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Research Article

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Postprandial Plasma Glucose Lower and Upper Boundary Study Using Two Glucose Coefficients of GH-Modulus from Linear Elastic Glucose Theory Based on GH-Method: Math-Physical Medicine, Part 9 (No. 361)

Gerald C. Hsu

EclaireMD Foundation, USA

***Corresponding author**
Gerald C. Hsu, EclaireMD Foundation, USA

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Abstract

This article is Part 9 of the author's linear elastic glucose behavior study, which focuses on searching for an applicable data range of two glucose coefficients of both GH.f-modules and GH.p-modules via lower bound and upper bounds of predicted postprandial plasma glucose (PPG) values which would be useful to most type 2 diabetes (T2D) patients.

The linear elastic glucose behavior equation is:

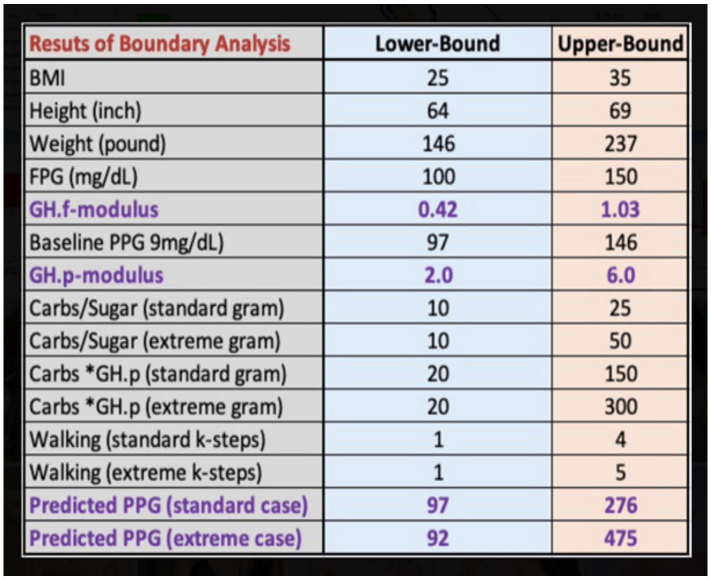
*Predicted PPG = (0.97 * GH.f-modulus * Weight) + (GH.p-modulus * Carbs&sugar) - (post-meal walking k-steps * 5)*

This equation is useful in predicting PPG values and helping patients with their diabetes control.

Here is the step-by-step PPG boundary analysis of the eight standard cases using linear elastic glucose theory as described in this paper [10, 17]:

1. *Baseline PPG has only two values, i.e. using lower bound of FPG 100*0.97 = 97, and upper bound of FPG 150*0.97 =146*
2. *plus carbs/sugar intake amount's lower bound of 10 grams of carbs/sugar intake: 97+10*GH.p 2.0 = 97+20 = 117 mg/dL, and higher bound of 25 grams of carbs/sugar intake: 146 + 25*6.0 = 146+150 = 296 mg/dL*
3. *minus post-meal walking k-steps' lower bound of 4K steps: -5*4 = - 20 = 117-20 =97 mg/dL, and higher bound of 1K steps: -5*1 = -5 = 296-5 = 291 mg/dL*
4. *Therefore, the boundary of predicted PPG shows data is located within the numerical range of lower bound of 97 mg/dL & upper bound of 291 mg/dL.*

The author has demonstrated the biomedical meaning and data sensitivity of these two glucose coefficients of GH.f-modulus and GH.p-modulus. From clinical viewpoints, the applicable glucose data range using the calculated lower and upper bounds of PPG values for the eight standard cases seems reasonable.



Resuts of Boundary Analysis	Lower-Bound	Upper-Bound
BMI	25	35
Height (inch)	64	69
Weight (pound)	146	237
FPG (mg/dL)	100	150
GH.f-modulus	0.42	1.03
Baseline PPG 9mg/dL)	97	146
GH.p-modulus	2.0	6.0
Carbs/Sugar (standard gram)	10	25
Carbs/Sugar (extreme gram)	10	50
Carbs *GH.p (standard gram)	20	150
Carbs *GH.p (extreme gram)	20	300
Walking (standard k-steps)	1	4
Walking (extreme k-steps)	1	5
Predicted PPG (standard case)	97	276
Predicted PPG (extreme case)	92	475

Introduction

This article is Part 9 of the author's linear elastic glucose behavior study, which focuses on searching for an applicable data range of two glucose coefficients of both GH.f-modules and GH.p-modules via lower bound and upper bounds of predicted postprandial plasma glucose (PPG) values which would be useful to most type 2 diabetes (T2D) patients.

Methods

Background

To learn more about the author's GH-Method: math-physical medicine (MPM) methodology, readers can refer to his article to understand his developed MPM analysis method in Reference 1.

Highlights of His Related Research & Engineering Theory of Elasticity

The readers can view the details of his previous research work related to this subject in the Reference. He would like to present again the linear elastic equation of the predicted PPG with two glucose coefficients of both GH.f-modules and GH.p-modules:

Predicted PPG =(0.97 * GH.f-modulus * Weight) + (GH.p-modulus * Carbs&sugar) - (post-meal walking k-steps * 5)

Where
fasting plasma glucose (FPG)= Weight * GH.f-modulus

By using this equation, a patient only needs the input data of body weight, carbs & sugar intake amount, and post-meal walking steps in order to calculate the predicted PPG without obtaining any measured glucose data.

