

Portfolio 1: Major Research Project

**The Impact of Flash Glucose Monitoring on Adults with Type 1 Diabetes with
Respect to Their Eating Behaviour and Their Relationship with Food**

Tamara Wallace

Submitted to the University of Hertfordshire in partial fulfilment of the requirement of the
degree of Doctor of Clinical Psychology

June 2022

Word Count: 29,975

Acknowledgements

My sincerest gratitude goes to the participants, who generously shared their stories and valuable time, without which this research project would not be possible. I also extend my sincerest gratitude to my panel of Experts by Experience who provided invaluable feedback and thought-provoking discussions.

A special thanks to my supervisory team Dr Jen Heath and Dr Christian Koebbel. Your immense knowledge and reliable, energising presence has kept me passionate about the research. And dare I say, future research.

To Chidi and Kalika at Bedford Hospital who continued to answer my endless diabetes questions. I am in awe of your expertise.

To Cohort 19, thank you for being the most wonderful group of human beings. To each and every one of you, I will forever be your cheerleader and can't wait to watch you thrive in post-qualified life.

To my friends, thank you for understanding my disappearance and waiting patiently from the other side, whilst mocking me for *still* studying. You've listened to me talking about 'wanting to be a psychologist' for twelve years now, but I can assure you I'm nearly there.

And to Thom and Dexter, thank you for the endless love and support. I promise to take a break from studying so we can go on some adventures.

List of Contents

Abstract	8
1. Introduction	9
1.1 Overview	9
1.2 Personal and Epistemological Position	9
1.2.1 Positionality	9
1.2.2 Epistemology.....	10
1.2.3 Reflexivity	11
1.3 Situating the Research in Context	12
1.3.1 Diabetes Mellitus	12
1.3.2 FreeStyle Libre Flash Glucose Monitor.....	14
1.3.3 FreeStyle Libre and Diabetes Management	15
1.3.4 Relationship with Food	16
1.3.5 Disordered Eating and Eating Disorders	17
1.3.6 Disordered Eating and Diabetes.....	18
1.3.7 The Quantified Self.....	20
1.3.8 Health-Tracking Technologies.....	21
1.3.9 Health-Tracking Technologies and Relationship with Food	22
1.4 Rationale for the Systemic Literature Review.....	25
Systematic Literature Review	26
1.5 Overview.....	26
1.6 Search Strategy Method	27
1.7 Systematic Literature Review Search Process	29
1.8 Results of Systematic Literature Review Search.....	29
1.9 Summary of Findings.....	31
1.10 Assessing Study Quality	52
1.10.1 Included Study Aims.....	52
1.10.2 Study Countries	53
1.10.3 Study Samples	54
1.10.4 Data Collection.....	54
1.10.5 Findings and Analysis	55
1.11 Synthesis Strategy	55
1.12 Synthesis of Findings	56
1.12.1 Motivators and Barriers to Use	56
1.12.2 The Process of Logging Food	59
1.12.3 Data as the Most Valuable Entity.....	60
1.12.4 Disordered Eating and Compulsive Exercise.....	61
1.12.5 Goal Achievement and Positive Self-Appraisal.....	64
1.13 Conclusions of Systematic Literature Review.....	65
1.14 Rationale for the Current Study	67

1.15 Aims for Current Study	69
2. Methodology	70
2.1 Overview	70
2.2 Design	70
2.2.1 Epistemology and Positionality	70
2.2.2 Rationale for a Mixed Methods Approach	72
2.2.3 Expert by Experience Consultation	73
Qualitative Methodology	74
2.3 Why Reflexive Thematic Analysis?	74
2.4 Participants	76
2.4.1 Participant Criteria	76
2.4.2 Recruitment	76
2.4.3 Participant Demographics	79
2.4.4 Interview Modality	80
2.5 Ethical Considerations	81
2.6 Data Collection	82
2.6.1 Resources	82
2.6.2 Interview Schedule	82
2.7 Interview Procedure	83
2.8 Data Analysis	85
2.9 Quality, Validity and Self-Reflexivity	86
2.9.1 Assessing Quality and Validity of the Methodology	86
2.9.2 Self-Reflexivity	87
Quantitative Methodology	88
2.10 PAID Questionnaire	88
2.11 Participants	89
2.11.1 Participant Criteria	89
2.11.2 Recruitment	89
2.11.3 Sample	89
2.12 Ethical considerations	89
2.13 Data Collection	90
2.14 Data Analysis	90
3. Results	91
3.1 Overview	91
3.2 Theme 1: Personal Food Story	92
3.2.1 Eating Identity	93
3.2.2 Deprived of Freedoms	95
3.2.3 Food Rules	98
3.3 Theme 2: New Opportunities	101
3.3.1 Novel Insights	101
3.3.2 "I can eat this"	105

3.3.3 Becoming the Professional	109
3.3.4 Peer Support	110
3.4 Theme 3: Body as a Machine	112
3.4.1 Food as Functional	112
3.4.2 Seeking Permission from Data	114
3.4.3 "I'm just a number"	116
3.4.4 Rigid Routines	118
3.4.5 "Information overload"	119
3.5 Theme 4: Re-evaluating Diabetes	123
3.5.1 "Got to be better"	123
3.5.2 "It's not an exact science"	126
3.5.3 Managing Body Weight	127
3.5.4 Visibility	128
3.6 Conclusion of Qualitative Analysis	131
3.7 PAID Quantitative Analysis	132
4. Discussion	137
4.1 Overview	137
4.2 Summary of Findings	137
4.3 Relevance of the Findings to the Literature	138
4.3.1 Theme 1: Personal Food Story	138
4.3.2 Theme 2: New Opportunities	140
4.3.3 Body as a Machine	145
4.3.4 Re-evaluating Diabetes	147
4.4 Reflections on the Problem Areas In Diabetes (PAID) Questionnaire	151
4.5 Clinical and Research Implications	155
4.6 Critical Appraisal	158
5. Conclusion	165
References	166
Appendices	185

List of Appendices

- Appendix A-** Reflective Research Journal Extracts
- Appendix B-** FreeStyle Libre Reflective Journal Extracts
- Appendix C-** 'A Day in the Life of My Stomach' Extracts
- Appendix D-** Quality Appraisal Tools
- Appendix E-** Study Advertisement Poster
- Appendix F-** Participant Information Sheet
- Appendix G-** Expression of Interest form
- Appendix H-** University of Hertfordshire Ethical Approval and Sponsorship
- Appendix I-** Health Research Authority Ethical Approval
- Appendix J-** Contacts for Further Support Sheet
- Appendix K-** Distress Protocol
- Appendix L-** Interview Schedule
- Appendix M-** Transcript Extract with Coding in NVivo
- Appendix N-** Example of Theme Development Process
- Appendix O-** SPSS Output

List of Tables

Table 1-	Methods of Reflexivity
Table 2-	Search Terms
Table 3-	Exclusion and Inclusion Criteria
Table 4 -	Summary and Evaluation of Studies in the Systematic Literature Review
Table 5-	Identified Tasks for Expert by Experience Consultation
Table 6-	Rationale for Reflexive TA
Table 7-	Participant Inclusion Criteria
Table 8-	Participant Demographic Information
Table 9-	Researcher's Six-Phase Process of Reflexive TA
Table 10-	Comparison of PAID Items and Interviewee Experiences
Table 11-	Clinical and Research Implications
Table 12-	Critical Appraisal of the Study

List of Figures

Figure 1-	Prisma 2020 Flow Diagram of Study Selection Process
Figure 2-	Flowchart of Interview Procedure
Figure 3-	Themes and Subthemes for Users' Experiences of the FSL in Relation to Eating Behaviour and their Relationship with Food
Figure 4-	Theme 1: Personal Food Story
Figure 5-	Theme 2: New Opportunities
Figure 6-	Theme 3: Body as a Machine
Figure 7-	Theme 4: Re-evaluating Diabetes
Figure 8-	Standardised PAID Score Prior to FSL and at Six Month Review

Abstract

The FreeStyle Libre (FSL) Flash Glucose Monitor is a device worn by individuals with diabetes to measure their blood glucose levels, designed largely to replace finger-prick testing. Research on the FSL has primarily focused on the utility of the device in aiding self-management of diabetes, rather than its psychological impact. As diet is a key component of diabetes self-management, focusing on an individual's relationship with food whilst using the FSL is important. This sequential mixed methods study explored adults with type 1 diabetes' experiences of the FSL in relation to its impact on their eating behaviour and relationship with food. Fifteen FSL users participated in semi-structured interviews. Four main themes were constructed from Reflexive Thematic Analysis: *Personal Food Story*, *New Opportunities*, *Body as a Machine* and *Re-evaluating Diabetes*. A quantitative analysis of Problem Areas in Diabetes (PAID) questionnaire data was conducted, followed by reflections on the questionnaire items in light of the constructed themes, highlighting the ways in which standardised measures of diabetes-related distress do and do not capture patients' relationship with food in the context of FSL use. The findings are discussed with reference to previous theory and research, highlighting the implications for future research and clinical practice.

1. Introduction

1.1 Overview

This research explores users' experiences of the FreeStyle Libre flash glucose monitor, a device used by people with diabetes, attending to how use of the device impacts users' eating behaviour and relationship with food. This mixed methods study utilises reflexive thematic analysis (TA; Braun & Clarke, 2006, 2013, 2019) to analyse qualitative interview data, and uses inferential statistics to analyse questionnaire data. This chapter begins by outlining the researcher's epistemological position and relationship with the research topic, followed by an overview of the topic area, relevant definitions and broad research literature. Then, a systematic review of the literature focusing on the impact of health-tracking technologies on users' relationship with food and eating. The chapter concludes with the rationale for the current study and a statement of the research aims and questions.

1.2 Personal and Epistemological Position

1.2.1 Positionality

My positionality will have impacted the story of this research. Being a thirty-year-old white-British, UK-born woman raised in South East England positions me within particular narratives, cultural expectations and privileges. These identities have influenced how I have interacted with knowledge and how I have perceived and been perceived by participants. Rather than trying to eradicate potential bias due to my influence, I have endeavoured to attend to and share my reflexive thoughts.

