GH-Method: Math-Physical Medicine
Special Issue

Investigating the Influential Factors on Body Weight and Its Impact on Glucose Using GH-Method: Math-Physical Medicine (No. 327)

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Abstract

The author attempts to identify 3 major and 2 secondary influential factors of body weight along with its impact on 6 different glucose components using Pearson correlation coefficient "R" of statistics to calculate the different degree of association between two datasets. This investigation utilized the daily weight and glucose data in conjunction with 6 lifestyle details, including food, exercise, water, sleep, and weather temperature, during a period of ~6 years from 1/1/2015–9/11/2020.

Weight's influential factors:

1) Food quantity: +47% (the more you eat, the higher your weight)

2) Daily walking steps: -52% (the more you exercise, the lower your weight, recommend walking within 20,000 steps per day)

3) Water intake: -48% (the more water you drink, the lower your weight, recommend within 3,000 cc per day)

4) Sleep hours: +24% (low moderate R)

5) Sleep quality: +16% (low moderate R)

Obesity is the root cause of 3 chronic diseases such as diabetes, hypertension, and hyperlipidemia. They can cause many other complications including, but not limited to, cardiovascular disease (CVD), stroke, chronic kidney disease (CKD), foot ulcer, diabetic retinopathy, hypothyroidism, dementia, and even cancer. As a result, individuals should focus on weight control as their priority to be able to control other chronic diseases.

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 within the normal range of body weight (BMI < 25). The author weighed 220 lbs. (110 kg) with a body mass index (BMI) of 32 in 2010. From 2015–2020, his average weight was reduced to 173 lbs. (78.6 kg) with a BMI of 25.54. Recently, his weight has further decreased to 169 lbs. (76.8 kg) with a BMI of 24.95. From his 10-year journey, he definitely understands how hard it is to reduce his body weight. During the past decade, he conducted research on metabolism, endocrinology, and various complications induced by chronic diseases; however, he was not able to identify a clear and significant influential factor for weight control. Occasionally, he feels that weight seems to have a mind on its own, randomly fluctuating according to its will. Of course, he also realized

that weight must have certain controlling factors within itself.
At least, in this study, he is able to prove his intuitive feeling that meal portion or food quantity is one of the most important contributing factors, even with a moderate R of 47%. In addition, adequate exercise and sufficient water intake assisted with his weight reduction.
With the higher correlation coefficients between weight and glucose components have been demonstrated many times in his previous published papers, he discovered the most efficient way to control his glucose is to concentrate on his body weight first.

Keywords: body weight, glucose, lifestyle, food, exercise, chronic diseases

Abbreviations: CVD: cardiovascular disease; CKD: chronic kidney disease; BMI: body mass index; MPM: math-physical medicine; FPG: fasting plasma glucose; PPG: postprandial plasma glucose

Introduction

The author attempts to identify 3 major and 2 secondary influential factors of body weight along with its impact on 6 different glucose components using Pearson correlation coefficient “R” of statistics to calculate the different degree of association between two datasets. This investigation utilized the daily weight and glucose data in conjunction with 6 lifestyle details, including food, exercise, water, sleep, and weather temperature, during a period of ~6 years from 1/1/2015–9/11/2020.

Methods

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, to understand his MPM analysis method [1].

Data collection

The author started measuring his body weight since 1/1/2012. He measures weight twice a day, once in early 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 measure his daily glucose. He measures his glucose 4 times each day, once in early morning - fasting plasma glucose (FPG) when he wakes up from sleeping, and 3 times at 2 h after each meal - postprandial plasma glucose (PPG).

To estimate his metabolism situation using his 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 6 items are required to conduct this particular study.

- Food quantity: percentage of his normal meal portion
- Daily walking steps
- Daily water intake amount
- Sleep hours
- Sleep quality: including 9 elements
- Ambient weather temperature: using the highest temperature around noon time each day [2–8]

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 the variables mentioned above including weight, glucose, and 6 lifestyle details are expressed in a form of the “time-series curve”. These curves have 2 axis. The horizontal x-axis is time (date) from 1/1/2015 throughout 9/11/2020 and the vertical y-axis is the amount of weight, glucose, or lifestyle details corresponding to different date on the x-axis. To avoid the “over-presentation” of the graphic results, the author does not include all of these time-series curves in the graphs section in this paper. As an alternative, he presents a summarized data table that includes all of the important and conclusive data related to the variables such as weight, glucose, lifestyles, and their corresponding correlation coefficients.