Linear Elastic Glucose Behaviors

By utilizing the concept of Young's modulus with stress and strain, which the author learned from engineering schools, he has initiated and engaged this linear elastic glucose behaviors research since 10/14/2020. The following paragraphs describe his research findings during the past month:

First, he discovered that there is a "pseudo-linear" relationship existed between carbs & sugar intake amount and incremental PPG amount. Based on this finding, he defined his first glucose coefficient of GH.p-modulus for PPG.

Second, similar to Young's modulus relating to stiffness of engineering inorganic materials, he found that the GH.p-modulus is depended upon the patient's severity level of obesity and diabetes, i.e. health conditions.

Third, comparable to GH.p-modulus for PPG, he uncovered a similar pseudo-linear relationship existing between weight and FPG in 2017. Therefore, he defined his second glucose coefficient of GH.f-modulus for FPG.

Fourth, he inserted these two glucose coefficients, GH.p-modulus and GH.f-modulus, into the PPG prediction equation to remove the burden of collecting measured glucoses by patients.

Fifth, by experimenting and calculating many predicted PPG values over a variety of time length from different diabetes patients with different health conditions, he finally revealed that GH.p-modulus seems to be "near-constant" or "pseudo-linearized" over a short period of 3 to 4 months. This short period is compatible with the known lifespan of red blood cells, which are living organic cells, which are different from the engineering inorganic materials, such as steel or concrete. The same conclusion was also observed using the monthly GH.p-modulus data from one particular patient during the 2020 COVID-19 period.

Sixth, he used three clinical cases during the 2020 COVID-19 period to delve into the hidden characteristics of the physical parameters and their biomedical relationships. More importantly, through the comparison study in Part 7, he was able to identify more biomedical interpretations of his two defined glucose coefficients of GH.p-modulus and GH.f-modulus.

Data Processing In This Article

First, he used the average height of a US male (5'9") and US female (5'4") and two BMI values, 25 for normal weight and 35 for obesity, to separate his hypothetical data into four general groups, i.e. normal male, obese male, normal female, and obese female. He then used two different diabetes levels, normal FPG at 100 mg/dL and diabetic FPG at 150 mg/dL, to further separate them into eight standard cases.

Second, he calculated the first glucose coefficient of GH.f-modulus using the following formula:

GH.f-modulus = FPG / Weight

In this way, he was able to obtain eight different GH.f-modulus values, which are corresponding to eight individual standard cases.

Third, he calculated the baseline PPG value using the following formula:

Baseline PPG
*= 0.97 * FPG*
*= 0.97 * Weight * GH.f-modulus*

He noticed from his calculated results that due to his specific definition of standard cases, there are only two fixed values of Baseline PPG, which are 97 mg/dL for a non-diabetic person and 146 mg/dL for a diabetic person, regardless of gender and weight.

Fourth, he selected two extreme-end values of the GH.p-modulus, i.e. 2.0 for the case where glucose is quite insensitive to carbs/sugar intake amount (i.e. non-severe diabetes) and 6.0 for the case where glucose is extremely sensitive to carbs/sugar intake amount (i.e. severe diabetes), in calculating the PPG influences from food intake. He believes that, in reality, for most diabetes patients the GH.p-modulus values are within the range between 2.0 to 6.0. Furthermore, he selected four levels of carbs/sugar intake amounts, i.e. 10g, 15g, 20g, and 25g for his calculation using either 2.0 or 6.0 for GH.p-modulus values. He assumed that for most diabetes patients' health concerns, their average carbs/sugar intake amount should be under 25 grams per meal. Otherwise, their diabetes conditions would be very difficult to control via a lifestyle management approach unless they are on numerous medications. For any patient who does follow the author's suggestion regarding diet, then this carbs/sugar intake amount recommendation would be very helpful to him or her. From a mathematical viewpoint, in the later part of this article, the author has also conducted an extreme "stress test" of 50 grams per meal of carbs/sugar intake amount, which would push this hypothetical patient's PPG level up to 475 mg/dL. This hyperglycemia situation does happen to some severe diabetes patients.

Fifth, he calculated the increased PPG amount due to food by using the following formula:

Increased PPG by food
= Carbs/sugar * GH.p-modulus

Sixth, he selected four exercise levels of post-meal waking steps of 1k, 2k, 3k, and 4k. In his extreme "stress test", he also added in a 5k walking steps of exercise to further reduce his predicted PPG by an additional 5 mg/dL. Over the past 7 years, the author's average post-meal walking is approximately 4,500 steps. Therefore, he does understand how much of an effort is needed to maintain this good habit.

