

SHORT-TERM GLYCAEMIC CHANGES FROM CONTINUOUS GLUCOSE MONITORING AMONG CHILDREN AND ADOLESCENTS WITH TYPE 1 DIABETES MELLITUS DURING FASTING IN RAMADAN MONTH

SZE TEIK TEOH¹, SUHAIMI HUSSAIN² and JANET YEOW HUA HONG¹

1. PAEDIATRIC UNIT, HOSPITAL PUTRAJAYA, FEDERAL TERRITORY OF PUTRAJAYA, MALAYSIA

2. PAEDIATRIC UNIT, HOSPITAL UNIVERSITI SAINS MALAYSIA, KELANTAN, MALAYSIA



INTRODUCTION

- Muslim T1DM children and adolescents in developing countries are often inclined to fast despite religious exemption, even during COVID-19 pandemic
- Ramadan fasting has been associated with increased metabolic risk of hypo or hyperglycaemia, diabetic ketoacidosis, dehydration and thrombosis

AIM

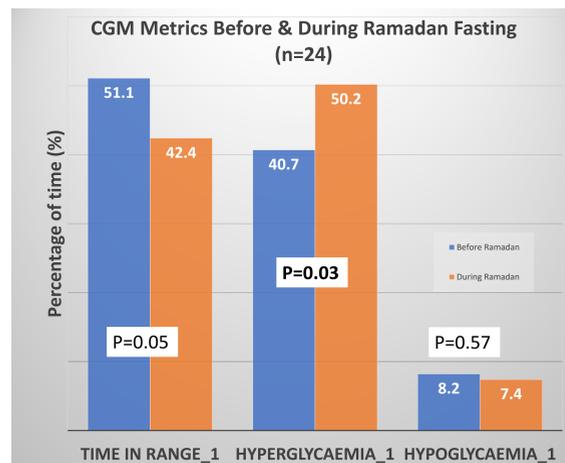
- To investigate the short-term glycaemic impact of Ramadan fasting in T1DM children and adolescents **via retrospective CGM**

METHOD

- Observational study
- Duration: February to May 2020 (including Ramadan Hijri 1441, 23/4/20- 24/5/20)
- Inclusion: T1DM aged 8-18 years old who intended to fast during Ramadan
- Exclusion: Hypoglycaemia unawareness, history of recurrent hypoglycaemia or DKA 3 months prior
- **Ramadan-focused education & SMBG** 3-4 times per day with standardised glucometers (Contour Plus One) and fully supplied strips
- **iPro2 (Medtronic)→ Before and During Ramadan month**
- In view of potential risk and background glycaemic control within cohort, 4 clinic visits were provided throughout study period
- Diabetes team consists of physician, dieticians and diabetic nurse educators

RESULTS

- Out of 32, 24 patients analysed (8 dropout)
 - 4 defaulted visit; 4 incomplete data pairs
- Average fasting duration was 20-30 days
- None had required emergency visit
- CGM analysis indicates:
 - **Increase** for time in mild hyperglycaemia (level 1), mean glucose and estimated A1c during Ramadan
 - **No difference** for time in range (level 1), time in severe hyperglycaemia (level 2), time in mild hypoglycaemia (level 1), time in severe hypoglycaemia (level 2)
 - **Reduction** for time in range (level 2) -not applicable in paediatric age
- During Ramadan, significant GV observed during non-fasting hours, compared to fasting hours, with **higher MAGE and HBGI during non-fasting hours**. No increased LBGI during fasting hours



DEMOGRAPHICS		Total (n=24)
Age (years)*		13.6 (3.06)
Duration of diabetes (years)*		5.4 (3.42)
Baseline HbA1c (%)*		9.6 (1.85)
Insulin delivery [#]	MDI	22 (91.7)
	CSII	2 (8.3)
Previous experience [#]	Yes	23 (95.8)
	No	1 (4.2)
Insulin dose* (unit/kg/day)	Before Ramadan	1.2 (0.2)
	During Ramadan	1.0 (0.2)
Socio-economic status [#]	B40	11 (45.8)
	M40	10 (41.7)
	T20	3 (12.5)

Footnotes: *Numerical, in means (SD); #Categorical, in number (%); B40, household income < RM4850 per month; M40, household income RM4851-RM10 970 per month; T20, Household income > RM10 971 per month

