



ECE

2023

EP494

Standard deviation

Soichi Takeishi, MD, Tatsuo Inoue, MD

Department of Diabetes, Inuyama Chuo General Hospital

Background

● We studied regarding simplifying standard deviation (SD) and useful metrics for achieving target SD (TSD).

Research design & Methods

- In a cross-sectional study, we analyzed 24-h glucose levels measured using continuous glucose monitor (CGM) [iPro2] in 150 patients with type 2 diabetes.
- We analyzed 51 time in range (TIR) (reference ranges: mean glucose level (M) ± 20, M ± 21 ... M ± 69, M ± 70 mg/dL [we referred to the underlined numbers as “Margin”]).
- We analyzed optimal cutoff values of TIR to predict SD below target, corresponding to 51 TIR × 26 TSD (25, 26 ... 49, 50 mg/dL), using receiver operating characteristic analysis.
- Of the 51 reference ranges, the reference range for which TIR had the largest AUC for each TSD was referred to as “optimal reference range 1”.
- We arranged the patients in ascending order of SD, ranking from 1 to 150.
- Consecutive 110 patients were selected 41 times while shifting one by one (from “1–110” to “41–150”: 41 groups).
- Of the 51 reference ranges, the reference range for which TIR most correlated to SD for each group was referred to as “optimal reference range 2”.

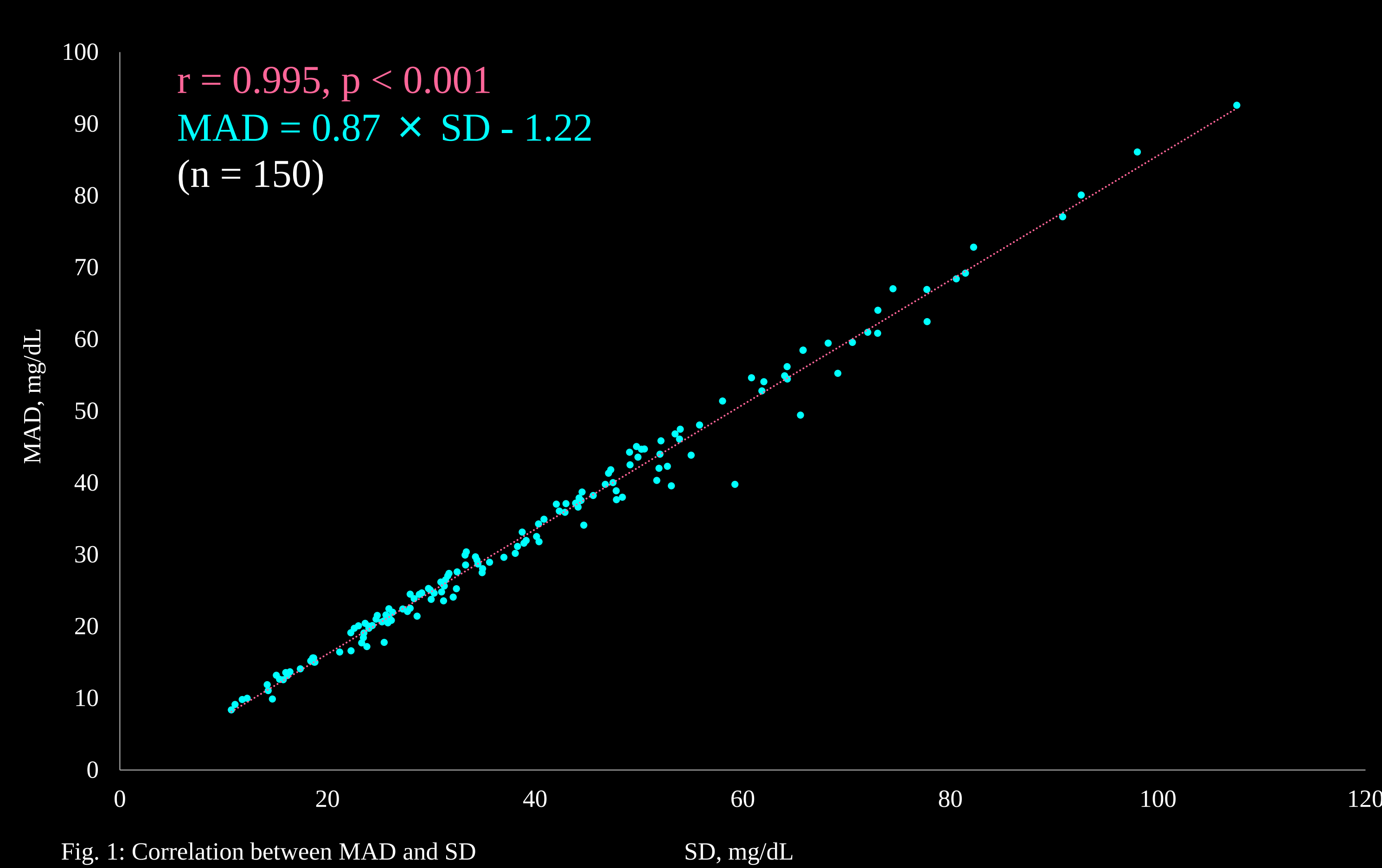
➤ Primary endpoints
Correlation between mean absolute deviation (MAD) and SD
➤ Secondary endpoints
Association between TSD and “Margin” of “optimal reference range 1” (M1)
The “optimal cutoff values of TIR for ‘optimal reference range 1’” (C1) in 26 TSD
Association between mean of SD (MSD) and “Margin” of “optimal reference range 2” (M2)

