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Accuracy of Predicted Glucose Using Both Natural Intelligence and Artificial Intelligence via GH-Method: Math-Physical Medicine (No. 320)

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Abstract

This paper describes the accuracy of using natural intelligence (NI) and artificial intelligence (AI) methods to predict three glucose, including fasting plasma glucose (FPG), postprandial plasma glucose (PPG), and daily average glucose, in comparison with the actual measured PPG by using the finger-piercing (Finger) method. The entire glucose database contains 7,652 glucose values (4 glucose data per day) over 1,913 days from 6/1/2015 to 8/27/2020. The most significant three conclusions are listed as follows: (1) NI-based PPG prediction has an accuracy of 99.8%. (2) NI-based daily glucose prediction has an accuracy of 100%, which is the most important factor for diabetes control. (3) Overall, NI-predicted glucose vs. finger-measured glucose has an accuracy of 99.3%, while AI-predicted glucose vs. finger-measured glucose has an accuracy of 98.8%. NI prediction is better than AI prediction by 0.5%. The author developed this tool with built-in AI capabilities, including auto-learning and auto-correction to make the system smarter and more accurate with additional data input. As a result, the AI prediction accuracy reached 98.8% and NI prediction accuracy reached 99.3% based on a relatively large dataset from a period of 1,913 days with 7,652 glucose values. The author observed AI and NI curves with a remarkably similar pattern (correlation of 94%), but the NI accuracy is still 0.5% better than the AI accuracy. This makes sense since his brain's NI knowledge created his AI tool. In summary, this article demonstrates the power and usefulness of GH-Method: math-physical medicine, including AI to win the war against diabetes. He believes that these glucose prediction methods can be used as a practical tool for other type 2 diabetes (T2D) patients to control their daily conditions of diabetes without the cumbersome, painful, and costly traditional glucose finger-piercing test method. This is a good example of what and how mathematics, physics, and AI technology can contribute to medicine.

Keywords: Type 2 diabetes; Natural intelligence; Artificial intelligence; Brain

Abbreviations: T2D: type 2 diabetes; NI: natural intelligence; AI: artificial intelligence; FPG: fasting plasma glucose; PPG: postprandial plasma glucose; MPM: math-physical medicine

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1. INTRODUCTION

This paper describes the accuracy of using natural intelligence (NI) and artificial intelligence (AI) methods to predict three glucose, including fasting plasma glucose (FPG), postprandial plasma glucose (PPG), and daily average glucose, in comparison with the actual measured PPG by using the finger-piercing (Finger) method. The entire glucose database contains 7,652 glucose values (4 glucose data per day) over 1,913 days from 6/1/2015 to 8/27/2020.

2. METHODS

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

2.1 Food database

Starting in 2010, the author self-studied food nutrition science and four chronic diseases, including obesity, diabetes, hypertension, and hyperlipidemia.

He spent his first two years from 2011 to 2013 building a large food database containing 6 million USDA food nutrition data and ~1.6 million re-organized franchise restaurant nutritional databases from different public sources. Beginning on 5/1/2015, he kept all of his meal data with three meal photos per day. To date, he collected a total of 5,739 meal photos which have ~0.5 million personal meal nutritional data. In total, his food database contains ~8 million data. It should be noted that each photo taken by an iPhone contains 20 million pixels and each lighting pixel is expressed by a unique 8 alpha-numerical digits combination. Therefore, each meal picture contains 160 million digits and 5,739 meal pictures equate to 57.39 billion digits. This kind of mathematical calculation is indeed a “big data” operation.

2.2 NI and AI

The author then defined a new terminology of natural intelligence as “NI” in comparison with artificial intelligence or “AI”. NI uses his eyes to receive various observed food information from the meal photos, then his brain processes the information based on the past 10 years of study and learning this subject.

The author learned the subject of “machine learning” before the term “artificial intelligence” was invented. He dedicated most of his professional career to AI technology development and its various applications in different industries, including spending 14 years on the auto-design of semiconductor chips using AI. It is his opinion that human brain power is always superior to computing power, at least in the arena of logical judgment and decision-making, in the foreseeable future. Therefore, he hopes that his NI-based prediction results will be more accurate than his AI-based prediction results. If there is a discrepancy in prediction accuracy between the NI and AI results, with continuous efforts to improve his AI algorithm, this discrepancy in prediction accuracy will decrease to a negligible range.

2.3 Methodology and tools

Since 2014, the author has conducted his research on metabolism and glucose, including both FPG and PPG. Initially, he utilized signal processing techniques of wave theory to decompose a synthesized glucose wave (i.e. curve of data) into 19 sub-waves (influential factors) for PPG and 5 influential factors for FPG. He also calculated the contribution percentage of each influential factor of glucose. For example, he found that carbs/sugar intake amount contributes ~39% and post-meal exercise contributes ~41%, hit weather temperature contributes ~5%, and all of the remaining 16 factors contribute ~15% to PPG formation. He also identified body weight as the primary factor of FPG with a contribution ratio of up to 90%, cold weather temperature contributes ~5%, and the rest of the three factors contribute 5% of FPG formation.

