



INTRODUCTION

- In situations where it is difficult for patients to visit hospitals, such as the coronavirus disease pandemic, it is important to more detailly predict hemoglobin A1c (HbA1c) from flash glucose monitor (FGM) data.
- CGM data over 14 days can be obtained from a FGM sensor; therefore, there are many options for extracting the duration from which glucose levels are derived.
- The extracted durations were closely studied to determine which mean glucose levels can predict HbA1c more accurately.

MATERIALS AND METHODS

- Seventy-three outpatients with type 2 diabetes mellitus underwent HbA1c testing, wore a FGM (FreeStyle Libre Pro), and did not change diabetic treatments, on a hospital visit.
- FGM data over 24 h × 13 days (from 00:00 on day 2 to 24:00 on day 14 [FGM attachment: day 1]) were analyzed.
- The mean glucose levels were calculated corresponding to the following durations:

- 1 day: day 2 ~ day 14 (n=13)
- 2 days: days 2-3 ~ days 13-14 (n=12)
- 3 days: days 2-4 ~ days 12-14 (n=11)
- 4 days: days 2-5 ~ days 11-14 (n=10)
- 5 days: days 2-6 ~ days 10-14 (n=9)
- 6 days: days 2-7 ~ days 9-14 (n=8)
- 7 days: days 2-8 ~ days 8-14 (n=7)
- 8 days: days 2-9 ~ days 7-14 (n=6)
- 9 days: days 2-10 ~ days 6-14 (n=5)
- 10 days: days 2-11 ~ days 5-14 (n=4)
- 11 days: days 2-12 ~ days 4-14 (n=3)
- 12 days: days 2-13 ~ days 3-14 (n=2)
- 13 days: days 2-14 (n=1)

Data were analyzed

- in all patients (n=73),
- in patients with hypoglycemia in the 13 days (Hypo) group (n=40),
- in patients without hypoglycemia in the 13 days (Nonhypo) group (n=33).

[Total 91 durations] (Extracted mean glucose levels).

- Endpoints
- In all patients (n=73), in the Hypo group (n=40), and in Nonhypo group (n=33)
- The extracted duration for which mean glucose levels most significantly correlated with HbA1c
- Correlations between HbA1c and extracted mean glucose levels (“r, HbA1c, EMGL”) (n=73)
- Correlation between “r, HbA1c, EMGL” and number of extracted days for the extracted mean glucose levels (n=91)

- Comparison of data between the Hypo group and the Nonhypo group

- Comparison of “r, HbA1c, EMGL” between the Hypo group and the Nonhypo group (n=91)

- Comparison of

- ◆ “coefficient of variations of 13 days with 24-h mean glucose levels” (“CV, 24hMGL”)

- ◆ “coefficient of variations over 13 days” (“CV, 13 days”)

