The close relationship among bodyweight, fasting plasma glucose, and HbA1C using 5.5 years data based on GH-Method: math-physical medicine (No. 469)

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Abstract

The author re-examines the existing close inter-relationships among bodyweight (weight), fasting plasma glucose (FPG), and HbA1C (A1C) using the Pearson correlation coefficient "R" of statistics to calculate different degrees of association between two datasets. If R is greater than 50%, then it indicates a strong inter-relationship between two datasets or two curves.

He also reconfirms the prediction accuracy of his developed weight and predicted FPG prediction models. If the prediction accuracy is greater than 90%, then the developed prediction models can be continuously used daily in controlling his diabetes conditions.

This investigation utilized his daily weight and finger-piercing FPG data in conjunction with the developed daily finger-based A1C prediction over a period of ~5.5 years from 1/1/2016 to 6/21/2021.

In summary, obesity is the root cause of the following three chronic diseases: diabetes, hypertension, and hyperlipidemia. They can also affect many other related complications including, but not limited to, cardiovascular disease (CVD), stroke, chronic kidney disease (CKD), foot ulcer, diabetic retinopathy, neuropathy, hypothyroidism, dementia, and even cancer. As a result, individuals should focus on weight control as their first and the most important priority in order to manage chronic diseases and also prevent many complications from occurring.

In the United States, approximately 36.5% of adults are obese and another 32.5% are overweight. In other words, there are only 31% of American adults who are within the normal range of body weight (BMI < 25). The author weighed 220 lbs. (110 kg) with a BMI of 32 in 2010. From 2015 to 2019, his average weight was reduced to 173 lbs. (78.6 kg) with a BMI of 25.54. Recently, during 2020-2021, his weight has further decreased to 169 lbs. (76.8 kg) with a BMI of 24.95. From an 11-year journey, he definitely understands how difficult it was in reducing his bodyweight. During the past decade, he conducted medical research work on metabolism, endocrinology, nutrition, and probability of developing various complications resulted from chronic diseases.

The "meal portion" or "food quantity" is one of the most important contributing factors. In addition, adequate exercise assisted with his weight reduction. The higher correlation coefficients among weight, glucose components, and HbA1C have been demonstrated many times in his published papers. He has proven that the most efficient way to control his glucose is to concentrate on his body weight reduction first.

Introduction

The author re-examines the existing close inter-relationships among bodyweight (weight), fasting plasma glucose (FPG), and HbA1C (A1C) using the Pearson correlation coefficient "R" of statistics to calculate different degrees of association between two datasets. If R is greater than 50%, then it indicates a strong inter-relationship between two datasets or two curves.

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Method

Background

To learn more about the GH-Method: math-physical medicine (MPM) research methodology, readers can review his specific

article, Biomedical research methodology based on GH-Method: math-physical medicine (No. 310), to understand his MPM analysis method.

Data Collection

The author started measuring his body weight since 1/1/2012. He weighs himself twice a day - early in the morning when he wakes up and at night when he is ready to go to sleep. In addition, he uses the traditional finger-piercing and test strip (Finger glucose) to check his daily glucose values. He measures his glucose readings four times each day: once in the early morning for FPG when he wakes up and three times at two-hours after each meal for postprandial plasma glucose (PPG).

In order to estimate his metabolism situation using the developed mathematical metabolism index (MI) model, he needs to collect many of his lifestyle details. Most of his lifestyle data collection started approximately on 1/1/2015. The following six items are required to conduct this particular study.

1. Food quantity: percentage of his normal meal portion
2. Daily walking steps
3. Daily water intake amount
4. Sleep hours
5. Sleep quality includes 9 elements
6. Ambient weather temperature: using the highest temperature around noon time each day

Correlation coefficients

Here is an excerpt from Wikipedia

A *correlation coefficient* is a numerical measure of some type of correlation, meaning a statistical relationship between two variables. The variables may be two columns of a given data set of observations, often called a sample, or two components of a multivariate random variable with a known distribution. Several types of correlation coefficient exist, each with their own definition and own range of usability and characteristics.

The Pearson product-moment correlation coefficient, also known as r, R, or Pearson's r, is a measure of the strength and direction of the linear relationship between two variables that is defined as the covariance of the variables divided by the product of their standard deviations. This is the best-known and most commonly used type of correlation coefficient. When the term "correlation coefficient" is used without further qualification, it usually refers to the Pearson product-moment correlation coefficient. Sometimes, it is also called the "bivariate correlation" which is a statistic that measures linear correlation between two variables X and Y. It has a value between +1 and −1. A value of +1 is total positive linear correlation, 0 is no linear correlation, and −1 is total negative linear correlation.

Time series analysis

All of the variables mentioned above including weight, FPG, and daily A1C are expressed in a form of the "time-series curve". These curves have two axes. The horizontal x-axis is time (date) from 1/1/2016 throughout 6/21/2021 and the

vertical y-axis is the amount of weight, FPG, and A1C, which correspond to a different date on the x-axis.

