ISSN: 2755-0184

Journal of Diabetes Research Reviews & Reports

SCIENTIFIC Research and Community

Research Article

Open Access

A Neural Communication Model between Brain and Internal Organs via Postprandial Plasma Glucose Waveforms Study Based on 95 Liquid Egg Meals and 110 Solid Egg Meals (No. 311)

Gerald C. Hsu

eclaireMD Foundation, USA

ABSTRACT

In this paper, the author described the progress on his two-year long special research project, from 5/5/2018 through 8/13/2020, to identify a 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 collected postprandial plasma glucose (PPG) data to investigate the glucose production amount at different timing and waveform differences between 95 liquid egg meals and 110 solid egg meals.

***Corresponding author**

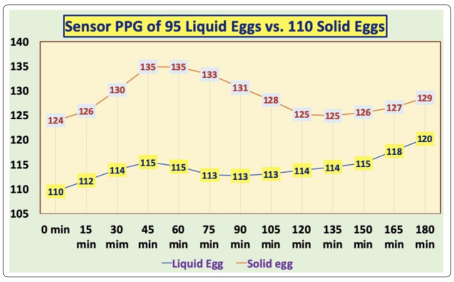
Gerald C. Hsu, eclaireMD Foundation, USA, E-Mail: g.hsu@eclairemd.com

Received: November 18, 2020; **Accepted:** November 19, 2020; **Published:** November 25, 2020

The author conducted this special investigative experiment in three phases. All of the findings from these research phases are extremely similar to each other, with minor deviations, even though his collected experimental data size nearly doubled in each phase.

From a neuroscientific point of view, the author utilized his developed math-physical medicine methodology (MPM) and his learned biomedical knowledge to "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 changing the cooking method, it can then help many type 2 diabetes (T2D) patients to lower their peak PPG and average PPG levels without reducing or changing their food nutritional contents. Obviously, T2D patients must avoid overeating foods with high carbohydrates and sugar contents at all times.

By sharing his research findings with other fellow medical research scientists, he hopes that they can provide some better explanations, more proof, or further justifications by using a different or traditional research methodology, such as the biochemical medicine (BCM) approach.



The significant PPG differences between these two food types can be easily observed (Figure 5). In addition, the PPG peak value differences are 20 mg/dL in Phase 2 study and Phase 3 study, with almost identical inputs of carbs/sugar intake amounts and post-meal walking steps.

Introduction

In this paper, the author described the progress on his two-year long special research project, from 5/5/2018 through 8/13/2020, to identify a 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 collected postprandial plasma glucose (PPG) data to investigate the glucose production amount at different timing and waveform differences between 95 liquid egg meals and 110 solid egg meals.

Method

Since 1/1/2012, the author developed a 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 from 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 food preparation method and PPG level using his own body to conduct the necessary experiments.

He described the results from his 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 meals and 30 pan-fried egg meals during phase one [1].

For the Phase 2 in his research work, he further collected an additional 36 liquid meals and 39 solid meals with identical food material and cooking method [2]. During this phase, from 9/25/2019 to 5/29/2020, he accumulated a total of 69 liquid meals (egg drop soup) and 66 solid meals (pan-fried egg). He also enhanced his software program to be able to present these glucose data using the Candlestick K-Line chart [3&4]. Through the Candlestick chart, it clearly reflects five key PPG values at different time instants between liquid food and solid food.

For his experimental Phase 3, from 9/25/2019 through 8/13/2020, he accumulated additional data from a total of 95 liquid egg meals (egg drop soup) and 110 solid egg meals (including 68 pan-fried eggs and 42 hardboiled eggs). In comparison with the Phase 2 data, he collected additional 26 liquid meals and 44 solid meals over these 76 days.

He focused on investigating the relationships among different food inputs such as meal nutritional contents, cooking methods, physical phases, and different glucose outputs, i.e. PPG "waveforms". When he observed those different physical phenomenon of glucose waves from liquid and solid meals, he wondered why these two different cooking methods would end up with two varying PPG waveforms with identical food nutritional ingredients input. Most of his medical associates in the fields of internal medicine and food nutrition have mentioned that food nutritional components, particularly carbohydrates and sugar amount, and exercise influence PPG values. Therefore, he decided to conduct an experiment of eating the same food ingredients but with two different cooking or preparation methods. It should be noted that he kept the intensity and duration of his post-meal exercise at the same level.

