Engagement of Type 1 Diabetes Patients with Insulin Pump Technology During Exercise and Physical Activity

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Introduction

Regular exercise and physical activity (PA) is crucial for improving cardiovascular health, glycaemic control, and overall well-being in people with type 1 diabetes. However, it can also lead to glycaemic disturbances and without the appropriate support and preparation (such as planning exercise; use of higher glucose target [HGT]; bolus insulin adjustment and carbohydrate [CHO] consumption), individuals risk frequent hypoglycaemia and subsequent disengaging from PA altogether.[1] Advancements in Automated Insulin Delivery (AID) technology offer a potential solution. A recent systematic review and meta-analysis showed that AID systems provide a moderate improvement in TIR during PA, when compared to standard care practices.[2] While AID can reduce the guesswork in diabetes management, it still requires user-initiated adjustments, particularly around exercise. Our aim was to capture the experience of individuals using AID systems during PA and identify key challenges and knowledge gaps in diabetes management during PA, thereby informing us on education and resource needs for our patients.

Methods

This was an observational study among patients using different insulin pumps (Medtronic MiniMed 780G, Tandem T:slim, CamAPSFX).

Recruitment Criteria: Type 1 Diabetes patients attending TUH Diabetes services using AID systems were initially contacted via email and asked to complete a semi-structured survey either via telephone or during their clinic visit.

Data Collection:

- **Surveys:** Patients self-reported their pump satisfaction, PA frequency and management, hypo/hyperglycaemia prevention and management strategies and educational support.

Results

34 participants completed the survey (22 Medtronic Minimed 780G; 7 CamAPSFX; 5 Tandem T: slim). See Table 1 for patient demographics. 32% of participants reported exercising <3 times/week, failing to meet PA recommendations (See Fig. 1). Most participants reported an average exercise duration of between 45-60 minutes per session. 76% always / usually plan their PA (Table 2).

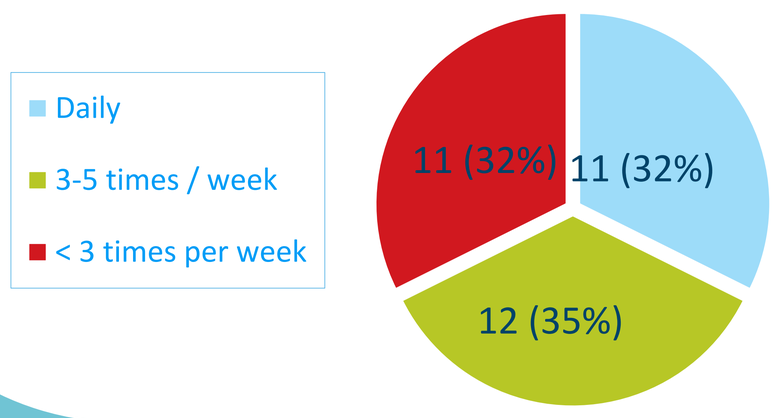
41% (n=14) remove their pump for PA, with the majority (77%) of these removing only for certain activities (see table 2). Only 57% (n=8) suspend insulin delivery on pump removal. The majority (86%, n=12) removed their pump “Immediately before” PA.

79% (n=27) stayed in closed loop during PA. Only 26% (n=7) always used HGT for PA (Fig 1). The majority activated this 30-60 mins before PA (Table 2).

Table 1: Demographic data

Variable		N	%	M	SD
Gender	Female	16	47.1		
	Male	18	52.9		
Diabetes Duration (years)				21	10.3
Age (Years)				32	10.9
Average pump use duration	≤6 months	9	26.5		
	6-12 months	1	2.9		
	1-2 years	5	14.7		
	≥2 years	19	55.9		
CGM Sensor Used	Dexcom G6	9	26.5		
	Dexcom G7	3	8.8		
	Libre	3	8.8		
	Guardian 4	16	47.1		
	None	3	8.8		

Figure 1 – PA frequency (n=34).