Results

Characteristic	Values	
N (Male / Female)	150 (86 / 64)	Table 1: Baseline characteristics
Age, years	69.3 ± 13.7	Data are shown as median (interquartile range).
BMI, kg/m ²	24.6 ± 5.0	BMI, body mass index; HbA1c, hemoglobin A1c
HbA1c (NGSP), %	9.0 ± 1.8	
		Table 2: M1 and C1 for each TSD
		M1, “Margin” of “optimal reference range 1”;
		C1, optimal cutoff values of TIR for “optimal reference range 1”;
		TSD, target SD

TSD, mg/dL	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0
M1, mg/dL	42.0	45.0	38.0	36.0	42.0	42.0	39.0	38.0	38.0	55.0	60.0	60.0	61.0	61.0	57.0	61.0	62.0	62.0	64.0	65.0	67.0	65.0	65.0	65.0	65.0	66.0
C1, %	91.3	91.7	86.5	80.6	86.1	84.7	81.3	75.7	74.3	89.6	91.7	91.0	91.7	91.7	87.8	89.6	87.8	87.8	88.9	88.9	88.5	88.2	87.8	85.1	85.1	84.7
Sensitivity, %	97.2	97.7	97.8	98.0	100.0	98.2	94.8	96.9	97.1	100.0	100.0	100.0	100.0	98.7	96.3	96.4	100.0	100.0	97.8	97.8	95.9	93.9	94.0	97.1	96.2	95.5
Specificity, %	97.4	96.3	100.0	97.0	100.0	97.9	96.7	96.5	97.6	96.2	100.0	100.0	100.0	100.0	98.5	98.5	95.2	95.2	98.3	98.3	96.2	98.0	96.0	97.8	97.7	95.0

Selected number	MSD, mg/dL	M2, mg/dL
1–110	30.6	35
2–111	31	35
3–112	31.3	35
4–113	31.7	35
5–114	32	35
6–115	32.4	35
7–116	32.7	37
8–117	33.1	37
9–118	33.4	37
10–119	33.8	37
11–120	34.1	37
12–121	34.5	43
13–122	34.8	43
14–123	35.2	43
15–124	35.5	43
16–125	35.9	43
17–126	36.3	43
18–127	36.7	43
19–128	37.1	43
20–129	37.5	43
21–130	37.9	43
22–131	38.3	43
23–132	38.7	45
24–133	39.1	45
25–134	39.5	45
26–135	39.9	45
27–136	40.4	45
28–137	40.8	45
29–138	41.2	45
30–139	41.7	57
31–140	42.1	57
32–141	42.6	57
33–142	43.1	57
34–143	43.6	57
35–144	44.1	57
36–145	44.6	57
37–146	45.1	57
38–147	45.7	61
39–148	46.3	64
40–149	47	64
41–150	47.7	64



- M2 tended to increase with increased MSD
- MSD correlated to M2 (r = 0.96, p < 0.001) (n = 41).

Table 3: MSD and M2 for each selected group	
MSD, mean of SD; M2, “Margin” of “optimal reference range 2”	

Conclusion

- SD means difference from M.
- If “optimal reference range 1” is used as an alarm threshold in a personal CGM and TIR for “optimal reference range 1” > 80–90% is achieved, SD below the target may be achieved.
- The mean of SD in study participants may affect the M2.

Contact information

Soichi Takeishi, MD

Inuyama-city, Aichi,

484-8511, JAPAN

E-mail: souichi19811225@yahoo.co.jp

Phone: +81-568-62-8111

Fax: +81-586-48-9289