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Quantitative Analysis of Relationship between Postprandial Plasma Glucose and Food/Meal (Math-Physical Medicine)

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Abstract

The author has been diagnosed with three chronic diseases including type 2 diabetes (T2D), hypertension, and hyperlipemia. Since 2010, he focused on T2D research to save his life. He collected and processed approximately 1.5 million data regarding his health and life details. In 2014, he developed a mathematical model of the metabolic system known as the math-physical medicine (MPM) approach by applying mathematics, physics, engineering modeling, and computer science such as big data analytics and artificial intelligence. This paper focuses on the quantitative relationship between postprandial plasma glucose and food/meal.

Keywords: Artificial Intelligence; Chronic Diseases; Food; Lifestyle Data; Math-Physical Medicine; Meals; Metabolic Conditions; Metabolism; Nutrition; Postprandial Plasma Glucose; Type 2 Diabetes

Introduction

The author used math-physical medicine to research and identify the quantitative relationship between postprandial plasma glucose (PPG) and food/meal.

Methods

Food is the most important factor of PPG, but it is also difficult to regulate eating habits. He created an artificial intelligent (AI) based software to collect his meal data by utilizing optical physics, signal processing, mathematics, statistics, and machine learning. He then developed a PPG prediction model by combining 6M food nutrition data from the United States Department of Agriculture (USDA) and his ~4,000 meal photos as his food database. Each meal picture links with data, including nation, meal location, food type, menu/dish name, and nutritional ingredients. The system can estimate consumed carbs/sugar amount and then predict PPG value prior to eating.

Results

He selected a period of 1,194 days (6/1/2015-9/7/2018) with 3,721 meals (including snacks) and ~100,000 data for his analysis. There were 86 airline meals consumed during his 94 trips during this period. The summary results are listed by both nation and meal location; then, they were sorted by PPG value with the format of PPG (mg/dL) & carbs/sugar (gram).

By Nation (Table 1):

Nation	No. Meals	PPG (mg/dL)	Carbs/Sugar (grams)	Nation %
USA	2148	117.6	13.0	58%
Taiwan	679	123	14.9	18%
Japan	294	117.4	15.6	8%
Canada	292	115.1	14.3	8%
Other Nations	222	123.7	19.8	6%
Airlines	86	137.3	26.0	2%
Grand Total	3721	119.1	14.5	100%

Table 1: Nation Summary Results.

USA: (117.6, 13.0g)
Taiwan: (123.0, 14.9g)
Japan: (117.4, 15.6g)
Canada: (115.1, 14.3g)
Other Nations: (123.7, 19.8g)
Airlines - Cross nations: (137.3, 26.0g)

In summary, he had 58% of meals within the USA and 42% in other nations.

By Location (Table 2):

Eating Place	No. Meals	PPG (mg/dL)	Carbs/Sugar (grams)	Place %
Home Cooking	2158	113.8	11.5	59%
Chain Restaurant	450	121.2	11.7	12%
Individual Restaurant	967	127.7	20.6	27%
Supermarket	59	130.2	25.7	2%
Airlines	86	137.3	26.0	2%
Grand Total	3634	121.9	14.8	100%

Table 2: Eating Location Summary Results.

Home Cooking: (113.8, 11.5g)
Chain Restaurant: (121.2, 11.7g)
Individual Restaurant: (127.7, 20.6g)
Supermarket: (130.3, 25.7g)
Airlines: (137.3, 26.0g)

In summary, he had 59% of meals at home and 41% outside.

Conclusion

The analysis **(Table 3 and Figures 1, 2)** and predicted PPG model (99.9% accuracy) assisted the author to lower his PPG from 279mg/dL to 119mg/dL.

