Multimorbidity, glycaemic variability and time in target range in people with type 2 diabetes: a baseline analysis of the GP-OSMOTIC trial

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ABSTRACT

Aims:

To explore associations between multimorbidity condition counts (total; concordant (diabetes-related); discordant (unrelated to diabetes)) and glycaemia (HbA1c; glycaemic variability (GV); time in range (TIR)) using data from a randomised controlled trial examining effectiveness of continuous glucose monitoring (CGM) in people with type 2 diabetes (T2D).

Methods:

Cross-sectional study: 279 people with T2D using baseline data from the General Practice Optimising Structured MOnitoring To Improve Clinical outcomes (GP-OSMOTIC) trial from 25 general practices in Australia. Number of long-term conditions (LTCs) in addition to T2D used to quantify total/concordant/discordant multimorbidity counts. GV (measured by coefficient of variation (CV)) and TIR derived from CGM data. Multivariable linear regression models used to examine associations between multimorbidity counts, HbA1c (%), GV and TIR.

Results:

Mean (SD) age of participants 60.4 (9.9) years; 40.9% female. Multimorbidity was present in 89.2% of participants. Most prevalent comorbid LTCs: hypertension (57.4%), painful conditions (29.8%), coronary heart disease (22.6%) and depression (19.0%). No evidence of associations between multimorbidity counts, HbA1c, GV and TIR.

Conclusions:

While multimorbidity was common in this T2D cohort, it was not associated with HbA1c, CV or TIR. Future studies should explore factors other than glycaemia that contribute to the increased mortality observed in those with multimorbidity and T2D.

Keywords:

multimorbidity; glycaemia; HbA1c; glycaemic variability; time in range; continuous glucose monitoring (CGM); general practice; primary care

1. INTRODUCTION

Multimorbidity is defined as the co-occurrence of two or more long term health conditions (LTCs) in an individual (1, 2). This is common in people with type 2 diabetes (T2D) where approximately 85% have at least one other LTC (3, 4). The often complicated clinical management of T2D can be more challenging in the presence of multimorbidity and the associated higher treatment burden related to having multiple LTCs (5). This can result in poorer outcomes including suboptimal glycaemic management which is a key component of clinical guidelines for T2D (6-8).

Although HbA1c is traditionally recognised as the gold standard for monitoring glycaemia, it does not characterise daily fluctuations in blood glucose including acute hyper- and hypoglycaemic events (9). In 2017 the Beyond A1c Movement, initiated by nine diabetes organisations around the globe, presented a unified case for the need to incorporate outcomes beyond HbA1c into regulatory decisions and clinical care (10). Two outcomes of importance identified were glycaemic variability (GV) and time in range (TIR) derived from data from continuous glucose monitoring (CGM) systems. CGM technology measures interstitial fluid glucose levels on a regular basis (every five to 15 minutes, depending on the device), providing insights into short-term fluctuations in glucose levels. Several measures of GV exist. The Beyond HbA1c Movement recommended that the coefficient of variation (CV) should be considered the primary measure of glycaemic variability (11) and that a CV ≥36% is considered high variability. In 2019 another international consensus recommended that a range of 3.9-10.0 mmol/L be used to calculate TIR in people with T2D (12). This involves calculating the percentage of time that a person spends with their blood glucose levels within the recommended target range, which is usually measured over a defined time period. Both GV and TIR are dependent on medication, physical activity and diet, and GV is known to be associated with the development of micro- and macrovascular complications (13-15). However, no studies have explored the association between TIR and macrovascular complications (16, 17).

We recently conducted a systematic review of the effect of multimorbidity on mortality and glycaemic outcomes in people with T2D (18, 19). We identified 14 cross-sectional studies that demonstrated that the associations between multimorbidity and HbA1c were variable. Importantly, the review also identified that no studies had explored the relationship between multimorbidity, GV and TIR. An important limitation of our review was that we were not able to explore the effect of different types of multimorbid conditions. This is an important consideration in studies of multimorbidity in T2D (20). LTCs can be considered as either concordant or discordant with T2D (7).

LTCs that are closely related to T2D, such as hypertension and cardiovascular disease, are considered concordant whereas unrelated conditions like asthma and cancer are considered as discordant.

It was therefore our aim to explore the associations between multimorbidity count (total, concordant and discordant) and blood glucose (reflected by HbA1c, GV and TIR) using baseline data from a randomised controlled trial examining the effectiveness of CGM in people with T2D in general practice in Australia (21, 22).