Results

Confidence in managing hypoglycaemia and hyperglycaemia using pump technology was high, with 77% (n=26) of participants feeling “very confident”. Despite this 50% (n=17) reported experiencing hypoglycaemia during exercise, while 24% (n=8) experienced hyperglycaemia (table 2). An average of 12-20g of CHO per session were consumed by 74% of participants to prevent hypoglycaemia. 80% (n=20) of these participants would prefer to exercise without needing to take CHO as a means to prevent hypoglycaemia.

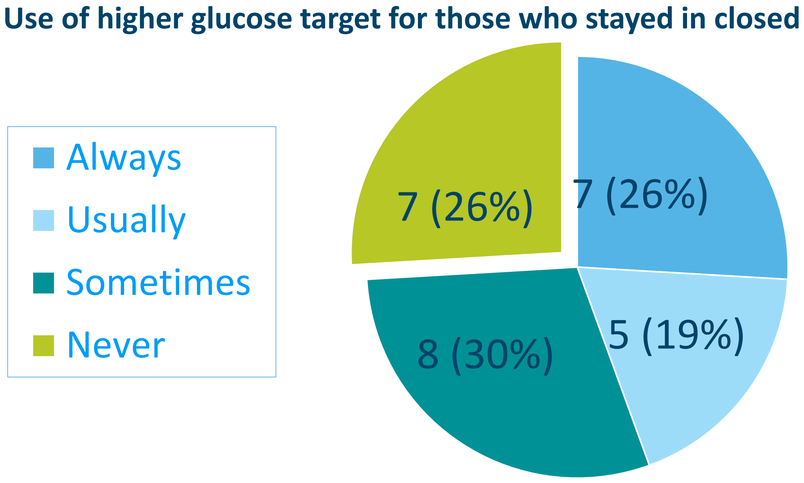
59% (n=20) reported eating within 2-3 hours before exercise. Only 40% (n=8) reduced the bolus for this meal. For those who had a meal / snack after exercise (n=16), 8 participants (50%) reduced their bolus for this.

23 pump users (66%) reported receiving some form of education related to exercise and pump use. 91% (n=31) would like further education. 1:1 educational sessions emerged as being the most favoured format

Table 2 Glucose management strategies and hypoglycaemia frequency during PA

Variable n = 34		N (%)
Planned PA		
Always / usually		26 (76)
Sometimes / rarely		6 (18)
Never		2 (6)
Pump removal for PA:		14 (41)
	Remove only for certain activites:	
	Contact	4 (28)
	Water sports	4 (28)
	Running	3 (21)
	Always remove regardless of activity:	3 (21)
Insulin suspension following pump removal		8 (57)
Higher glucose target activation timing if ever used:		
	Immediately before	2 (10)
	30-60mins before	12 (44)
	>1 hour before	6 (30)
Hypoglycaemia frequency:	***Overall reported***	17 (50)
	Frequent	7 (41.2)
	Occasional	7 (41.2)
	Rare	3 (17.6)

Figure 2 – Use of higher glucose target for those who stayed in closed loop (n=27).



Discussion and conclusion

This study found that activity levels were low among pump users. Despite the majority reporting high confidence levels in managing glucose around PA, hypo and hyperglycaemia remain an issue. Inconsistent and incorrect use of HGT; CHO consumption before PA without setting a HGT; as well as insufficient adjustments of bolus insulin may all be contributing factors. Increasing access to personalised 1:1 education and exercise-specific education tools was identified by both AID users and HCPs as desirable to help support those looking to improve glucose management around PA while using AID systems.

Recommendations

- Delivery of personalized 1:1 education on PA and AID at TUH joint dietitian and nurse led pump optimization clinic
- HCP education on glucose management strategies while exercising on AID systems
- Development of patient education factsheets for the various pumps based on the recently published consensus recommendation on AID around PA in type 1 diabetes[3]

References

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