Prediction model of Weight & FPG

His predicted weight is based on "weighted" body weight data for the past three days (70% from yesterday's weight, 20% from weight two days before, and 10% from weight three days before) as well as the adjustment factor for the daily bowel movement amounts (scale 1 to 5).

His predicted FPG equation utilizes the "least square mean method" to obtain values of R, avgX, avgY, sumSX, sumSY. He then calculates the standard deviation values of sdX and sdY by:

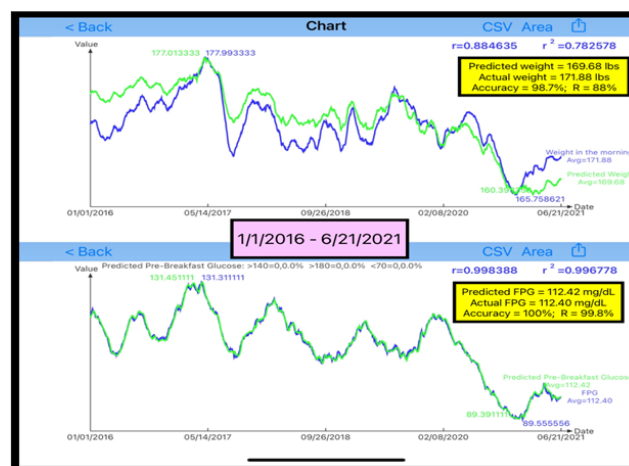sdX = sqrt (sumSX / no. of X)
sdY = sqrt (sumSY / no. of Y)

b = R * (sdY / sdX)
a = avgY -b * avgX

Finally, he obtains his predicted FPG using weight's input by:

Predicted FPG = a + b * weight

His predicted daily finger-based A1C is 25% from FPG and 75% from PPG and "weighted" average glucose data of the past 90 days (60% from the past 0-30 days, 30% from the past 30-60 days, and 10% from the past 60-90 days).

Results

**Figure 1:** Predicted and actual weight; predicted and actual FPG (1/1/2016 - 6/21/2021)

Figure 1 shows the prediction accuracies and correlations of his two prediction models as follows:

Predicted versus actual weight (accuracy: 98.7% & R = 88%)
Predicted versus actual FPG (accuracy: 100% & R = 99.8%)

These two extremely high prediction accuracies (98.7% and 100%) have proven the effectiveness of his prediction models. The other two high correlations (88% and 99.8%) have also demonstrated the strong waveform shape similarities between

the predicted values and the actual values of both weight and FPG.
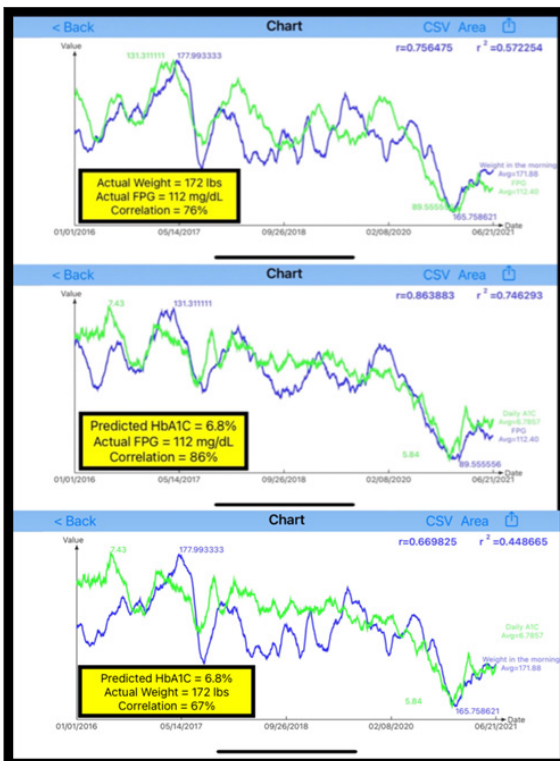
Figure 2: Correlations among Weight, FPG, and A1C (1/1/2016 - 6/21/2021)

Figure 2 reveals the correlations among 3 biomarkers as follows:

Weight versus FPG (R = 76%)
FPG versus A1C (R = 86%)
Weight versus A1C (R = 67%)

These high correlations (67%-86%) have validated the tight inter-relationships among weight, FPG, and A1C.
Category: Chronic Diseases

Conclusions

In summary, obesity is the root cause of the following three chronic diseases: diabetes, hypertension, and hyperlipidemia. They can also affect many other related complications including, but not limited to, cardiovascular disease (CVD), stroke, chronic kidney disease (CKD), foot ulcer, diabetic retinopathy, neuropathy, hypothyroidism, dementia, and even cancer. As a result, individuals should focus on weight control as their first and the most important priority in order to manage chronic diseases and also prevent many complications from occurring [1-9].

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