The GH-Method

A Neural Communication Model between the Brain and Internal Organs, Specifically the Stomach, Liver, and Pancreatic Beta Cells Based on PPG Waveforms of 131 Liquid Egg Meals and 124 Solid Egg Meals (No. 340)

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Abstract

This is an extended research report on the author's paper No. 311, "A neural communication model between the brain and internal organs via postprandial plasma glucose waveforms study based on 95 liquid egg meals and 110 solid egg meals (No. 311)". This article includes an additional 50 meals (+25%) in his experimental datasets from Phase 3 of 205 meals to Phase 4 of 255 meals. It also connects his previous research findings regarding pancreatic beta cells' self-recovery of 2.7% per year to complete his current defined scope of research on communication between the brain and pancreas. He described the progress on his 2+ year special research project, from 5/5/2018 through 10/3/2020, to repeatedly prove his identified neural communication model between the brain's cerebral cortex and certain internal organs such as the stomach, liver, and pancreas. He used a continuous glucose monitor (CGM) sensor that collected postprandial plasma glucose (PPG) data since 5/5/2018 to investigate the glucose production amount and timing with two distinguished waveforms between 131 liquid egg meals and 124 solid egg meals. The significant PPG differences between these two food preparation types can be easily observed. Their average sensor PPG difference is 15 mg/dL, but his average peak sensor PPG is 113 mg/dL at 45 minutes for liquid meals, and 135 mg/dL at 45 minutes for solid meals. Their peak sensor PPG difference is actually 22 mg/dL. This PPG peak value difference of >20 mg/dL was also found consistently in his research study for Phases 2, 3, and 4, with almost identical inputs of carbs/sugar intake amounts and the same level of post-meal walking steps. In addition, he identified his pancreatic beta cells' insulin secretion quality and production as being self-repaired at an annual rate of 2.3% to 3.2% per year, or more precisely, at a 2.7% annual rate during 2016 - 2020. If adopting this 2.7% self-repair rate, he can further modify or "boost" his PPG data and curves by 6.5% (2.7% multiply 2.4 years) to remove some of the PPG reduction due to insulin improvement. The author conducted this 2+ years-long special investigative the studies in four phases. All of his findings from these 4 research phases are extremely similar to each other, with minor deviations, even though his collected experimental data size nearly doubled in each advanced phase. The most recent investigation of phase 4 with a total of 255 egg meals has produced slightly lower averaged PPG than his 3 previous studies, but with a slightly wider gap of 22 mg/dL of peak PPG values between liquid and solid egg meals. This is due to his excellent diabetes and weight control during the recent COVID-19 quarantined lifestyle. Most importantly, he utilized his physical observation results and his neuroscience hypothesis regarding the neural communication model that existed between the brain and certain internal organs, specifically, the stomach, liver, and pancreas, to link them with glucose fluctuation patterns. From a neuro-scientific point of view, he can then "trick" the cerebral cortex of the brain into producing or releasing a "lesser" amount of PPG, without altering or disturbing the required food nutritional balance. If this idea works, by merely changing the meal preparation method, it can then help many type 2 diabetes (T2D) patients to lower their peak PPG and average PPG levels without disturbing their food nutritional requirements. Obviously, T2D patients must avoid overeating foods with high carbohydrates and sugar content at all times.

Keywords: Type 2 diabetes; Brain; Internal organs; Stomach; Liver; Pancreatic beta cells

Abbreviations: CGM: continuous glucose monitor; T2D: type 2 diabetes; PPG: postprandial plasma glucose; MPM: math-physical medicine

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1. INTRODUCTION

This is an extended research report on the author's paper No. 311, "A neural communication model between the brain and internal organs via postprandial plasma glucose waveforms study based on 95 liquid egg meals and 110 solid egg meals (No. 311)". This article includes an additional 50 meals (+25%) in his experimental datasets from Phase 3 of 205 meals to Phase 4 of 255 meals. It also connects his previous research findings regarding pancreatic beta cells' self-recovery of 2.7% per year to complete his current defined scope of research on communication between the brain and pancreas.