By Nation	Within Each Nation	No. Meals	PPG (mg/dL)	Carbs/Sugar (grams)	Place %
USA	National Total	2148	117.6	13.0	100%
	Home Cooking	1389	113.7	11.3	65%
	Chain Restaurant	265	120.1	11.0	12%
	Individual Restaurant	453	125.6	18.2	21%
	Supermarket	40	132.4	27.1	2%
Taiwan	National Total	679	123	14.9	100%
	Home Cooking	355	117.4	11.7	52%
	Chain Restaurant	87	124	9.0	13%
	Individual Restaurant	237	129.9	22.6	35%

Japan	National Total	294	117.4	15.6	100%
	Home Cooking	151	110.7	11.6	51%
	Chain Restaurant	64	124.2	17.1	22%
	Individual Restaurant	71	133.8	25.4	24%
	Supermarket	8	126.1	20.9	3%
Canada	National Total	292	115.1	14.3	100%
	Home Cooking	220	110	10.8	75%
	Chain Restaurant	17	122.1	19.3	6%
	Individual Restaurant	55	129.4	25.8	19%
Other Nations	National Total	222	123.7	19.8	100%
	Home Cooking	43	116.2	15.2	19%
	Chain Restaurant	17	116.3	15.9	8%
	Individual Restaurant	151	127.3	21.6	68%
	Supermarket	11	125.1	24.2	5%
Air lines	National Total	86	137.3	26.0	100%
	Airline In-flight Food	48	134.2	26.4	56%
	Airline Lounge Food	14	150.4	35.3	16%

Table 3: Detailed Meal Analysis.

