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Relationship between Glucose and Blood Pressure During Three Different Periods from the Viewpoint of Biomedical Pattern Changes (GH-Method: Math-Physical Medicine)

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Introduction

The author uses the GH-Method: math-physical medicine approach to investigate the relationship between his glucose and blood pressure during three different time periods.

Methods

Here is the three different time periods:

Long period: 5/5/2014-6/13/2020

Short period: 5/5/2018-6/13/2020

Medium period: 2/1/2014-11/2/2018

In this article, the author uses his fingerstick daily average glucose, four data per day, and a combined score of blood pressure, known as "M3" for the convenience of his calculations and graphic presentations.

BP (M3) is defined as follows:

M3 = (SBP/120+DBP/80+HR/60)/3

He applies both time-series analysis, x or y vs. time, which is similar to EKG charts, along with spatial analysis in a two-dimensional x and y space, without "time" factor, to analyze his collected big data.

In the time-series analysis, when the correlation coefficient ("R") is greater than 50% (strong), it is considered as highly correlated. When R is less than 30% (weak), then it is deemed as non-correlated. It should be mentioned that the correlation coefficient can only be calculated for two sets of data. In spatial analysis, if the "data cloud" is concentrated within a long and narrow band (similar to the shape of a cucumber or a football) and skewed with an angle where the slope is greater than zero, which means the degree of correlation, then these two sets of data are correlated. On the other hand, if the angle of the plotted data cloud is either flat or vertical, then they have a low R value and are non-correlated (Reference 1).

Using time-series analysis, the author presents his results in both daily discrete data chart and 90-days moving average data chart. The reason for including the 90-days moving average data is based on the general understanding that the HbA1C value is an average glucose for the past 90 days.

Another purpose of this study is to demonstrate the effectiveness of these two statistical tools, time-series analysis and spatial analysis, on medical research work.

Results

Figure 1 shows his results of glucose and BP for the long period from 5/5/2014 to 6/13/2020. The author started his finger glucose collection in early 2012 along with his BP readings in early 2014. During the earlier years of this long period, both his glucoses and BP reached to extremely high levels. In the middle diagram of Figure 1, his glucose peaked to 227 mg/dL, and his M3 reached to 1.322 which is equivalent to 159/106/79 for his SBP/DBP/HR. These high value data points would extend his data range wider, where the majority of glucoses are covered within a range from 80 mg/dL to 180 mg/dL, and somewhat taller via high BP in the spatial analysis diagram. However, his hypertension condition in 2014 was temporary; therefore, these few high BP data points are sparsely distributed. More importantly, when combining these higher glucose/BP values with lower glucose/BP values together, it would create a skewed "data cloud" (i.e. with a slope) as indicated in the yellow box and orange box in the top spatial diagram of Figure 1. The orange box indicates data are within +/- 10 % of the skewed green line in the center, while the yellow box indicates data are within +/- 20 % of the center green line. As indicated in Figure 1, +/- 10% orange box contains 81% of total data, while +/- 20 % yellow box contains 98% of total data. It should be pointed out that, after 11/2/2018, his glucose levels decreased, while BP level increased in comparison with the time frame prior to 11/2/2018. This is the reason he inserted a medium period from 2/1/2014 to 11/2/2018 as a comparison purpose.

