

# Applying Segmentation Pattern Analysis to Investigate Postprandial Plasma Glucose Characteristics and Behaviors of the Carbs/Sugar Intake Amounts In Different Nations (GH Method: Math-Physical Medicine)

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## Introduction

In this paper, the author presents the results of his national segmentation pattern analysis of the sensor PPG data based on both high-carb and low-carb intake amounts. It also verified his earlier findings on the communication model between the brain and internal organs such as the stomach, liver, and pancreas.

## Methods

First, he studies the overall combined PPG waveforms associated with various meals in different nations. Secondly, he defines low-carb intake as 0-14.9 grams carbs/sugar intake amount per meal and high-carb intake as 15-150 grams carbs/sugar intake amount per meal, and then analyze PPG accordingly. He generates the PPG sub-waveforms associated with these two different carbs/sugar intake ranges. Thirdly, he calculates the data and plots the graphs of PPG differences between high-carbs and low-carbs. He utilized this third step to reverify his earlier findings of communication model between the brain along with stomach, liver, and pancreas.

## Results

(1) National overall PPG combined waveform data: Final results are shown in Figures 1 and 2 and conclusions are listed below in the format of (averaged carbs; finger PPG; sensor PPG; and walking steps)

*USA: (12.5; 114.4; 136.2; 4,222)*  
*Taiwan: (14.7; 113.7; 132.1; 4,745)*  
*Japan: (16.3; 117.6; 135.9; 4,658)*  
*Others: (18.7; 119.6; 140.2; 4,301)*  
**Total: (14.6; 115.8; 136.3; 4,252)**

In summary, both USA and Taiwan are better than the overall average number. These are due to more home cooked meals by the author, who has deep knowledge regarding the relationship between glucose behaviors and food nutritional input. Japan is also remarkably close to the average, but worse than Taiwan and USA. This is due to higher sugar content and higher carb-based dishes in Japan. Other nations fall into the last category as being the worst because the author stayed in the hotels and ate at restaurants exclusively. Lastly, all of the national exercise amounts are comparable.

It should be pointed out that the averaged sensor PPG is 18% higher than the averaged finger PPG.

(2) National low-carb vs. high-carb segmented data: Final results are shown in Figures 3, 4, 5, 6 and conclusions are listed below in the format of (low-carbs; high-carbs; averaged carbs; low finger PPG; high finger PPG, averaged finger PPG)

*USA: (7.9; 25.8; 12.5; 111; 126; 114)*  
*Taiwan: (8.5; 27.8; 14.7; 110; 124; 114)*  
*Japan: (9.1; 30.2; 16.3; 112; 124; 118)*  
*Others: (10.4; 26.1; 18.7; 112; 126; 120)*  
**Total: (8.5; 27.1; 14.6; 111; 126; 116)**

It should be noted that all of the low-carb intakes are in the range of 8-10 grams and high-carbs are in the range of 26-30 grams. The high carb grams are ~3x of the low-carb grams. All of the low-carb finger PPG are in a narrow range of 110-112 mg/dL and high-carb finger PPG are in a narrow range of 124-126 mg/dL. These national carb segmented analysis results are dissimilar to the national overall combined PPG results, which have many noticeable and significant varying conclusions.

(3) Differences between high-carb PPG and low-carb PPG for these four national subgroups are quite similar to the national overall combined PPG difference.

Observing from Figures 7 and 8, the author has summarized his findings as follows. At 0-minute, the PPG gaps are extremely small. At 30-minutes, initial digestion stage, the PPG gaps become larger (2x to 6x, overall around 4x). At 60 to 75-minutes, full digestion stage, the PPG gaps become huge (6x to 10x, overall around 8x). However, after the full digestion stage, the PPG gaps become even slightly bigger, but largely due to the different decaying speeds of two PPG waves, and partially also due to continuously burn off of the remaining energies associated with high carbs. At 120 to 135-minutes, low-carb waves almost completely decrease, while high-carb waves still have an excessive amount of left-over energy (~10% of opening glucose and ~20% of leftover energy) inside the blood system.

The above descriptions were derived from careful physical observations of complex biochemical behaviors of glucoses. They have reconfirmed the author's previous hypothesis regarding the

communication model between the heart along with stomach, liver, and pancreas.