He described the progress on his 2+ year special research project, from 5/5/2018 through 10/3/2020, to repeatedly prove his identified neural communication model between the brain's cerebral cortex and certain internal organs such as the stomach, liver, and pancreas. He used a continuous glucose monitor (CGM) sensor that collected postprandial plasma glucose (PPG) data since 5/5/2018 to investigate the glucose production amount and timing with two distinguished waveforms between 131 liquid egg meals and 124 solid egg meals.

2. METHODS

2.1 Background

To learn more about his developed GH-Method: math-physical medicine (MPM) research methodology, readers can review his articles, Biomedical research methodology based on GH-Method: math-physical medicine (No. 54 and No. 310)[1].

2.2 Data collection

Since 1/1/2012, the author developed research-oriented software on his iPhone to collect all of his diabetes-related medical data and lifestyle details. In addition, he started to collect his glucose data using a CGM sensor device on 5/5/2018. He accumulated approximately 80 to 96 glucose data per day with 13 glucose data per meal over a 3-hour timeframe. On 9/25/2019, he launched a special investigation regarding the relationship between meal preparation methods and PPG levels using his own body to conduct the necessary experiments.

2.3 Neuroscience study

He described the results from Phase 1 in his research work, from 9/25/2019 to 2/11/2020, by utilizing the collected data from his 30 egg drop soup (liquid) meals and 30 pan-fried egg (solid) meals[1].

In Phase 2, he collected an additional 36 liquid meals and 39 solid meals with identical food materials and cooking methods[5]. During this phase 2, from 9/25/2019 to 5/29/2020, he accumulated a total of 69 liquid meals and 66 solid meals. He also enhanced his software program to present the glucose data using the candlestick K-line chart[2,3]. The chart clearly reflects five key PPG values at different time instants between liquid food and solid food.

In Phase 3, from 9/25/2019 through 10/3/2020, he accumulated additional data from a total of 95 liquid meals and 110 solid meals, including 68 pan-fried eggs and 42 hardboiled eggs. In comparison to Phase 2, he collected additional 26 liquid meals and 44 solid meals over these 76 days.

Phase 4 described in this article, from 9/25/2019 through 8/13/2020, he accumulated data from a total of an additional 131 liquid egg meals and 124 solid egg meals. In comparison to Phase 3, he collected an additional 36 liquid meals and 14 solid meals over these 52 days.

The actual research method of this article is identical to his previous three research phases on this subject regarding the "neural communication model between the brain, stomach, and liver"[2-7]. Therefore, he would omit this part and delve into an additional subject of "Pancreatic beta cells self-recovery". Readers can investigate more on this subject and his research work from his articles[8-11].

3. RESULTS

In this Phase 4 study, he focused on the following two specific meal groups which involved eggs only. The main difference

between these two egg-only meals is the cooking method or meal preparation method.

In Figure 1, one large egg contains mainly proteins (6.3g) and fat (5g) with a small amount of carbohydrates (0.38g) and sugar (0.38g). It should be noted that he uses two eggs, and occasionally adds a small quantity of chopped spring onions in his egg drop soup and pan-fried egg for flavor, along with a small amount of seaweed (for iodine) in his soup.

