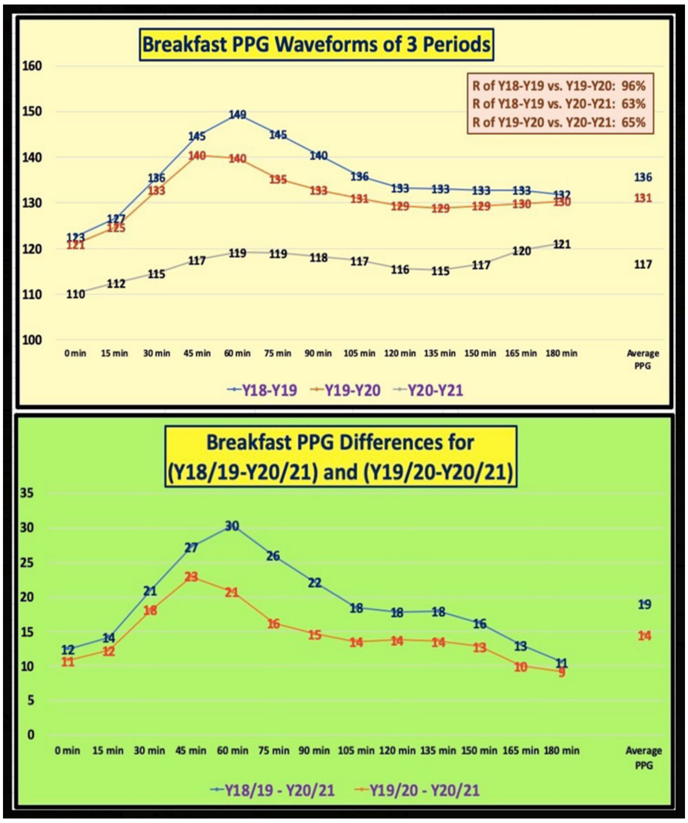

Figure 4: Comparison of PPG waveforms and Differences of PPG component data of 3 periods

Conclusions

The key conclusion is that the Case C (with 70% of IF influences) has indeed shown significant differences versus those two selected non-IF Case A and Case B in regard to breakfast PPG, daily PPG, daily glucose (eAG), and body weight. Even the averaged breakfast glucose fluctuation of Case C (11 mg/dL) is significantly less than those two Non-IF cases (19 mg/dL for Case B and 27 mg/dL for Case A). However, in terms of Case C's daily glucose GF (~95 mg/dL) and PPG GF (~44 mg/dL), the Case C has demonstrated comparable GF values as both Case A and Case B.

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