Seventh, he calculated the decreased PPG amount due to exercise by using the following formula:

Decreased PPG by walking= Walking k-steps * 5

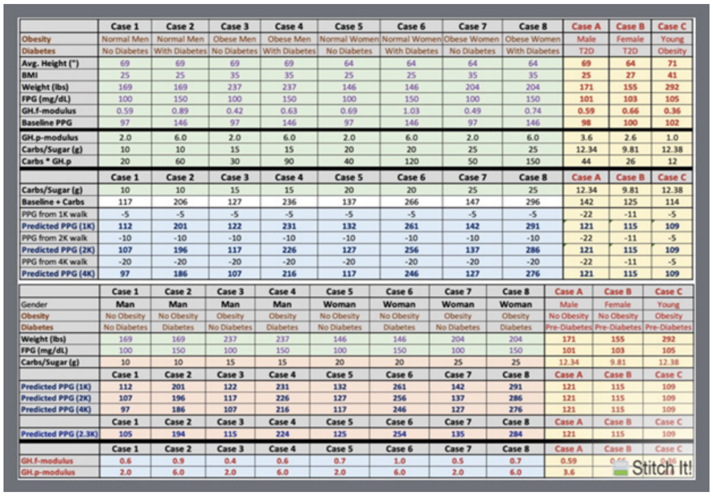
Eighth, he could calculate the predicted PPG by using the following formula:

Predicted PPG
= Baseline PPG + PPG by carbs/sugar - PPG by walking= (0.97 * Weight * GH.f-modulus) + (Carbs/sugar * GH.p-modulus) - (Walking k-steps * 5)

Finally, the ninth step is to use these 256-separated calculation groups (256 = 8*2*4*4) from his detailed calculations to figure out the PPG "boundaries", i.e. the lower bound and upper bound of the predicted PPG values. He then checked those boundaries against the realistic biomedical boundary of clinical diabetes conditions.

In this study, he used Excel to conduct his grouping boundary calculations instead of writing a customized software for this task. After obtaining more proof, evidence, and validation, he would consider in transforming the above steps and calculations into an APP program for the mobile phones for use by a larger pool of diabetes patients.

Results



	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case A	Case B	Case C
Obesity	Normal Men	Normal Men	Obese Men	Obese Men	Normal Women	Normal Women	Obese Women	Obese Women	Male	Female	Young
Diabetes	No Diabetes	With Diabetes	No Diabetes	With Diabetes	No Diabetes	With Diabetes	No Diabetes	With Diabetes	T2D	T2D	Obesity
Avg. Height (")	69	69	69	69	64	64	64	64	69	64	71
BMI	25	25	35	35	25	25	35	35	25	27	41
Weight (lbs)	169	169	237	237	146	146	204	204	171	155	292
FPG (mg/dL)	100	150	100	150	100	150	100	150	101	103	105
GH.f-modulus	0.59	0.89	0.42	0.63	0.69	1.03	0.49	0.74	0.59	0.66	0.36
Baseline PPG	97	146	97	146	97	146	97	146	98	100	102
GH.p-modulus	2.0	6.0	2.0	6.0	2.0	6.0	2.0	6.0	3.6	2.6	1.0
Carbs/Sugar (g)	10	10	15	15	20	20	25	25	12.34	9.81	12.38
Carbs * GH.p	20	60	30	90	40	120	50	150	44	26	12
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case A	Case B	Case C
Carbs/Sugar (g)	10	10	15	15	20	20	25	25	12.34	9.81	12.38
Baseline + Carbs	117	206	127	236	137	266	147	296	142	125	114
PPG from 1K walk	-5	-5	-5	-5	-5	-5	-5	-5	-22	-11	-5
Predicted PPG (1K)	112	201	122	231	132	261	142	291	121	115	109
PPG from 2K walk	-10	-10	-10	-10	-10	-10	-10	-10	-22	-11	-5
Predicted PPG (2K)	107	196	117	226	127	256	137	286	121	115	109
PPG from 4K walk	-20	-20	-20	-20	-20	-20	-20	-20	-22	-11	-5
Predicted PPG (4K)	97	186	107	216	117	246	127	276	121	115	109
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case A	Case B	Case C
Gender	Man	Man	Man	Man	Woman	Woman	Woman	Woman	Male	Female	Young
Obesity	No Obesity	No Obesity	Obesity	Obesity	No Obesity	No Obesity	Obesity	Obesity	No Obesity	No Obesity	Obesity
Diabetes	No Diabetes	Diabetes	No Diabetes	Diabetes	No Diabetes	Diabetes	No Diabetes	Diabetes	Pre-Diabetes	Pre-Diabetes	Pre-Diabetes
Weight (lbs)	169	169	237	237	146	146	204	204	171	155	292
FPG (mg/dL)	100	150	100	150	100	150	100	150	101	103	105
Carbs/Sugar (g)	10	10	15	15	20	20	25	25	12.34	9.81	12.38
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case A	Case B	Case C
Predicted PPG (1K)	112	201	122	231	132	261	142	291	121	115	109
Predicted PPG (2K)	107	196	117	226	127	256	137	286	121	115	109
Predicted PPG (4K)	97	186	107	216	117	246	127	276	121	115	109
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case A	Case B	Case C
Predicted PPG (2.3K)	105	194	115	224	125	254	135	284	121	115	109
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case A	Case B	Case C
GH.f-modulus	0.6	0.9	0.4	0.6	0.7	1.0	0.5	0.7	0.59	[illegible]	0.36
GH.p-modulus	2.0	6.0	2.0	6.0	2.0	6.0	2.0	6.0	3.6	[illegible]	[illegible]

Figure 1: Data table and calculation table of 8 standard cases and 3 clinical cases