By 2/11/2020 with ~30 meals in each liquid and solid category, he discovered the vast differences existing between these two types of meals. At that moment, he came up with a neural communication "hypothesis" between the brain and certain internal organs via our nervous system. He then decided to extend his experiments in order to verify this neural communication model with the path of sending messages from the stomach to the brain and then forwarding the feedback message to the liver and pancreas, which determines the PPG production amount at different time instance by using a bigger experimental database and additional mathematical tools.

On 5/29/2020, his friend, Dr. Deborah Zelinsky, a research scientist and a clinical doctor, who specializes in the area of interaction among the ear, eye, and brain, forwarded him an article [5].

Here is an Excerpt

Published May 18th in the Proceedings of the National Academy of Sciences, an important world first, a study co-authored by Dr. Levinthal and Dr. Peter Strick, both from the Pitt School of Medicine, has explained what parts of the brain's cerebral cortex influence stomach function and how it can impact health. Dr. Peter Strick is a world leader in establishing evidence that internal organs are strongly modulated at the highest levels by the cerebral cortex. It's been traditional in biology and medicine that the internal organs are self-regulatory through the autonomic nervous system, largely independent of higher brain regions. Dr. Strick's previous research, for instance, also showed that similar areas of the cerebral cortex also control kidney and adrenal function. That course of research now could extend to "the heart, liver and pancreas to discover more about how the brain coordinates control of internal organs," said Mr. Sterling who holds a Ph.D. in neuroscience. When it comes to trusting your gut, it already is well-established that the stomach and gut send "ascending" signals to the brain in a way that influences brain function. But the study has found that the "central nervous system both influences and is influenced by the gastrointestinal system." What people haven't understood to date, Dr. Strick said, is that the brain also has "descending influences on the stomach" with various parts of the brain involved in that signaling, including those areas that control movement and emotions. Those areas control the stomach "as directly as cortical control of movement. These are not trivial influences."

On May 27, 2020, David Templeton, a writer for the Pittsburgh Post-Gazette presented this excellent medical discovery report. It described exactly what the author, for almost a year, guessed and felt about the neural communication model between the brain and other internal organs. By training, he is a mathematician, physicist, and engineer, but not a medical doctor or a neuroscientist. However, during his research work in this area since 9/15/2019, he has discovered and proved his "gut-feel" of these "ascending" messages from the stomach to brain regarding food entry, and also "descending" messages from the brain to liver and pancreas regarding glucose production or release. He also verified these observations via his examination of specific physical phenomena, established a few mathematical models, and then confirmed with big data analytics. In 2019, he cautiously selected words, such as hypotheses, guess, and might be, to describe his gut-feelings generated from his findings, but now he has found the support and proof from the neuroscientific work done by other brain experts [5].

Since he published a few articles along this line of thought in early 2020, by using various food and glucose data, he will forgo some explanations and come to the same conclusion based on a relatively "larger" size of experimental data.

Results

In this phase three study, he focused on the following two specific meal groups which involved eggs only. The main difference between these two "egg alone" meals is the cooking or 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 occasionally takes two eggs or adds chopped spring onions in his pan-fried egg for flavor, or a small amount of seaweed in his egg drop soup for iodine.