2. SUBJECTS, MATERIALS AND METHODS

2.1 Study design and participants

This is a cross-sectional study consisting of 279 people with T2D using baseline data (October 2016 – November 2017) from the General Practice Optimising Structured MOnitoring To Improve Clinical outcomes (GP-OSMOTIC) randomised controlled trial (RCT) (21, 22). To summarise, the GP-OSMOTIC trial aimed to explore the effectiveness of a CGM device (FreeStyle Libre Pro® Flash Glucose Monitoring System, Abbott Diabetes Care, Witney, Oxon, UK) used in the clinical care of people with T2D in 25 general practices in Victoria, Australia (23). The inclusion criteria for the trial only included adults (≥18 years) with a diagnosis of T2D, whose most recent HbA1c level (within 30 days prior to recruitment) was 0.5% (6mmol/mol) above the general Australian target of 7% (53mmol/mol) (24). A detailed description of the GP-OSMOTIC trial is provided elsewhere (21, 22).

2.2 Procedures

Multimorbidity is measured as a condition count of LTCs based on previous published literature (4, 20). This condition count was adapted for use in our cohort and consists of 35 individual LTCs where eight conditions were concordant with T2D and the remainder discordant with T2D (Table S1). We identified the LTCs based on the participant's medical history retrieved from their clinical electronic medical records and on enrolment nurse-led survey interviews. Three variables were created for multimorbidity: total number of LTCs, number of concordant conditions and number of discordant conditions.

CGM data were collected at baseline of the GP-OSMOTIC trial, prior to any therapeutic intervention. The CGM device was applied by clinically trained research assistants to the underside of the participant's upper arm to measure individual interstitial fluid glucose levels in 15 minute intervals for two weeks. After two weeks, the sensor was removed, and data were uploaded to Microsoft Office Excel 365 (Microsoft Corp., Seattle, WA, USA) on a secure computer. The CGM data was not available to the participants during the two-week period (i.e. it was masked). Survey and clinical data

were entered into REDCap© (REsearch Data CAPture software), a secure, web-based application designed to support research data capture (25).

2.3 Clinical outcome

We had three glycaemic outcome measures of interest, all treated as continuous variables: HbA1c, GV, and TIR. We used the most recently collected HbA1c at baseline. Both GV and TIR were calculated using baseline CGM data. CV was used as the measure of GV based on the international consensus (11) and was calculated using EasyGV© (26). TIR is defined as the percentage of time spent in the consensus suggested target range of 3.9-10.0 mmol/L (12). The duration of CGM for inclusion in the study was five to 14 days which is consistent with recommendations from the CGM manufacturer (27).

2.4 Statistical analysis

Descriptive statistics were used to summarise overall characteristics of the participants. The multimorbidity counts and prevalence of individual LTCs were also summarised. Summaries include means and standard deviations for normally distributed continuous data and medians and interquartile range for skewed continuous data, frequencies and percentages for categorical data. Multivariable mixed-effects linear regression models were used to examine the association between each of the multimorbidity counts (total; total of concordant conditions; total of discordant conditions) and each of our outcomes of interest (HbA1c; CV; TIR) adjusting for age, gender, socioeconomic status (measured by Index of Relative Socioeconomic Disadvantage (IRSD) deciles) (28), body mass index (BMI), smoking status, insulin use, and number of non-insulin hypoglycaemic medications. Duration of diabetes was excluded from the adjusted model due to multicollinearity with age. In our regression models, all co-variates were treated as fixed effects and the general practice as a random effect to allow for the correlation of our outcomes of interest within each practice. All analyses were carried out using STATA version 15.1 (StataCorp, College Station, Texas). Ethics approval for this study was obtained from the Human Research Ethics Committee at the University of Melbourne (Ethics ID 1647151·1).

3. RESULTS

In our cohort of 279 people with T2D attending Victorian general practice the mean (SD) age was 60.4 (9.9) years and 40.9% were female. Mean (SD) HbA1c was 8.9 (1.2)% (74 (13)mmol/mol), CV 30.0 (8.3)% and TIR 41.1 (25.6)% and number of days that CGM was worn was 12.3 (2.4) days. Multimorbidity was present in the majority (249 (89.2%)) of participants. Table 1 describes the overall characteristics of our study participants.