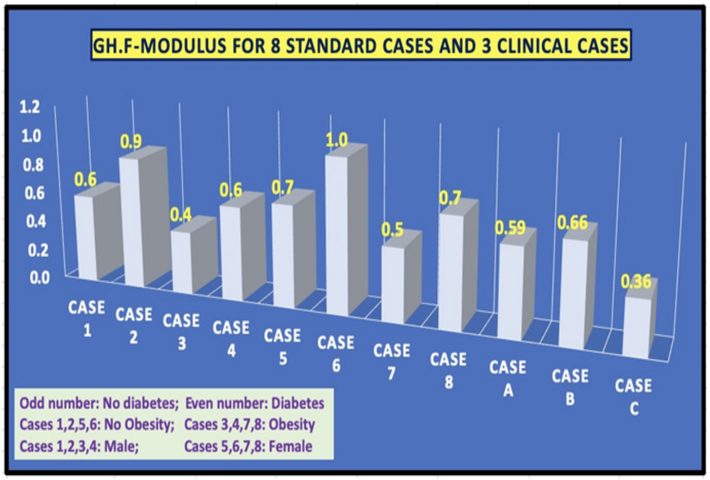
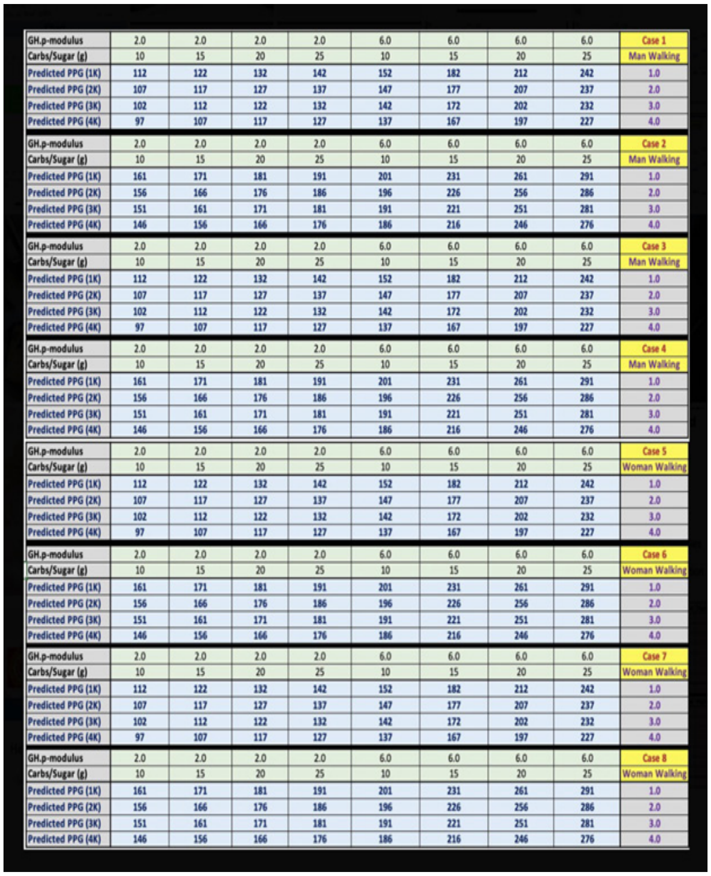


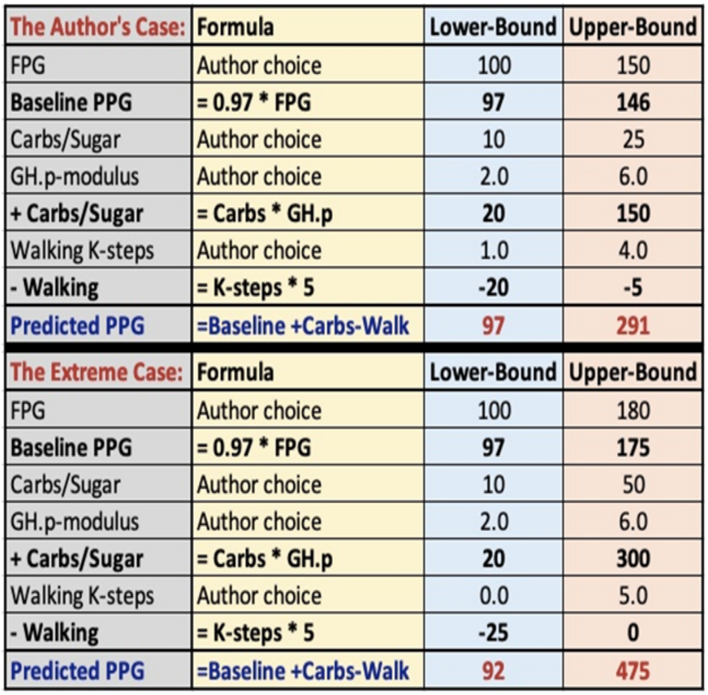
Figure 2: Different Glucose coefficients of GH.f-modulus for 8 standard cases and 3 clinical cases