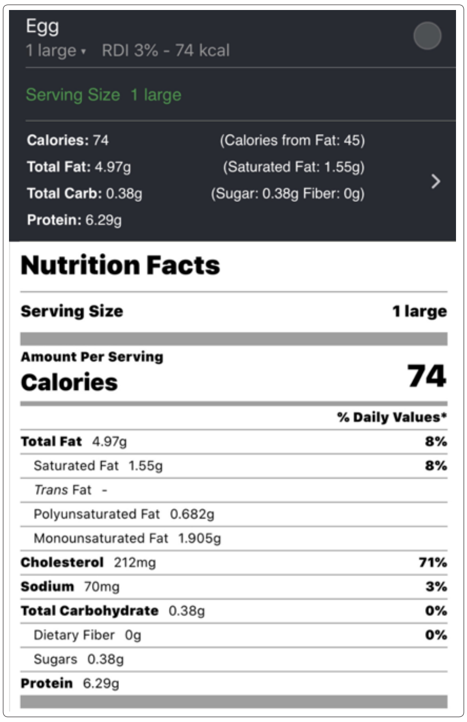


Figure 1: Nutrition ingredients of one large egg

Here is some important data from Figures 2 and 3. To date, the author has eaten 95 liquid egg meals and 110 solid egg meals without any other food materials including carbs/sugar ingredients. The average carbs/sugar intake amounts are 2.7 grams for liquid meals and 2.2 grams for solid meals. His average post-meal walking steps are 4,390 for liquid meals and 4,604 for solid meals. His average finger PPG is 107 mg/dL for liquid meals and 112 mg/dL for solid meals. (Note: finger PPG has no value in his study due to its limited data size and measurement timing at 120-minutes after first bite of meal).

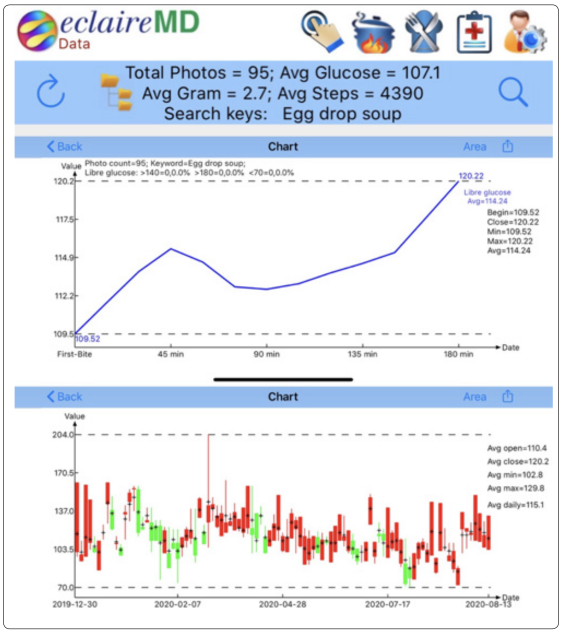


Figure 2: 95 Liquid egg meals:
Key data, Sensor PPG waveform, and candlestick K-Line chart

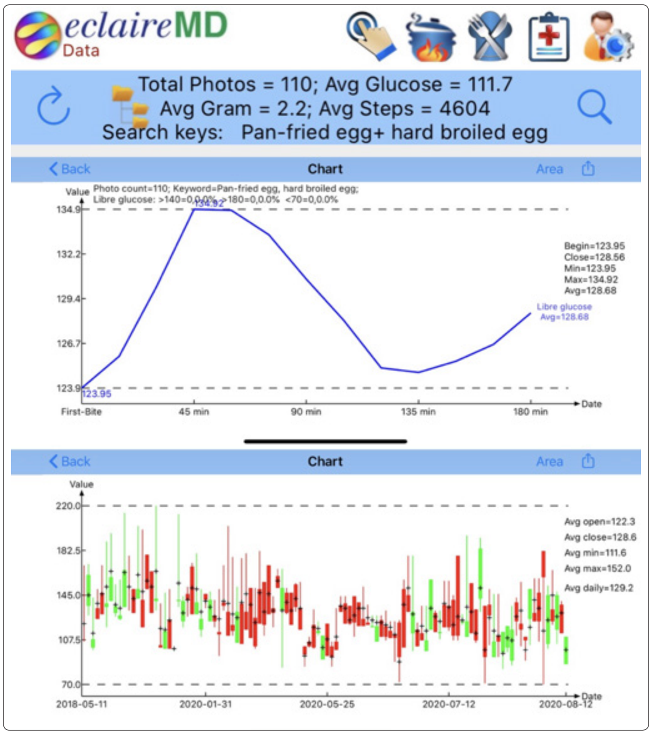


Figure 3: 110 Solid egg meals:
Key data, Sensor PPG waveform, and candlestick K-Line chart

His average sensor PPG is 114 mg/dL for liquid meals (7% higher than finger PPG), and 129 mg/dL for solid meals (15% higher than finger PPG). Their average sensor PPG difference is 15 mg/dL. But his average peak sensor PPG is 115 mg/dL for liquid meals, and 135 mg/dL for solid meals. Their peak sensor PPG difference is 20 mg/dL.