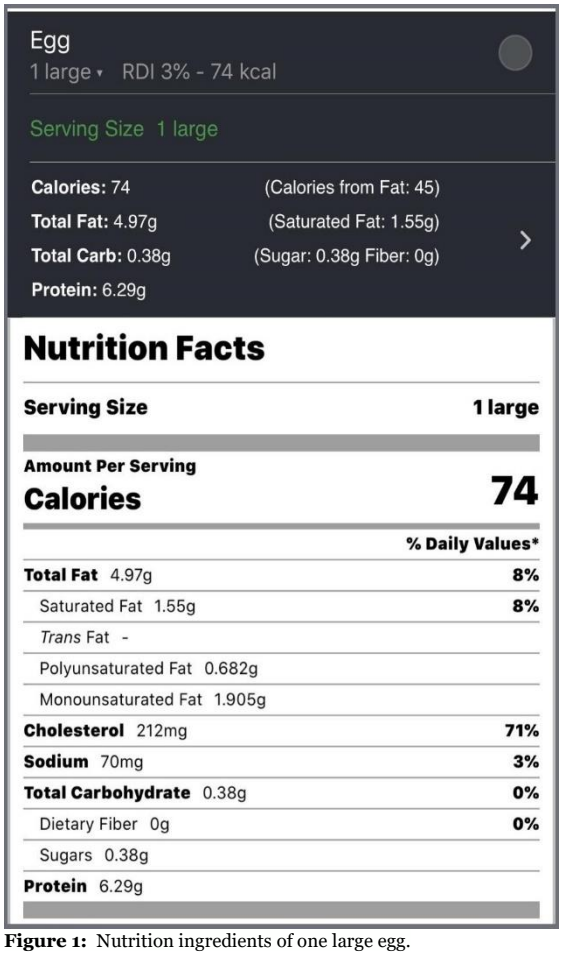

Figure 1: Nutrition ingredients of one large egg.

Here are some important findings from the data table (Figure 2) and PPG comparison (Figure 3). To date, the author has eaten 131 liquid meals and 124 solid meals without any other food materials having additional carbs/sugar ingredients. The average carbs/sugar intake amounts are 2.7 grams for liquid meals (0.5 grams from seaweed or chopped spring onion) and 2.2 grams for solid meals (sometimes with chopped spring onions). His average post-meal walking steps are 4,257 for liquid meals and 4,657 for solid meals. The additional 400 post-meal walking steps are due to his subconscious effort on the extra-exercise amount based on his acquired knowledge of higher PPG associated with solid egg meals. His average finger PPG is 106 mg/dL for liquid meals and 111 mg/dL for solid meals. (Note: finger PPG has not been included in this study since its limited data size cannot assist him with the waveform investigation of PPG).

His average sensor PPG is 113 mg/dL for liquid meals (7% higher than finger PPG of 106 mg/dL), and 128 mg/dL for solid meals (15% higher than finger PPG of 111 mg/dL). With his average peak sensor, PPG is 113 mg/dL at 45 minutes for liquid meals, and 135 mg/dL at 45 minutes for solid meals. Their peak sensor PPG difference is 22 mg/dL at 45 minutes after the first bite of his meal.

His personal target for post-meal walking is 4,000 steps. Every 1,000 post-meal steps decrease PPG value by approximately 5 mg/dL. Since his post-meal exercise for these two food categories is almost equal between 4,257 steps and 4,657 steps, he can focus on the influence of food intake on his PPG values. Based on his previous research results, each gram of carbs/sugar intake amount increases his PPG value by 1.8 mg/dL to 2.0 mg/dL. Therefore, his finger PPG values would increase by about 4 to 5 mg/dL due to the carbs/sugar intake amount, which is in small quantities and almost negligible. These facts provide evidence that something else or an unknown influential factor exists in his observed physical phenomenon of this biomedical problem at hand, the PPG waveform investigation.

In this study, the food's nutritional ingredients are almost identical, but the cooking methods are completely different. Therefore, he decided to concentrate on his cooking method that yields these two different physical states, liquid versus solid.

His first exposure to physics and chemistry occurred in his second year of middle school, at age 11. He was taught the three states of matter: solid, liquid, and gas/steam. After 62 years, this basic knowledge of physics came to his mind assisting him to discover this neurological-related glucose phenomenon.

Figure 2 shows the background data table of this study.