In the absence of any physical health conditions, I am an outsider to the characteristics of my participants. My interest in diabetes began during doctoral training in an earlier research context that has since spread into my clinical practice. My connection to eating behaviours is via several routes. Personally, I encountered disordered eating in my youth and gained insight into the power that numbers had on physical and mental wellbeing. Whilst my own relationship with food has meandered to the edge of what might be considered disordered, for most of my life it would be considered a healthy relationship. Professionally, my understanding of disordered eating increased when I supported adolescents in an inpatient eating disorder ward. Hearing patients' stories, sharing mealtimes and standing beside them while they weathered the distress highlighted the complexity of one's relationship with one's own body, food, and self-worth.

1.2.2 Epistemology

Understanding the philosophical assumptions underpinning a study helps the reader and researcher determine how the research is framed in its pursuit of knowledge. The current study aims to situate the experiences of FreeStyle Libre (FSL) users among broader contextual factors that may influence how users make sense of their relationship with food. Whilst relationship with food and eating might be shaped by various social phenomena, I am also interested in the way in which these perceptions shape the 'reality' of how individuals use the FSL to aid diabetes self-management. Therefore, I adopt a critical realist epistemological stance, a perspective which lies between realism and relativism. That is, a realist approach assumes the world has knowable truths to explore and proposes that data derived from research directly reflects reality. Conversely, a relativist approach suggests that truth is constructed and therefore there can be numerous interpretations of the same

data (Harper, 2011). Taking a critical realist stance “combines the realist ambition to gain a better understanding of what is ‘really’ going on in the world with the acknowledgement that the data the researcher gathers may not provide direct access to reality” (Willig, 2012, p.13). Thus, as an individual’s beliefs and values are likely to influence their perception of their relationship with food and FSL use, my own experiences, beliefs and values shape the way in which I approach and interpret the research.

1.2.3 Reflexivity

Considering the potential influence of my own beliefs and values on the research, it is crucial that I reflect on how, as a researcher and an individual, I am implicated in the research and the conclusions (Willig, 2013), particularly considering that researchers often gravitate towards issues they feel passionately about (Burnham, Palma & Whitehouse, 2008). Such passion is beneficial in motivating a thorough investigation of the phenomena in question, however a preconceived vision of the outcome, informed by previous experiences, can impede construction of novel findings. In line with the critical realist approach, I have attempted to make known my biases, assumptions and personal relationship to the topic. Table 1 details the methods used to actively practice reflexivity throughout the research.

Table 1

Methods of Reflexivity

Method	Task
Reflective Journal	<ul style="list-style-type: none"> • A reflective research journal (see Appendix A for extracts) to record thoughts, questions, curiosities, supervisory discussions

	<p>and discussions with other professionals that influenced understanding and approach to the project.</p> <ul style="list-style-type: none"> • I wore the FSL for two weeks and kept a reflective journal of the experience and reviewed the data (see Appendix B for extracts) • I wrote a short reflective piece entitled 'A Day in the Life of my Stomach' to reflect on my own relationship with food (see Appendix C for extracts).
Consultation	<ul style="list-style-type: none"> • A group of three Experts by Experience with T1DM who use the FSL consulted on recruitment, data collection and analysis (detailed in Chapter 2). • 'Coder reliability checks' with another trainee; shared extracts of transcripts with each other, coded these separately and compared codes with a reflexive discussion noting points of similarity and difference.

1.3 Situating the Research in Context

1.3.1 Diabetes Mellitus

Diabetes mellitus is a chronic health condition that causes an individual's blood glucose (BG) level to become too high (NHS, 2019). This occurs when the pancreas does not produce any insulin at all, known as type 1 diabetes (T1DM), or when the pancreas either cannot produce enough insulin or the body's cells do not react to insulin, known as type 2 diabetes (T2DM). Insulin allows glucose in the blood to enter cells and fuel the body. Without insulin, glucose accumulates in the blood which can be fatal if left unattended (Allan, 2019). T1DM is considered an autoimmune condition as the absence of insulin production is due to the immune system attacking and destroying the insulin-producing cells of the pancreas

(Juvenile Diabetes Research Foundation; JDRF, 2020). However, T2DM is considered a metabolic condition and has been associated with ethnicity, genetics and lifestyle (JDRF, 2020). Approximately one in fifteen people in the UK have diabetes, of whom 90% have T2DM (Diabetes UK, 2020). The diabetes.co.uk website cites the cost of diabetes to the NHS as £14 billion a year, or 10% of the NHS budget for England and Wales, the majority of which is spent on treating complications (Diabetes.co.uk, 2019). Accordingly, research such as the current study is invaluable in understanding the impact of technologies on self-management of diabetes, and potential prevention of complications.

The self-management of T1DM and T2DM differs significantly, in terms of cognitive demands, short-term consequences of mismanagement and daily regimes. Managing T2DM involves lifestyles changes, such as diet and exercise, oral medications and possibly insulin prescription. Managing T1DM involves the individual mimicking the pancreas by administering synthetic insulin to regulate BG levels, which are affected by numerous factors including food, temperature, illness, stress and exercise (Kilpatrick, Rigby & Atkin, 2007; McDonnell & Umpierrez, 2012). Too much insulin in the blood and therefore too little glucose in the brain results in hypoglycaemia (low BG levels), which if not treated can result in coma and death. Conversely, not enough insulin and therefore too much glucose in the blood results in hyperglycaemia (high BG levels). If insulin is not administered during hyperglycaemia, Diabetic Ketoacidosis (DKA) will ensue, a life-threatening condition which can lead to multiple organ failure, coma or death. Due to the differences in aetiology, nature and management of T1DM and T2DM, the present study focuses only on T1DM.

For many years individuals with T1DM have checked their BG levels using the finger-prick method. The individual uses a lancet to prick their finger then applies the resultant drop of blood to a single-use test strip in a BG meter, which provides a BG level reading.

Finger-prick testing is recommended multiple times a day (first thing in the morning, before mealtimes, before bed, before driving and if symptoms of high or low blood sugar are experienced) to enable the individual to gain snapshots of their BG level and identify whether food, movement or medication is needed to keep BG within the target range. For some, finger-prick testing becomes part of their normal routine. For others, it can be an unpleasant experience for a multitude of reasons, such as pain, needle phobia, worries about the result and self-consciousness when in public (Shlomowitz & Feher, 2014). There can also be issues obtaining the medication or equipment necessary for self-management (Whicher, O'Neill & Holt, 2020), for example one in four people are reportedly not being prescribed the required number of glucose test strips (Diabetes UK, 2017). It is unsurprising that individuals living with diabetes report varying levels of diabetes-related distress, which encompasses the emotional response to living with diabetes, the burden of unrelenting self-management, the social impact of diabetes and the prospect of its long-term complications.

1.3.2 FreeStyle Libre Flash Glucose Monitor

In November 2017, the FreeStyle Libre (FSL) flash glucose monitor (FSL; Abbott Diabetes Care) became available on prescription (subject to local health authority approval) for people with T1DM who met clinical criteria. In line with the NHS Long Term Plan (NHS, 2019), national arrangements were made in England from March 2019 to reduce regional variation in availability. The FSL is a device worn on the arm for 14 days, roughly the size of a large coin, and has a short filament (4mm long) that must be inserted into subcutaneous tissue of the upper arm. The FSL system measures glucose concentration in the interstitial fluid surrounding the skin cells and then downloads the glucose measurements from the sensor to the reader. The wearer scans the device using a hand-held reader or their

smartphone to get a digital reading of their interstitial BG level, without having to draw blood. Data are recorded automatically every 15 minutes and trends for the previous eight hours can be seen on the screen. The FSL also offers an estimation of the user's HbA1c.¹

1.3.3 FreeStyle Libre and Diabetes Management

Research on the FSL has primarily focused on the utility and accuracy of the device in aiding self-management of diabetes. Impressively, the FSL has been shown to be associated with improved glycaemic control, increased awareness of hypoglycaemic episodes and increased frequency of checking BG levels (Gleeson et al., 2019; Overend, Simpson & Grimwood, 2019). A multicentre, randomised controlled trial (RCT) found that adults in the FSL intervention showed reduced time in both hypoglycaemia and hyperglycaemia (Bolinder et al., 2016). A later study on adults with T1DM found a reduction in mean HbA1c following FSL use (Dover, Stimson, Zammit & Gibb, 2017). Furthermore, FSL use has been positively associated with measures of quality of life and treatment satisfaction in adults with T1DM (Ish-Shalom, Wainstein, Raz & Mosenzon, 2016; Ólafsdóttir et al., 2017). A small proportion of the literature focuses on the psychological impact of using the FSL; it has been shown to significantly decrease diabetes-related distress in children and young people (Al Hayek, Robert & Al Dawish, 2020), and there is evidence to suggest that using the device does not negatively affect the level of diabetes-related anxiety (Whitehouse, Kaidis & Jayagopal, 2020).

¹ The term HbA1c refers to glycated haemoglobin which identifies average plasma glucose concentration. For individuals with diabetes, the higher the HbA1c, the greater the risk of developing diabetes-related complications.

The impact of the FSL on eating behaviours and the individual's relationship to food, however, has received little attention in the literature. Considering the fundamental nature of eating, and the interruptions to this process that diabetes causes, there exists a significant proportion of the population that must adjust how they eat to survive. Investigating what it means to people to change their food intake is important; changes in diabetes management methods have previously been shown to cause changes in food beliefs and behaviours, such as patient perceptions of 'good' and 'bad' foods, or patients choosing to eat high fat meals to avoid carbohydrates and the need to inject insulin (Lawton et al., 2011). As diet is a key component of diabetes self-management, focusing on an individual's relationship with food whilst using the FSL is crucial.

1.3.4 Relationship with Food

Humans cannot live without food or sustenance of some kind. In addition to food being an inescapable physiological and existential element, it can also be considered a social, emotional and cognitive construct. Specifically, one's relationship with food can be contemplated in several ways. Firstly, by considering what food does *for* the individual, be it offering pleasure, nurture, entertainment or mental stimulation. Secondly, by considering what food does *to* the individual; certain foods may lead to feelings of guilt, fear, conflict, distraction or obsession. Lastly, by considering how the individual *uses* food. Food may be used to express love and care, it may be used to communicate status, for example by only visiting the best restaurants, or it may be used to gain respect via culinary skills or meaningful dishes. Food may also be used to demonstrate virtue, for example through a diet that consists of only vegan, organic, plastic-free packaging foods.

