

Analysis of 24-hour number of steps obtained with pedometer in comparison with records of continuous glucose monitoring in type 1 diabetes

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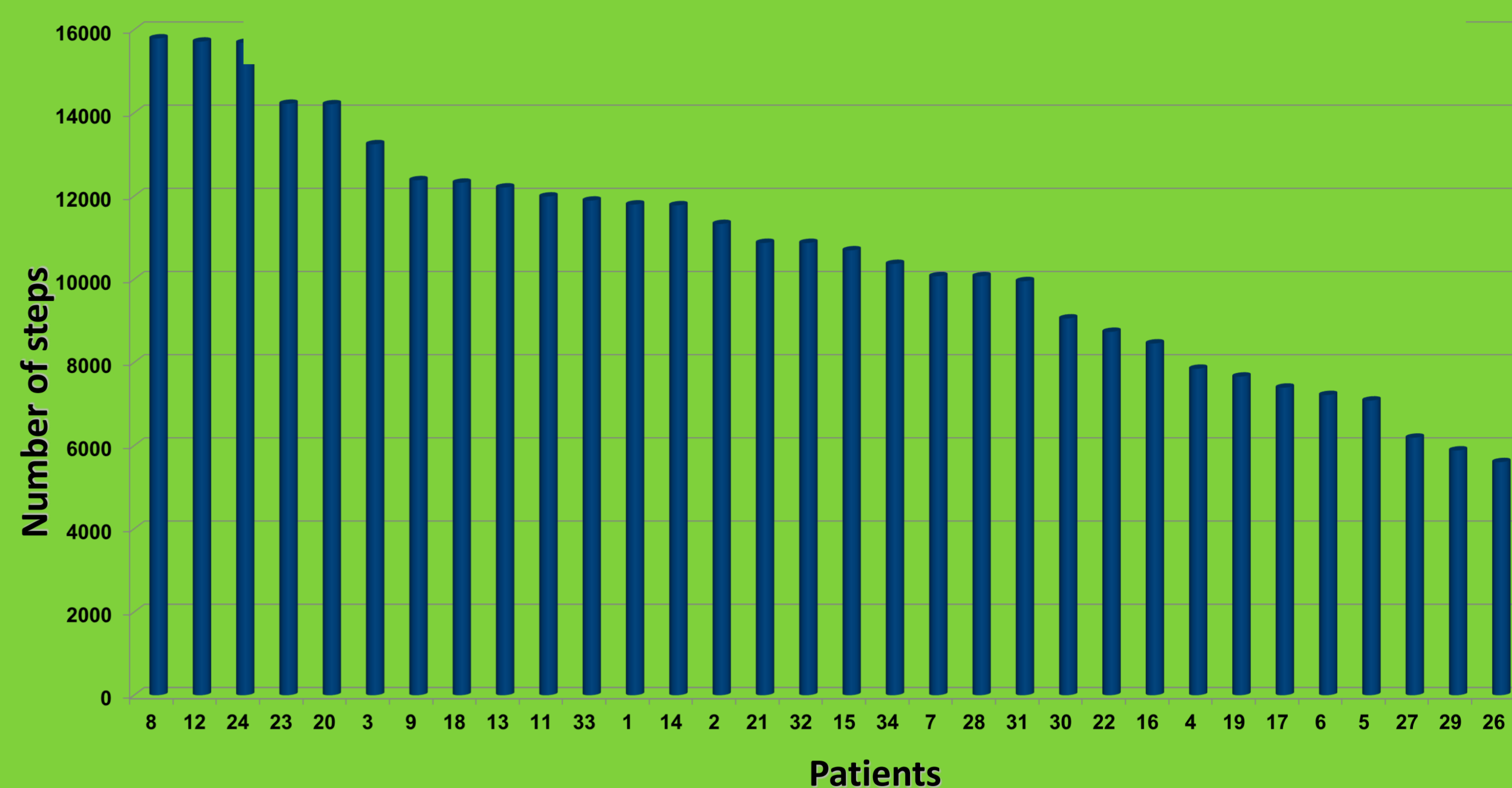
Introduction: glycemic values of patients with type 1 diabetes are complex results of many factors. The most influential ones are considered to be amount of carbohydrates in a meal, insulin dose and level of physical activity. The most common type of physical activity is walking. In addition to the reduction of cardiovascular diseases, physical activity also affects blood glucose levels. The primary objective of the study was to determine the daily steps taken and the effect on people with type 1 diabetes. The secondary objective was the analysis of its relation to current blood glucose levels and also an attempt to identify the level of daily steps needed for implying a significant effect on blood glucose level. Such a finding would improve patients' awareness of the impact of daily steps and the effect on hypoglycaemia and thus reduce the risk of such events. Another objective was to determine daily variations in steps taken and whether these correlates with blood glucose values, and then indirectly determine whether the patient is able to respond on this difference with adequate changes in his or her therapy (insulin dose and amount of carbohydrates).