Sensor PPG	Liquid Egg	Solid Egg	5/5/18 - 10/3/20	PPG (Solid - Liquid)
0 min	107	124	0 min	17
15 min	110	126	15 min	16
30 min	112	130	30 min	19
45 min	113	135	45 min	22
60 min	112	134	60 min	22
75 min	111	132	75 min	21
90 min	111	129	90 min	18
105 min	112	128	105 min	16
120 min	112	125	120 min	13
135 min	113	125	135 min	11
150 min	114	125	150 min	11
165 min	116	127	165 min	10
180 min	119	128	180 min	9
Finger PPG, Carbs, Walking	**Liquid Egg**	**Solid Egg**	**5/5/18 - 10/3/20**	**Difference**
No. of Meals	131	124	No. of Meals	-7
Avg Sensor PPG	113	128	Avg Sensor PPG	16
Avg Finger PPG	106	111	Avg Finger PPG	6
Carbs/Sugar grams	2.7	2.2	Carbs/Sugar grams	-0.5
Post-Meal Walking	4257	4657	Post-Meal Walking	400
Candlestick K-Line PPG	**Liquid Egg**	**Solid Egg**	**5/5/18 - 2/29/20**	**K-Line Difference**
Avg PPG	113	129	Avg PPG	16
Open PPG	108	122	Open PPG	14
Closed PPG	119	129	Closed PPG	9
Max PPG	127	152	Max PPG	24
Min PPG	101	111	Min PPG	10

Figure 2: Background data table.

Figure 3 illustrates the two 3-hour PPG waveforms of liquid and solid meals, with an extremely low correlation coefficient of 7% and peak PPG of 135 mg/dL at 45 minutes of solid meals and 113 mg/dL at 45 minutes of liquid meals. This means that the liquid waveform is almost completely different from the solid waveform. The interesting findings of the 22 mg/dL difference in their peak PPG occur 45 minutes after the first bite of the meal. This indicates that the absorption rate of chyme in the gastrointestinal system has nothing to do with the observed physical phenomenon with the complicated situations of glucose and insulin. The observation triggers him to explore this unknown source from a neuro-scientific viewpoint.

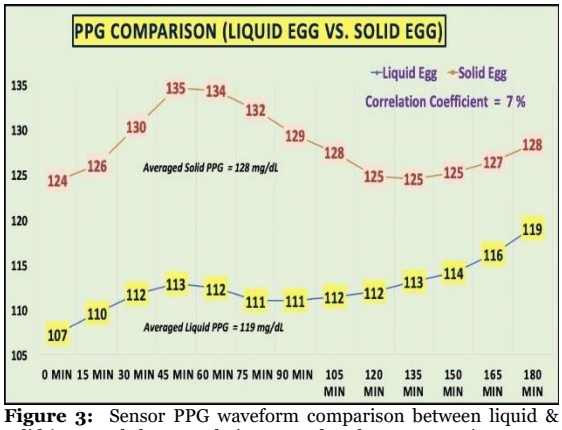

Figure 3: Sensor PPG waveform comparison between liquid & solid (extremely low correlation 7% and peak PPG at 45 minutes, 135 mg/dL for solid vs. 113 mg/dL for liquid).

Figure 4 depicts these two candlestick K-line charts with key data of these 131 liquid meals and 124 solid meals.

Figure 5 reflects the PPG difference at each 15-minute over the 3-hour (180-minutes) duration.

Figure 6 confirms five key values of PPG from his candlestick K-line chart technique[3,4]. Each candlestick chart has five key characteristics, which include opening glucose at 0 minutes, closing glucose at 180 minutes, maximum glucose usually around 45 minutes to 75 minutes, minimum glucose usually around 120 minutes, and average glucose over a period of 180 minutes. These key values for liquid and solid meals are different as well, especially with the maximum PPG of solid meals at 152 mg/dL which is 25 mg/dL higher than the maximum PPG of liquid meals at 127 mg/dL.