On a broader level, one's relationship to food, its production and consumption is shaped by time, memory and nostalgia. Interactions with food occur within a range of social practices, including farming and gardening, shopping, cooking and dining out, which are each associated with various judgements and values (De Solier & Duruz, 2013). Food also plays a key role in the maintenance of social identities based on ethnicity, gender, nation and class.

“Bringing on stage cultural values, food becomes a central identity marker, defining personality, social class, lifestyles, gender roles and relationships, from family, to community, to ethnic groups or nationality, changing through time and place. Food is a lens to analyse society order, historical changes, power and politics. The way we understand and we relate to food, food practices, is always related to our identity, in the deepest manner.”

(Boutard, Becut & Marinescu, 2016)

In the context of T1DM, it is noteworthy that diabetes shapes the individual's relationship with food as the fundamental link between food and survival is problematized. In this way, links can be made between irregular food intake in diabetes and irregular food intake in eating disorders.

1.3.5 Disordered Eating and Eating Disorders

Disordered eating encompasses a range of irregular, unhealthy eating behaviours including food restriction, compulsive eating, fasting, self-induced vomiting and laxative or diuretic misuse (DSM-5) (American Psychiatric Association; APA, 2013). Such behaviours may reflect

many but not all symptoms of an eating disorder or may not be frequent or severe enough to meet criteria for an eating disorder.

Eating disorders, for example anorexia nervosa, bulimia nervosa or binge eating disorder, are characterised by preoccupation with food and body weight and disordered eating behaviour, with or without compensatory weight control behaviours. Therefore, if left untreated, disordered eating behaviours can develop into an eating disorder.

The required focus on food consumption in diabetes management has been suggested to contribute to the development of disordered eating (Nash & Skinner, 2005; Tse et al., 2012). Self-management can involve paying close attention to refined carbohydrates and food portions, which can mirror the rigid thinking about food and weight reported by individuals with eating disorders who do not have diabetes. Indeed, adolescents and women with T1DM are at greater risk of developing disordered eating behaviours than adolescents and women without diabetes (Grylli, Darwautz, Hafferl-Gattermayer & Schober, 2003; Nielson, Emborg & Molbak, 2002; Starkey & Wade, 2010). Consequently, it makes sense to circumvent the medical management approach to diabetes to view and explore diabetes through the lens of eating behaviours.

1.3.6 Disordered Eating and Diabetes

Aside from the psychological burden of diabetes being linked to various eating disorder risk factors such as depression, anxiety, low self-esteem, and family conflict (Goebel-Fabbri, 2017; Rodin et al., 2002), individuals may lose a significant amount of weight prior to diabetes diagnosis. This is due to the body burning fat and muscle for energy. Once an insulin regime is started the weight is often regained alongside temporary fluid retention. Insulin use has also been associated with long-term weight gain, with annual weight changes

correlating with insulin dose changes, despite improved glycaemic control (Alderisio et al., 2019). Injecting insulin can therefore be a challenging experience likely to impact the individual's emotional wellbeing and views about insulin (Goebel-Fabbri, 2017), and has been described by people with diabetes as akin to injecting fat or lard (Staite et al., 2018). In this way, an individual with diabetes contemplating administering insulin may feel similarly to an individual with an eating disorder contemplating consuming food, with high levels of anxiety and stress.

Individuals with T1DM may intentionally omit prescribed insulin for the purpose of weight control, known as diabulimia (Young-Hyman & Davis, 2010). Excessive carbohydrates may be consumed to keep BG levels high and without compensatory insulin, the resulting hyperglycaemia causes loss of glucose (and therefore calories) in the urine. The body burns fat and muscle for energy, leading to rapid weight loss. Up to 40% of women aged between 15-30 and 11% of men are estimated to have intentionally restricted their insulin to lose weight (Fairburn et al., 1991; Goebel-Fabbri, 2017; Hevelke, Albrecht & Busse-Widmann, 2016). The consequences of insulin omission are severe and lifechanging, as it can lead to kidney disease, nerve damage, retinopathy, stroke and heart attack (Bryden et al., 1999; Goebel-Fabbri, 2017; Mathieu, 2008; Shaban, 2013). In comparison to individuals with T1DM who do not restrict insulin, diabulimia can reportedly triple an individual's risk of mortality and reduce their life expectancy by up to 13 years (Goebel-Fabbri et al., 2008). Typically, individuals omitting insulin for weight loss are often referred to Eating Disorder Services. However, effective care requires a comprehensive understanding of the physical, behavioural and emotional factors associated with managing T1DM therefore many Eating Disorder Services are not equipped to support individuals with diabulimia as the difficulties extend beyond food and eating (Flury & Solomons, 2019).

In relation to binge eating, diabetes introduces additional complications. In the event of an eating binge, and in the absence of sufficient insulin, hyperglycaemia and DKA occur. If the individual experiences post-binge shame, guilt or fear of long-term complications, a large amount of insulin may be injected to reduce BG levels. However, this may cause a sudden drop in BG levels leading to hypoglycaemia and ongoing difficulties in stabilising BG levels. Furthermore, if the individual engages in post-binge purging behaviour, the amount of insulin required is difficult to ascertain.

Lastly, interventions aimed at stabilising BG within optimum levels have been identified as encouraging perfectionist tendencies (Goebel-Fabbri, 2017). Management strategies based upon target setting, such as reducing HbA1c, continuous checking and keeping track of numbers can prioritise data collection over connection with one's body. Self-tracking by collecting data on the body and its response to intervention is a widely used tool in healthcare. Self-tracking technology can be condition-specific, such as the FSL within diabetes care, or it can be used for much broader health and wellbeing purposes. Therefore, links can be made between experiences of the FSL and of health-tracking technologies.

1.3.7 The Quantified Self

The terms 'self-tracking' and 'quantified self' are now frequently used to describe the use of health-tracking technologies (Smarr, 2012). Increasingly these technologies are used by lay people as voluntary self-tracking strategies that contribute to perceptions of health, embodiment and identity and can be viewed as part of managing and improving one's life (Lupton, 2013). The Apple Store alone offers over 53,000 health-related applications (apps) that allow users to monitor, log and graph bodily functions such as sleep, pain, menstrual cycle, exercise and diet (Ceci, 2021). The practice of collecting data about oneself via a

wellness app or device is marketed as “maintaining or encouraging a healthy lifestyle and is unrelated to the diagnosis, cure, mitigation, prevention, or treatment of a disease or condition” (FDA, 2019).

Lupton (2013) highlights that self-tracking practices privilege highly detailed knowledge of the body based on the assumption that such knowledge offers a means by which illness and disease may be prevented. The privileging of good health can be considered as promoting the discourse of ‘healthism’, which positions the achievement of good health above other areas of the individual’s life and tends to be embraced by the socio-economically privileged, who have the economic and educational resources to do so. This discourse therefore does not consider the social and economic determinants of health states.

1.3.8 Health-Tracking Technologies

Health-tracking technologies have been referred to in the literature in multiple ways, but for the purposes of current study ‘health-tracking technologies’ encompasses ‘fitness-tracking’ or ‘activity-tracking’ technologies designed to record daily physical activity and ‘calorie-tracking’ or ‘food-tracking’ technologies designed to record daily dietary consumption. The use of such trackers is grounded in research that suggests that technology increases self-awareness of health-related behaviours which motivates behavioural change (Anderson, Winett & Wojcik, 2007; Chen, Gemming, Hanning, & Allman-Farinelli, 2018).

Health-tracking technologies are often in the form of wearables, such as the FitBit, or mobile apps such as MyFitnessPal. The FitBit is an activity monitor worn on the wrist that collects activity data including steps climbed and distance travelled. The device has demonstrated high validity and reliability for energy expenditure estimates (Lee, Kim &

Welk, 2014) and the companion app allows the user to log food intake and provides visual feedback of performance in graphs. The MyFitnessPal app has a reported 180 million users worldwide (MyFitnessPal, 2019) and allows users to create a diet plan by entering their height, weight, goal weight, weekly weight loss/gain goal, and activity level. Users enter their consumed food and can input exercise manually or by synchronizing other apps or wearables, such as the FitBit. As with many health-tracking technologies, FitBit and MyFitnessPal offer connection with other users through adding friends, participating in challenges and posting on forums.

1.3.9 Health-Tracking Technologies and Relationship with Food

When considering the impact that health-tracking technologies have on the user's relationship with food, it is notable that such technologies are commonly used in weight loss interventions. A systematic review of research comparing the effectiveness of weight loss practices with and without mobile apps found broad support for their use, suggesting participants aided by an app lose more weight because of better nutrition decisions and increased activity (Lyzwinski, 2014). Steinert and colleagues (2016) also demonstrated that limited and personally adapted goal setting in relation to diet has been associated with successful behavioural change. Self-tracking can offer a dieter a memory aid for their daily consumption or facilitate consideration of whether certain foods fit into their diet plan. Others may use health-tracking technology to log planned meals at the beginning of the day, therefore avoiding any spontaneous decisions about food. Furthermore, the process of logging every mouthful may prompt a momentary evaluation of the food item as opposed to automatic consumption (Wang, Bublitz & Zhao, 2021). It appears then that health-

tracking technologies can alter an individual's relationship with food and how they interact with it, at least during the pursuit of short-term goals.

Although some of the literature indicates that regular self-monitoring of diet can have a positive impact on food choices and contribute to dietary change (El Khoury et al., 2019), health-tracking technologies are not void of concerns. A significant issue with health-tracking technologies, particularly activity trackers, is that they do not build in rest days or breaks from monitoring. The focus on continuous tracking can encourage prioritising the numbers rather than feedback from the body. This can be unhelpful for individuals vulnerable to disordered eating, as it mirrors the practice of ignoring signals from the body, such as hunger or pain, which is often seen in eating disorder presentations. Dennison and colleagues (2013) interviewed university staff and students to explore their experiences of using health-tracking mobile apps. Despite participants valuing the detail involved in tracking their dietary consumption, many reported concerns that self-tracking might reveal upsetting results if the data reveals large discrepancies between desired and actual achievement, which was thought to reduce motivation to pursue goals, particularly if the data was shared on social media.