GH.p-modulus	2.0	2.0	2.0	2.0	6.0	6.0	6.0	6.0	Case 1
Carbs/Sugar (g)	10	15	20	25	10	15	20	25	Man Walking
Predicted PPG (1K)	112	122	132	142	152	182	212	242	1.0
Predicted PPG (2K)	107	117	127	137	147	177	207	237	2.0
Predicted PPG (3K)	102	112	122	132	142	172	202	232	3.0
Predicted PPG (4K)	97	107	117	127	137	167	197	227	4.0
GH.p-modulus	2.0	2.0	2.0	2.0	6.0	6.0	6.0	6.0	Case 2
Carbs/Sugar (g)	10	15	20	25	10	15	20	25	Man Walking
Predicted PPG (1K)	161	171	181	191	201	231	261	291	1.0
Predicted PPG (2K)	156	166	176	186	196	226	256	286	2.0
Predicted PPG (3K)	151	161	171	181	191	221	251	281	3.0
Predicted PPG (4K)	146	156	166	176	186	216	246	276	4.0
GH.p-modulus	2.0	2.0	2.0	2.0	6.0	6.0	6.0	6.0	Case 3
Carbs/Sugar (g)	10	15	20	25	10	15	20	25	Man Walking
Predicted PPG (1K)	112	122	132	142	152	182	212	242	1.0
Predicted PPG (2K)	107	117	127	137	147	177	207	237	2.0
Predicted PPG (3K)	102	112	122	132	142	172	202	232	3.0
Predicted PPG (4K)	97	107	117	127	137	167	197	227	4.0
GH.p-modulus	2.0	2.0	2.0	2.0	6.0	6.0	6.0	6.0	Case 4
Carbs/Sugar (g)	10	15	20	25	10	15	20	25	Man Walking
Predicted PPG (1K)	161	171	181	191	201	231	261	291	1.0
Predicted PPG (2K)	156	166	176	186	196	226	256	286	2.0
Predicted PPG (3K)	151	161	171	181	191	221	251	281	3.0
Predicted PPG (4K)	146	156	166	176	186	216	246	276	4.0
GH.p-modulus	2.0	2.0	2.0	2.0	6.0	6.0	6.0	6.0	Case 5
Carbs/Sugar (g)	10	15	20	25	10	15	20	25	Woman Walking
Predicted PPG (1K)	112	122	132	142	152	182	212	242	1.0
Predicted PPG (2K)	107	117	127	137	147	177	207	237	2.0
Predicted PPG (3K)	102	112	122	132	142	172	202	232	3.0
Predicted PPG (4K)	97	107	117	127	137	167	197	227	4.0
GH.p-modulus	2.0	2.0	2.0	2.0	6.0	6.0	6.0	6.0	Case 6
Carbs/Sugar (g)	10	15	20	25	10	15	20	25	Woman Walking
Predicted PPG (1K)	161	171	181	191	201	231	261	291	1.0
Predicted PPG (2K)	156	166	176	186	196	226	256	286	2.0
Predicted PPG (3K)	151	161	171	181	191	221	251	281	3.0
Predicted PPG (4K)	146	156	166	176	186	216	246	276	4.0
GH.p-modulus	2.0	2.0	2.0	2.0	6.0	6.0	6.0	6.0	Case 7
Carbs/Sugar (g)	10	15	20	25	10	15	20	25	Woman Walking
Predicted PPG (1K)	112	122	132	142	152	182	212	242	1.0
Predicted PPG (2K)	107	117	127	137	147	177	207	237	2.0
Predicted PPG (3K)	102	112	122	132	142	172	202	232	3.0
Predicted PPG (4K)	97	107	117	127	137	167	197	227	4.0
GH.p-modulus	2.0	2.0	2.0	2.0	6.0	6.0	6.0	6.0	Case 8
Carbs/Sugar (g)	10	15	20	25	10	15	20	25	Woman Walking
Predicted PPG (1K)	161	171	181	191	201	231	261	291	1.0
Predicted PPG (2K)	156	166	176	186	196	226	256	286	2.0
Predicted PPG (3K)	151	161	171	181	191	221	251	281	3.0
Predicted PPG (4K)	146	156	166	176	186	216	246	276	4.0

Figure 3: Data table of food influences and predicted PPG for 8 standard cases

Figure 4 reflects the upper and lower bounds of the predicated PPG values of eight standard cases. Each standard case contains 32 (=2 GH.p * 4 carbs/sugar * 4 walking) sets of detailed calculations. Nevertheless, he chose the lowest PPG value of 97 mg/dL as the lower bound value and the highest PPG value of 291 mg/dL as the upper bound value for these eight hypothetical standard cases. In this diagram, he also performed an extreme "stress test" by increasing the carbs/sugar intake amount to 50 grams for pushing the PPG value or by increasing the walking steps to 5k steps for reducing the PPG value. This stress test has provided a new lower bound PPG of 92 mg/dL by walking 5k steps and a new upper bound PPG of 475 mg/dL by consuming 50 grams of carbs/sugar per meal. Based on the author's personal experience and his collected glucose record regarding his diabetes conditions, this lower bound of 97 mg/dL and upper bound of 271 mg/dL are quite close to his own collected glucose data range. By observing other T2D patients, the lower bound of 92 mg/dL and upper bound of 475 mg/dL for extreme stress test are also feasible. In Figure 5, he shows his past PPG record of post-lunch PPG of 280 mg/dL from consuming a local island food and sweets in Hawaii in May of 2018. This extreme high PPG value must accompany with a higher GH.p-modulus value, which also reveals his glucose's super sensitivity to carbs/sugar intake at that time. In other words, this GH.p-modulus reflects the overall health conditions of his liver and pancreatic beta cells at that time.