Material and methods: 34 patients with type 1 diabetes have been included into the study (20 women and 14 men). Data from 31 of these patients have been evaluated. Each patient was equipped with an electronic pedometer Flex (Fitbit, Inc.) and a continuous glucose monitoring system Guardian REAL-Time (Medtronic Inc.). Multiple regression analysis and GAM (Generalized additive model) were used for the statistical model-based data processing.

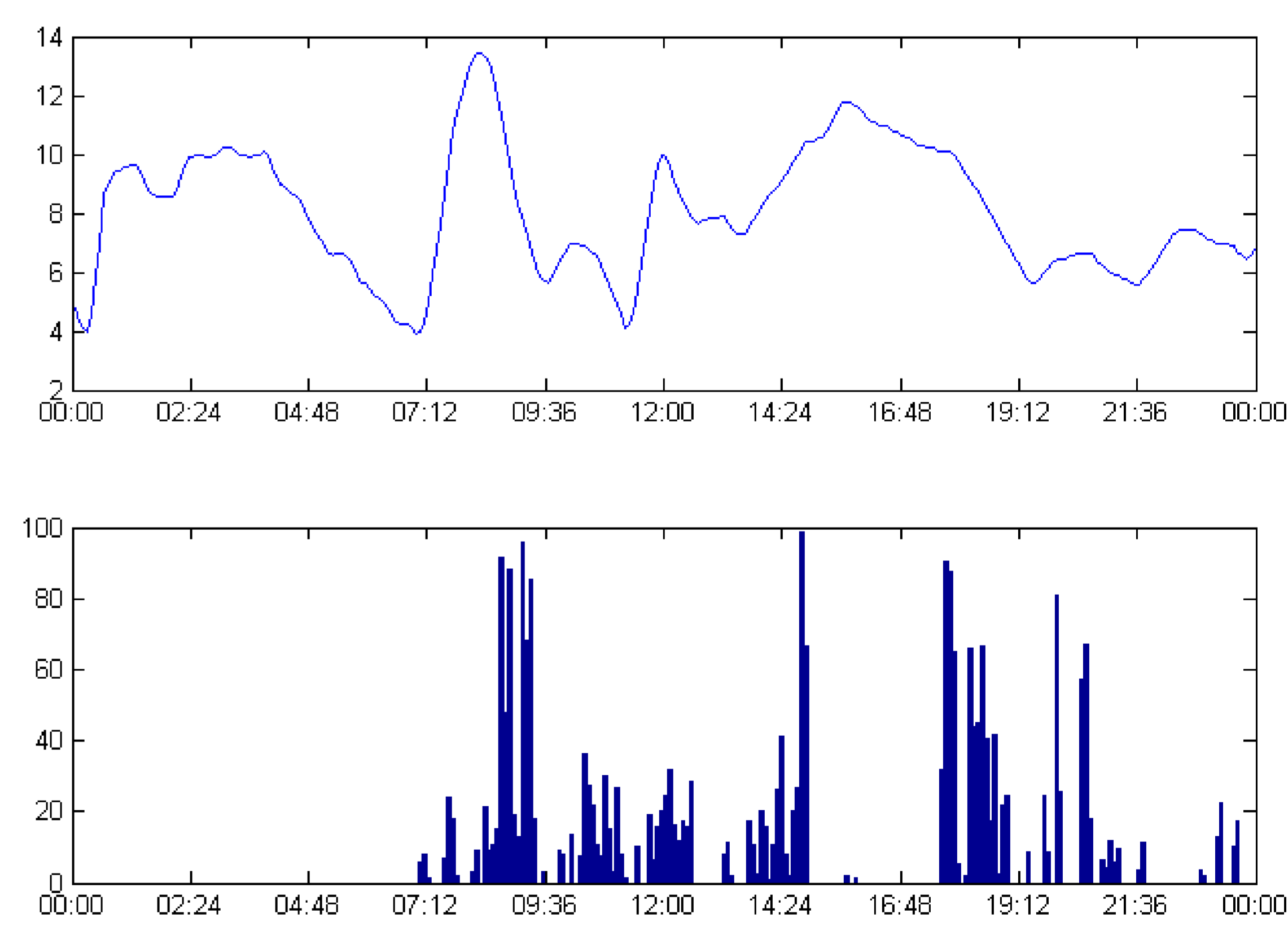
Results: The system was used by patients for approx. 5.82 ± 0.89 days in average, in total, 120 days of usage were evaluated. The average number of steps per patient was $10,285 \pm 3172/24$ hours, the lowest average daily steps among the patients was 4241 and the largest number was 15,790. We proved a negative correlation between the average number of steps per day and the average daily blood glucose value (GAM). The relationship between the intraday numbers of steps and the blood glucose levels was not found.