Many existing health-tracking technologies were not designed for individuals with a history of eating disorder and have not been robustly evaluated in these populations (Levinson, Fewell & Brosof, 2017). Given that individuals with current or historical eating disorders may be drawn to perfectionistic habits around calorie counting and numbers, it is important to understand the potential impact of technology. However, the literature offers inconsistent conclusions. It has been suggested that MyFitnessPal should not be used by individuals with eating disorders as it can lead to over-evaluation of weight and shape and a restrictive, unbalanced diet (Evans, 2016; Rentko, 2015). In two cross-sectional studies

focusing on MyFitnessPal, almost three quarters of female participants with eating disorders viewed the application as, at a minimum, having somewhat contributed to their eating disorder (Levinson et al., 2017). A smaller proportion, almost half, of male users recruited from health and fitness websites described the app as a contributing factor to disordered eating (Lindardon & Messer, 2019). Conversely, an experimental study found no evidence for a causal effect of using MyFitnessPal on eating disorder symptomology (Jospe et al., 2017), and apps can be used to promote recovery via tracking macronutrient intake (Eikey & Reddy, 2017).

McCaig and colleagues (2020) conducted a qualitative analysis on comments in MyFitnessPal online forums and identified numerous concerns around app use. Specifically, due to the app calculating weight loss goals using height, weight and gender, men reported entering that they were women to be offered a lower daily energy intake. Commenters also reported practices to overestimate energy intake, such as recording fake 'ghost calories' or logging a meal but not eating it all. Underestimating energy intake was also commonplace for individuals who engaged in episodes of binge eating, with binges either not recorded or recorded as a lower set number of calories. Eikey and Reddy (2017) conducted interviews with 16 women with a history of eating disorders who had used health-tracking technologies. Participants shared experiences of anxiety surrounding the need to meet calorie targets and how this affected their ability to spend time with family or eat in restaurants where tracking became difficult. Participants reported changes in their relationship with food, due to food becoming a visual representation of a number. Apps that visually represented total calorie consumption as green, for meeting the goal, and red, for exceeding the calorie goal (even by 1 calorie), were described as problematic as they had a significant impact on mood and self-esteem. For individuals with weight gain goals, apps are

often not designed to encourage weight gain and still use red for exceeding the calorie allocation.

1.4 Rationale for the Systemic Literature Review

Overall, the literature suggests that while some users of health-tracking technologies may experience thought cycles that lead to new insights and progress (i.e. self-reflection), others may also experience negative thought cycles that can be associated with disordered eating, guilt and shame (Eikey et al., 2011). Users who experience negative emotions and cognitions in response to their self-monitoring may then be more likely to abandon the technology to avoid such experiences or to abandon their health-related goals. It is possible that user experiences and outcomes could be associated with the type of health-tracking technology, their motivations for use and the way in which it is used.

There are many similarities between the FSL and health-tracking technologies, namely the collection of continuous data, visual representation of data in colour-coded graphs, the requirement for user input and encouragement of self-reflection to pursue a numeric goal. Due to the lack of existing research on the FSL and its impact on the user's relationship with food, the following systematic literature review will explore the impact of health-tracking technologies on users' relationship with food. Insights from the literature may be generalisable, in part, to the experiences of users of the FSL which will inform the current study.

Systematic Literature Review

1.5 Overview

This section presents a systematic review of literature relevant to the current study's research questions and aims. A scoping literature search highlighted a paucity of research focusing on the impact of the FSL on users' relationship with food and eating behaviours, despite an existing understanding that diabetes management practices impact eating behaviours. To understand more about the potential impact of health-tracking technology on eating behaviour, a systematic review was conducted with a focus on non-clinical populations. This systematic review of empirical literature seeks to answer the following question:

What does the literature tell us about experiences of health-tracking technologies in relation to relationship with food and eating in non-clinical populations?

Initial searches revealed a plethora of health-tracking technologies used to assess or monitor physical health conditions, for example smartwatch seizure detection. Additionally, many health-tracking technologies monitor factors unrelated to food or eating which are not relevant to the current study aims. As the FSL requires users to scan multiple times a day and requires input of carb counting, insulin doses and exercise throughout the day, the researcher decided that only health-tracking technologies that require user input and collect continuous data should be included in the literature review. Initial searches identified studies using once-daily diet-related text message reminders, which were deemed not relevant. Studies that involved an intervention monitored by health-tracking technologies

were also deemed irrelevant, as any changes to eating behaviours were considered a result of the intervention rather than the health-tracking technology.

1.6 Search Strategy Method

Searches were conducted in January 2022 using the following bibliographic databases accessed via the University of Hertfordshire: Scopus, Cinahl Plus and PubMed. Databases were chosen as they incorporated literature from various disciplines including medicine, nursing and applied social sciences. A scoping search was also conducted using Google Scholar but identified no additional papers. The final search strategy was informed by conducting several pilot searches to capture the commonly used terms and relevant articles. Titles and abstracts of articles previously identified as relevant were also examined for key terms.

Databases were searched from 2011 onwards to capture recent health-tracking technologies. Considering the rapid development of technology and continuously updating smartphones, literature from over a decade ago was deemed less relevant as it largely involved text messaging and personal digital assistants (PDAs), which did not reflect the accessibility and complexity of widely-used current apps and devices. Table 2 shows the three concepts and associated search terms used to conduct the search:

Table 2

Search Terms

Concept 1: Terms relating to health-tracking technologies		Concept 2: Terms relating to eating behaviour		Concept 3: Terms relating to experiences
--	--	--	--	---

Fitbit OR "apple watch" OR myfitnesspal OR "my fitness pal" OR "wearable tech*" OR "wellness device" OR Garmin OR "wellness track*" OR "activity track*" OR "wellbeing monitor" OR "fitness monitor" OR "fitness track*" OR "health track*" OR "digital health"	AND	Food OR eat OR eating OR diet* OR "eating disorder" OR "disordered eating" OR restrict* OR "calorie counting" OR meal OR "meal plan*" OR consum*	AND	experience OR narrative OR impact OR psychosocial OR attitude OR opinion OR perce* OR belie* OR feel* OR know* or understand*
---	-----	---	-----	---

Per Siddaway, Wood & Hedges' (2019) methodology, the researcher segmented the topic into individual concepts to create search terms, and considered alternative terminologies, checking search terms against a thesaurus and adding new terms from the literature. The search terms were truncated where appropriate to yield all relevant papers (e.g., consum*= consume, consumption). Search terms were combined using Boolean operators 'AND'/ 'OR'. Given the limited resources available and timescale of the project, only English language papers were included. Table 3 provides a summary of the inclusion and exclusion criteria below.

Table 3

Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
Published since 2011	Published before 2011

Focused on the experience of health-tracking technology users	Conceptual or theory
Device or mobile application that collects continuous data or requires user input	Clinical population e.g. physical health conditions, diagnosis of eating disorder or obesity
Device or mobile application that collects data on food consumption	Self-monitoring as part of medical intervention e.g. to monitor heart arrhythmia, weight loss
Reporting original peer-reviewed	Paediatric population
Qualitative, quantitative or mixed methods	
Adult or older adult population	

1.7 Systematic Literature Review Search Process

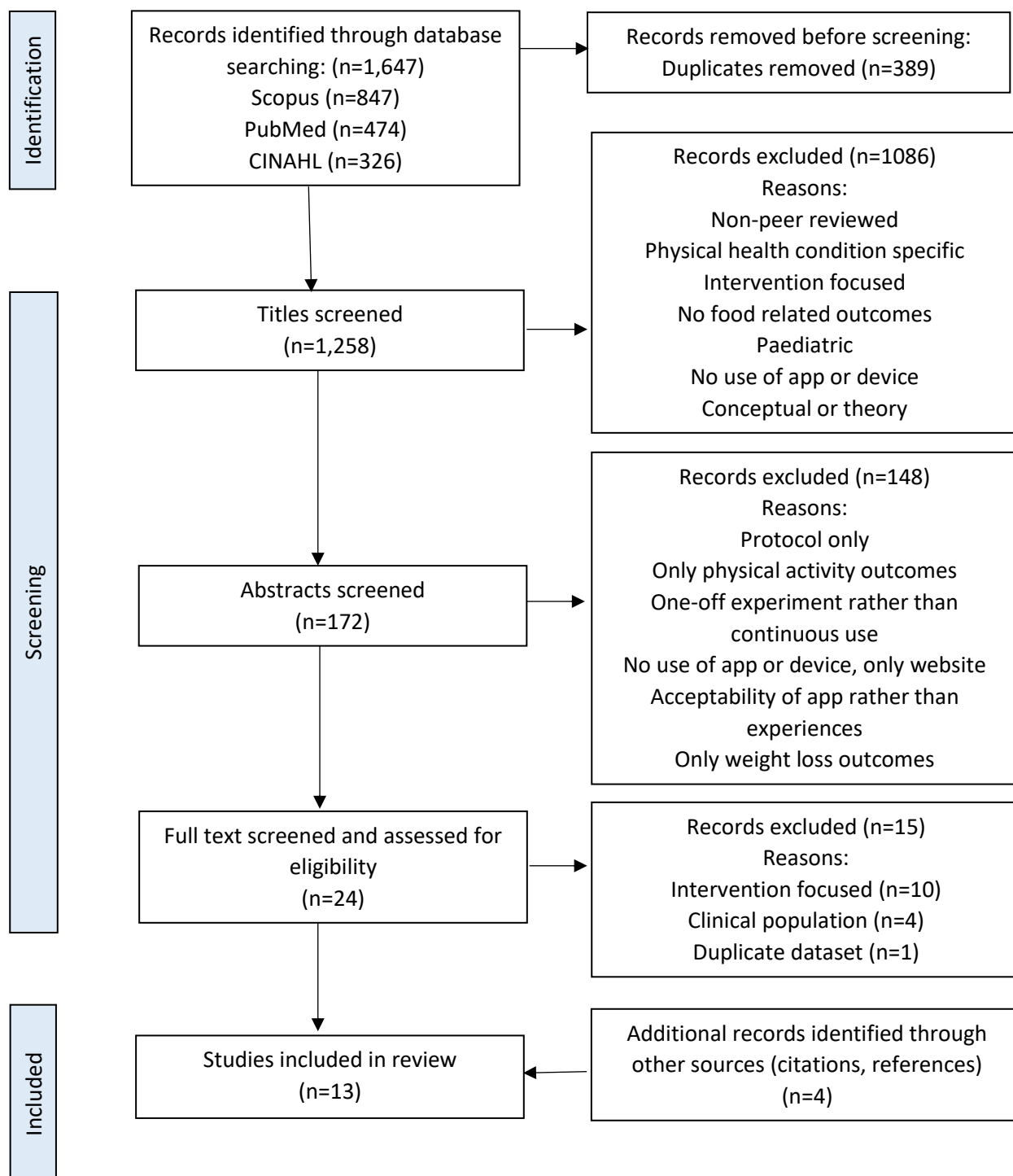
Figure 1 presents a flow chart of search results and Prisma screening process (Page et al., 2021).

