

## CASE REPORT

# Impact of Socializing, Fasting and Feasting on Day to Day Blood Glucose Profiles in Diabetes Elucidated by the FreeStyle® Libre™ System

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## Abstract

**Background:** Total day-time fasting is observed by millions of adult Muslims during the whole lunar month of Ramadan. However, many people, particularly elderly men and women, do fast isolated or somehow consistent days outside Ramadan. This may pose clinical management challenges. **Case Report:** A case of an elderly diabetic man observing day-time Ramadan-type fasting on Mondays and Thursdays throughout the year is described. Detailed blood glucose (BG) profiles over a 10 week period were captured using the FreeStyle® Libre™ Flash glucose monitoring system. Detailed study of these profiles revealed three distinctly different BG patterns every week. One pattern on the two fasting days (Mondays and Thursdays) with blood glucose peaking after dawn and after sunset with a downward trend throughout the day. A second pattern on Fridays with the BG levels that peak and remain high for a few hours in the early afternoon following the large and rich weekly family meal. The third pattern was seen on the

remaining 4 non-fasting days where BG starts to rise in the midmorning reflecting the patient's life style of hosting and sharing with his business clients. Such detailed and visually presented information gave insights into his BG daily patterns enabling his therapeutic plans for hyperglycemia to be tailored on daily basis. **Conclusions:** This is the first documentation of glucose profiles during "Ramadan-type fasting" and feasting using the flash glucose monitoring system. In addition to detailed clinical and social history, use of medical technology may occasionally help resolve some difficult blood glucose patterns.

**Key words:** Continuous glucose monitoring (CGM) systems, Diabetes in the Elderly, Hyperglycemia, Hypoglycemia, Ramadan-type fasting, FreeStyle® Libre™ Flash glucose monitoring system, Ethnicity and Diabetes.

## Introduction

Total day-time fasting is observed by millions of adult

Muslims during the whole of the 9<sup>th</sup> lunar month of Ramadan (1). However, many people, do fast isolated or somehow consistent days outside Ramadan. Although those who suffer certain medical conditions such as diabetes may be exempted from fasting, some may insist on fasting even against clear medical advice (2). This may pose clinical management challenges.

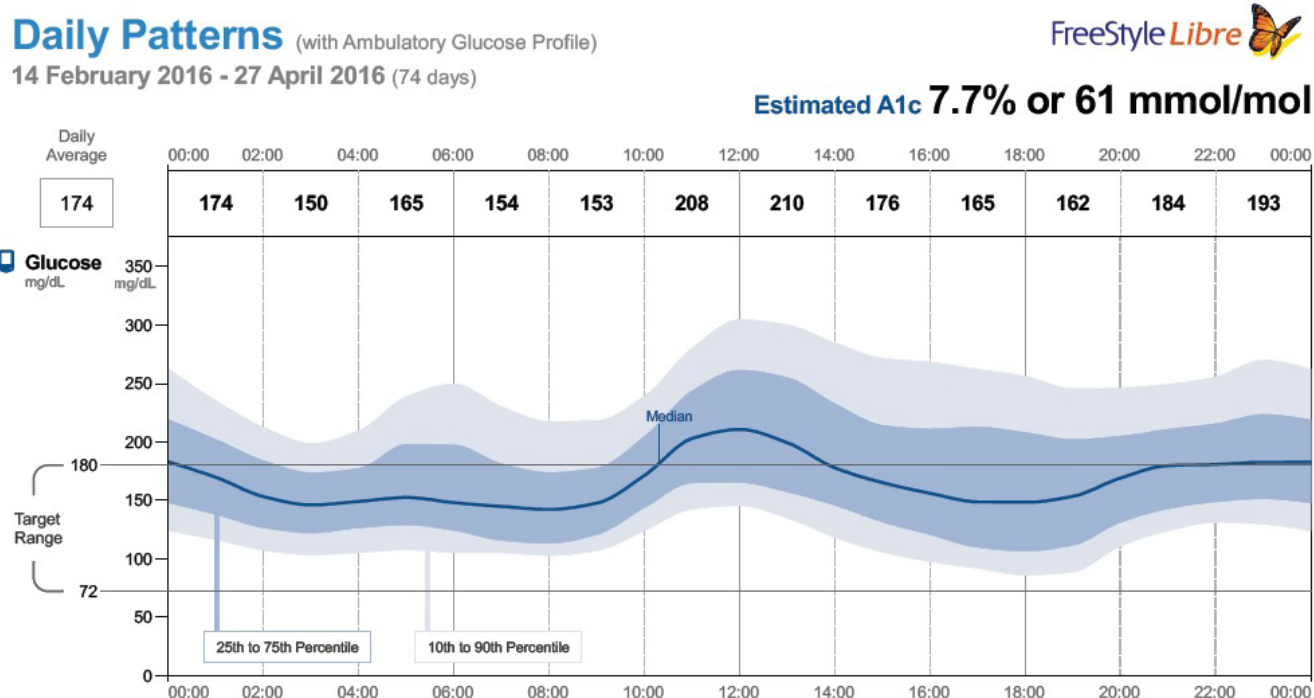
Anecdotally, Ramadan-type fasting on Mondays and Thursdays of every week is commonly practiced particularly by middle-aged and elderly men and women. The medical profession’s interest in fasting has focused almost exclusively on fasting during Ramadan itself (3). However, fasting on these other odd days outside of Ramadan may have important medically-relevant implications. There would be a need to adjust the medication around these days of fasting to avoid complications that may pass unrecognized as the patient may be the only person in the family observing the fast and the rest of the family may be unaware of this.