Table 1. Characteristics of participants with type 2 diabetes

Demographics	**Total (n = 279)**
Potential confounding variables	
Age, years, mean (SD)	60.4 (9.9)
Female, n(%)	114 (40.9)
IRSD Decile, n(%)	
Decile 1- most deprived	24 (8.7)
Decile 2	59 (21.5)
Decile 3	13 (4.7)
Decile 4	34 (12.4)
Decile 5	9 (3.3)
Decile 6	41 (14.9)
Decile 7	45 (16.4)
Decile 8	23 (8.4)
Decile 9	22 (8.0)
Decile10 – least deprived	5 (1.8)
Missing	4 (1.4)
Current smoker, n(%)	39 (14.0)
BMI, kgm^{-2}, median (IQR)	33.9 (7.8)
Know diabetes duration, years, median (IQR)	12 (9, 20)
Duration of r-CGM use, days, mean (SD)	12.3 (2.4)
Prescribed insulin, n (%)	143 (51.3)
Number of non-insulin hypoglycaemic agents, n(%)	
0 agents	11 (3.9)
1 agent	35 (12.5)
2 agents	142 (50.9)
3 agents	81 (29.0)
≥4 agents	10 (3.6)
Outcome variables	
HbA1c, %, mean (SD)	8.9 (1.2)
HbA1c, mmol/mol, mean (SD)	74 (13)
Glycaemic variability, CV, %, mean (SD)	30.0 (8.3)
High glycaemic variability (CV≥36%), n (%)	57 (20.4)
Time-in-range, %, mean (SD)	41.1 (25.6)
Time-above-range, % mean (SD)	56.6 (27.2)

Time-below-range, % mean (SD)	2.3 (5.9)
Predictor variable	
Number of chronic conditions, n(%)	
T2D only	30 (10.8)
T2D + 1 chronic condition	70 (25.1)
T2D + 2 chronic condition	68 (24.4)
T2D + 3 chronic condition	42 (15.1)
T2D + ≥4 chronic conditions	69 (24.7)

T2D, type 2 diabetes; SD, standard deviation; IRSD, Index of Relative Socioeconomic Disadvantage; IQR, inter-quartile range

The prevalence of individual LTCs included in our multimorbidity counts are shown in Table 2. Of the 279 study participants, 192 (68.8%) people had at least one concordant condition and 183 (65.6%) had at least one discordant condition in addition to T2D. Hypertension (57.4%) was the most prevalent concordant condition followed by coronary heart disease (22.6%). Painful conditions (29.8%) was the most prevalent discordant condition followed by depression (19.0%).

Table 2. Prevalence of individual multimorbid conditions in participants with type 2 diabetes

Presence of chronic conditions concordant with type 2 diabetes, n (%)	**N=279**
At least 1 chronic condition concordant with diabetes	192 (68.8)
Hypertension	160 (57.4)
Coronary heart disease	63 (22.6)
Peripheral vascular disease	8 (2.9)
Chronic kidney disease	17 (6.1)
Stroke/TIA	9 (3.2)
Diabetic retinopathy	28 (10.0)
Diabetic neuropathy	28 (10.0)
Atrial fibrillation	12 (4.3)
Presence of chronic conditions discordant with type 2 diabetes, n (%)	**N=279**
At least 1 chronic condition discordant with diabetes	183 (65.6)
Depression	53 (19.0)
Painful conditions	83 (29.8)
Asthma	39 (14.0)
GORD	39 (14.0)
Thyroid disorders	14 (5.0)
Rheumatoid arthritis and other connective tissue disorders	6 (2.2)
COPD	12 (4.3)
Anxiety	13 (4.7)
Irritable bowel syndrome	1 (0.4)
Cancer	7 (2.5)
Alcohol problems	0 (0)
Other psychoactive substance misuse	0 (0)
Treated constipation	0 (0)
Diverticular disease	16 (5.7)

Prostate disorders	6 (2.2)
Glaucoma	5 (1.8)
Epilepsy	0 (0)
Dementia	0 (0)
Schizophrenia/bipolar disorder	4 (1.4)
Psoriasis/eczema	21 (7.5)
Inflammatory bowel disease	1 (0.4)
Migraine	4 (1.4)
Chronic sinusitis	1 (0.4)
Anorexia/bulimia	0 (0)
Bronchiectasis	0 (0)
Parkinson's disease	1 (0.4)
Multiple sclerosis	0 (0)
Viral hepatitis	1 (0.4)
Chronic liver disease	4 (1.4)

T2D, type 2 diabetes; TIA, transient ischaemic attack; COPD, chronic obstructive pulmonary disease; GORD, gastroesophageal reflux disease

The mean difference in HbA1c, CV and TIR between participants with different multimorbidity counts are presented in Tables 3, 4 and 5, respectively. The reference group was people with T2D and no other LTCs. For all increasing counts of multimorbidity (total, concordant and discordant) there were no statistically significant associations with HbA1c, GV nor TIR.

