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Review Article

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Using GH-Method: Math-Physical Medicine to Conduct Segmentation Analysis to Investigate the Impact of Weather Temperatures on Glucose (Both FPG And PPG)

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Introduction

This paper is based on big data collected from a period of 1,420daysfrom 6/1/2015 to 4/21/2019 with a total of 4,260 data, including highest ambient temperature (weather) of each day in degree Fahrenheit (°F), fasting plasma glucose (FPG) and postprandial plasma glucose (PPG) in mg/dL. The dataset is provided by the author, who uses his own type 2 diabetes metabolic conditions control, as a case study via the "math-physical medicine" approach of a non-traditional methodology in medical research.

Math-physical medicine (MPM) starts with the observation of the human body's physical phenomena (not biological or chemical characteristics), collecting elements of the disease related data (preferring big data), utilizing applicable engineering modeling techniques, developing appropriate mathematical equations (not just statistical analysis), and finally predicting the direction of the development and control mechanism of the disease.

Method

In this analysis, the author defines his targeted glucose level at <120 mg/dL and the following three weather temperature ranges:

1. Chilly: <67°F
2. Comfortable: 67-77°F
3. Warm: >77°F

His previously published papers have indicated that FPG has ~5 influential factors with weight contributes ~85%, while PPG has ~19 influential factors with combination of carbs/sugar intake and post-meal exercise contributing ~80% (carbs/sugar ~39% and exercise ~41%). In both of FPG and PPG formations, temperature plays a secondary role and contributes ~10% of their formation. However, cold weather only influences FPG due to hibernation effect and warm weather only influences PPG due to higher metabolic demands. Recently, he conducted a detailed segmentation analysis to further validate his earlier findings [1-5].

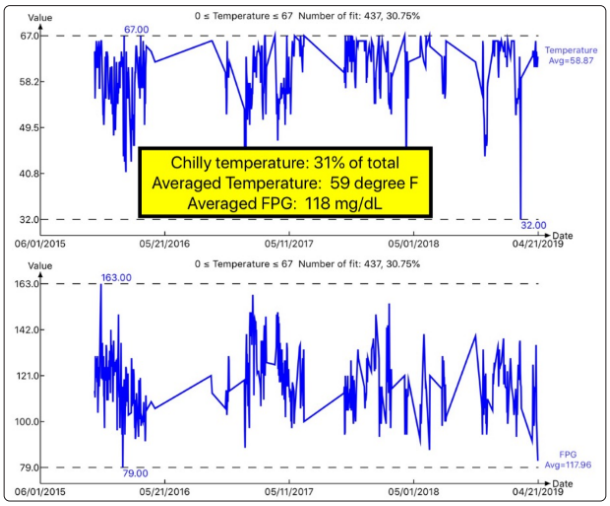

Figure 1: Chilly weather temperature (<67°F) and FPG

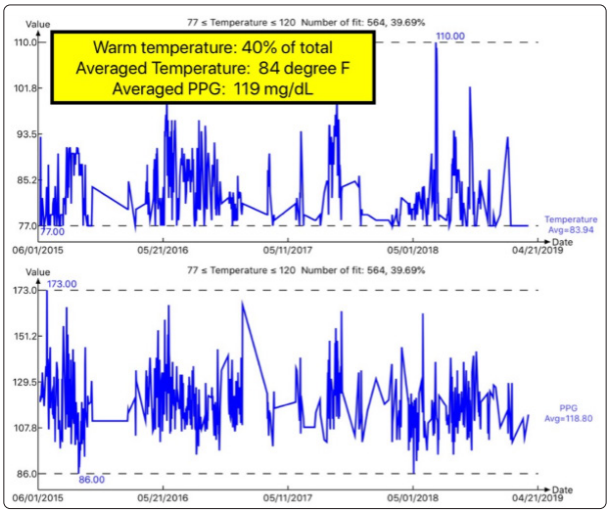

Figure 2: Warm weather temperature (>77°F) and PPG

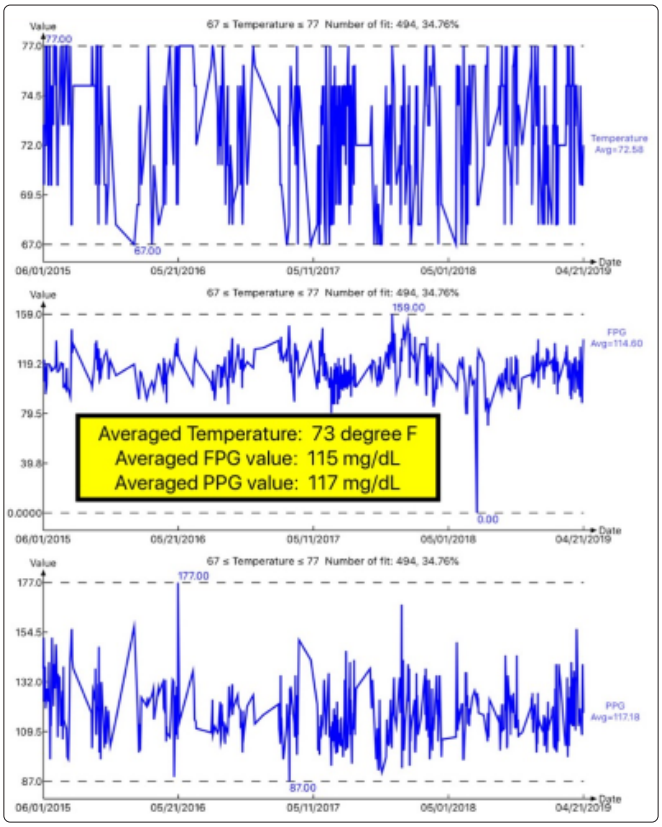

Figure 3: Comfortable weather temperature (67-77°F) and Glucose (both FPG and PPG)

Results

Chilly Weather:
Contribution ratio ~30% of total
Average temperature 59°F
Average FPG 118 mg/dL

Warmer Weather:
Contribution ratio ~40% of total
Average temperature 84°F
Average PPG 119 mg/dL

Comfortable Weather:
Contribution ratio ~30% of total,
Averaged temperature 73°F
Average FPG 115 mg/dL
Average PPG 117 mg/dL

The similarity of data patterns between temperature and glucose can also be visually observed from the three attached graphs.

Conclusion

By using the GH-Method: math-physical medicine, the author proved again the relative high correlation between temperature and glucose by this segmentation analysis. The secondary importance of weather temperature on glucose has been demonstrated by this pattern analysis. However, due to unavailability of applicable data collection from patients who reside in either tropical or freezing zones, the author cannot draw the same conclusions of temperature impact on glucose for them.

References

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