Ramadan-type fasting peculiarly results in two contrasting

metabolic environments that are produced by a strict “total fasting” in the day time and liberal “feasting” during the night time (3-7). Hypoglycemia during the daytime of Ramadan remains the most feared complication of diabetes nonetheless, evening time hyperglycemia should not be ignored nor treated with any degree of complacency. Understanding the glucose homeostasis during Ramadan-type fasting is crucial to formulate rational therapeutic strategies. There are limited studies giving insights into the changes in blood glucose levels during the fasting of Ramadan using different technologies of blood glucose monitoring and insulin delivery (4-12). We report the first illustration of the glucose changes during Ramadan-type fasting and feasting on two days per week complicated by stereotyped socializing and dining patterns on other days of the week in an elderly man with T2DM using the new flash glucose monitoring system for interstitial glucose (13).

**Case report**

A 73 year old elderly Arab man with 25 year history of T2DM and multiple medical complications reflecting a combination of micro and macrovascular diseases is



**Figure 1.** The summated daily pattern with ambulatory glucose profiles showing a wide variation and excess exposure peaks that are difficult to reconcile.

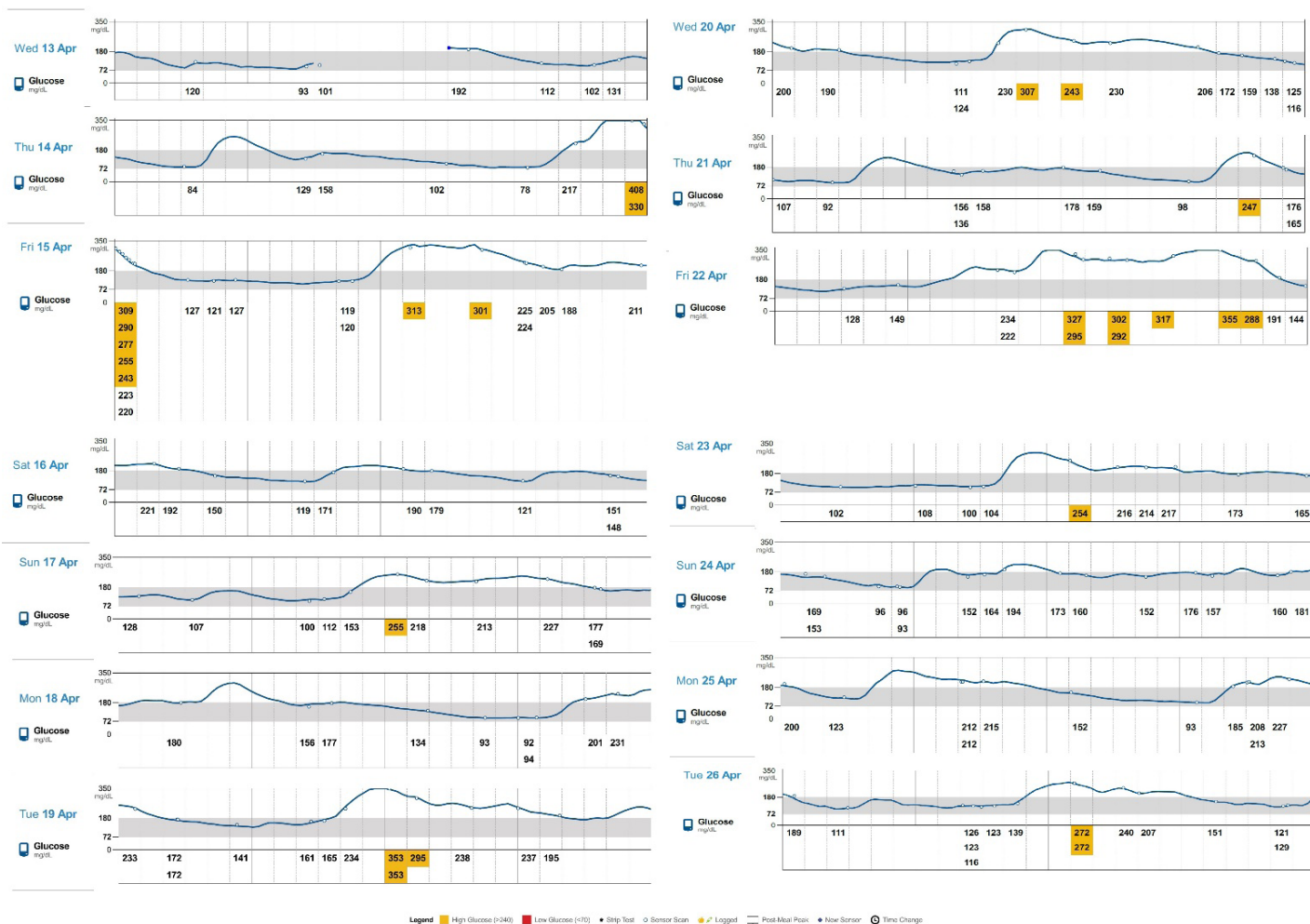
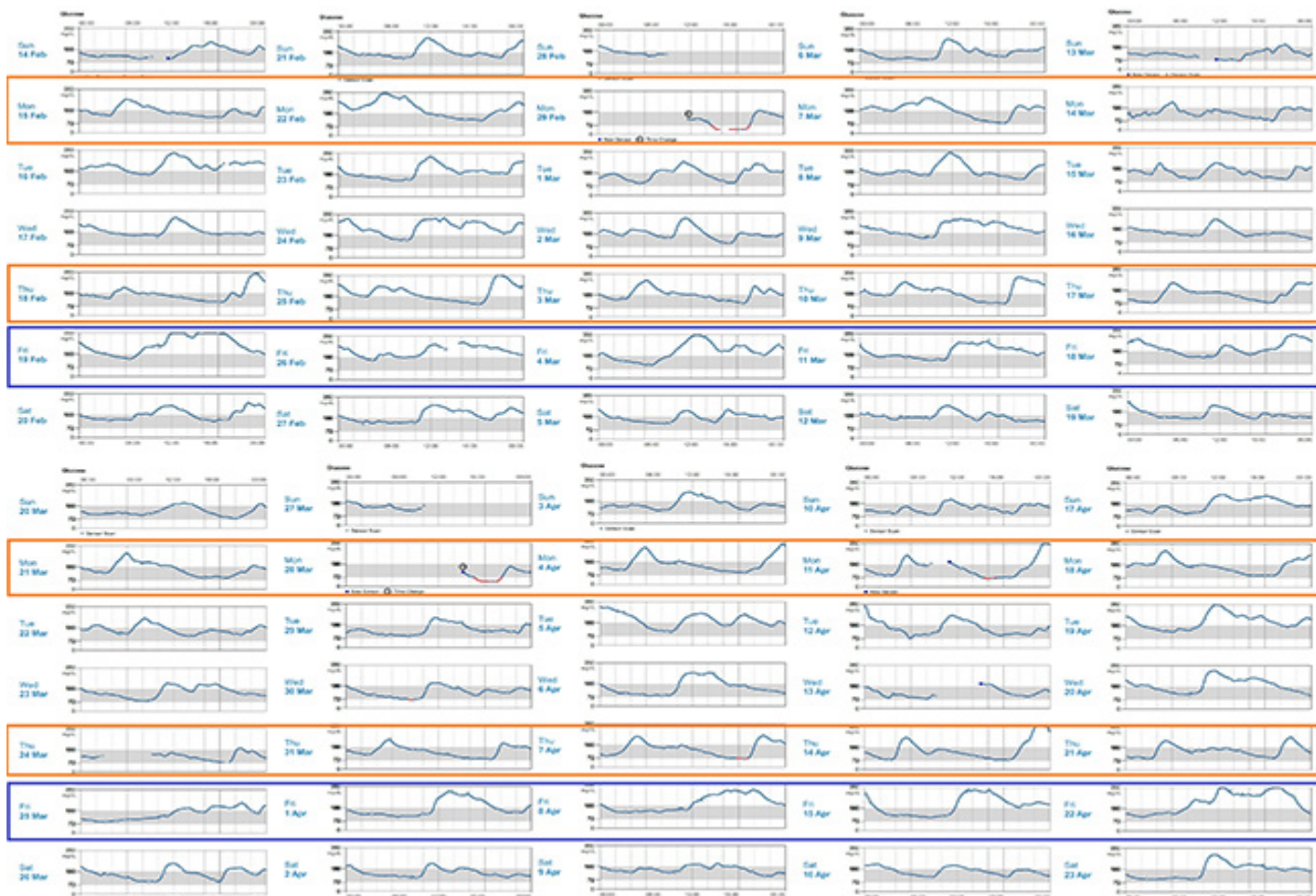


