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Traveling Impact on Glucose, Metabolism, Exercise and Daily Life Routines Based on 8 Years of Big Data using GH-Method: Math-Physical Medicine (No. 335)

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Abstract

In this article, the author conducted an impact study of his average glucose, overall metabolism, and two key lifestyle details based on a period of 8 years (2,938 days) from 1/1/2012 to 9/19/2020. He separated his 242 trips during this period into 134 short travel trips (<3 hours of flying time) and 108 long travel trips (>3 hours of flying time). He has purposely chosen glucose, metabolism, exercise, and daily life routines for this special investigation because he has had Type-2 Diabetes (T2D) for over 25 years and his main medical research work is based on lifestyle and metabolism. Among the lifestyle details, he has selected exercise and daily life routines due to the fact they are extremely difficult to maintain during travel days.

Here is a summary of the results in the format of glucose/Metabolism Index (MI) score/Walking steps/Daily life routines score with the respective baselines or "break-even" scores of 120 mg/dL, 73.5%, 15,000 steps, 0.7 or 70%.

Glucose/MI score/Walking steps/Daily life routine score:

Long:127/79.7%/12,316/99.95%

Short:126/76.6%/15,784/84.96%

Total:124/69.7%/16,124/73.00%

It should be pointed out that all scores in these four categories are above the baselines or break-even scores. This means that his glucose level, metabolism index, exercise, and daily routine regularity are "unhealthy".

By using a designated set of baselines, we can further calculate how much excessive percentage of these four parameters above the "baseline" conditions such as glucose, MI, walking, daily life routines that are associated with long trips, short trips, and total period.

Glucose/MI score/Walking steps/Daily life routine score:

Long:106%/108%/177%/143%

Short:105%/103%/142%/121%

Total:103%/95%/140%/104%

To compare the results of these three periods, the total period has the best performance of all four parameters. This is due to the fact that the total period (2,938 days) contains more non-traveling days, stable environment, and healthier days (92% of total days). Scores of short and long trips (total 242 traveling days, 8% of total days) are higher than the score of total period, specifically 8% to 13% higher from glucose and MI, and 37% to 39% higher from exercise and daily life routines. Furthermore, the long trips scores are higher than the short trips scores by 1% to 5% for glucose and MI, and 22% to 35% for exercise and daily life routines. It should be noted that the author adopts the traditional medical principles, where the lower score indicates a better condition. Therefore, when traveling, his diabetes conditions contribute to higher glucoses along with elevated MI percentage, which confirms additional damage to his overall health. Due to interruptions to his meals, exercise schedule, sleep pattern, and his daily life routines cause the four markers to become higher or unhealthier during air travel days. Long trips are worse than short trips because the long air travel time covers at least two meals without post-meal exercise and typically crosses over multiple time zones, resulting in jet lag.

The observed conclusions from above may be intuitive for some patients and for most doctors; however, this study utilized a big data analytics approach based on several hundred thousand data over an 8-year period, the segmentation analysis method, along with a complex mathematical model of metabolism to offer some concrete evidence with a high precision and quantitative numerical proof to readers.

Keywords: Glucose; Type-2 diabetes; Metabolism index; Fasting plasma glucose; Postprandial plasma glucose

Introduction

In this article, the author conducted an impact study of his average glucose, overall metabolism, and two key lifestyle details based on a period of 8 years (2,938 days) from 1/1/2012 to 9/19/2020. He separated his 242 trips during this period into 134 short travel trips (<3 hours of flying time) and 108 long travel trips (>3 hours of flying time). He has purposely chosen glucose, metabolism, exercise, and daily

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life routines for this special investigation because he has had Type-2 Diabetes (T2D) for over 25 years and his main medical research work is based on lifestyle and metabolism. Among the lifestyle details, he has selected exercise and daily life routines due to the fact they are extremely difficult to maintain during travel days.

After reading that specific news, the author decided to review his collected 4,050 meals data from 5/5/2018 to 1/18/2020 (1,350 days). First, he sorted them into four different national groups: the US, UK/Canada, Japan, and Taiwan. Then, he investigated their Continuous Glucose Monitor (CGM) sensor Postprandial Plasma Glucose (PPG) waveforms and data.

Methods

Background

To learn more about the GH-Method: Math-Physical Medicine (MPM) research methodology, readers can review his article, Bio medical research methodology based on GH-Method: Math-Physical Medicine (No. 310), to understand his MPM analysis method.