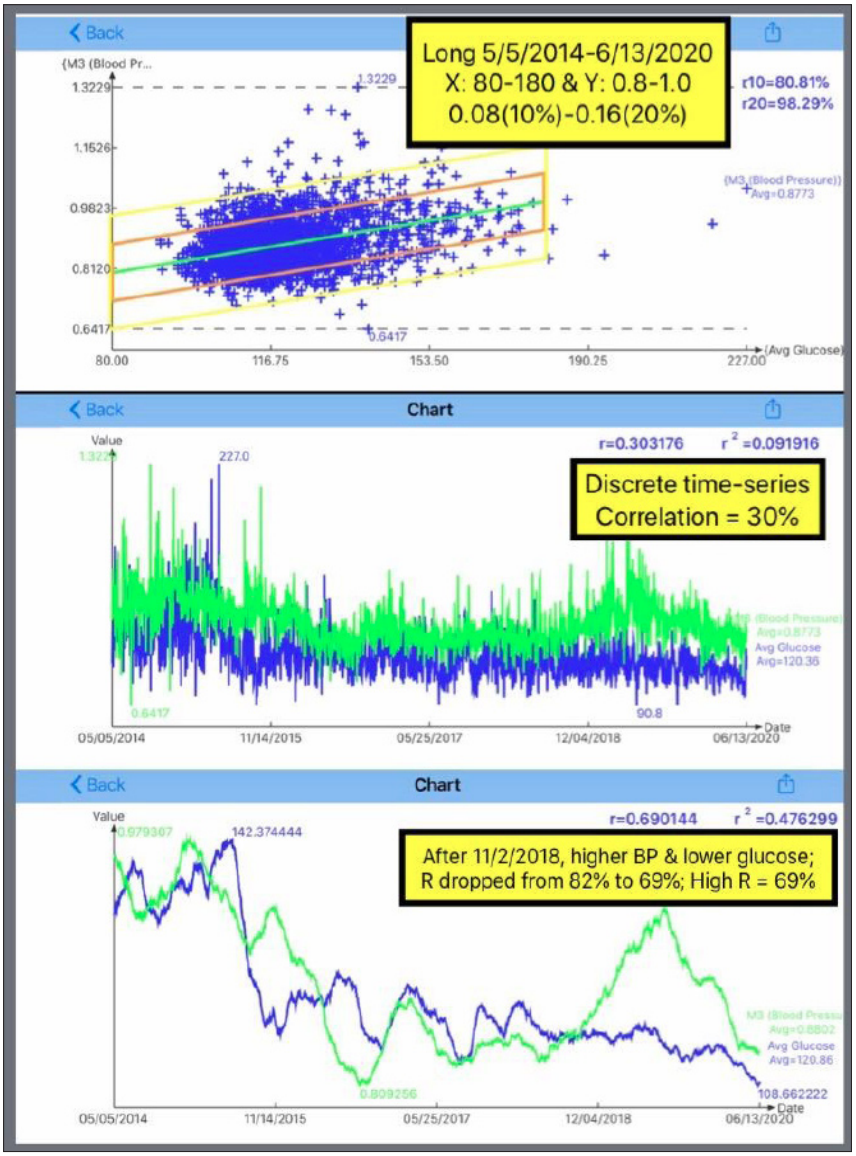

Fig1. *Long period (5/5/2014 - 6/13/2020) has high R (69%).*

Figure 2 illustrates his results of glucose and BP for the short period from 5/5/2018 to 6/13/2020. The author selects this period due to the fact that his glucose has been under very well control (114 mg/dL) and his M3 (BP) level at 0.8734 (SBP/DBP/HR at 105/70/52). He wants to investigate what type of correlation existing between glucose and BP under this situation. His glucose data range of short period is narrower than the long period, where the majority of glucoses are covered within a range from 90 mg/dL to 135 mg/dL. For both long and short periods, their BP data coverage ranges are quite similar. As shown in Figure 2, the green line, orange box, and yellow box in the top spatial analysis diagram are "horizontal", i.e. zero slope, or non-correlated. This spatial diagram observation can be seen in the middle discrete data diagram of R = 14% and the bottom 90-days moving average diagram of R = 25%. Again, there is exceptionally low or no correlation existing between glucose and BP during this short period.

Finally, he took his results of the medium period from 2/1/2014 to 11/2/2018 in Reference 2 to reflect them in Figure 3. The important point is that the medium period's correlation was 82% in comparison with the long period's correlation of 69%. This 13% correlation decrease is due to the short period's different pattern of glucose and BP.