Figure 2. Detailed examination of the ambulatory glucose profiles data over a two weeks period showing three different patterns: great homology of the profiles on Mondays and Thursdays with peaks after dawn and sunset times, a different pattern is seen on Fridays in both weeks with the blood glucose levels starting to rise in the early afternoon, whereas the blood glucose levels on the remainder of the week days start to rise in the late morning rather than after lunch (See text).

reported. He was seen in the routine diabetic clinic for monitoring of his blood glucose levels jointly by the physician and diabetes nurse educator. His antidiabetic medication included basal insulin (Glargine) 16 Units HS, Metformin 1000mg BID, Gliclazide MR 60 mgs QD and Dulaglutide 1.5 mg weekly. On this regimen, his HbA1c ranged between 7.0% and 8.2% over the previous 2 years. His renal, hepatic and thyroid functions were all normal. He used to monitor blood glucose using a conventional capillary blood glucose meter. He acquired an ambulatory glucose profile (AGP) using the FreeStyle® Libre™, flash glucose monitoring system (Abbott Diabetes Care, Alameda, CA) (13-14). AGP data were being downloaded on bi-weekly or monthly basis. These were discussed with

the patient and his home care nurse with fine-tuning of the medications being contemplated based on the daily patterns summated during the period in question. However, blood glucose levels were showing a pattern difficult to reconcile with unusually-timed peaks (Figure 1). These were consistent with “an excess exposure that starts in the late morning and extends to early afternoon”. Whilst reflecting on his results to adjust his doses, further social details were elucidated. It turned out that: a) he observes a daytime Ramadan-type fasting on Mondays and Thursdays all year round invariably, b) he goes to his office during the week days Saturday to Thursday around 10 am and entertains his clients in his office with dates and deserts being served almost all day and c) he hosts his extended family with a



**Figure 3.** The AGP over a ten week period confirming the findings suggested in figure 2. of three different patterns per week on Mondays and Thursdays (red box), Fridays (blue boxes) and rest of the week days (See text).

large meal every Friday in the early afternoon following the Friday prayers. Once the social details were uncovered, the AGP data were re-examined more carefully for the current two week period (Figure 2). In both weeks, three recurring patterns of glucose profiles could be recognized which are compatible with reported individual daily life style. On Mondays and Thursdays, blood glucose levels were gradually decreasing progressively in the day time flanked with two blood glucose peaks after dawn and after sunset times. This reflects the impact of his total Ramadan-type fasting in the day time and the two traditional Ramadan-type meals *Iftar* at sunset and *Suhoor* just before dawn. A second pattern was seen on Fridays with a small glucose rise in the morning 10-11 am but with a consistent and extended rise of blood glucose levels (all afternoon). These coincide with a late breakfast and the rich and large family lunch taken after mid-day Friday prayers and the afternoon family gathering thereafter. Whereas on the remainder of

the week days, the blood glucose levels rise starts late in morning (rather than the traditional middle eastern lunch time) and merge with the lunch time rise. This must reflect the mid to late morning hospitality in his office described above (Figure 2). Furthermore, we have re-examined the AGP data over a ten week period and confirmed the same three patterns every week being seen consistently (Figure 3). We have employed these data to enhance patient education and adjust the timing and doses of his medication on specific daily basis.