Data collection

The author started measuring his daily glucose since 1/1/2012 by using traditional finger-piercing and test strip (Finger glucose) 4 times each day, once in early morning as his Fasting Plasma Glucose (FPG) value when he wakes up from sleeping, and three times at two-hours after each meal as his Postprandial Plasma Glucose (PPG) values. He then takes the average value of these four-glucose data as his daily glucose. His glucose target is 120 mg/dL which is equivalent to the perfect score of 1.0 as the perfect score of this category of measured glucose [1-3].

Furthermore, he usually walks for 45 minutes to an hour after each meal with an average 4,300 steps or 16,000 steps each day. His daily walking target is 20,000 steps which is equivalent to a perfect score of 0.5 for this category of daily exercise.

His defined daily life routines include many detailed elements such as traveling and jet lag; schedules of work, meal, sleep and exercise; health incidents of sickness, trauma, fatigue, discomfort, and allergy; weather, living environment, urination and bowel movement, relaxation, meditation, brain exercise, and others. He evaluates these daily performance elements at the end of each day to enter an overall performance score. He has defined an overall target at 0.7 or 70% as the satisfaction score for this category of daily life routines.

Metabolism

Metabolism is a complex subject which warrants a special section to explain this "big" category. The author has spent his past 10 years to self-study and research on the subjects of endocrinology, especially diabetes, metabolism, and lifestyle issues. After the first 4 years (2010-2013) of self-studying endocrinology and food nutrition, he spent the entire year of 2014 to develop a sophisticated mathematical model of metabolism. This model contains four easily measured biomarkers of medical conditions such as body weight, glucose, blood pressure, lipids and others, along with six lifestyle details including food portion quantity and nutritional quality balance, drinking water intake, appropriate exercise, sleep amount and quality, stress reduction, and daily life routine regularity. He applied the concept of topology from mathematics and the modeling technique of finite element method from engineering to develop this mathematical model of metabolism which became the cornerstone of his follow-on medical research work.

In 2014, he further defined a specific output parameter of his metabolism model as "Metabolism Index (MI)". MI is the combined score of the four medical conditions and six lifestyle details which can be calculated on one specific day, a time instant, or over a period of time. He has also identified a "break-even line" at 0.735 (73.5%) to separate his metabolic conditions between the healthy state (below 0.735) and unhealthy state (above 0.735).

His MI was above 73.5% prior to 2014 and below 73.5% after 2014; therefore, his health "turning-point" year was 2014. To date, he has collected about two million data regarding his own metabolism conditions, including both medical conditions and lifestyle details [4-6].

Traveling

When he traveled between two cities with a total flying time less than three hours, this type of short trip only affected one meal and he did not suffer any jet lag. On the contrary, when his flying time is more than 3 hours, this kind of long trip affected two meals and he would suffer jet lag most of the time. As we know, jet lag can impact many other categories of metabolism, including sleep, stress, daily life routines, and more.

In his previous research reports, he has identified a variety of air-travel food and meals which are unhealthy for glucose control. Other eating options include home-cooked meals, chain restaurant food, individual restaurant food, and supermarket prepared meals.

As a result, based on the information above, he separated his travel category into short trips versus long trips. During these 2,938 days over an 8-year period, he had a total of 242 air trips, where he traveled every 12 days, which is about 8.2% of days in total period. In summary, he had 134 short trips (4.6% of total period) and 108 long trips (3.7% of total period).

Results

Figure 1 shows the background data table of this study. Here is a summary of the analysis results in the format of glucose/Metabolism Index (MI) score/Walking steps/Daily life routines score with the respective baselines or "break-even" scores of 120 mg/dL/73.5%/20,000 steps/0.7 or 70%.

(1/1/2012- 1/18/2020)	Glucose	MI %	Walking Steps	Daily Routine
108 Long Trips (> 3 hrs)	127	79.70	12,316	0.9995
134 Short Trips (< 3 hrs)	126	76.00	15,784	0.8496
Total Period (2,938 days)	124	69.74	16,124	0.7300
Baseline Scores	120	73.50	20,000	0.7000
(1/1/2012 - 9/19/2020)	Glucose	MI %	Exercise	Daily Routine
108 Long Trips (> 3 hrs)	106%	108%	177%	143%
134 Short Trips (< 3 hrs)	105%	103%	142%	121%
Total Period (2,938 days)	103%	95%	140%	104%

Figure 1: Background data tables of long trips, short trips, and total period (1/1/2012 - 1/18/2020) and background data tables of long trips, short trips and total period (1/1/2012 - 9/19/2020).