Results

The figure (Figure 1) shows the summarized background data of this study. As a result, the figures (Figure 2, 3 and 4) are produced based on this background data table.

(1/1/2015 - 9/11/2020)		Morning Weight = 173.21 lbs	
Weight inputs:	**Correlation**	**Real Data**	**Note:**
Food quantity	47%	83%	Moderate association
Daily Exercise	-52%	16652 steps	Moderate association
Water drinking	-48%	2898 cc (5.8 bottles)	Moderate association
Sleep hours	24%	7.1 hours	Negligible association
Sleep Quality	16%	63%	Negligible association
Weather temperature	-5%	73 degree F	Almost no association
Weight Impacts:	**Correlation**	**Real Data**	**Note:**
Breakfast PPG	58%	119.49 mg/dL%	Moderate association
Lunch PPG	73%	121.92 mg/dL%	Moderate association
Dinner PPG	67%	115.01 mg/dL%	Moderate association
PPG	70%	118.98 mg/dL%	Moderate association
FPG	67%	116.78 mg/dL%	Moderate association
Daily Glucose	74%	118.66 mg/dL%	Moderate association
Glucose, Food, Weight	**Correlation**	**Real Data**	**Note:**
FPG & Food quantity	53%	116.78 mg/dL & 83%	Moderate association
PPG & Food quantity	82%	118.98 mg/dL & 83%	Very strong association
weight loss & gain	-96%	Weight loss in sleep: -2.47 lbs	Weight gain in day: +2.51 lbs

Figure 1: Background data table (1/1/2015–9/11/2020)

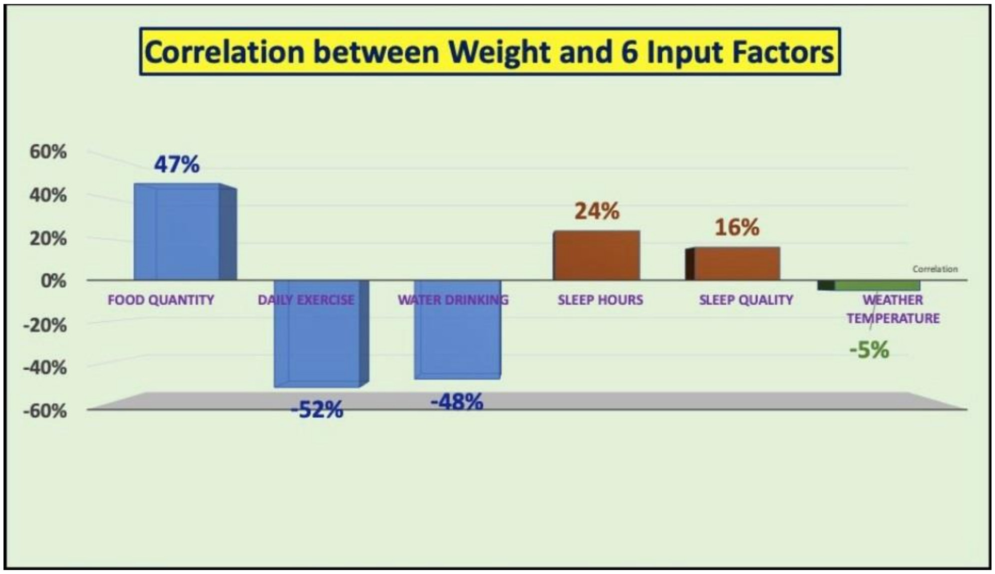


Figure 2: 6 R values between weight and 6 influential factors (1/1/2015–9/11/2020).