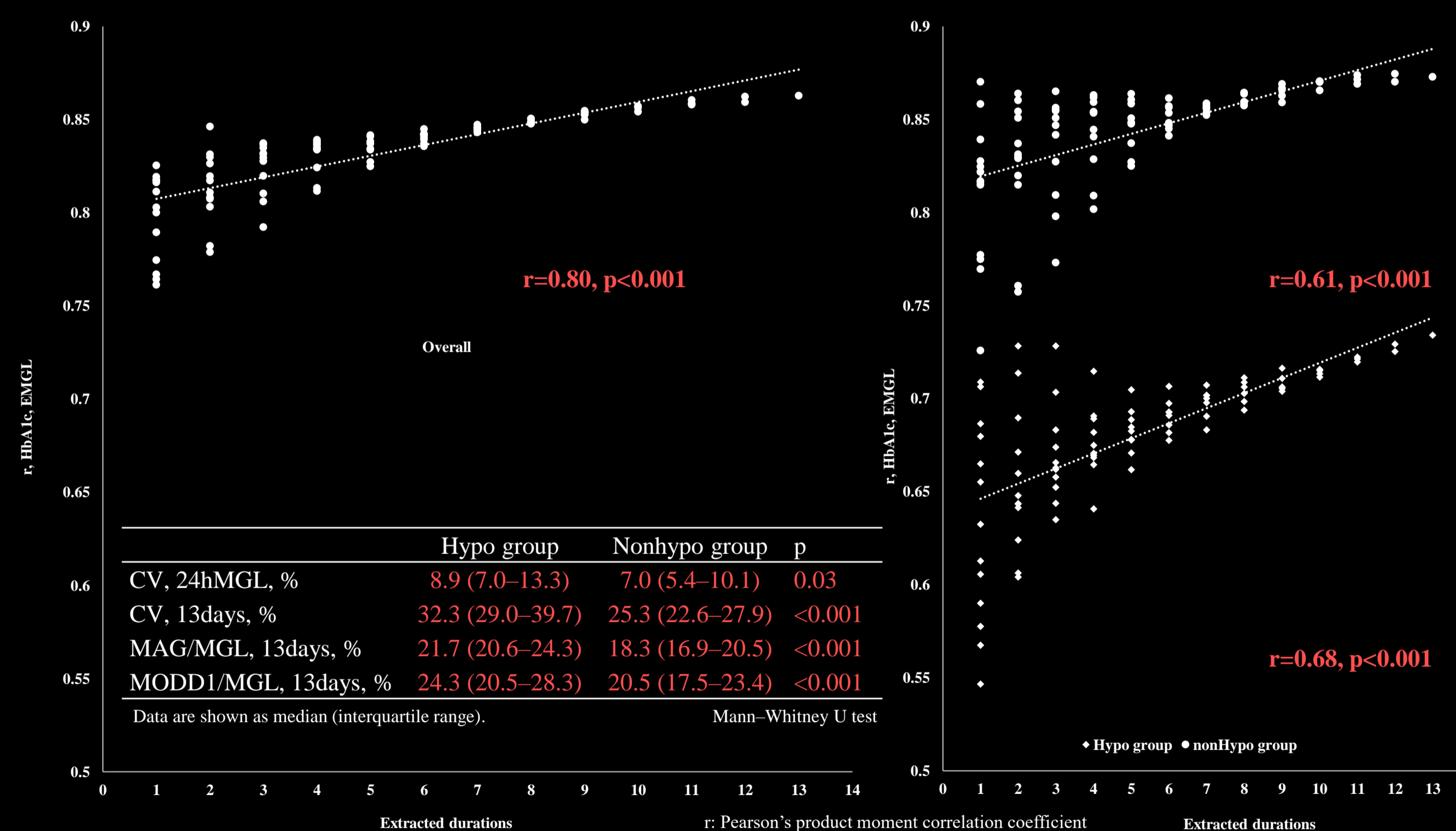
- ◆ “mean absolute glucose over 13 days ÷ mean glucose levels over 13 days × 100” (“MAG/MGL, 13 days”)

- ◆ “mean of daily differences 1 over 13 days ÷ mean glucose levels over 13 days × 100” (“MODD1/MGL, 13 days”)

between the hypo group and the Nonhypo group (n=40 and n=33, respectively)

Characteristic	Overall	Hypo group	Nonhypo group	p
N (Male / Female)	73 (40 / 33)	40 (22 / 18)	33 (18 / 15)	p <sub>2</sub> =0.97
Age, years	70.1 ± 12.5	74.5 (69.8–81.0)	67.0 (61.0–77.0)	p <sub>1</sub> =0.01
BMI, kg/m <sup>2</sup>	23.9 ± 4.2	22.4 (21.1–24.3)	23.9 (22.1–27.0)	p <sub>1</sub> =0.02
HbA1c (NGSP), %	7.8 ± 1.4	7.2 (6.7–7.8)	8.1 (7.6–8.7)	p <sub>1</sub> <0.001