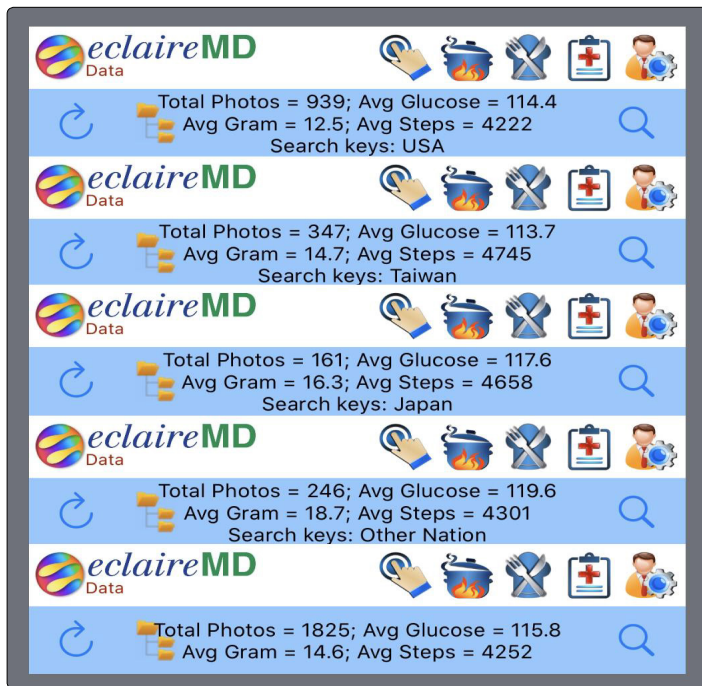


Figure 1: Summary data of national combined PPG

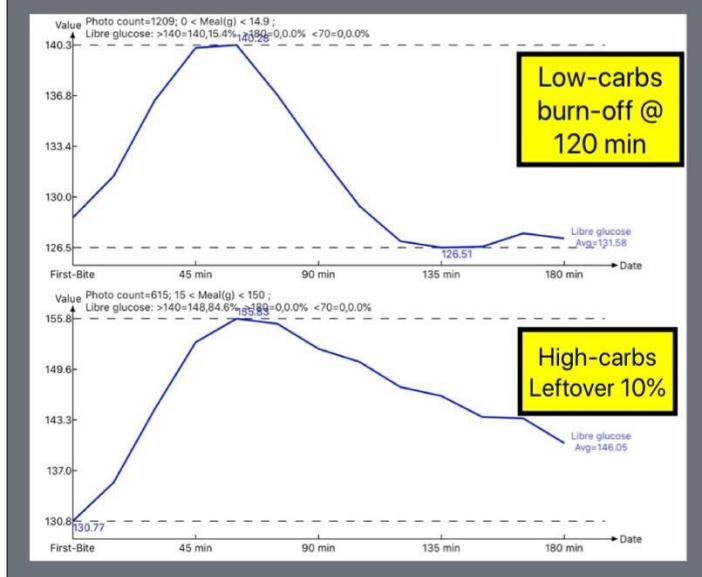
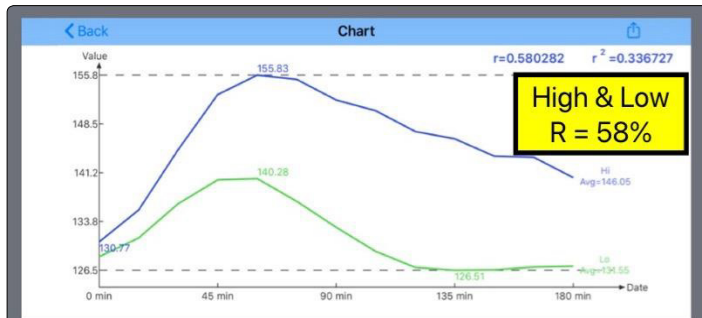