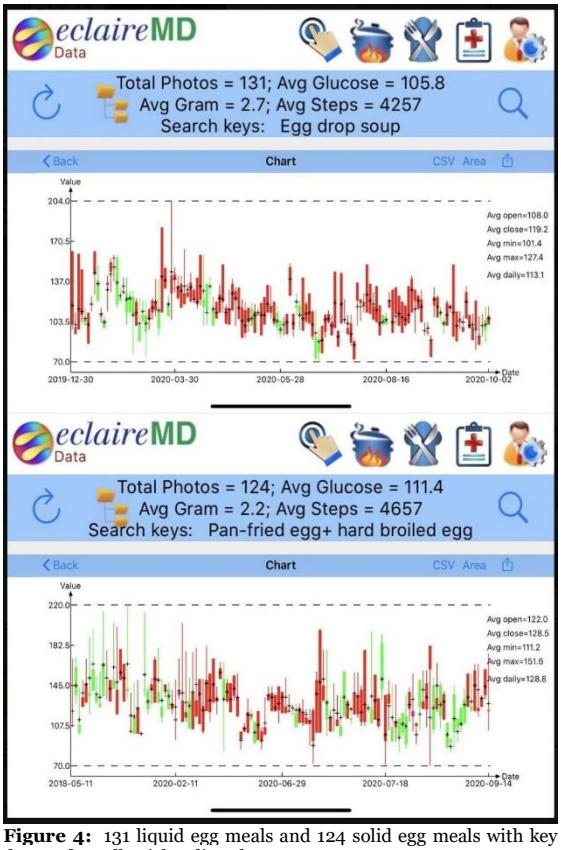

Figure 4: 131 liquid egg meals and 124 solid egg meals with key data and candlestick K-line charts.

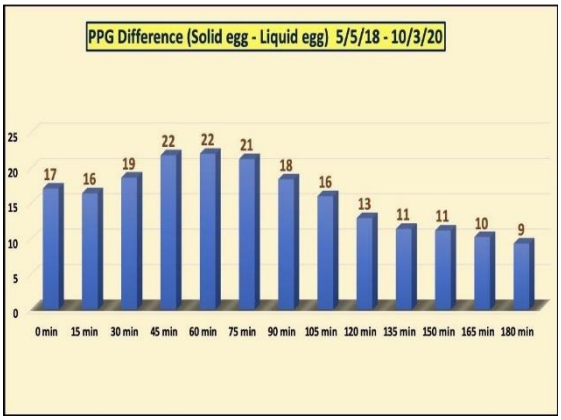

Figure 5: PPG difference at 15-minute time intervals between 131 liquid egg meals and 124 solid egg meals.

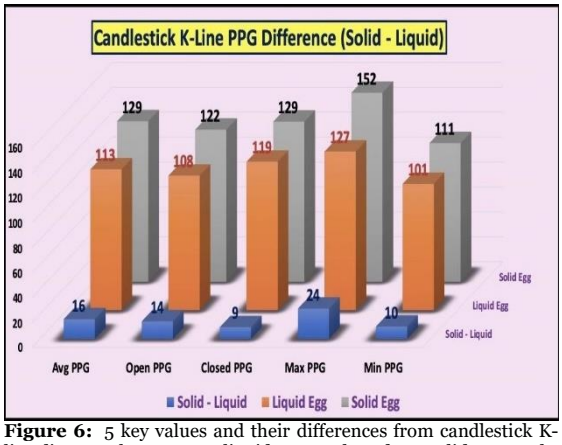

Figure 6: 5 key values and their differences from candlestick K-line diagrams between 131 liquid egg meals and 124 solid egg meals.

Figures 7, 8, and 9 show the comparison of liquid and solid meals with and without beta cells' self-recovery.