1.8 Results of Systematic Literature Review Search

The initial search identified 1,647 papers, of which 389 duplicates were removed. Screening titles and abstracts against inclusion criteria removed a further 1,234 papers with 24 articles remaining for full-text screening. Of these, ten met criteria for inclusion in the review. Two studies (Lieffers, Arocha, Grindod & Hanning, 2018; Lieffers, Arocha & Hanning, 2016) used the same dataset and both publications offered the same results, therefore only the most recent publication was included. One study (Hahn et al., 2021b) included a sample recruited from an RCT (Hahn et al., 2021a) and both were included as the secondary analysis offered novel findings. The reference lists of selected papers were hand-searched to check for papers that met inclusion criteria; an additional four papers were identified. Therefore, 13 papers are included in the current review. This sample features eight studies using

Figure 1

Prisma 2020 Flow Diagram of Study Selection Process



quantitative methods (Bracken & Waite, 2020; Gittus et al., 2020; Hahn et al., 2021a; Hahn, Sonnevile, Kaciroti, Eisenberg & Bauer, 2021; Linardon & Messer, 2019; Plateau, Bone, Lanning & Meyer, 2018; Sarcona, Kovacs, Wright & Williams, 2017; Simpson & Mazzeo, 2017), four studies using qualitative methods (Didžiokaitė, Saukko & Greiffenhagen, 2018; Hahn et al., 2021b, Lieffers, Arocha, Grindrod & Hanning, 2018; Régnier & Chauvel, 2018) and one study using mixed methods (Honary, Bell, Clinch, Wild & McNaney, 2019). Table 4 presents a summary of each paper's findings, strengths and limitations.

1.9 Summary of Findings

Table 4

Summary and Evaluation of Studies in the Systematic Literature Review

#	Author/s and Year	Title	Sample Details	Study Design	Health-tracking technology	Summary of Key Findings	Strengths and Limitations
1	Bracken, M. L. & Waite, B. M. (2020)	Self-Efficacy and Nutrition-Related Goal Achievement of MyFitnessPal Users	Participants: n = 112, age 18-59. Primarily female (75.0%) and Caucasian (80.4%). Eligibility: downloaded and used MyFitnessPal (MFP) app in the past year. Recruited from: social media (i.e., Facebook/ Twitter; n = 31) and the MFP website (n = 23), undergraduate courses offered by physical education (n = 44) and	Cross-sectional online survey. Participants completed survey on how often they used MFP, their self-efficacy for healthy eating and self-reported achievement of nutrition-related goals. Self-efficacy for healthy eating was assessed using a seven-item subscale of the Social Cognitive Scales of Healthy Eating Behaviour (Dewar et al., 2012). MFP use was self-reported for total number of months in past year and how many minutes a day.	MyFitnessPal use within the past year.	Higher levels of self-efficacy for healthy eating and greater use of MFP predicted greater goal achievement. The relationship between MFP use and goal achievement was stronger for those with lower self-efficacy. MFP could be a useful tool for those who are less confident in their ability to maintain a healthy diet and who might otherwise be less successful in meeting their nutritional goals.	Strengths: Self-selecting sample of individuals who were already using the app not under research conditions. Limitations: Correlational design, cannot infer cause and effect. Total self-reported MFP use calculation was not validated and could underestimate or overestimate actual usage. Likely additional factors (e.g., motivation) that were not accounted for in this study that could have influenced goal achievement.

			psychology (n = 14) department at a public university in New England.	Participants indicated how frequently they were able to meet their nutrition goals in a typical week when using MFP.			
2	Didžiokaitė G., Saukko P., & Greiffenhagen C. (2018)	The mundane experience of everyday calorie trackers: Beyond the metaphor of Quantified Self	Participants: n=31, aged 22-53, men (n=12) and women (n=19). Eligibility: previous or current use of MyFitnessPal. Recruited from: adverts in local fitness Facebook groups, a participant recruitment website (callforparticipants.com), the bulletin board for local university staff and	Semi-structured interviews conducted with participants. Participants were asked to tell their story of using MyFitnessPal, to talk about their engagement with the app and to evaluate it. Transcripts analysed with thematic analysis. Participants also provided a two-week extract of their food and exercise diary from MyFitnessPal. This was not compulsory	MyFitnessPal, previous or present use.	Most participants used MFP for dieting, some used the app mainly to improve fitness or sport performance. Three main themes – goals, use and effect –people pursuing every day, limited goals engage in basic self-tracking and achieve temporary changes. Majority of participants were self-tracking to achieve a specific weight goal, mainly weight loss.	Strengths: Large sample for interviews. Themes inter-rater checked by three authors. Limitations: No demographic information regarding participants. No researcher reflexivity included.

			students, and in local UK East Midland gyms.	and resulted in 16 extracts.		Participants usually followed the calorie and nutrient limit offered by the technology. MFP led to modest and temporary changes in behaviour with participants perceiving food items in terms of calories.	
3	Gittus, M., Fuller-Tyszkiewicz, M., Brown, H. E., Richardson, B., Fassnacht, D. B., Lennard, G. R.; Holland, E. & Krug, I. (2020)	Are Fitbits implicated in body image concerns and disordered eating in women?	Participants: n=262. Eligibility: no prior use of a wearable fitness self-tracking device. Recruited from: three universities across Australia and general community, through online advertisements on social media	Randomised controlled trial. Participants were allocated to a Fitbit (n = 101) or control condition (n = 161). Participants provided baseline data on sociodemographics, eating pathology, and exercise. Fitbit condition wore a Fitbit over the entire assessment period (10	FitBit used for ten days.	Fitbit participants were significantly more likely to report exercising for fitness/health motives and were less likely to report binge eating or dietary restraint during the 10-day testing period. The Fitbit group reported higher body satisfaction	Strengths: Large sample size. Baseline measures and demographic information controlled for. Study was the first to examine potential effects of Fitbit self-tracking in daily life on body image and disordered eating symptoms.

			<p>and career websites.</p>	<p>days). InstantSurvey signalled participants six times daily for the 10 days at semirandom intervals between 9am and 9pm stratified in time blocks of a 2-hour duration (maximum 60 assessments). Signals prompted participant to complete brief 1-2 minute survey containing items about exercise, motives for exercise, body satisfaction, and disordered eating behaviours. Disordered eating was assessed by asking yes/no to binge eating or dietary restriction.</p>		<p>and exercise amounts, on average, and more exercise for appearance-related reasons, although these effects were nonsignificant.</p>	<p>Limitations: Very brief use of FitBit. The novelty of wearing a Fitbit device may have masked any adverse effects of Fitbit self-tracking. Disordered eating variables in the daily monitoring assessment not defined; dietary restriction and binge eating could have been left to interpretation biases. Despite the community sample, approximately 20% were at risk for an eating disorder.</p>
--	--	--	-----------------------------	--	--	--	--

				Questionnaires: Eating Attitudes Questionnaire–26, Exercise Dependence–21.			
4	Hahn S. L., Linxwiler A. N., Huynh T., Rose K. L., Bauer K. W. & Sonnevile K. R. (2021b)	Impacts of dietary self- monitoring via MyFitnessPal to undergraduate women: A qualitative study	Participants: n=20, female. Eligibility: no prior or current diagnosis of eating disorder, low risk for an eating disorder (measured by Eating Disorder Examination Questionnaire), no use of dietary self-monitoring in previous year. Recruited from: intervention condition of the Tracking Our Lives study, an	Semi-structured interviews were conducted to explore participants’ experiences of dietary self-monitoring. Research assistants set up an account using standardized settings including the individuals’ daily caloric needs for weight maintenance. Participants had to track everything they ate for approximately one month. Transcripts analysed using inductive content analysis.	MyFitnessPal used for one month.	Participants’ experiences of dietary self- monitoring were highly variable, some participants reported increased negative feelings (n = 9), positive feelings (n = 7), or both (n = 2). Half the participants reported increased weight and/or shape concerns and an increase in other types of self- monitoring e.g. exercise and water intake. Seven	Strengths: Participants had been randomised to dietary self- monitoring in wider RCT so had not self- selected to do dietary monitoring. Three researchers met 85% agreement on all themes. Limitations: 20 undergraduate women from single university. Post- intervention interview was supposed to be 30 days of MFP but was actually 21-60 days

			<p>RCT assessing the cognitive and behavioural impacts of dietary self-monitoring use by undergraduate women.</p> <p>University of Michigan emailed 2,101 randomly selected female undergraduate students with study information and invitation to online screening survey.</p>			<p>participants described that they felt better or prideful when eating within MFP recommendations. Majority of participants reported that dietary self-monitoring made them more aware of their food choices and they spent more time thinking about food and exercise.</p>	<p>which may have influenced experiences.</p>
5	<p>Hahn, S. L., Kaciroti, N., Eisenberg, D., Weeks, H. M., Bauer, K. W., Sonnevile,</p>	<p>Introducing Dietary Self-Monitoring to Undergraduate Women via a Calorie Counting App Has No Effect</p>	<p>Participants: n=200, female.</p> <p>Recruitment method as above.</p> <p>Among the students emailed, 808 completed the screening</p>	<p>Randomised controlled trial.</p> <p>Participants randomly assigned to dietary self-monitoring via MyFitnessPal for one month or no intervention.</p>	<p>MyFitnessPal used for one month.</p>	<p>Assignment to intervention was not associated with changes in eating disorder risk, anxiety, depressive symptoms, body satisfaction, quality</p>	<p>Strengths: Participants were randomised to condition therefore not self-selecting. All mental health outcomes were</p>