Figure 2: High-carb and low-carb national segmented PPG waveforms

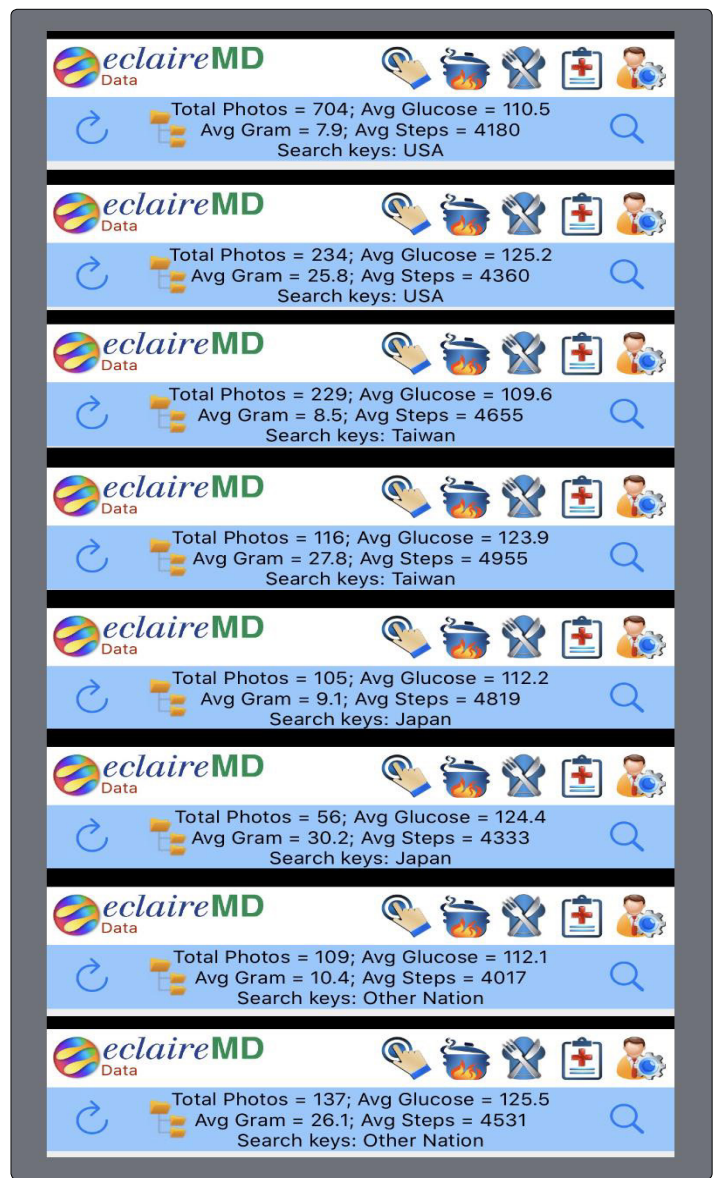


Figure 3: Summary data of national carbs segmented PPG

Nations	Meal #	Avg Grams	Avg Steps	Finger PPG
USA - Low	704	7.9	4180	110.5
USA - High	235	26.2	4360	125.8
USA	939	12.5	4222	114.4
Taiwan - Low	229	8.5	4655	109.6
Taiwan - High	116	27.8	4955	123.9
Taiwan	347	14.7	4745	113.7
Japan - Low	105	9.1	4819	112.2
Japan - High	56	30.2	4333	124.4
Japan	161	16.3	4658	117.6
Others - Low	109	10.4	4017	112.1
Others - High	137	26.1	4531	125.5
Others	246	18.7	4301	119.6
Total - Low	1209	8.5	4238	110.8
Total - High	615	27.1	4282	125.6
Total	1825	14.6	4252	115.8

Figure 4: Summary data table of national combined PPG and carbs segmented PPG



USA			Taiwan			Japan			Others		
Date	Hi	Lo	Date	Hi	Lo	Date	Hi	Lo	Date	Hi	Lo
0 min	134.30	128.69	0 min	131.09	129.07	0 min	127.24	129.56	0 min	124.96	123.99
15 min	138.61	132.05	15 min	136.10	130.43	15 min	132.76	132.91	15 min	130.19	126.77
30 min	147.91	138.20	30 min	146.15	133.41	30 min	139.31	135.06	30 min	139.57	132.74
45 min	154.73	142.01	45 min	155.59	136.52	45 min	148.06	136.80	45 min	149.72	137.54
60 min	156.83	142.28	60 min	156.89	136.36	60 min	150.10	135.26	60 min	154.96	139.38
75 min	156.88	139.24	75 min	153.64	130.59	75 min	151.68	133.77	75 min	154.05	138.33
90 min	152.81	134.46	90 min	148.18	125.22	90 min	151.65	133.18	90 min	152.48	136.80
105 min	151.71	130.70	105 min	144.46	120.39	105 min	150.53	131.54	105 min	152.33	135.19
120 min	146.95	127.48	120 min	140.66	119.39	120 min	146.86	129.69	120 min	151.95	134.10
135 min	146.29	127.07	135 min	138.29	119.88	135 min	146.94	129.49	135 min	150.36	132.91
150 min	144.66	127.06	150 min	135.30	121.49	150 min	145.73	129.21	150 min	147.62	131.28
165 min	144.78	128.53	165 min	134.24	122.57	165 min	146.23	128.41	165 min	146.81	131.26
180 min	140.67	128.14	180 min	134.24	123.64	180 min	142.06	126.70	180 min	145.07	128.29