His personal target for post-meal walking is 4,000 steps. Each 1,000 post-meal steps decreases PPG value by approximately 5 mg/dL. Since his post-meal exercise for these two food categories are almost equal between 4,400 steps and 4,600 steps, he can just focus on the influence from 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 about 4 to 5 mg/dL due to the carbs/sugar intake amount, which is in small quantities and almost negligible. This finding not only proves that the finger-piercing PPG values are insignificant to his research work, it provides a hint that "something-else" is occurring.

In this particular study, the food nutritional ingredients are almost identical, but the cooking methods are completely different. Therefore, he decided to focus on his cooking method that yields 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 mind in assisting him to discover these neurological related phenomenon.

The two 3-hour PPG waveforms with their respective candlestick K-Line charts are illustrated for liquid meals and solid meals, respectively (Figures 2 and 3).

In Figure 4, it shows 5 key values of PPG from his candlestick K-Line chart technique [3&4]. Each candlestick chart has five key characteristics, which includes opening glucose at 0-minute, close glucose at 180-minutes, maximum glucose usually around 45-minutes to 75-minutes, minimum glucose usually around 120-minutes, and average glucose over a time period of 180 minutes. These five key values for liquid meals and solid meals are quite different as well.

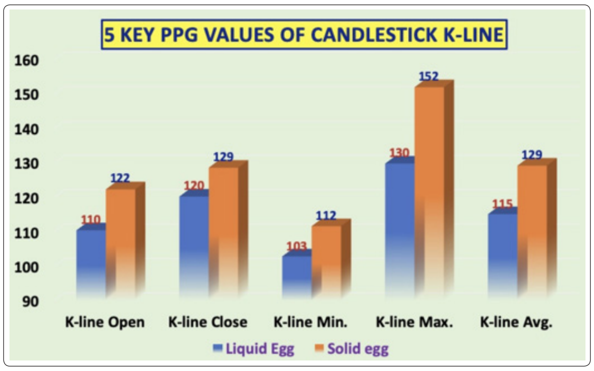


Figure 4: Comparison of 5 key values of Candlestick K-Line charts between 95 liquid egg meals and 110 solid egg meals

The most important figure in this article is shown in Figure 5. The author put two waveforms of both liquid meals and solid meals together in the same diagram.

Sensor PPG (mg/dL)	Liquid Egg	Solid egg
No. of meals	95	110
Average Sensor PPG	114	129
Post-meal Walking	4390	4604
Carbs/Sugar (grams)	2.7	2.2
Finger PPG (mg/dL)	107	112
K-line Open	110	122
K-line Close	120	129
K-line Min.	103	112
K-line Max.	130	152
K-line Avg.	115	129

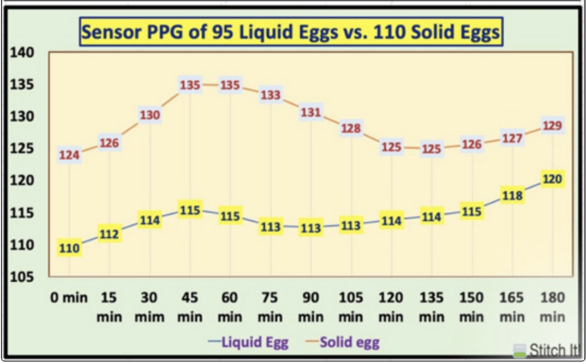


Figure 5: PPG Data and Waveform Graphics Comparison between 95 Liquid egg meals and 110 Solid egg meals

The significant PPG differences between these two food types can be easily observed. In addition, the PPG peak value differences are 20 mg/dL from both Phase 2 study and Phase 3 study, with almost identical inputs of carbs/sugar intake amounts and post-meal walking steps.

Discussion

With the same food ingredient, why do they have different PPG values? Both food's physical appearances have the same nutritional ingredient inputs; however, their different cooking or preparation methods result into different physical states, liquid or solid. Maybe the message (or signal) ascending from the stomach to the cerebral cortex is not food ingredients, but rather the food's arrival and its physical state. Therefore, the brain misinterprets soup as an equivalent to a cup of decaf-coffee, tea, or water and then the brain descends a message to the liver for producing or releasing a lesser amount of glucose.