	<p>K. R. (2021a)</p>	<p>on Mental Health or Health Behaviours: Results From a Randomized Controlled Trial</p>	<p>survey and 401 were eligible. The first 201 participants were invited to enrol in the study. Following one exclusion, control condition (n=100) and intervention condition (n=100) met a priori sample sizes.</p>	<p>Research assistants downloaded MFP for intervention condition and set daily caloric needs for weight maintenance. Risk of eating disorder was assessed using the Eating Disorder Examination Questionnaire. Depressive symptoms were assessed using the Centre for Epidemiologic Studies Depression Scale Revised; anxiety was assessed using the state subscale of the State-Trait Anxiety Inventory; body image was assessed using the Body Image States Scale, and overall quality of life was assessed using the</p>		<p>of life, nutritional intake, physical activity, screen time, or other forms of weight-related self-monitoring. There were no differences in Eating Disorder Examination Questionnaire score between study conditions post-intervention. The intervention did not change participants' likelihood of fasting, compulsive exercising, binge eating, limiting amount of food or engaging in loss of control eating.</p>	<p>assessed using validated scales. Limitations: Sample comprised women at a single university. Loss to follow up only in intervention condition.</p>
--	----------------------	--	--	---	--	---	---

				Brunnsviken Brief Quality of life scale.			
6	Hahn, S. L., Sonneville, K. R., Kaciroti, N., Eisenberg, D., & Bauer, K. W. (2021)	Relationships between patterns of technology-based weight-related self-monitoring and eating disorder behaviours among first year university students	Participants: n=647, aged 18-22. Predominantly female (68.9%) and white (66.0%). Recruited from: three campuses of a state university in the midwestern USA. Invitations to complete the survey distributed via email to random sample of 3600 students. Response rate of approximately 23% with final 647 participants with sufficient response data.	Cross-sectional online survey to assess use of technology-based weight related self-monitoring (WRSM) and eating disorder behaviours. Participants were asked if they had used any WRSM in the past year and to specify which app or device. Also asked how often they weigh themselves. Modified version of the assessments used by Project EAT to assess eating disorder behaviours. Questions were modified based on prior interviews with professionals and focus groups with	MyFitnessPal, FitBit, JawBone, etc.	Compared to the 67.0% of females who did not use WRSM, females engaging in high amounts of technology-based WRSM (33.0%) were more likely to report fasting, skipping meals, excessively exercising, and using supplements. Among males, those who reported all forms of WRSM (9.5%) were more likely to report fasting, skipping meals, purging, and using supplements. Males who only used exercise self-monitoring (11.9%)	Strengths: Identified gender-specific patterns of technology-based WRSM use and relationships between WRSM and eating disorder behaviours. Included apps that have not been previously studied. Limitations: Single item measures were used to assess WRSM and eating disorder behaviours. Students who did not identify as male or female were excluded due to sample size (n=4) which are a population at high risk for using eating

				college students to include more modern examples of weight management behaviours.		did not have increased likelihood of eating disorder behaviours. Females were more likely to skip meals for weight loss than males (62.7% vs 48.5%) and males were more likely than females to excessively exercise (61.6% vs 47.6%).	disorder behaviours. Did not collect data on frequency or duration of use of WRSM.
7	Honary, M., Bell, B. T., Clinch, S., Wild, S. E., & McNaney, R. (2019)	Understanding the role of healthy eating and fitness mobile apps in the formation of maladaptive eating and exercise behaviours in young people.	Participants for online survey: n=95, aged 18-25. Eligibility: current or past experience of using healthy eating and fitness apps. Recruited from: social media using a snowball sampling method.	Mixed methods design. Conducted in two phases, through an online survey (n=95) and two workshops (n=8), aiming to gain an understanding of young adult's perceptions of healthy eating and fitness apps and any potential harm that	MyFitnessPal, Fitbit, etc.	Almost half survey participants reported negative experiences and behaviours through app use. (1) guilt due to the nature of persuasive models, (2) social withdrawal due to personal regimens around fitness goals and diet, (3) fear of	Strengths: Mixed-method approach for a holistic understanding. Limitations: Workshop participants were all female. Survey was not validated.

			<p>Workshop participants were recruited via an email advertisement. The first workshop was held with 6 female students recruited from York St. John University. Second was held with 2 peer educators from a local youth organization who had undertaken training explicitly around promoting a positive body image in young people.</p>	<p>their use might have. Explored views further through interviews with experts (n=3) in eating disorders and body image.</p>		<p>receiving negative responses when targets are not achieved, and (4) feelings of being controlled by the app. Most common negative behaviour across males and females was obsessive calorie counting. Some participants reported although app led to obsessive exercise behaviours, they needed the push to succeed, forcing them to do exercise when tired. Workshop participant said that apps can encourage shifts away from homecooked meals</p>	
--	--	--	--	---	--	--	--

						as processed food is easier to log.	
8	Lieffers J.R.L., Arocha J.F., Grindrod K. & Hanning R.M. (2018)	Experiences and Perceptions of Adults Accessing Publicly Available Nutrition Behaviour-Change Mobile Apps for Weight Management	Participants: females (n=19) and males (n=5) who had used nutrition mobile apps for weight management for >1 week within the past 3-4 months. Recruited from: the community in southern Ontario and Edmonton, Canada, using different methods (e.g., social media, posters and word of mouth). Participants used nutrition apps for various amounts of time (mean	Semi-structured interviews conducted with participants to explore experiences and perceptions of adults using nutrition mobile apps outside of a research setting. Transcripts analysed using content analysis. Information on body weight status, dieting/eating disorder history, education level, income, and ethnicity were not collected from participants.	MyFitnessPal was most common	Four categories of experiences with nutrition apps: food data entry (portion size, complex foods); accountability, feedback, and progress; technical and app-related factors; and personal factors (self-motivation, privacy, knowledge, and obsession). Some participants had concerns around colour-coding (e.g., promotes negative feelings). Female participants (n=8) noted that app use could be “addictive”; “overcome life”;	Strengths: recruitment of participants with various experiences and perspectives, capturing both positive and negative aspects of app use and using rigorous qualitative methods, including using the COREQ checklist for reporting. Limitations: Many participants were female and aged 18-30 so may represent certain demographic. Participants were also not screened for previous eating disorders/issues, which could potentially influence

			approximately 14 months).			<p>promote an unhealthy obsession with calories, food and weight; and lead to eating disorder development. Some participants mentioned experiencing some type of obsession with these tools. Some strategies used to overcome this concern included stopping use for a while, ignoring recommended targets for a while to understand there was no difference in outcomes, or skipping the recording of some meals.</p>	<p>experiences of obsession. Interviews were conducted in public locations, e.g. coffee shops, which might have impacted personal disclosures.</p>
--	--	--	---------------------------	--	--	--	--

<p>9</p>	<p>Linardon J. & Messer M. (2019)</p>	<p>My fitness pal usage in men: Associations with eating disorder symptoms and psychosocial impairment</p>	<p>Participants: n=122, mean age = 28.4, primarily Caucasian (77.9%). Recruited from: fitness-related social media sites. No participants self-reported a diagnosed eating disorder.</p>	<p>Cross-sectional online survey to estimate MFP usage and examine its association with eating disorder symptoms and psychosocial impairment. Online questionnaire: EDE-Q and Dichotomous Thinking in Eating Disorder Scale (DTES). Clinical Impairment Assessment (CIA) 16 item self-report that assesses psychosocial impairment secondary to disordered eating symptoms. MFP use assessed by the questions: (1) Have you used My Fitness Pal to track your calories? and (2) Did</p>	<p>MyFitnessPal used for unknown period of time.</p>	<p>56% of the sample reported having used MFP to track their calories. Nearly 40% of users perceived MFP as a factor contributing to disordered eating symptoms to some extent. MFP users reported significantly higher levels of attitudinal (dichotomous thinking, shape, weight, and eating concerns) and behavioural (binge eating, dietary restraint) eating disorder symptoms and psychosocial impairment than non-users. MFP use predicted a significant and small</p>	<p>Strengths: All male sample. Use of MFP outside of research conditions, therefore self-selecting sample. Limitations: Cross-sectional design, cannot infer cause and effect. Frequency and duration of MFP use not assessed. Psychometric properties of eating scales have not been validated in male samples.</p>
----------	---	--	--	---	--	---	--

				you feel that My Fitness Pal contributed to any pattern of disordered eating (e.g., binge eating) in any way?		amount of unique variance in global eating disorder symptoms after controlling for the variance explained by eating disorder behaviours, psychosocial impairment, and demographics.	
10	Plateau, C. R., Bone, S., Lanning, E. & Meyer, C. (2018)	Monitoring eating and activity: Links with disordered eating, compulsive exercise, and general wellbeing among young adults.	Participants: n=352, aged 18-35, 65% female, 82% White British. Recruited from: opportunity sampling at a UK university campus, via a research participation scheme (in exchange for course credits)	Cross-sectional survey. Participants indicated their use of activity and food intake monitoring tools, and completed the Compulsive Exercise Test (CET), Eating Disorders Examination Questionnaire (EDE-Q) and the Warwick Edinburgh Mental Wellbeing Scale (WEMWBS).	'Food intake monitors and activity monitoring devices'	Users of monitoring tools reported a higher BMI than non-users. Users of monitoring tools reported significantly higher CET scores and on three of the four EDE-Q subscales (EDE-Q-Restraint, EDE-Q Eating Concern, and EDE-Q-Weight Concern). Participants who	Strengths: Included measure of compulsive exercise which many studies do not. Limitations: The measure of monitoring tool use was developed for the purpose of the study and would benefit from further validation. Twenty-five participants reported only using

			and via adverts on social media. Participants provided age, gender and self-reported height and weight data.	Participants reported a) whether they used a device b) the type of device used; c) frequency of use; d) their main reasons for use; e) responded to three questions about their perceptions of the tools (perceived helpfulness, level of concern if denied access, and the impact of the device on their activity or eating behaviours).		reported primarily using monitoring tools to manage shape and weight (n = 32) reported significantly higher rates of purging behaviours than those who reported using the tools for health and fitness.	food intake monitors, 117 used just activity monitoring devices and 87 used both activity and food intake monitors. Due to the small frequency of participants only using food intake monitoring tools, the groups were combined into those who monitored (n = 229) and those who did not (n = 123).
11	Régnier F. & Chauvel L. (2018)	Digital inequalities in the use of self-tracking diet and fitness apps: Interview study on the influence of social,	Participants: n=79, age 23-70. Eligibility: existing users of fitness self-tracking apps living in France. Recruited from: sports clubs, via snowball sampling on the	Semi-structured interviews with each participant (Weight Watchers, n=37; MyFitnessPal, n=20; Sport apps, n=22). Participants were asked about their use of digital devices in daily life: reasons for	MyFitnessPal, WeightWatchers Sport apps.	Majority of sport app users were men. Sport app users tended to belong to high-income milieus, users of MyFitnessPal to the intermediate categories, and Weight Watchers	Strengths: one of the few qualitative studies on digital apps based on large sample of in-depth interviews. Good reliability of data (number of interviews, ethnographic