In early 2015, he developed an AI product via a computer software program containing all of his learned knowledge of food and diabetes from the past, collected NI information from his food database, plus many other AI features, such as machine-learning, auto-judging, and self-correction capabilities.

Initially, he applied optical physics (e.g. amplitude, frequency, period, and wavelength of optical waves) to identify the physical characteristics of food and link those optical wave characteristics (i.e. color of food) with the food's molecular structural characteristics (i.e. nutritional ingredients), specifically carbs and sugar content. Next, he was able to calculate glucose generation through food intake amounts based on his previous diabetes research results.

Using his MPM approach, he could bypass the need for detailed learning and research on botanical molecular structures and their chemical interactions with food components. In other words, he can apply just physics and mathematics and bypass biology and chemistry to study a biomedical problem.

Based on his 10 years of diabetes research and these two different approaches of using AI and NI, he was able to develop an end-user-oriented APP, known as the "AI Glucometer" (Figure 1), for diabetes patients to use in their daily life. One example of this AI Glucometer is shown in Figure 2. The yellow rectangular area in the left diagram of Figure 2 shows the high carbs/sugar area, mainly rice, and its original AI-predicted PPG was 119.0 mg/dL. After removing a small portion of this high carbs/sugar food, white rice, his AI-predicted PPG would drop down to 117.6 mg/dL.

Figure 1: AI glucometer tool.

Figure 2: Example of using AI to predict PPG (removing a small portion of white rice to reduce 1.4 mg/dL of PPG).

In 2017, he developed another AI-based software (APP and software for both a smartphone and PC) using only a portion of those identified influential factors of glucose, for example, 8-factors for PPG and 2-factors for FPG, to predict FPG, PPG, and daily glucose. Since PPG contributes around 75% to 80% of HbA1C he placed more emphasis on monitoring PPG fluctuations.

3. RESULTS

Figure 3 reflects the conclusive data table for this article.

Figure 4 depicts the comparison of three PPG among breakfast, lunch, and dinner which are expressed in the following format (measured PPG mg/dL, Predicted PPG mg/dL, Accuracy in %):

Breakfast: (118.3, 115.0, 97.3%)
Lunch: (120.0, 120.8, 99.3%)
Dinner: (113.4, 116.8, 97.1%)

6/1/15-8/27/20				
90-days Avg.	Measured	NI Predicted	1+(P-M)/M	Accuracy
FPG	115.8	115.7	99.9%	99.9%
Breakfast PPG	118.3	115.0	97.3%	97.3%
Lunch PPG	120.0	120.8	100.7%	99.3%
Dinner PPG	113.4	116.8	102.9%	97.1%
PPG	117.3	117.6	100.2%	99.8%
Daily Glucose	117.2	117.2	100.0%	100.0%
NI vs. Measured			100.7%	99.3%
AI vs. Measured			101.2%	98.8%

Figure 3: Summarized data table.

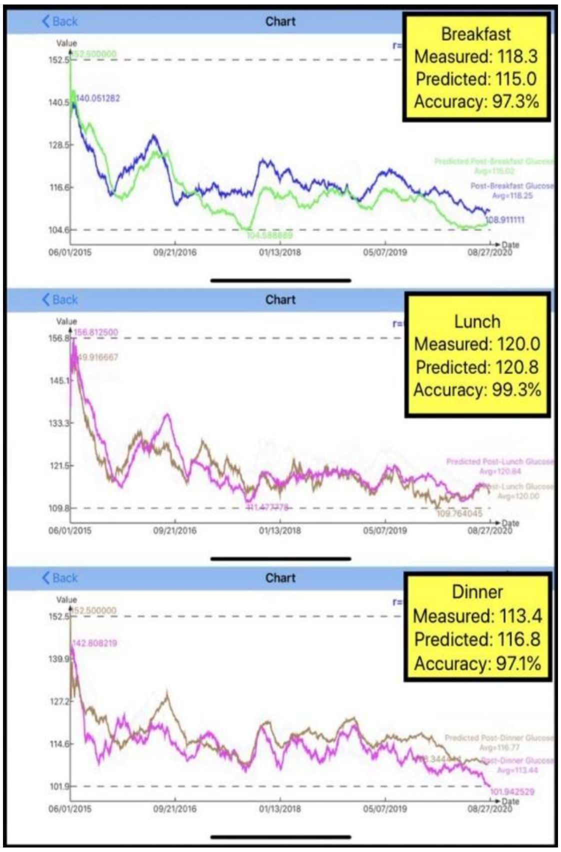

Figure 4: NI predicted PPG for breakfast, lunch, and dinner.

Figure 5 shows the comparison of three glucose among FPG, PPG, and daily glucose which are expressed in the following format (measured PPG mg/dL, Predicted PPG mg/dL, Accuracy %, correlation R %):

FPG: (115.8, 115.7, 97.3%, 99%)
PPG: (117.3, 117.6, 99.8%, 87%)
Daily glucose: (117.2, 117.2, 100%, 87%)

It should be mentioned that Figures 4 and 5 use NI-based prediction results which are slightly more accurate than AI-based prediction results as shown in Figure 6.