SUMMARY TABLE		BEFORE RAMADAN (n=24)	DURING RAMADAN (n=24)	P-value
Sensor Accuracy	Readings (each subject/week)	1739.8 (366.9)	1613.9 (416.1)	0.14 ^a
	MARD (%)	14.3 (7.7)	15.0 (9.4)	0.61 ^a
	Calibrations (each subject/week)	23.7 (1.4)	21.9 (1.7)	0.29 ^a
CGM Metrics	Mean glucose (mmol/L)	9.7 (2.2)	10.6 (2.9)	0.04^a
	CV (%)	42.9 (8.1)	40.8 (9.1)	0.31 ^a
	Estimated A1c (%)	7.7 (1.4)	8.3 (1.8)	0.03^a
	Time in range_1 (%)	51.1 (14.6)	42.4 (20.9)	0.05 ^a
	Time in range_2 (%)	34.6 (16.0)	27.3 (17.4)	0.02^a
	Time in hyperglycaemia_1 (%)	40.7 (18.78)	50.2 (25.66)	0.03^a
	Time in hyperglycaemia_2 (%)	19.5 (13.96)	25.6 (18.55)	0.10 ^a
	Time in hypoglycaemia_1 (%)	8.2 (10.61)	7.4 (10.49)	0.57 ^a
Time in hypoglycaemia_2 (%)	4.2 (7.11)	3.5 (5.33)	0.54 ^a	

Footnotes:

Numerical data, in means (SD); MARD, mean absolute relative difference; CV, co-efficient of variance; Time in range_1, SG between 3.9-10 mmo/L; Time in range_2, SG between 3.9-7.8 mmol/L; Time in hyperglycaemia_1, SG >10 mmol/L; Time in hyperglycaemia_2, SG >13.9 mmol/L; Time in hypoglycaemia_1, SG <3.9 mmol/L; Time in hypoglycaemia_2, SG <3.0 mmol/L; ^a Paired sample t test

		Fasting hours (06:00- 1900)	Non-fasting hours (19:00-06:00)	P-value
Glycaemic Variability (GV)	MAGE	10.22 (2.83)	10.99 (3.10)	0.02^a
	LBGI	5.03 (5.83)	5.59 (4.63)	0.64 ^a
	HBGI	15.10 (7.94)	19.11 (8.99)	0.002^a

Footnotes: Numerical data, in means (SD); MAGE, mean amplitude glycaemic excursion; HBGI, high blood glucose index; LBGI, low blood glucose index; ^a Paired sample t test

CONCLUSIONS

1. Despite cohort of suboptimal baseline HbA1c with lack of access to advanced diabetes technology, and low household income, safe fasting was observed
2. Fasting is **not associated with short-term glycaemic deterioration**, except for increased time in mild hyperglycaemia, **without effect onto time in range, severe hyperglycaemia or hypoglycaemia**
3. Individualised insulin titration based on published Ramadan guidelines, focused education and regular SMBG help to ensure safe fasting in T1DM children

REFERENCES

1. Guidelines P. Diabetes and Ramadan Diabetes and Ramadan International Diabetes Federation (IDF), collaboration with Diabetes and Ramadan (DAR) International Alliance.; 2021.
2. Hassanein M, et al. Ramadan fasting in people with type 1 diabetes during COVID-19 pandemic: The DaR Global survey. *Diabetes Res Clin Pract.* 2021;172:108626. doi:10.1016/j.diabres.2020.108626
3. Deeb A, et al. ISPAD Clinical Practice Consensus Guidelines: Fasting during Ramadan by young people with diabetes. *Pediatr Diabetes.* 2020;21(1):5-17. doi:10.1111/pedi.12920
4. Danne T, et al. International consensus on use of continuous glucose monitoring. *Diabetes Care.* 2017;40(12):1631-1640. doi:10.2337/dc17-1600
5. Kaplan W, et al. Blood glucose fluctuation during ramadan fasting in adolescents with type 1 diabetes: Findings of continuous glucose monitoring. *Diabetes Care.* 2015;38(10):e162-e163. doi:10.2337/dc15-1108
6. Kaplan W, et al. Comparison of continuous glucose monitoring in adolescents with type 1 diabetes: Ramadan versus non-Ramadan. *Diabetes Res Clin Pract.* 2017;134:178-182. doi:10.1016/j.diabres.2017.10.010

ACKNOWLEDGEMENTS

1. Director General, Ministry of Health, Malaysia
2. Deputy Director General (Research and Technical Support), Ministry of Health, Malaysia
3. Hospital Directors
4. Diabetes team members and patients

CONTACT INFORMATION

1. Sze Teik, Teoh. Paediatric Unit, Hospital Putrajaya, Jalan P9, Presint 7, 62250, Federal Territory of Putrajaya, Malaysia. Email: hpj.paedsendo@gmail.com