		<p>economic, and cultural factors</p>	<p>MyFitnessPal social network (initial participants were recruited via the forum and the messaging systems), and via researcher’s participation in Weight Watchers meetings. Sample included 60 women, which was attributable to the high proportion of women enrolled in Weight Watchers and using MyFitnessPal.</p>	<p>choosing the particular device, frequency and circumstances of use, functionalities used, information taken into account when using the device, and effect of use on dietary or sporting habits. A triangulation of methods (content, textual, and quantitative analyses) was performed. The 22 individuals in the sport apps group were characterized by the use of common self-tracking tools accessible via cell phone apps, bracelets or watches with accelerometers, and instruments equipped</p>		<p>members to intermediate- to low-income milieus. Identified three clusters of users: “Resistant” cluster- those with little inclination to use digital devices who monitored diet or physical activity and weighed themselves, but recorded little on the apps; “For self-improvement” cluster- mostly sport app and MyFitnessPal users; “For sharing” cluster- actively engaged with social forums and often looked for the most precise self-measurements</p>	<p>observations, quantitative analysis, and triangulation of methods) and in-depth interviews (1-2 hours). Comments on researcher position and reflexivity. Limitations: Interview was predominantly conducted with current users of digital devices, who were willing to share their experiences because they were largely satisfied with the outcomes.</p>
--	--	---------------------------------------	--	---	--	---	--

				with global positioning system.		possible. The largest weight loss “successes” (up to 45 kilos) were found in this cluster.	
12	Sarcona A., Kovacs L., Wright J., & Williams C. (2017)	Differences in eating behaviour, physical activity, and health-related lifestyle choices between users and nonusers of mobile health apps.	Participants: n=401, age 18-22. The female-to-male ratio of 2.7:1 was almost consistent with the 2:1 female-to-male ratio for the university. Recruited from: one suburban and one urban university campus. Researchers set up tables in high-traffic areas of both campuses and recruited students to complete the	Cross-sectional survey to assess eating behaviour, physical activity, and health-related lifestyle choices and mobile health app usage. Questionnaires used: Lifestyle and Habits Questionnaire—brief version, which assesses lifestyle behaviours. Godin-Shephard Leisure-Time Physical Activity Questionnaire which measures frequency of physical activity. Eating Behaviour Inventory (EBI) which	MyFitnessPal, Jawbone, Fitbit used within the last 12 months.	Mobile health app users had significantly higher scores for eating behaviour than nonusers (higher scores associated with positive eating behaviours), and the impact of using more than one type of mobile health app significantly improved eating behaviour. Most participants also identified app use with having more motivation to eat healthier and increase physical	Strengths: Large sample size and used of validated questionnaires. Limitations: Wide variety of mobile health apps utilized by participants. EBI questionnaire was altered; six items changed and six deleted. When looking at ethnicity participants were grouped into white and ‘non-white’. Frequency and duration of app use not assessed.

			survey, where healthy snacks were offered as an incentive.	is designed to assess behaviours associated with weight loss and weight management.		activity. There was a 4:1 positive to negative response regarding how participants felt about their mobile health apps. Participants noted feelings of obsession with their exercise and food intake, anxiety/guilt when exercise or food intake goals were not met, interference with daily activities and/or social life, and neurosis about body image.	
13	Simpson, C. C. & Mazzeo, S. E. (2017)	Calorie counting and fitness tracking technology: Associations with eating	Participants: n=493, female (n=345) and male (n=148) undergraduate students.	Cross-sectional survey. Participants reported their demographics, use of tracking technology and completed	MyFitnessPal, Fitbit used for unknown period of time.	Individuals who reported using calorie trackers manifested higher levels of eating concern and dietary	Strengths: Large, diverse sample of young adults who are most likely to use health tracking applications and are

		<p>disorder symptomatology</p>	<p>Recruited from: public university in the mid-Atlantic United States.</p>	<p>measures of eating disorder symptomatology, measured by the Eating Disorder Examination-Questionnaire. Participants indicated (yes/no) whether they used a calorie tracking device and fitness tracking device regularly. (N = 68; 13.8%) of the sample regularly used a calorie tracking device; 64.7% of these individuals also endorsed using a fitness tracking device. Nearly one-fifth (N = 98; 19.6%) of the sample regularly used a fitness tracking device; 44.9% of these</p>		<p>restraint, controlling for BMI. Additionally, fitness tracking was uniquely associated with eating disorder symptomatology after adjusting for gender and bingeing and purging behaviour within the past month. Shape concern and weight concern did not differ between groups. Hierarchical multiple regression analysis revealed that use of fitness tracking devices uniquely accounted for eating disorder symptomatology.</p>	<p>at heightened risk for eating disorder symptomatology. Limitations: Participants were recruited from an undergraduate psychology participant pool and reimbursed with course credit. Cross-sectional design. No information on duration of device/app use, 'regular' use was not defined.</p>
--	--	--------------------------------	---	--	--	---	--

				individuals also endorsed using a calorie tracking device.			
--	--	--	--	--	--	--	--

1.10 Assessing Study Quality

The quality of studies included in the review was evaluated using four method-specific quality appraisal tools.

The four qualitative studies were appraised using the “Big-Tent” Criteria for Excellent Qualitative Research (Tracy, 2010). Due to the range of approaches used (e.g. semi-structured individual interviews and workshops), it was important to use an appraisal framework that conceptualises different qualitative methodological paradigms (Tracy & Hinrich, 2017).

Of the eight quantitative studies, the two RCTs were appraised using the Critical Appraisal Skills Programme (CASP) Checklist for Randomised Controlled Trials (CASP, 2020) and the six cross-sectional survey studies were appraised using the Appraisal tool for Cross-Sectional Studies (AXIS) (Downes et al., 2016).

The mixed methods study was appraised using the Mixed-Methods Appraisal Tool (MMAT) (Hong et al., 2018). The MMAT criteria for qualitative and quantitative studies are less comprehensive than other method specific criteria, however the MMAT was used to evaluate both arms of the study and combine these in one overall evaluation. The quality appraisal frameworks used to evaluate each study are included in Appendix D.

No papers were considered poor quality such that findings should be considered with caution. The detail of the appraisal tools alongside the researcher’s subjectivity of ratings meant that some studies partially met criteria, justified by the researcher where necessary, and most quantitative studies received at least one ‘Not Stated’ response, where details were not document in the paper.

1.10.1 Included Study Aims

All studies contributed in a meaningful way to the knowledge base. Authors provided clear research aims and situated their research within relevant literature to identify the research gap. Research aims included exploring experiences of health-tracking technologies in university students (Hahn et al., 2021b; Hahn et al., 2021a; Hahn et al., 2021; Sarcona et al., 2017; Simpson & Mazzeo, 2017), investigating experiences, goal achievement or eating pathology in adults who were existing health-tracking technology users (Bracken & Waite, 2020; Didžiokaitė et al., 2018; Honary et al., 2019; Lieffers et al., 2018; Linardon & Messer, 2019; Plateau et al., 2018), examining the experiences of Fitbit self-tracking (Gittus et al., 2020) and determining the social, economic and cultural conditions under which adults were more likely to use self-tracking apps (Régnier & Chauvel 2018).

1.10.2 Study Countries

Studies were all from the Western world, with studies conducted in the USA (Bracken & Waite, 2020; Hahn et al., 2021b; Hahn et al., 2021a; Hahn et al., 2021; Sarcona et al., 2017; Simpson & Mazzeo, 2017), in the UK (Didžiokaitė et al., 2018; Honary et al., 2019; Plateau et al., 2018), in Australia (Gittus et al., 2020; Linardon & Messer, 2019), in France (Régnier & Chauvel 2018) and in Canada (Lieffers et al., 2018). The dominance of the West may be overshadowing cultural differences in eating behaviours and health-tracking technology use across the globe, as technology is rarely designed in a neutral absence of any cultural influences. For example, Lu, Chen and Epstein (2021) found that Chinese food journaling apps use persuasive design principles to promote thinness, an ideology heavily influenced by cultural norms, whereas Western counterparts were considered to prioritize health and not centre body image as directly.

1.10.3 Study Samples

Sample sizes ranged from 20 to 79 interview participants, from 95 to 647 cross-sectional survey participants and from 200 to 262 RCT participants. Some studies detailed limited information on participant demographics (e.g. Lieffers et al., 2018). Sarcona et al (2017) recruited survey participants by offering healthy snacks in a busy area of campus, however students motivated by healthy snacks may hold certain views about health and diet. Similarly, Simpson and Mazzeo (2017) recruited psychology undergraduates and compensated participants with course credit, therefore participants may have been motivated by compensation rather than expressing their experiences.

Two studies recruited only females (Hahn et al., 2021b; Hahn et al., 2021a) and one recruited only males (Linardon & Messer, 2019). Considering Hahn et al (2021) identified gender-specific patterns of health-tracking technology use, further studies focusing on male samples would be valuable within the literature, particularly as psychometric properties of some eating scales have not yet been validated in male samples (Linardon & Messer, 2019).

1.10.4 Data Collection

Lieffers and colleagues (2018) conducted interviews in public locations, such as coffee shops, which may have impacted participants' level of disclosure. Of the ten studies on existing health-tracking technology users, only one collected self-reported data on frequency and duration of technology use (Bracken and Waite, 2020). Lieffers et al (2018) collected data on duration of use, two studies explored frequency of use (Plateau et al., 2018; Régnier & Chauvel, 2018), and Simpson and Mazzeo (2017) specified 'regular' use however this was not defined. The remaining five studies defined health-tracking technology users as those with 'current or past use' which likely encompassed a wide range

of user engagement (Didžiokaitė et al., 2018; Hahn et al., 2021; Honary et al., 2019; Linardon & Messer, 2019; Sarcona et al., 2017).