Figure 6 illustrates the comparison between predicted glucose using NI and AI, respectively. The results are as follows:

NI vs. measured glucose: 99.3%
AI vs. measured glucose: 98.8%

The top diagram in Figure 6 uses daily data, providing a more accurate average value. The bottom diagram uses 90-days moving average data, giving better views regarding curve patterns and trends while sacrificing a small amount of accuracy.

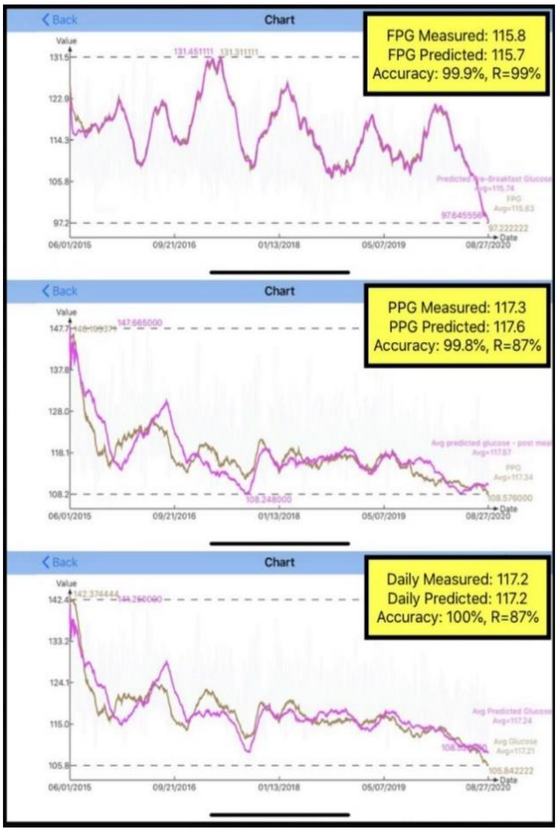

Figure 5: NI predicted PPG for FPG, PPG, and daily glucose.

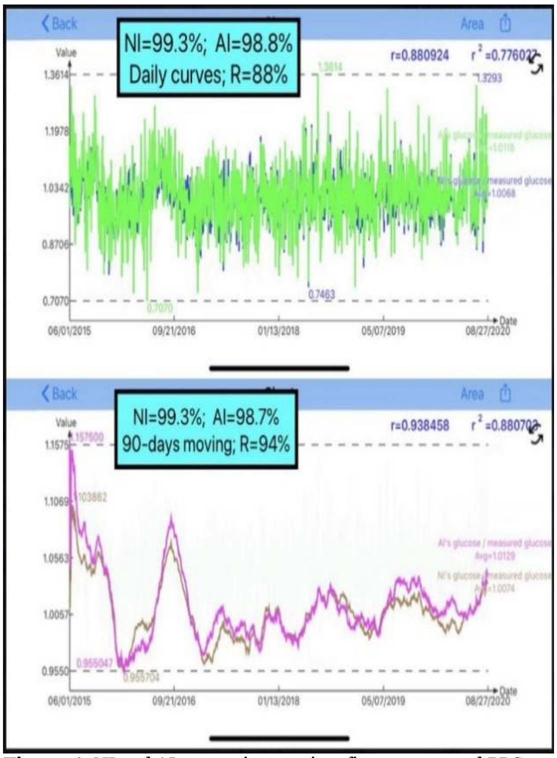

Figure 6: NI and AI comparison against finger-measured PPG.

4. CONCLUSION

The most significant three conclusions are listed as follows:

(1) NI-based PPG prediction has an accuracy of 99.8%.

(2) NI-based daily glucose prediction has an accuracy of 100%, which is the most important factor for diabetes control and HbA1C prediction.

(3) Overall, NI-predicted glucose vs. finger-measured glucose has an accuracy of 99.3%, while AI-predicted glucose vs. finger-measured glucose has an accuracy of 98.8%. NI prediction is better than AI prediction by 0.5%.

The author developed this tool with built-in AI capabilities, including auto-learning and auto-correction to make the system smarter and more accurate with additional data input. As a result, the AI prediction accuracy has reached 98.8% and NI prediction accuracy has reached 99.3% based on a relatively large dataset from a period of 1,913 days with 7,652 glucose values. The author observed AI and NI curves with a remarkably similar pattern (correlation of 94%), but the NI accuracy is still 0.5% better than the AI accuracy. This makes sense since his brain's NI knowledge created his AI tool.

In summary, this article demonstrates the power and usefulness of GH-Method: math-physical medicine, including AI to win the war against diabetes. He believes that these glucose prediction methods can be used as a practical tool for other T2D patients to control their daily conditions of diabetes without the cumbersome, painful, and costly traditional glucose finger-piercing test method. This is a good example of what and how mathematics, physics, and AI technology can contribute to medicine.

5. REFERENCES

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