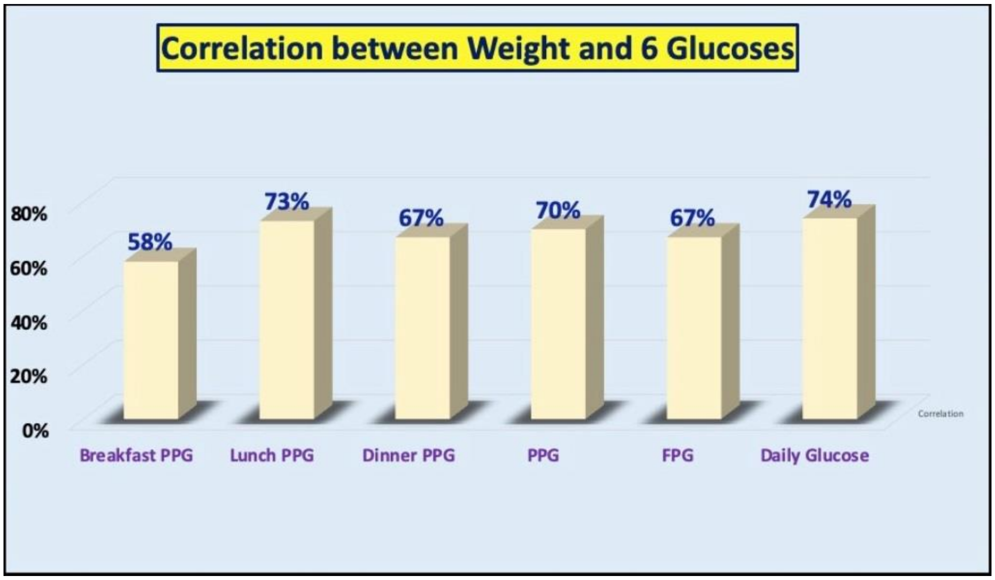
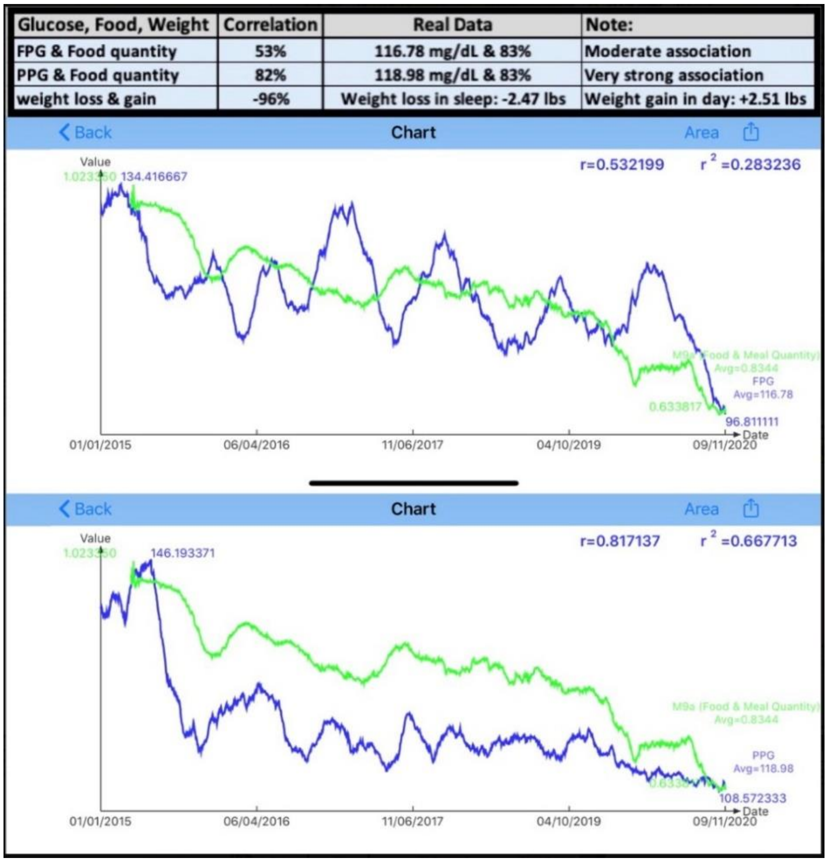


Figure 3: 6 R values of weight impact on 6 glucose components (1/1/2015–9/11/2020).

The figure (Figure 2) only reflects the R between weight and 6 lifestyle inputs. The correlation coefficient R can only be calculated between 2 variables. The objective is to identify what influential factors actually control his body weight. With this purpose in mind, his weight variable becomes the common denominator of this entire analysis. Consequently, he went through many calculations of R to search for the significant influential factors of weight. At the end, he only identified 5 significant factors. The R of the ambient weather temperature is almost 0% (-5%); therefore, it does not have a noticeable influence on weight. During the process of searching and calculation, he also discovered some more evidence regarding the impact of his weight on his glucose associated with his 3 daily meals. As shown in the figure (Figure 3), his body weight has different degrees of influences on all the 6 glucose components, including breakfast PPG, lunch PPG, dinner PPG, daily PPG, FPG, and daily average glucose.