### Discussion

Self-monitoring of blood glucose (SMBG) is essential for optimizing glycemic control in patients with diabetes. Available methods include monitoring of capillary blood glucose using conventional glucose meters and continuous glucose monitoring (CGM) systems (15). The FreeStyle® Libre™ flash glucose monitoring system used in the current

report is unique. It was found to be accurate compared with capillary BG reference values, with accuracy remaining stable over 14 days of wear and unaffected by patient characteristics such as body mass index, age, type of diabetes, clinical site, insulin administration, or hemoglobin A1c. Further technical details are beyond the scope of this case report (13,14).

Monitoring of blood glucose during both the abstinence and the liberal hours of the day during the holy month of Ramadan has been recommended for all patients on insulin therapy or on insulin-secreting agents to safeguard against both hypo- and hyperglycemia. Most of the large Ramadan studies were based on SMBG and only the smaller studies used continuous glucose monitoring (CGM) technology (6-12). To our knowledge, this is the first report that assesses BG fluctuation during Ramadan-type fasting using the new AGP technology. The ready access to real time blood glucose levels, trends and the lack of any prohibiting cost issue once the system is acquired are self-evident (13,14). Whereas previous reports involved children, adolescents and young adults, our case is also unique in that it involves an elderly man with a high risk profile. The visual examination of the daily patterns over the whole week could readily identify three contrasting blood glucose patterns even in a busy diabetes clinic. Although we cannot claim expertise in usage of this new technology and we must admit that we found ourselves on a steep learning curve since we acquired the new system, we can confidently recommend that examination of the individual daily curves is needed when the weekly pattern could not be reconciled with the expected patterns resulting from known effects of diet and lifestyle factors. The three distinct patterns described in our case cannot be detected in the summative weekly pattern as the changes in blood glucose levels in the different days would have nullified each other.

We described the glucose profiles in an illustrative case of an elderly Arab man with T2DM in the context of observing a Ramadan-type fasting outside of the month of Ramadan. As Ramadan is observed by millions of patients with diabetes throughout the world, information about glucose variability is useful to guide management particularly in relation to treatment adjustment. This case report also highlights the importance of the new monitor in disclosing different glucose patterns during different days of the week. To our knowledge, this is the first description of the FreeStyle® Libre™ flash glucose monitoring system during Ramadan-type fasting. Complacency

about medication and monitoring during Ramadan is well established phenomenon. The FreeStyle® Libre™ may help overcome this by its easy use, lack of finger-pricking pain, and avoiding limitations imposed by glucose testing strip consumption.

Although utilization the device for studying pattern of glycemia during fasting is novel, this is admittedly a single case report. On the other hand, the fairly long duration of using the device and the consistency of the documented patterns lend it some strength. Naturally, a bigger scale study is needed to establish the reproducibility of the glycemia pattern as well as the reliability of using the device for such a purpose.

Finally, the underlying purpose of the case study was to highlight the importance of newly available devices to uncover interesting observations, which may in turn lead to carefully planned studies. For example, it suggests that at least two different treatment regimens may be needed (our patient was following the same regimen on fasting and non-fasting days). We accept that the AGP for the entire period is valuable since the inter-quartile range and the inter-decile range differentiate between physiological and behavioral causes of the glucose variability characteristic of the AGP. When different daily patterns are present, to understand whether behavioral or physiological factors are contributing to the excess glucose exposure and variability, some patterns can only be detected by the human eye matching the observed profiles with carefully documented history.

### Disclosures

The clinical and blood glucose monitoring data were collected during the normal conduct of the patient's clinical care. The manufacturer of the The FreeStyle® Libre™ flash glucose monitoring system (Abbott Diabetes Care, Alameda, CA) and the local trading agents had no prior knowledge of this case report. The meter and sensors were obtained by the patient via the normal conduct of business. Prior IRB approval is not required for single case reports from our institution.

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