Table 3. Multivariable linear regression model: Relationship between HbA1c (%) and multimorbidity in participants with type 2 diabetes.

	Non-adjusted			Adjusted		
Predictor variables	**β (SE)**	**95% CI**	**P**	**β (SE)**	**95% CI**	**p**
Categories of diabetes and multimorbidities						
Diabetes only (reference)						
Diabetes plus 1 chronic condition	-0.31 (0.26)	-0.84, 0.21	0.240	-0.27 (0.29)	-0.83, 0.29	0.345
Diabetes plus 2 chronic conditions	-0.15 (0.27)	-0.68, 0.38	0.575	-0.22 (0.29)	-0.79, 0.35	0.450
Diabetes plus 3 chronic conditions	-0.00 (0.29)	-0.58, 0.57	0.996	0.06 (0.32)	-0.56, 0.68	0.844
Diabetes plus ≥4 chronic conditions	-0.20 (0.27)	-0.73, 0.32	0.460	-0.20 (0.30)	-0.78, 0.38	0.504
Categories of diabetes and concordant conditions						
Diabetes only (reference)						
Diabetes plus 1 concordant condition	-0.18 (0.18)	-0.52, 0.17	0.317	-0.10 (0.19)	-0.47, 0.26	0.578
Diabetes plus 2 concordant conditions	-0.04 (0.22)	-0.46, 0.39	0.865	-0.04 (0.24)	-0.50, 0.43	0.880
Diabetes plus 3 concordant conditions	0.04 (0.29)	-0.54, 0.60	0.915	0.21(0.31)	-0.39, 0.83	0.488
Diabetes plus ≥4 concordant conditions	-0.06 (0.39)	-0.83, 0.71	0.884	-0.01 (0.42)	-0.83, 0.80	0.979
Categories of diabetes and discordant conditions						
Diabetes only (reference)						
Diabetes plus 1 discordant condition	0.14 (0.18)	-0.21, 0.50	0.433	0.13 (0.19)	-0.26, 0.51	0.517
Diabetes plus 2 discordant conditions	0.26 (0.20)	-0.13, 0.66	0.183	0.21 (0.21)	-0.20, 0.61	0.320
Diabetes plus 3 discordant conditions	-0.14 (0.27)	-0.68, 0.40	0.611	-0.20 (0.29)	-0.78, 0.37	0.488
Diabetes plus ≥4 discordant conditions	0.03 (0.35)	-0.65, 0.72	0.927	0.11 (0.38)	-0.63, 0.87	0.761

SE: Standard error

Adjusting for age, gender, socioeconomic status, BMI, smoking status, insulin use, and number of non-insulin hypoglycaemic medication. All co-variates were treated as fixed effects and the general practice as a random effect to allow for the correlation of HbA1c within each practice.

Table 4. Multivariable linear regression model: Relationship between glycaemic variability (CV) and multimorbidity in participants with type 2 diabetes.