Another point is, during the period of 5/5/2018 to 8/13/2020, his diabetes conditions were already under control without taking any medication. This means that these results are strictly the internal biological outcomes by his stringent lifestyle management program and without any external medication's chemical intervention.

The author analyzed his 2,493 meals with 32,409 PPG data for the past 831 days. 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 both liquid egg meals and solid egg meals, it takes about 45 minutes for the liver to release glucose at its peak amount. Based on his findings from his previous research work, the peak PPG occurring time instants are between 45 minutes to 75 minutes (in average, around 60 minutes) after eating.

When the author could not locate a satisfactory explanation from professional knowledge 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 by the liver. Of course, the human body and all of its internal organs, including the stomach, liver, and pancreas are dependent on the food supply for their needed energy.

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

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

Based on the above acquired biomedical knowledge, the author further developed his second hypothesis. When one particular food type enters into the gastrointestinal system, the stomach will immediately send a message (or a signal) to inform the brain about the arrival of food and its physical state. After receiving this input signal from the stomach, the brain will then start to process information, make proper judgements, and then issues its feedback message (descending marching order) to the liver regarding how much glucose amount should be produced or released at what time instant, as well as within what time frame to reach to the peak of glucose. At the same time, the brain will also inform the pancreas regarding how much insulin should be produced or released when an excessive amount of glucose has been 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 (i.e. production quantity and insulin resistance) will not be the same to influence the final PPG reading.

These two particular hypotheses support the author's view on how his neural communication model between the cerebral cortex of the brain and internal organs, specifically stomach, liver, and pancreas regarding the PPG production (during the 180 minutes period) after the first bite of meal.

Perhaps the difference in PPG readings may also be affected by the absorption factors of chyme, which is a semiliquid digested food that passes from the stomach to small intestine, consisting of gastric juices and some leftover food. In theory, chyme from solid meals is relatively dense and may take more time passing through the absorptive surface area of the small intestine, while chyme from liquid meals is mostly liquid shape and may pass through the absorptive surface more quickly. However, the author is not convinced about the absorption speed of chyme affecting the timing of peak PPG. In his findings during the Phase 2 experiments, he found that peak PPG occurred at 45 minutes for liquid meals and at 60 minutes for solid meals, while his Phase 3 experimental findings indicate that both meal type's peak PPG values took place at the same 45 minutes after eating. From his previous research findings, he has already found that the peak PPG usually occurred approximately 45 minutes to 75 minutes after eating.

Conclusions

The author conducted this special investigative experiment in three phases. All of the findings from these research phases are extremely similar to each other, with minor deviations, even though his collected experimental data size nearly doubled in each phase.

From a neuroscientific point of view, the author utilized his developed math-physical medicine methodology (MPM) and his learned biomedical knowledge to "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 changing the cooking method, it can then help many type 2 diabetes (T2D) patients to lower their peak PPG and average PPG levels without reducing or changing their food nutritional contents. Obviously, T2D patients must avoid overeating foods with high carbohydrates and sugar contents at all times.

By sharing his research findings with other fellow medical research scientists, he hopes that they can provide some better explanations, more proof, or further justifications by using a different or traditional research methodology, such as the biochemical medicine (BCM) approach.

References

1. Gerald C Hsu (2020) "Hypothesis on glucose production communication model between the brain and internal organs via investigating the PPG values of pan-fried solid egg meal vs. egg drop liquid soup meal using GH Method: Math-Physical Medicine (No. 229)" 2: 1-3.
2. Gerald C Hsu (2020) "Physical evidence of neural communication among brain, stomach, and liver via PPG waveform differences between liquid food and solid food (No. 266)." 1: 1-3.
3. Gerald C Hsu (2020) "Using Candlestick Charting Techniques to Investigate Glucose Behaviors using GH-Method: Math-Physical Medicine (No. 76)."
4. Hsu, Gerald C. eclaireMD Foundation, USA. "Comparison study of PPG characteristics from candlestick model using GH-Method: Math-Physical Medicine (No. 261)."
5. Templeton David (2020) "Pitt study shows brain and stomach connections are a two-way street" Pittsburgh Post-Gazette.

Copyright: ©2020 Gerald C. Hsu. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.