Glucose/MI score/Walking steps/Daily life routine score:

Long:127/79.7%/12,316/99.95%

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It should be pointed out that all scores in these four categories are above the baselines or break-even scores. This means that his glucose level, metabolism index, exercise, and daily routine regularity are

"unhealthy".

By using a designated set of baselines, we can further calculate how much excessive percentage of these four parameters above the "baseline" conditions such as glucose, MI, walking, daily life routines that are associated with long trips, short trips, and total period. Please beware that the total period includes ~92% of non-traveling days [7-9].

Glucose/MI score/Walking steps/Daily life routine score:

Long:106%/108%/177%/143%

Short:105%/103%/142%/121%

Total:103%/95%/140%/104%

In Figure 2, it reflects his daily average glucoses and a daily MI score of the total period. It demonstrates the calculated daily values in two separated bar charts to provide a better viewing of results.

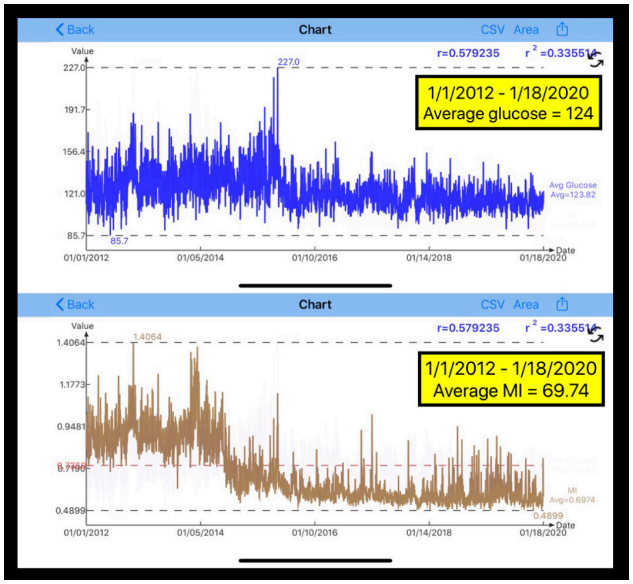

Figure 2: Daily average glucose and daily metabolism index (MI) score during the period of 1/1/2012 to 1/18/2020 (2,938 days).

The bar charts in Figure 3 reveal the excessive difference percentage of these four parameters in comparison against the "baseline" conditions, showing a much clearer comparison than a simple table.

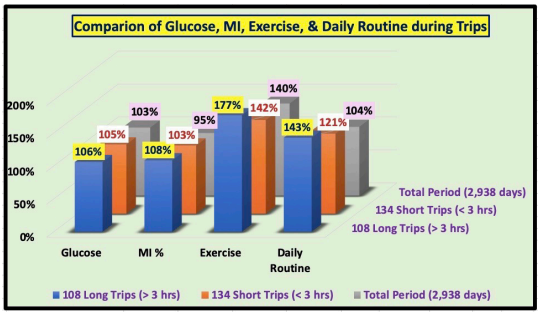

Figure 3: Bart chart of excessive glucose, Metabolism Index (MI), exercise, and daily life routines comparison of long trips and short trips versus total period (1/1/2012-1/18/2020).

Discussion and Conclusion

To compare the results of these three periods, the total period has the best performance of all four parameters. This is due to the fact that the total period (2,938 days) contains more non-traveling days (~92% of total days), stable environment, and healthier days. Scores of short and long trips (total 242 traveling days, ~8% of total days) are higher than the score of total period, specifically 8% to 13% higher from glucose and MI, and 37% to 39% higher from exercise and daily life routines. Furthermore, the long trips scores are higher than the short trips scores by 1% to 5% for glucose and MI, and 22% to 35% for exercise and daily life routines. It should be noted that the author adopts the traditional medical principles, where the lower score indicates a better condition.

Therefore, when traveling, his diabetes conditions contribute to higher glucoses along with elevated MI percentage, which confirms additional damage to his overall health. Due to interruptions to his meals, exercise schedule, sleep pattern, and his daily life routines cause the four markers to become higher or unhealthier during air travel days. Long trips are worse than short trips because the long air travel time covers at least two meals without post-meal exercise and typically crosses over multiple time zones, resulting in jet lag.

The observed conclusions from above may be intuitive for some patients and for most doctors; however, this study utilized a big data analytics approach based on several hundred thousand data over an 8-year period, the segmentation analysis method, along with a complex mathematical model of metabolism to offer some concrete evidence with a high precision and quantitative numerical proof to readers.

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