	Non-adjusted			Adjusted		
Predictor variables	**β (SE)**	**95% CI**	**P**	**β (SE)**	**95% CI**	**p**
Categories of diabetes and multimorbidities						
Diabetes only (reference)						
Diabetes plus 1 chronic condition	2.52 (1.76)	-0.94, 5.97	0.154	0.09 (1.75)	-3.34, 3.52	0.959
Diabetes plus 2 chronic conditions	4.44 (1.78)	0.96, 7.93	0.012	1.70 (1.78)	-1.78, 5.18	0.338
Diabetes plus 3 chronic conditions	1.97 (1.94)	-0.83, 5.78	0.309	-1.20 (1.93)	-4.99, 2.58	0.533
Diabetes plus ≥4 chronic conditions	3.93 (1.81)	0.39, 7.48	0.029	-0.45 (1.87)	-4.11, 3.21	0.808
Categories of diabetes and concordant conditions						
Diabetes only (reference)						
Diabetes plus 1 concordant condition	2.92 (1.14)	0.70, 5.15	0.010	1.34 (1.11)	-0.85, 5.53	0.230
Diabetes plus 2 concordant conditions	4.84 (1.39)	2.11, 7.56	0.001	2.57 (1.42)	-0.20, 5.36	0.070
Diabetes plus 3 concordant conditions	0.49 (1.88)	-3.19, 4.17	0.794	-1.43 (1.86)	-5.08, 2.22	0.442
Diabetes plus ≥4 concordant conditions	5.53 (2.57)	0.50, 10.55	0.031	-0.98 (2.65)	-6.18, 4.21	0.711
Categories of diabetes and discordant conditions						
Diabetes only (reference)						
Diabetes plus 1 discordant condition	-0.34 (1.23)	-2.75, 2.07	0.782	-1.33 (1.17)	-3.63, 0.97	0.258
Diabetes plus 2 discordant conditions	-0.61 (1.38)	-3.31, 2.09	0.657	-1.84 (1.29)	-4.37, 0.68	0.153
Diabetes plus 3 discordant conditions	0.39 (1.83)	-3.20, 3.98	0.832	-1.10 (1.77)	-4.57, 2.37	0.536
Diabetes plus ≥4 discordant conditions	-1.45 (2.35)	-6.06, 3.15	0.536	-2.31 (2.33)	-6.86, 2.25	0.322

SE: Standard error

Adjusting for age, gender, socioeconomic status, BMI, smoking status, insulin use, and number of non-insulin hypoglycaemic medication. All co-variates were treated as fixed effects and the general practice as a random effect to allow for the correlation of GV within each practice.

Table 5. Multivariable linear regression model: Relationship between percentage time-in-range and multimorbidity in participants with type 2 diabetes.

	Non-adjusted			Adjusted		
Predictor variables	**β (SE)**	**95% CI**	**P**	**β (SE)**	**95% CI**	**p**
Categories of diabetes and multimorbidities						
Diabetes only (reference)						
Diabetes plus 1 chronic condition	3.09 (5.58)	-7.84, 14.04	0.579	0.92 (5.96)	-10.77, 12.61	0.877
Diabetes plus 2 chronic conditions	-5.84 (5.63)	-16.85, 5.17	0.299	-6.75 (6.04)	-18.58, 5.09	0.264
Diabetes plus 3 chronic conditions	-2.46 (6.13)	-14.47, 9.55	0.688	-6.51 (6.56)	-19.37, 6.36	0.322
Diabetes plus ≥4 chronic conditions	-2.93 (5.66)	-14.01, 8.16	0.605	-4.96 (6.28)	-17.26, 7.34	0.430
Categories of diabetes and concordant conditions						
Diabetes only (reference)						
Diabetes plus 1 concordant condition	1.71 (3.69)	-5.51, 8.94	0.642	0.77 (3.84)	-6.76,8.30	0.841
Diabetes plus 2 concordant conditions	-6.02 (4.49)	-14.82, 2.78	0.180	-7.95 (4.85)	-17.47,1.56	0.101
Diabetes plus 3 concordant conditions	-0.66 (6.09)	-12.60, 11.28	0.914	-3.73 (6.43)	-16.34, 8.86	0.561
Diabetes plus ≥4 concordant conditions	4.89 (8.24)	-11.27, 21.04	0.553	2.64 (8.71)	-14.43, 19.72	0.762
Categories of diabetes and discordant conditions						
Diabetes only (reference)						
Diabetes plus 1 discordant condition	-1.92 (3.81)	-9.39, 5.54	0.615	-2.30 (3.98)	-10.11, 5.50	0.563
Diabetes plus 2 discordant conditions	-8.59 (4.19)	-16.81, -0.37	0.040	-7.87 (4.24)	-16.18, 0.43	0.063
Diabetes plus 3 discordant conditions	5.85 (5.70)	-5.33, 17.03	0.305	8.40 (5.98)	-3.32, 20.11	0.160
Diabetes plus ≥4 discordant conditions	-8.65 (7.28)	-22.92, 5.61	0.234	-9.52 (7.82)	-24.86, 5.82	0.224

SE: Standard error

Adjusting for age, gender, socioeconomic status, BMI, smoking status, insulin use, and number of non-insulin hypoglycaemic medication. All co-variates were treated as fixed effects and the general practice as a random effect to allow for the correlation of TIR within each practice.