Liquid Egg	Liquid (No repair)	Liquid (with repair)
0 min	114	107
15 min	117	110
30 min	119	112
45 min	120	113
60 min	120	112
75 min	118	111
90 min	118	111
105 min	119	112
120 min	119	112
135 min	121	113
150 min	122	114
165 min	124	116
180 min	127	119
Solid Egg	**Solid (No repair)**	**Solid (with repair)**
0 min	133	124
15 min	134	126
30 min	139	130
45 min	144	135
60 min	143	134
75 min	141	132
90 min	138	129
105 min	136	128
120 min	133	125
135 min	133	125
150 min	134	125
165 min	135	127
180 min	137	128

Figure 7: Data table of PPG differences with and without pancreatic beta cells self-recovery.

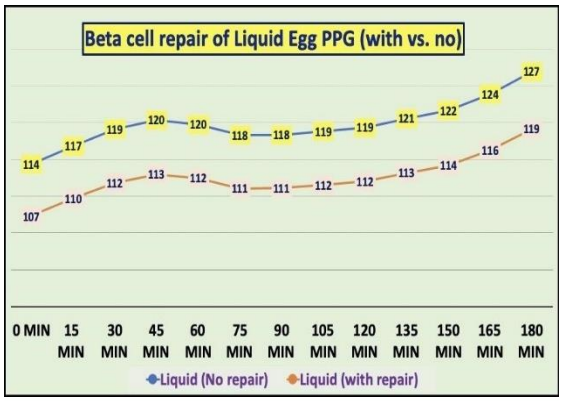

Figure 8: PPG differences from with and without pancreatic beta cells self-recovery of 131 liquid egg meals.

The most important figure in this article is shown in Figure 3. The author put two waveforms of liquid and solid meals together to drive the following conclusion.

The significant PPG waveform and value differences between these two food types can be easily observed. In addition, the PPG peak value differences of > 20 mg/dL from his research studies of Phases 2, 3, and 4, with almost identical inputs of carbs/sugar intake amounts and post-meal walking steps.

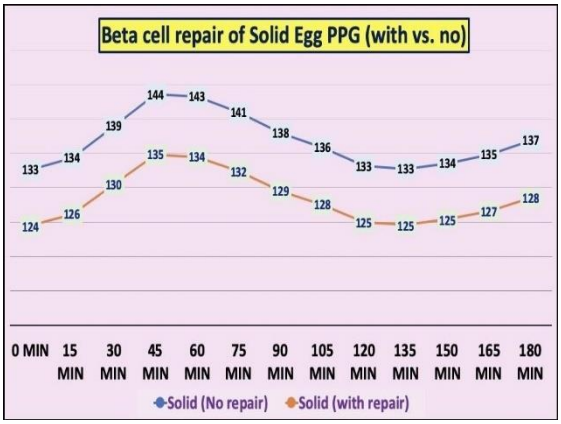

Figure 9: PPG differences from with and without pancreatic beta cells self-recovery of 124 solid egg meals.

3.1 Neuroscience discussion

With the same food ingredient, why do they have different PPG values?

The two prepared meals have the same nutritional ingredient inputs; however, their different cooking method or meal preparation methods lead to different physical states, liquid or solid. Perhaps, in the human biomedical system, the signal ascending from the stomach to the cerebral cortex is not based on the food ingredients, but rather on the food's arrival message and its physical state. Therefore, the brain misinterprets soup as an equivalent intake to a cup of decaf coffee, tea, or water and then the brain descends a message (or marching order) to the liver to produce or release a lesser amount of glucose.

Another point is, during the period of 5/5/2018 to 10/3/2020, his diabetes conditions were already well under control without medication. This means that these results are strictly from the internal biological outcomes caused by his stringent lifestyle management program, without any chemical intervention by medication.

Based on his big data analytics, the first evidence is that the stomach takes about 10-15 minutes to inform the food entry message to the brain. The second indication is that, for liquid and solid meals, it takes about 45 to 60 minutes for the liver to produce or release glucose to reach its peak amount. From the previous findings of his diabetes research work, the peak PPG occurring time instants are usually between 45 minutes to 75 minutes with an average of 60 minutes after eating for most of the other meals.