The Author's Case:	Formula	Lower-Bound	Upper-Bound
FPG	Author choice	100	150
Baseline PPG	**= 0.97 * FPG**	**97**	**146**
Carbs/Sugar	Author choice	10	25
GH.p-modulus	Author choice	2.0	6.0
+ Carbs/Sugar	**= Carbs * GH.p**	**20**	**150**
Walking K-steps	Author choice	1.0	4.0
- Walking	**= K-steps * 5**	**-20**	**-5**
Predicted PPG	**=Baseline +Carbs-Walk**	**97**	**291**

The Extreme Case:	Formula	Lower-Bound	Upper-Bound
FPG	Author choice	100	180
Baseline PPG	**= 0.97 * FPG**	**97**	**175**
Carbs/Sugar	Author choice	10	50
GH.p-modulus	Author choice	2.0	6.0
+ Carbs/Sugar	**= Carbs * GH.p**	**20**	**300**
Walking K-steps	Author choice	0.0	5.0
- Walking	**= K-steps * 5**	**-25**	**0**
Predicted PPG	**=Baseline +Carbs-Walk**	**92**	**475**

Figure 4: Lower bound and Upper bound of Predicted PPG values from 8 standard cases and the extreme "stress test" case

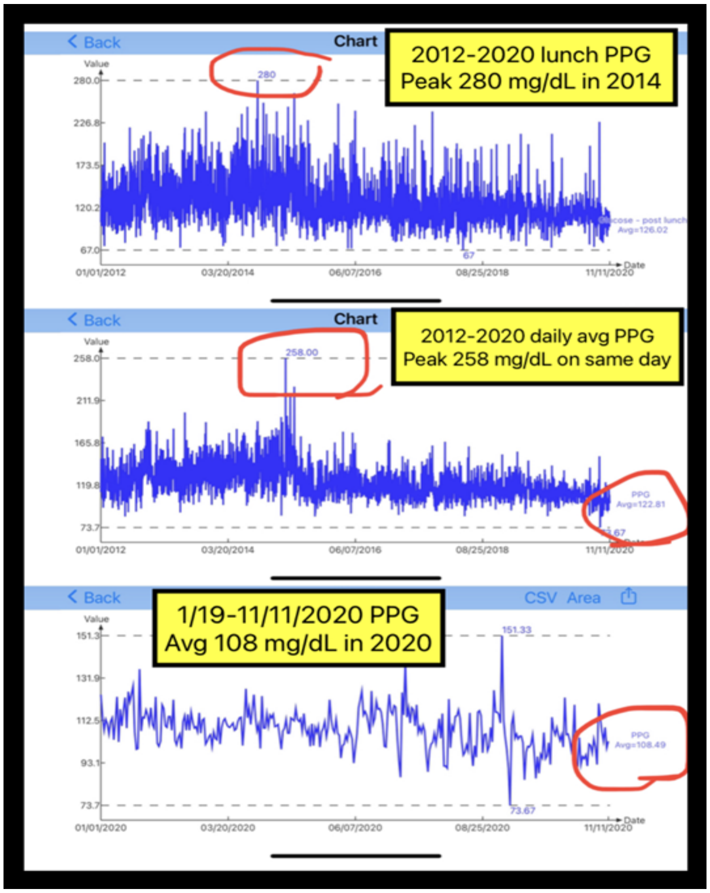


Figure 5: Clinical Case A's hyperglycemia data example in May of 2015

In Figure 6, he applied a special 4-dimensional presentation diagram developed by him as described in Reference 17 to graphically present these four extreme PPG locations together in terms of their close relationships with carbs/sugar and post-meal walking along with the hidden relationship with GH.f-modulus (weight and FPG) and GH.p-modulus (diet and exercise). This special 4-dimensional diagram can clearly present the four PPG boundary points.