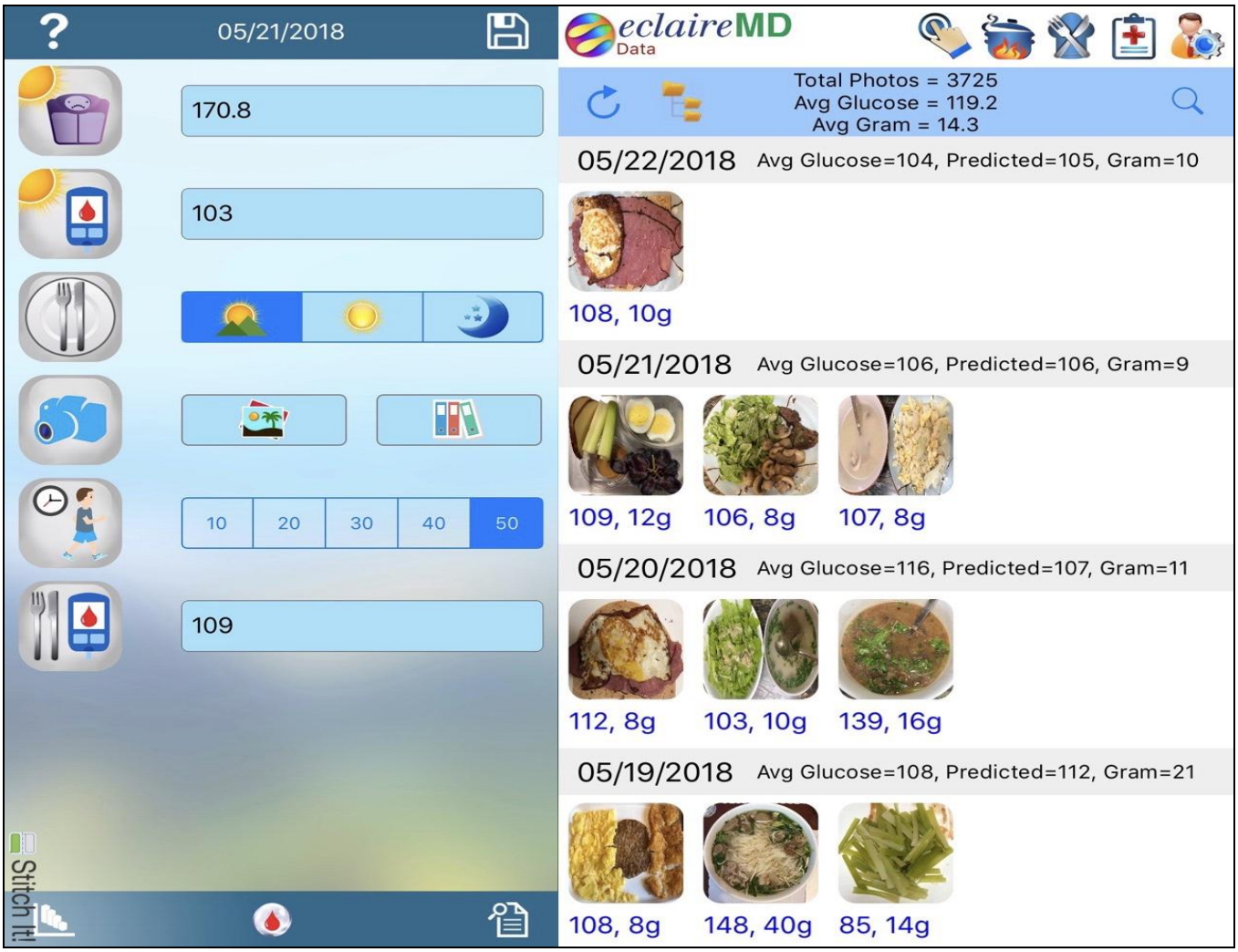

Figure 1: Using AI Glucometer to Predict Glucose Value via Meal Photos.

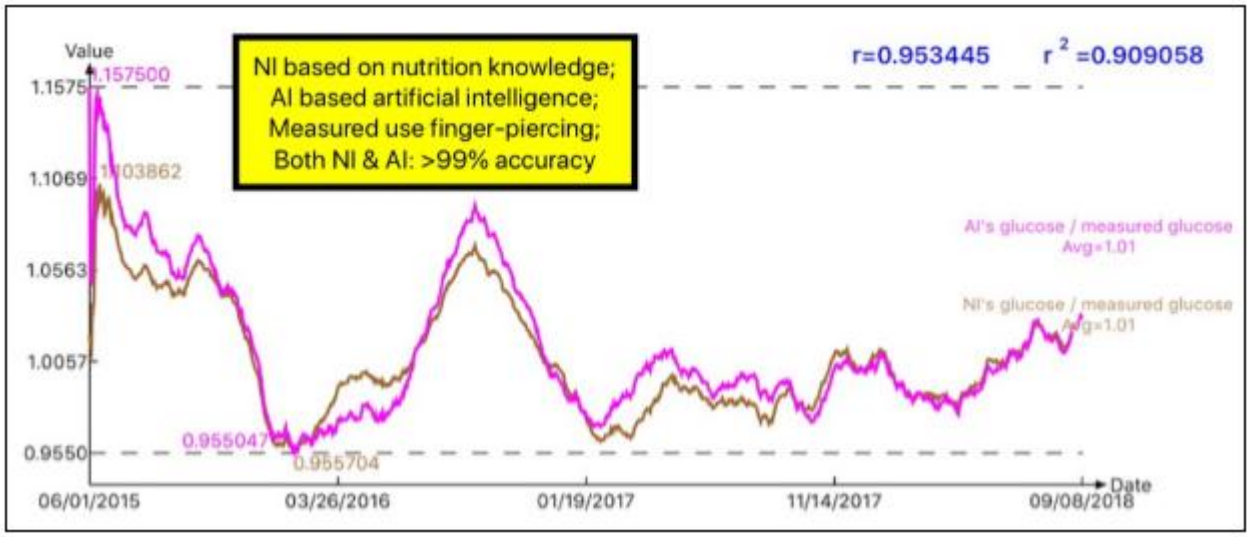

Figure 2: Accuracy Comparison between Nutritional Intelligence (NI) and Artificial Intelligence (AI).

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