4. DISCUSSION

In this study, we examined associations between multimorbidity and measures of glycaemia in 279 people with T2D in Australian general practice using data from the GP-OSMOTIC trial collected at the time of patient enrolment. The majority of people with T2D in this cohort (89.2%) were living with multimorbidity. We used CGM data to derive GV and TIR in this cohort. Our findings suggest that there was no significant relationship between multimorbidity (total, concordant and discordant) and various measures of glycaemia, including HbA1c, GV (using CV), and TIR, reflecting glucose control over 3-months to several weeks respectively.

Uncertainty exists about the association between multimorbidity and HbA1c in people with T2D (18). We did not find significant relationships between multimorbidity and a single concurrent measure of HbA1c, nor CGM related measures of glycaemia in this cohort. Our findings may be linked to the higher health care utilisation (29) and better quality of care (30) seen in people with other LTCs. Higher health care utilisation may result in more opportunities for clinical interventions leading to better glycaemic management. We did not explore health utilisation, nor did we evaluate HbA1c measures over the longer term.

Evidence suggests associations between higher GV and micro- and macrovascular complications (13, 14) including the development of diabetes peripheral neuropathy (31), and the development of cardiovascular diseases (32). Lower TIR has been linked to the development of diabetic retinopathy and diabetic nephropathy (15). There is good evidence of a relationship between higher GV, lower TIR and complications of T2D, yet we did not find any significant associations between concordant LTCs (which include some important complications of T2D), GV and TIR.

To the best of our knowledge, this is the first study to explore the effect of the total burden of disease reflected in multimorbidity on GV and TIR in people with T2D. The prevalence of multimorbidity and individual LTCs in this study align with the prevalence numbers found in studies of community cohorts of people with T2D in the UK and Taiwan (4). This suggests that a strength of this study is that we could capture multimorbidity and LTCs similar to the general population of people with T2D despite using a specialised RCT T2D cohort in general practice. There are some limitations to note for our study. This was a cross-sectional analysis of a relatively small sample size using baseline data from the GP-OSMOTIC trial, which was powered to detect differences in HbA1c between the intervention and control groups. Therefore, there may be insufficient statistical power to observe differences in GV and TIR across different multimorbidity categories. We therefore did

not explore the effects of individual LTCs on glycaemic measures. Information on LTCs for this cohort was only collected at baseline and we were unable to model for changes in multimorbidity. Therefore, a limitation of our study is that we were unable to consider the temporality and duration of the conditions in addition to diabetes. Another limitation is that the study only included people attending general practice. It is possible that people attending general practice, as opposed to those receiving care from specialists, may have a lower GV as we observed the mean (SD) CV was 30.0 (8.3)% which was below the consensus cut-off of 36% defining high GV (11). As a result, we do not know if our results apply to the population that experience higher levels of GV. Therefore, those with worse GV, who may be seeing specialists and attending hospital clinics may not be represented. However, this cohort of people with T2D had HbA1c levels significantly above the recommended target. Although the mean CV of this cohort was not high as determined by the consensus cut-off, the mean (SD) TIR of 41.1 (25.6)% was relatively low. The higher levels of HbA1c and low TIR in this cohort may be linked to why we did not observe significant differences in our outcomes between the different categories of multimorbidity. Detecting a difference in our outcomes might have been more likely in a cohort with a greater spread of HbA1c, CV and TIR.

There is an association between multimorbidity and increased mortality in people with T2D (4, 18). We explored multimorbidity's effects on measures of blood glucose as a way to help us understand the underlying mechanisms to the increased mortality seen in those with LTCs. Our findings suggest that future studies should explore factors other than glycaemic measures, that could contribute to the increased mortality that has been observed elsewhere. Future research involving larger patient populations to examine how clinicians and people with T2D utilise CGM and interpret CGM outputs to approach glycaemic targets and make treatment decisions in the context of multimorbidity are warranted.

CONCLUSION

In 279 well characterised people with T2D in Australian general practice, we found no significant associations between multimorbidity counts, HbA1c, GV and TIR. This study, together with recent publications on this topic (4, 18), suggest that out of target glycaemic levels do not explain the increased mortality seen in those with T2D and multimorbidity. Future studies should try to identify which factors, other than glycaemic measures, contribute to the increased mortality in those with T2D and multimorbidity.

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Declaration of competing interest

No competing financial interests exist.

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