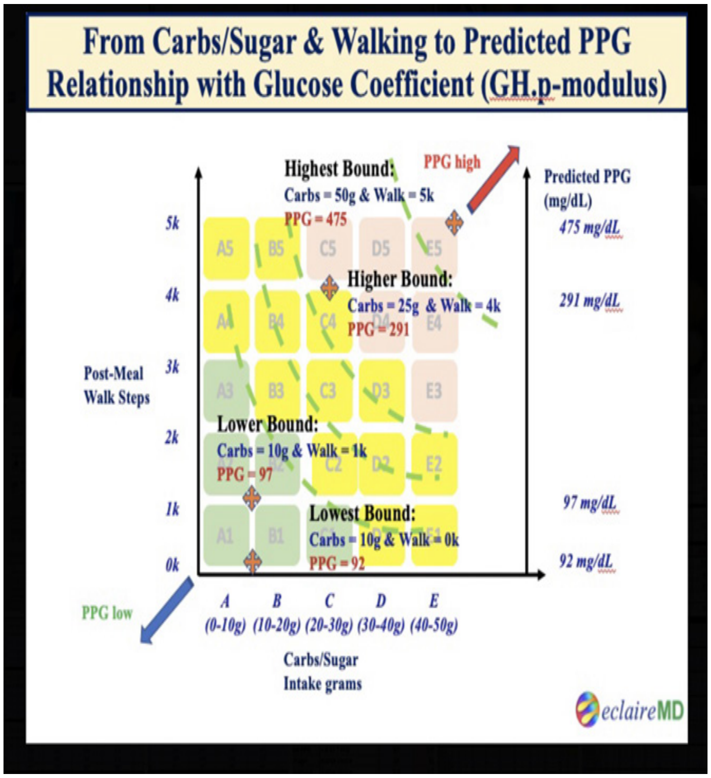
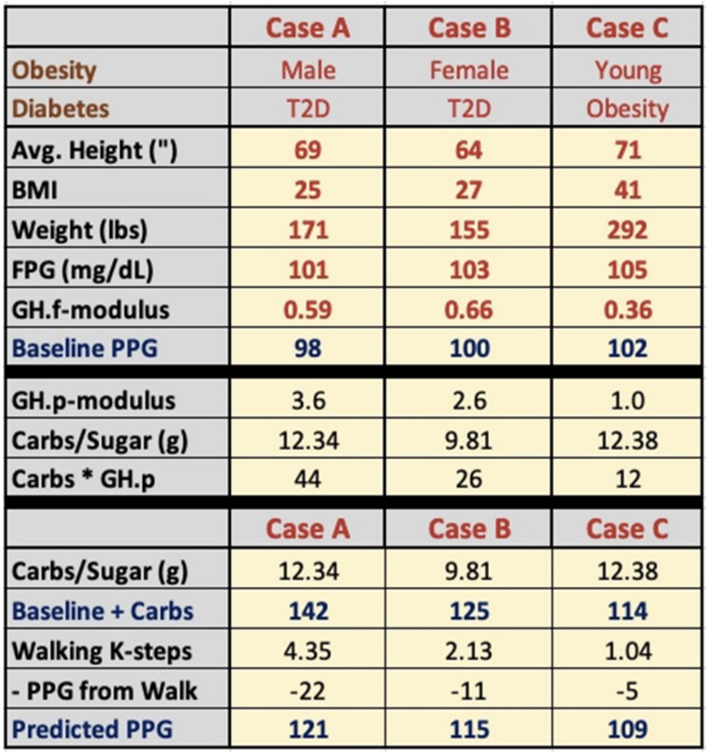


Figure 6: A special 4-dimensional representation of upper bound and lower bound of predicted PPG values, including carbs/sugar, walking, PPG, and the "hidden" GH.p-modulus

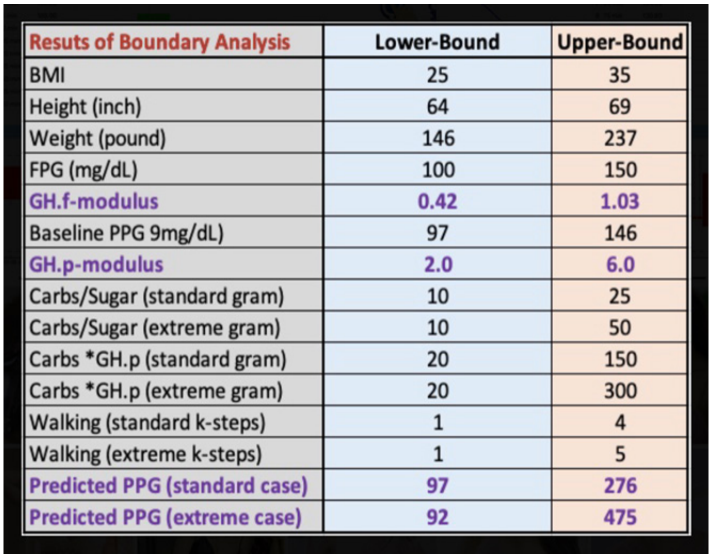
Some results in Figure 7 are recopied from Part 1 through Part 8 of his research work [10, 17]. The three clinical cases are different from the eight standard cases since each case has a unique set of input data (weight, FPG, carbs, walking, GH-modulus) and output data (GH-modulus and PPG) instead of the eight standard cases constituting a "numerical range" of input and output data. As a comparison, the three clinical cases data are very well located within the data range (i.e., from lower bound to upper bound) of the eight standard cases. It should be pointed out that the results from the clinical cases are more skewed toward the lower bound side of the eight standard cases, which means that their diabetes condition are quite well under control.



	Case A	Case B	Case C
Obesity	Male	Female	Young
Diabetes	T2D	T2D	Obesity
Avg. Height (")	69	64	71
BMI	25	27	41
Weight (lbs)	171	155	292
FPG (mg/dL)	101	103	105
GH.f-modulus	0.59	0.66	0.36
Baseline PPG	98	100	102
GH.p-modulus	3.6	2.6	1.0
Carbs/Sugar (g)	12.34	9.81	12.38
Carbs * GH.p	44	26	12
	Case A	Case B	Case C
Carbs/Sugar (g)	12.34	9.81	12.38
Baseline + Carbs	142	125	114
Walking K-steps	4.35	2.13	1.04
- PPG from Walk	-22	-11	-5
Predicted PPG	121	115	109

Figure 7: Predicted Glucose values of 3 clinical cases

Figure 8 shows the summarized results of lower bound and upper bound of predicted PPG boundary analysis.



Resuts of Boundary Analysis	Lower-Bound	Upper-Bound
BMI	25	35
Height (inch)	64	69
Weight (pound)	146	237
FPG (mg/dL)	100	150
GH.f-modulus	0.42	1.03
Baseline PPG 9mg/dL)	97	146
GH.p-modulus	2.0	6.0
Carbs/Sugar (standard gram)	10	25
Carbs/Sugar (extreme gram)	10	50
Carbs *GH.p (standard gram)	20	150
Carbs *GH.p (extreme gram)	20	300
Walking (standard k-steps)	1	4
Walking (extreme k-steps)	1	5
Predicted PPG (standard case)	97	276
Predicted PPG (extreme case)	92	475

Figure 8: Results of lower bound and upper bound of predicted PPG boundary analysis

Conclusions

The linear elastic glucose behavior equation is:

Predicted PPG =
(0.97 * GH.f-modulus * Weight) + (GH.p-modulus * Carbs&sugar) - (post-meal walking k-steps * 5)

This equation is useful in predicting PPG values and helping patients with their diabetes control.