When the author could not find a satisfactory explanation from viewpoints of either food nutrition or clinical internal medicine, he started to delve deeper into the source of this problem: "the creation of glucose". He realized that glucose is not directly converted from food nutritional ingredients. Instead, the glucose was directly produced or released by the liver from stored glucoses inside the liver or muscle. Of course, the human body and all of its internal organs, in particular, the stomach, liver, and pancreas are dependent on food nutrition to convert glucose into their needed energy.

As a result, he came up with his first hypothesis that the glucose amount difference is probably due to the physical state of consumed food, such as liquid or solid, that is used by the brain to make a decision.

Furthermore, the author has learned three basic facts from his past 9-years of biomedical research work. First, our brain and nervous system consume 70% of our daily energy intake. Second, the brain is the only internal organ that has the power of cognition, judgment, information processing, decision-making, and marching order issuance, similar to the CPU of a computer. Third, all the internal organs work closely together but under the orders of a single command center, the brain.

Based on the above-acquired biomedical knowledge and his acquired computer architecture knowledge, the author further developed his second hypothesis. When one particular food type enters the gastrointestinal system, the stomach will immediately send a signal to inform the brain about the food's arrival message along with its physical state. After receiving this input signal from the stomach, the brain will then start to process the information, make proper judgments, and then issue its feedback message (descending marching order) to the liver regarding how much glucose should be produced or released at what time instant and at what time frame to reach to the peak of glucose. At the same time, the brain will inform the pancreas how much insulin should be produced and released based on the excessive amount of glucose produced or released by the liver. However, for severe diabetes patients whose pancreatic beta cells were damaged to a certain degree, each patient's insulin capabilities and qualities such as the production quantity and insulin resistance will not be the same to make up the final PPG reading. The author has also conducted a year-long research project on his pancreatic beta cells' self-recovery rate and also published seven medical papers regarding this subject[8-11]. In summary, he has identified his pancreatic beta cells' insulin secretion quality and production have been self-repairing at an annual rate of 2.3% to 3.2% per year, or more precisely, at a 2.7% annual rate from 2015 to 2020. By adopting this 2.7% self-repair rate, he can further modify or "boost" his PPG data and curves by 6.5% (2.7% multiply 2.4 years) to simulate his "should-be" PPG waveform during 2015-2020. This is how he constructed his PPG waveforms of liquid meals and solid meals as shown in the data table (Figure 6), liquid meals "with versus without" beta cells self-repair (Figure 7), and solid meals "with vs. without" beta cells repair (Figure 8). Figures 7 and 8 offer a clear view regarding the relative gap of 6.5% between the state of diabetes control efforts and without control efforts.

4. CONCLUSION

The author conducted this 2+ years-long special investigative the studies in four phases. All of his findings from these 4 research phases are extremely similar to each other, with minor deviations, even though his collected experimental data size nearly doubled in each advanced phase. The most recent investigation of phase 4 with a total of 255 egg meals has produced slightly lower averaged PPG than his 3 previous studies, but with a slightly wider gap of 22 mg/dL of peak PPG values between liquid and solid egg meals. This is due to his excellent diabetes

and weight control during the recent COVID-19 quarantined lifestyle.

Most importantly, he utilized his physical observation results and his neuroscience hypothesis regarding the neural communication model that existed between the brain and certain internal organs, specifically, the stomach, liver, and pancreas, to link them with glucose fluctuation patterns.

From a neuro-scientific point of view, he can then "trick" the cerebral cortex of the brain into producing or releasing a "lesser" amount of PPG, without altering or disturbing the required food nutritional balance. If this idea works, by merely changing the meal preparation method, it can then help many type 2 diabetes (T2D) patients to lower their peak PPG and average PPG levels without disturbing their food nutritional requirements. Obviously, T2D patients must avoid overeating foods with high carbohydrates and sugar content at all times.

5. REFERENCES

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