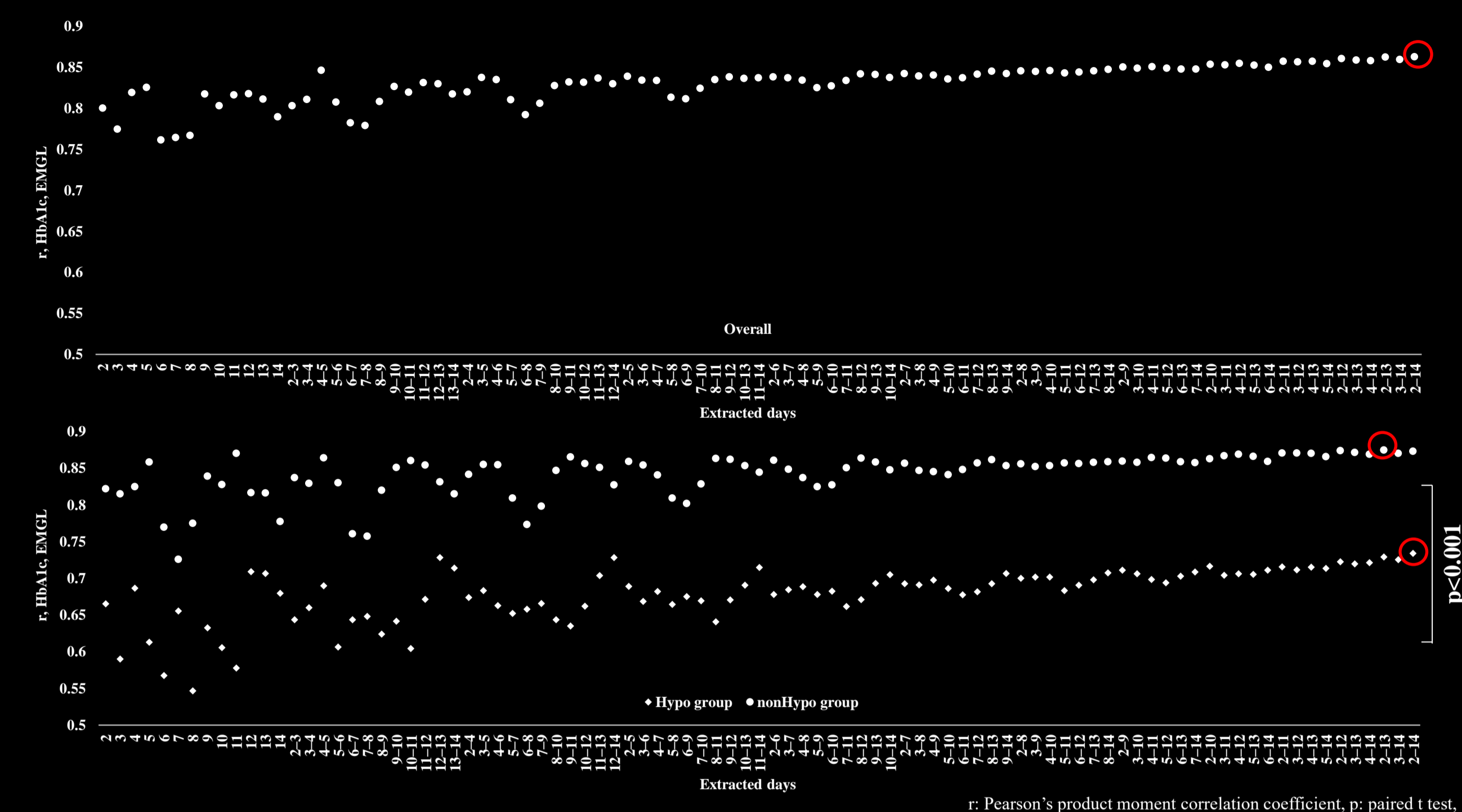
Data in overall patients are shown as mean ± standard deviation. Data in Hypo and Nonhypo groups are shown as median (interquartile range). p<sub>1</sub>: Mann-Whitney U test, p<sub>2</sub>: chi-square test  
BMI: body mass index, HbA1c: hemoglobin A1c, Hypo group: patients with hypoglycemia in the 13 days, Nonhypo group: patients without hypoglycemia in the 13 days



CONCLUSION

- In the prediction of HbA1c using data from one FGM sensor, prolonged measurement can make the glucose management indicator more accurate.
- Especially for patients with hypoglycemia, the importance of prolonged measurement may be applicable.

RESULTS AND DISCUSSIONS



- The median CGM measurement durations for mean glucose levels were 13 days [1] and 48 days [2], that are consistent with the present study result in that the measurement durations exceeded approximately 2 weeks.
- The minimum duration to estimate TIR over 90 days is 14 days [3], which is in line with the present study result.
- The present study is novel because the data over 13 days of monitoring were obtained after HbA1c measurement, whereas the CGM data were measured before HbA1c measurement in the previous studies [1, 2], and the minimum duration of 14 days was the initial monitoring days in the 90 days in the previous study [3].
- The rationale behind the significantly lower “r, HbA1c, EMGL” in the Hypo group than that in the Nonhypo group was studied accordingly.
- The result for “CV, 13 days” is consistent with the results reported in a previous study [4].
- The results for “CV, 13 days” and “MAG/MGL, 13 days” may show that patients with hypoglycemia have high glycemic variability amplitude and frequency.
- Day-to-day glycemic variability is associated with within-day glycemic variability [5]. Therefore, the results for “CV, 13 days” and “MAG/MGL, 13 days” may have led to the result for “MODD1/MGL, 13 days,” which may have further led to the result for “CV, 24hMGL.”
- It is thought that higher “CV, 24hMGL” led to the lower “r, HbA1c, EMGL” in the Hypo group than in the Nonhypo group.

1. Nathan DM, et al. Diabetes Care. 2008; 31:1473-8. 2. Bergenstal RM, et al. Diabetes Care. 2018; 41:2275-80. 3. Riddlesworth TD, et al. Diabetes Technol Ther 20: 314-316 4. Monnier L, et al. Diabetes Care. 2017; 40:832-8 5. Ohara M, et al. Diabetes Res Clin Pract. 2016; 122:62-70.

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