Figure 5: Detailed data table of national carbs segmented PPG

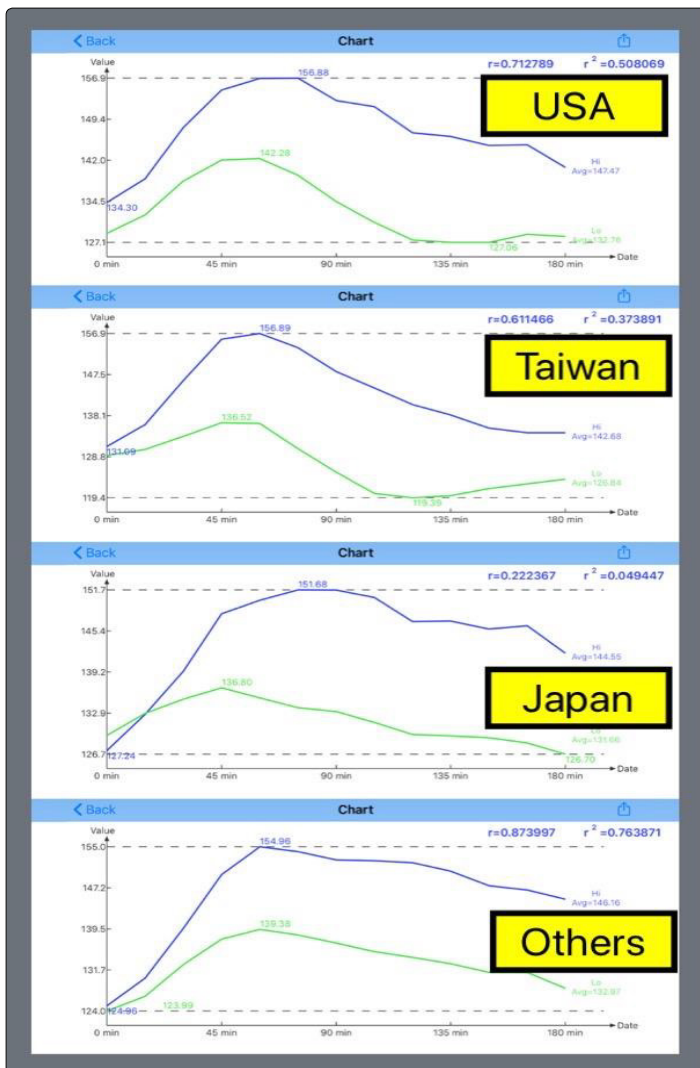


Figure 6: Waveforms of national carbs segmented PPG

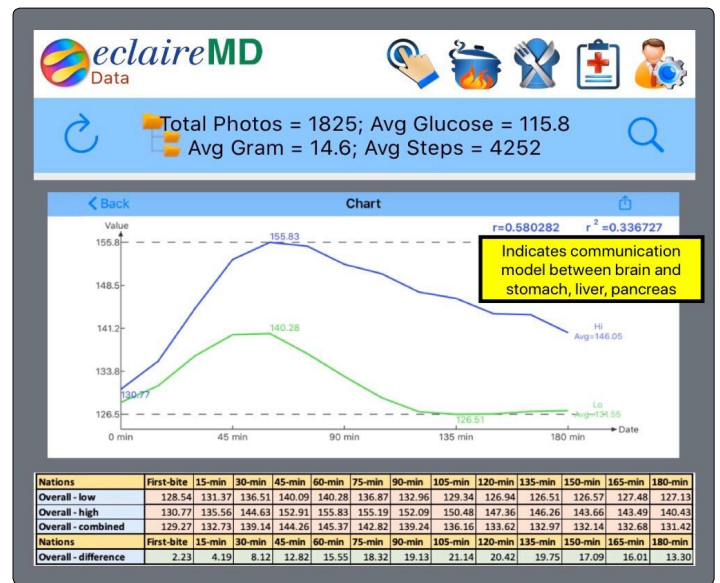


Figure 7: Detailed data table and waveforms of national combined PPG for verification of brain's function

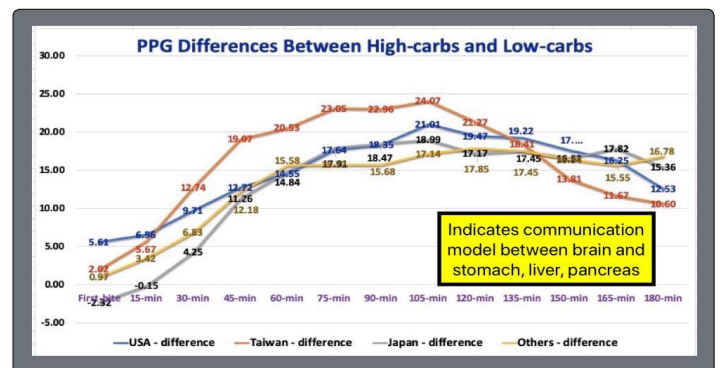


Figure 8: Detailed national PPG differences from carbs segmented PPG for verification of brain's function

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## Conclusions

The conclusions derived from this analysis are based on sensor data exclusively during a period of about 20 months (5/5/2018 - 12/13/2019), which are quite similar to some of his previously published conclusions derived from finger PPG data analysis.

However, the “waveform” created by massive sensor data have indeed offered more insights regarding the PPG characteristics and behaviors. For example, the verification of his hypothesis using carb-segmented analysis related to communication model between the brain and some internal organs are remarkably similar to his previously published findings based on the overall PPG waveform study [1-5].

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