Here is the step-by-step PPG boundary analysis of the eight standard cases using linear elastic glucose theory as described in this paper [10, 17]:

1. ***Baseline PPG** has only two values, i.e. using lower bound of FPG 100*0.97 = 97, and upper bound of FPG 150*0.97 =146*
2. ***plus** carbs/sugar intake amount's lower bound of 10 grams of carbs/sugar intake: 97+10*GH.p 2.0 = 97+20 = 117 mg/dL, and higher bound of 25 grams of carbs/sugar intake: 146 + 25*6.0 = 146+150 = 296 mg/dL*
3. ***minus** post-meal walking k-steps' lower bound of 4K steps: -5*4 = - 20 = 117-20 =97 mg/dL, and higher bound of 1K steps: -5*1 = -5 = 296-5 = 291 mg/dL*
4. *Therefore, the boundary of predicted PPG shows data is located within the numerical range of lower bound of 97 mg/dL & upper bound of 291 mg/dL.*

The author has demonstrated the biomedical meaning and data sensitivity of these two glucose coefficients of GH.f-modulus and GH.p-modulus. From clinical viewpoints, the applicable glucose data range using the calculated lower and upper bounds of PPG values for the eight standard cases seems reasonable [1-17].

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References

1. Hsu Gerald C (2020) Biomedical research methodology based on GH-Method: math-physical medicine (No. 310). Journal of Applied Material Science & Engineering Research 4: 116-124.
2. Hsu Gerald C (2020) Application of linear equations to predict sensor and finger based postprandial plasma glucoses and daily glucoses for pre-virus, virus, and total periods using GH-Method: math-physical medicine (No. 345).
3. Hsu Gerald C (2020) A simplified yet accurate linear equation of PPG prediction model for T2D patients using GH-Method: math-physical medicine (No. 97). Diabetes and Weight Management 1: 9-11.
4. Hsu Gerald C (2020) Application of linear equation-based PPG prediction model for four T2D clinic cases using GH-Method: math-physical medicine (No. 99).
5. Hsu Gerald C (2020) Self-recovery of pancreatic beta cell's insulin secretion based on 10+ years annualized data of food, exercise, weight, and glucose using GH-Method: math-physical medicine (No. 339). Internal Med Res Open J 5: 1-7.
6. Hsu Gerald C (2020) A neural communication model between brain and internal organs, specifically stomach, liver, and pancreatic beta cells based on PPG waveforms of 131 liquid egg meals and 124 solid egg meals (No. 340).
7. Hsu Gerald C (2020) Using Math-Physics Medicine to Predict FPG (No. 349). Archives of Nutrition and Public Health 2.
8. Hsu Gerald C (2020) Community and Family Medicine via Doctors without distance: Using a simple glucose control card to assist T2D patients in remote rural areas via GH-Method: math-physical medicine (No. 264).
9. Hsu Gerald C (2020) Investigation on GH modulus of linear elastic glucose with two diabetes patients' data using GH-Method: math-physical medicine, Part 2 (No. 349).
10. Hsu Gerald C (2020) Linear relationship between carbohydrates & sugar intake amount and incremental PPG amount via engineering strength of materials using GH-Method: math-physical medicine, Part 1 (No. 346).
11. Hsu Gerald C (2020) Investigation on GH modulus of linear elastic glucose with two diabetes patients' data using GH-Method: math-physical medicine, Part 2 (No. 349).
12. Hsu Gerald C (2020) Investigation of GH modulus on the linear elastic glucose behavior based on three diabetes patients' data using the GH-Method: math-physical medicine, Part 3 (No. 349).
13. Hsu Gerald C (2020) Coefficient of GH.f-modulus in the linear elastic fasting plasma glucose behavior study based on health data of three diabetes patients using the GH-Method: math-physical medicine, Part 4 (No. 356).
14. Hsu Gerald C (2020) High accuracy of predicted postprandial plasma glucose using two coefficients of GH.f-modulus and GH.p-modulus from linear elastic glucose behavior theory based on GH-Method: math-physical medicine, Part 5 (No. 357).
15. Hsu Gerald C (2020) Improvement on the prediction accuracy of postprandial plasma glucose using two biomedical coefficients of GH-modulus from linear elastic glucose theory based on GH-Method: math-physical medicine, Part 6 (No. 358).
16. Hsu Gerald C (2020) High glucose predication accuracy of postprandial plasma glucose and fasting plasma glucose during the COVID-19 period using two glucose coefficients of GH-modulus from linear elastic glucose theory based on GH-Method: math-physical medicine, Part 7 (No. 359).
17. Hsu Gerald C (2020) Investigation of two glucose coefficients of GH.f-modulus and GH.p-modulus based on data of 3 clinical cases during COVID-19 period using linear elastic glucose theory of GH-Method: math-physical medicine, Part 8 (No. 360).