Conclusion: The performed simulations show a correlation between the average number of steps per day and the average daily blood glucose values. This finding is in concordance with general knowledge about relationship between glycemia and physical activity but also suggests that pedometer could identify days (those with less physical activity) with increased needs of insulin.

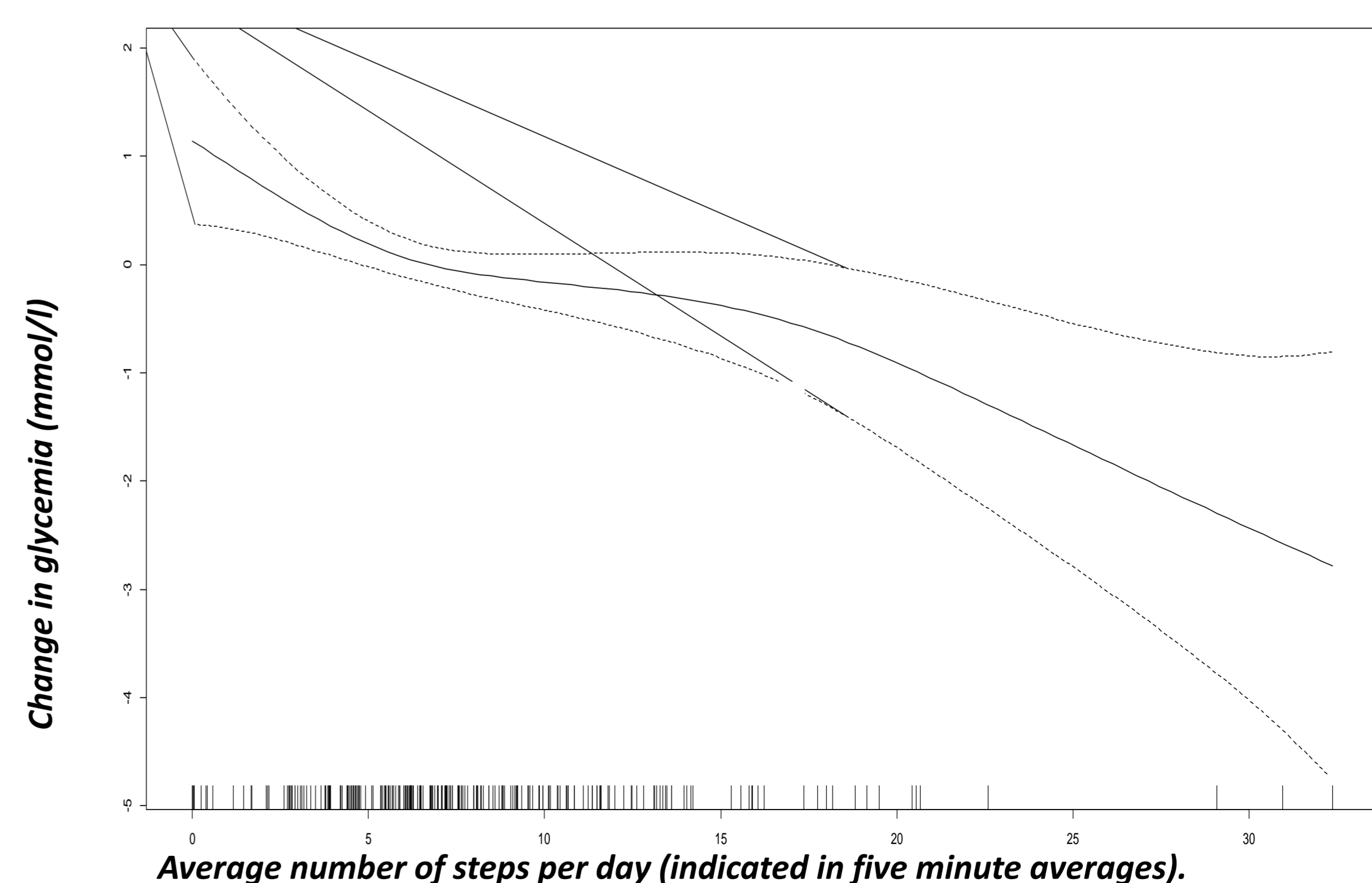
Average number of steps per one day in each patient



An example of CGM record (above) and pedometer record (below) in a one day day



Relation between average number of steps per day and difference in glycaemia



NB. The figure shows the relationship between average blood glucose values per day in mmol/l and the changing average number of steps per day (indicated in five minute averages).