Glucose, Food, Weight	Correlation	Real Data	Note:
FPG & Food quantity	53%	116.78 mg/dL & 83%	Moderate association
PPG & Food quantity	82%	118.98 mg/dL & 83%	Very strong association
weight loss & gain	-96%	Weight loss in sleep: -2.47 lbs	Weight gain in day: +2.51 lbs

Figure 4: Time-series curves of weight *vs* FPG and weight *vs* PPG (1/1/2015–9/11/2020).

The following descriptions highlight the conclusions drawn from figure 1, 2 and 3. It is expressed in terms of individual correlation coefficient percentage of R.

A) Weight's influential factors

- Food quantity: +47% (the more you eat, the higher your weight)
- Daily walking steps: -52% (the more you exercise, the lower your weight, recommend walking within 20,000 steps per day)
- Water intake: -48% (the more water you drink, the lower your weight, recommend 3,000 cc per day)
- Sleep hours: +24% (low moderate R)
- Sleep quality: +16% (low moderate R)
- Weather temperature: -5% (negligible R)

Food quantity, exercise level, and water intake amount have moderate influences on body weight. In contrast, sleep has a low moderate influence on weight, while weather temperature has a negligible influence on weight (-5%).

B) Weight's impact on glucose

- Breakfast PPG: 58%
- Lunch PPG: 73%
- Dinner PPG: 67%
- PPG: 70%
- FPG: 67%
- Daily average glucose: 74%

Body weight has quite high correlation coefficients with all the 6 glucose components; therefore, weight definitely has a strong impact on glucose. This conclusion can be observed *via* the two time-series curves between weight *vs* FPG and weight *vs* PPG (Figure 4).

In the figure (Figure 5), it depicts an interesting finding in this weight study. His average weight gain is +2.51 lbs. during the daytime and his average weight loss is -2.47 lbs. during his sleep time over this ~6-year period. These 2 values almost cancel out each other. As a result, his weight has been maintained around 173 lbs. with a BMI of ~25 for the past ~6 years. This fact further demonstrates an important message regarding his satisfaction with the overall metabolism situation because body weight contains many vital information for both medical conditions and lifestyle details.

Glucose, Food, Weight	Correlation	Real Data	Note:
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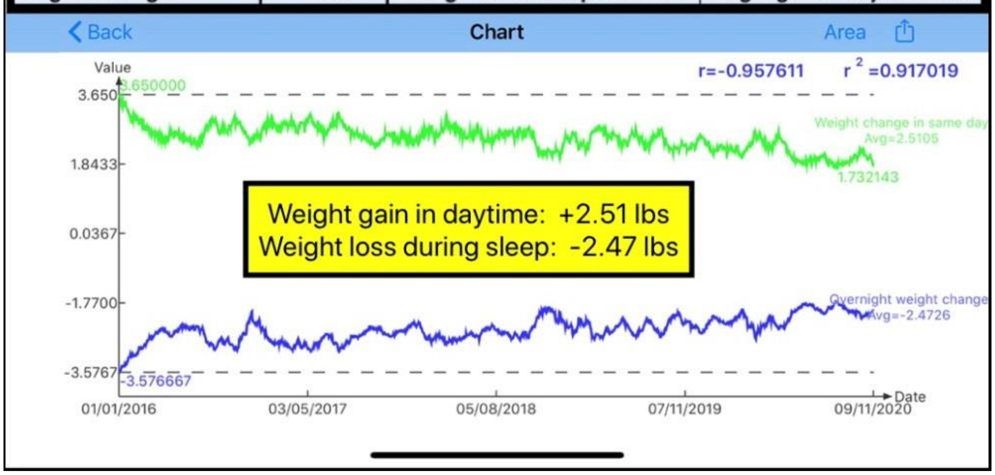

Figure 5: Average weight gain in daytime and average weight loss during sleep time (1/1/2015–9/11/2020).

Conclusion

Obesity is the root cause of 3 chronic diseases such as diabetes, hypertension, and hyperlipidemia. They can cause many other complications including, but not limited to, cardiovascular disease (CVD), stroke, chronic kidney disease (CKD), foot ulcer, diabetic retinopathy, hypothyroidism, dementia, and even cancer. As a result, individuals should focus on weight control as their priority to be able to control other chronic diseases.

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