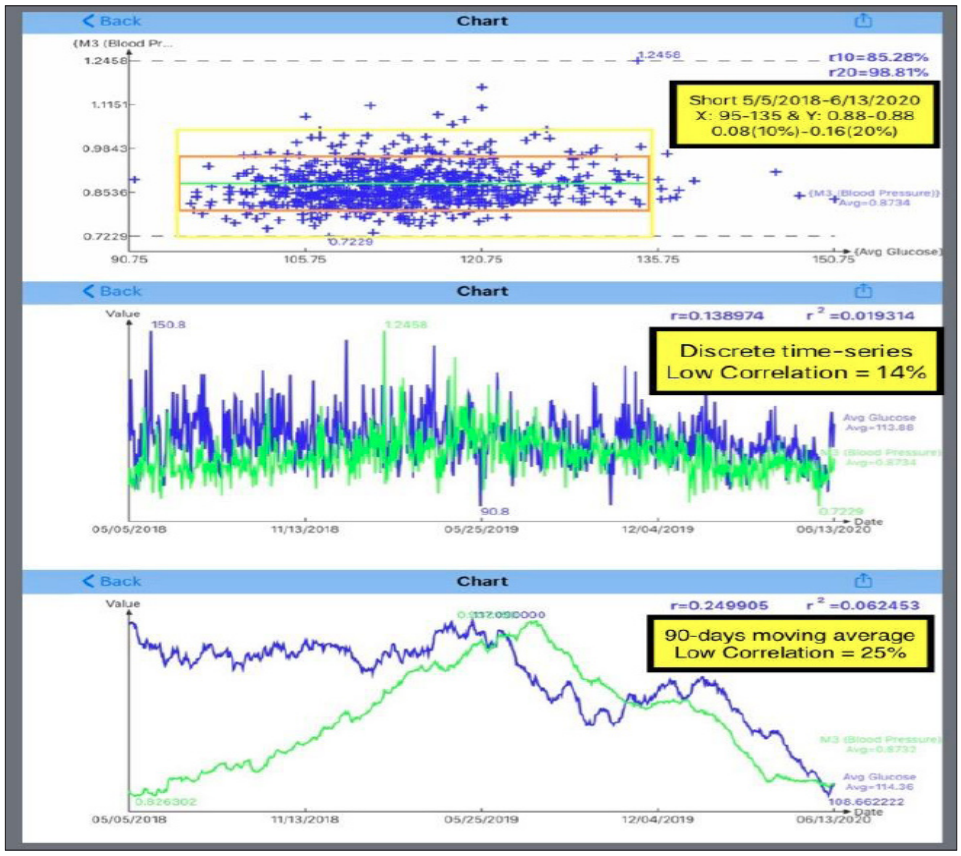

Fig2. *Short period (5/5/2018 - 6/13/2020) has exceptionally low R (14%)*

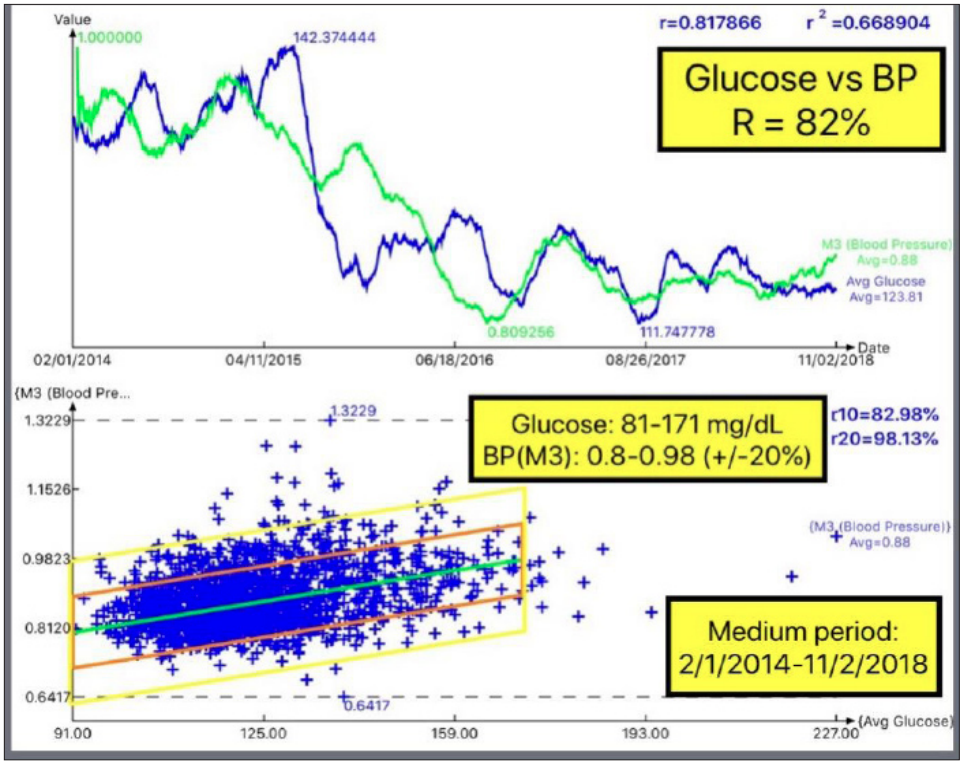

Fig3. *Medium period (2/1/2014 - 11/2/2018) has exceedingly high R (82%).*

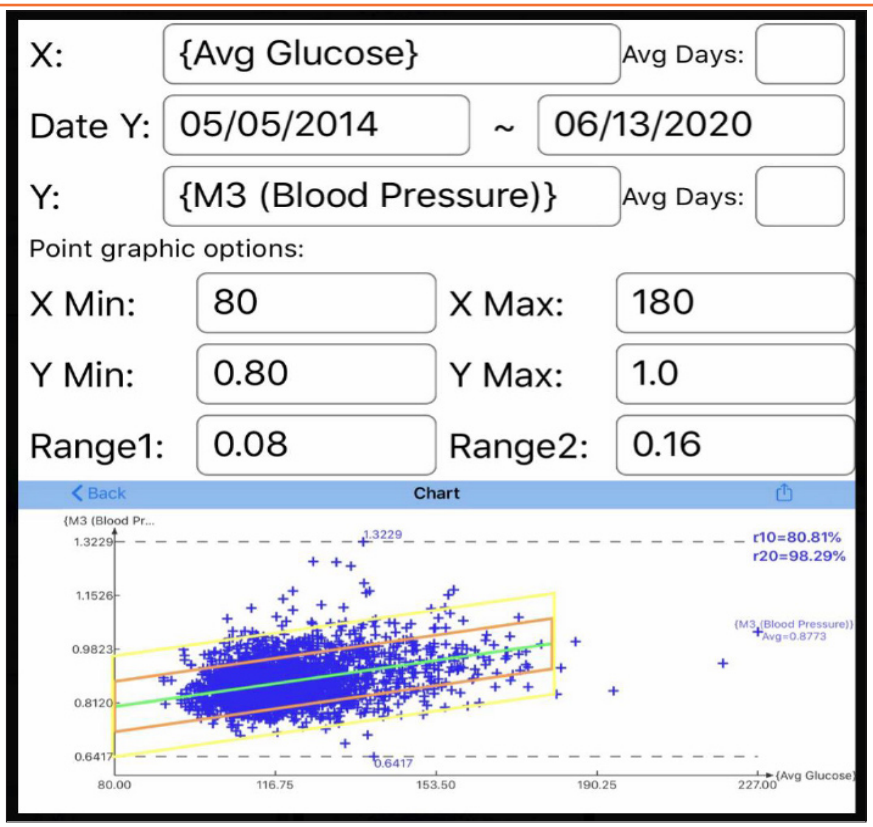

Fig4. *Spatial analysis of long period (5/5/2014 - 6/13/2020).*

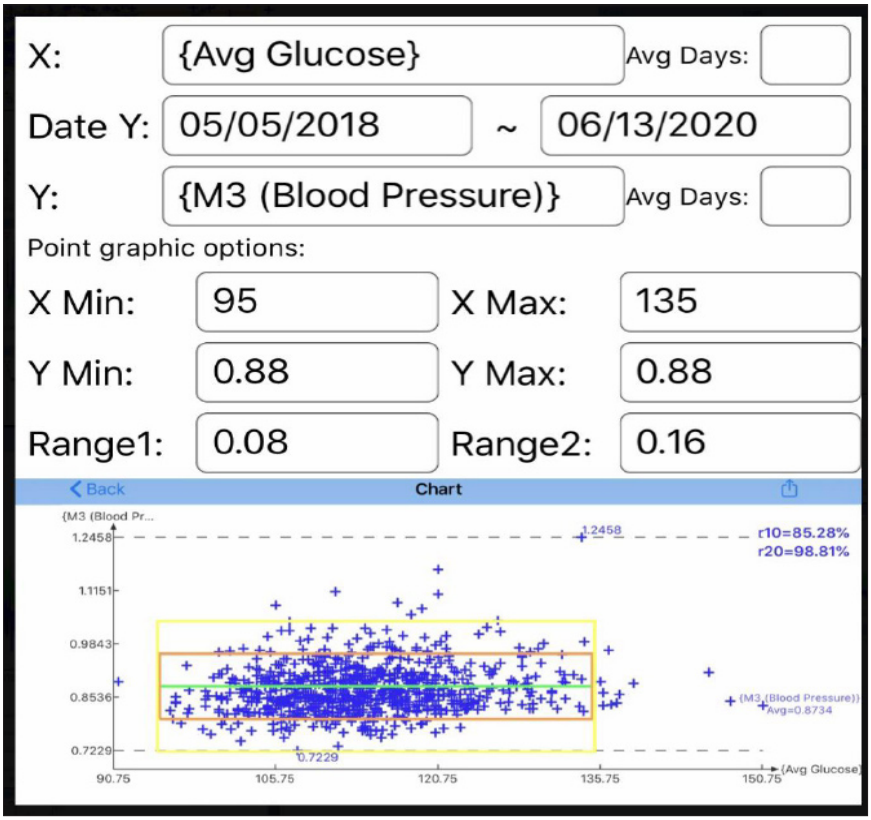

Fig5. *Spatial analysis of short period (5/5/2018 - 6/13/2020).*

Conclusion

By using the GH-Method: math-physical medicine approach, the relationship between glucose and BP have been examined again from the viewpoint of biomedical pattern changes. This study confirms many qualitative descriptions within the medical community. Even though the author did not discover any breakthrough information or surprising findings, the usefulness and effectiveness of the two statistical tools, time-series and spatial analysis, on identifying and interpreting various biomedical phenomena provide support. He was able to offer additional mathematical verification and quantitative evidence of complex relationship existing among different metabolic disorder diseases. In addition, his research work has proven the importance of lifestyle management on metabolic disorder control (Reference 3).

References

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