1.10.5 Findings and Analysis

All studies use quotes (qualitative studies) and discussions (quantitative studies) to illustrate the data. Didžiokaitė and colleagues' (2018) paper merged the findings and discussion sections and referred to their findings in the literature review, which made navigation of the paper difficult. Additionally, they did not offer reflections on study limitations. Only two papers offered the researcher's relationship to the research topic, providing sincerity and transparency, but without mention of epistemological or ontological position. (Lieffers et al., 2018; Régnier & Chauvel, 2018).

1.11 Synthesis Strategy

The review synthesises the 13 papers' findings using guidance from Siddaway et al (2019). Following familiarisation with the papers, the researcher noted prominent or recurring themes to interpret and construct patterns of meaning specific to the experiences of health-tracking technology users. Following further review of the papers, the researcher identified central and recurring concepts which were grouped into the following categories discussed below:

- Motivators and Barriers to Use
- The Process of Logging Food
- Data as the Most Valuable Entity
- Disordered Eating and Compulsive Exercise
- Goal Achievement and Positive Self-Appraisal

1.12 Synthesis of Findings

1.12.1 Motivators and Barriers to Use

Where participants were already health-tracking technology users, some studies referenced participants' reported reasons for initiating use.

The majority of Didžiokaitė and colleagues' (2018) sample of 31 adults, recruited from social media and gyms, reported using MyFitnessPal for dieting. Some participants used the app to improve fitness and some were personal trainers who also used the app in their work. In Honary and colleagues' (2019) sample of 106 survey participants recruited through social media, the most common reasons for health-tracking technology use were calorie-tracking (31%), weight loss (20%) and exercise (21%). Lieffers et al's (2018) sample of 24 participants, recruited through social media, were mostly interested in weight loss or maintenance, however two were interested in weight gain. For Plateau et al's (2018) sample of 352 university students, those using activity-tracking devices reported this was for either health and wellbeing, weight and shape reasons, or sporting goals. Of those using food-tracking devices, 30% reported doing so for health-related reasons and 70% reported doing so to manage weight and shape. Overall, it appears that dieting, weight loss or appearance concerns were the most popular motivators for users to initiate use of health-tracking technologies, followed by exercise, fitness and sport performance goals (Didžiokaitė et al., 2018; Honary et al., 2019; Lieffers et al., 2018; Plateau et al., 2018). Individuals who are pursuing weight loss, and therefore aiming to alter dietary habits, may seek out health-tracking technologies to help them achieve their diet goals. Moreover, Plateau et al's (2018)

analysis of the type of app and associated motivators suggests that individual goals may influence the type of app chosen (activity-tracking or food-tracking).

Régnier and Chauvel (2018) investigated motivators for use via exploration of the social, economic and cultural conditions in which individuals in France were more likely to use health-tracking technologies. In their sample of 79 adults aged 23-70, they identified three clusters of users. The first cluster ('Resistant') encompassed individuals who monitored dietary intake or physical activity but with little enthusiasm and therefore recorded very little on the apps. Most of these users were Weight Watchers members and former MyFitnessPal users living in deprived areas whose app use was temporary because of disinterest or reaching their weight goal. The second cluster ('For self-improvement') consisted largely of sport app and MyFitnessPal users who valued quantifying themselves and measuring progress. The third cluster ('For sharing') encompassed users who actively engaged with the digital community, published their data, had online followers, and who tended to be professionals in their 40s. This study highlighted contextual factors associated with health-tracking technology use and motivators, in that individuals from affluent social milieus were most likely to use apps with a preventative approach to healthy living, whereas individuals from lower milieus were more reluctant to use health-tracking technologies and often used apps for weight loss purposes. Clearly, individual financial circumstances influence the technology available to the user, be it costly sport performance devices or free food-tracking apps, as well as potentially the quality and variety of food options available to the user.

Several papers identified that use of health-tracking technologies was often temporary, as opposed to an expansive goal of continuous self-tracking. Didžiokaitė et al (2018) reported that their interviewees often reported implementing a specific, time-limited

goal. This was typically losing weight to look better, and participants reported terminating app use upon goal accomplishment. Similarly, Régnier and Chauvel (2018) found that MyFitnessPal users, who were typically aiming for a slimmer physique, used the app for short periods of time, ranging from several weeks to several months, possibly several times a year. Authors did not report whether use stopped with goal achievement, or if participants stopped using the app before the goal was reached. Although interviewees in Lieffers et al's (2018) study also reported intermittent use of health-tracking technologies, some participants reported persistent use, for up to four years. However, authors did not report participants' rationale for long-term use.

Barriers to continued health-tracking technology use were mentioned in three papers (Honary et al., 2019; Lieffers et al., 2018; Régnier & Chauvel, 2018). Honary et al (2019) highlighted that both online survey and workshop participants reported discontinuing app use because logging data was burdensome and time-consuming. Similar views were shared in a different study by interviewees (Lieffers et al., 2018). In contrast, interviewees in Régnier and Chauvel's (2018) study expressed that recording food was seen as a way to make time for oneself outside domestic or professional obligations. Unfortunately, authors did not report from which aforementioned cluster of users these opinions were expressed.

Overall, the reviewed literature suggests that the most common motivators for initiating use of health-tracking technologies were managing weight and shape via self-monitoring of dietary intake. For those using activity-tracking apps, fitness and sport performance goals were more likely. It may be that users of activity-tracking devices that are costly, such as Garmin watches, have the financial resources to not only purchase the

device, but also have the means to consume a higher-quality, varied diet in a preventative approach to health and fitness.

1.12.2 The Process of Logging Food

The literature outlined several aspects associated with technology use that appeared to impact users' eating habits, due to the practicalities of logging their dietary intake.

Hahn et al (2021b) reported that almost all 18 interview participants shared that dietary self-monitoring made them more aware of their food choices, in terms of the type of foods they were and were not eating. Consequently, participants spent more time thinking about food. Self-monitoring was also associated with increased reflection on dietary behaviours which encouraged 'improvements' (Lieffers et al., 2018) as well as users perceiving food items differently, in terms of calorific content (Didžiokaitė et al., 2018). Interestingly, the process of logging home-cooked meals with multiple ingredients encouraged some users to gravitate towards readymade food as this could be logged quickly using the barcode scanner (Honary et al., 2019). This inclination was also voiced by participants in Lieffers et al's (2018) study. Their sample also shared challenges associated with quantifying portion sizes which led to several participants buying weighing scales to accurately log portion sizes.

It therefore appears that the process of logging food can encourage users to actively engage with eating habits, including identifying gaps in dietary intake, at least in the short-term. For some, logging food data was associated with viewing foods as their calorific content and prioritising ease of logging, via use of ready meals, over nutritional content. For others, it seems that logging food encourages precision, with users starting to weigh food to accurately input data.

1.12.3 Data as the Most Valuable Entity

A number of papers hinted at participants' attitudes towards data collection or value placed on the data.

Two papers identified a perspective that data gave an activity its value. A proportion of Régnier and Chauvel's (2018) interviewees stated that when their activity-tracker did not record an activity, it was as though the activity never happened. In this way, the benefits of physical activity were deemed redundant without data to evidence its completion. A similar view was expressed by several male interviewees in a different study, explaining that if their steps were not documented it felt as though they had not happened (Honary et al., 2019). In the same study, two female interviewees described occasions of cheating the technology by not logging 'bad' foods, presumably to not tarnish their food intake records. Such an approach implies that participants offered more value to their data profiles than their own experience of exercise or food consumption.

Several papers identified participants who used more than one type of health-tracking technology concurrently. Hahn et al. (2021b) recruited 20 female participants to use MyFitnessPal for one month and found that participants voluntarily began other types of self-monitoring, including tracking exercise and water intake. Two further studies found that participants often used more than one type of health-tracking technology (Hahn et al., 2021; Sarcona et al., 2017) and Simpson and Mazzeo (2017) found a positive correlation between use of calorie-tracking and fitness-tracking in their sample of 493 undergraduate students. Overall, it appears that a proportion of health-tracking technology users afford high value to the appearance of their data profile, with perhaps the record of the activity or food intake offering a greater sense of achievement than the action itself. Moreover, the

initiation of self-monitoring may encourage users to collect data on a wider range of behaviours.

1.12.4 Disordered Eating and Compulsive Exercise

Over half the studies highlighted negative outcomes of health-tracking technology use, including disordered eating and compulsive exercise.

Negative outcomes may be triggered by a perception of health-tracking technology as authoritative. Two studies noted that participants followed the calorie limit offered by the technology without question (Didžiokaitė et al., 2018; Lieffers et al., 2018), with only some interviewees noting that food-tracking apps often do not account for individual needs, such as breastfeeding or specific dietary requirements. Another potential risk factor is a desire to keep data private. Interviewees reported worries about receiving reminders from apps at inappropriate times, not wanting others to see notifications or not feeling comfortable entering data around others (Honary et al., 2019; Lieffers et al., 2018). As engagement with mobile phone apps is largely private, this was viewed as a risk factor for intensifying negative, isolating behaviours.

The literature identified a range of negative feelings associated with self-monitoring. Following one month of MyFitnessPal use, almost half of Hahn et al's (2021b) sample of 20 women reported increased self-consciousness around food choices, about body shape and weight, or guilt and worry. Similarly, almost half of 95 survey participants indicated they had experienced guilt, because of the persuasive nature of apps, social isolation due to personal regimens around diet and fitness goals, and feelings of being controlled by the app (Honary et al., 2019). Males in particular discussed feelings of disappointment and failure when not achieving their goals. Interestingly, only female participants interviewed by Lieffers et al

(2018) shared that use of health-tracking technologies could be “addictive” and “overcome life” to promote an unhealthy obsession with calories, food and weight.

In relation to disordered eating behaviours, Hahn et al (2021) found that female and male undergraduate students who reported using all forms of weight-related self-monitoring, defined as use of a wearable fitness tracker, online food journal and weight tracking, were more likely to report fasting, skipping meals and excessively exercising. However, males who only used activity-tracking did not have increased likelihood of disordered eating behaviours. Their findings suggest that use of food-tracking or multiple health-tracking technologies increases the likelihood of disordered eating behaviours. In contrast, in their online survey of undergraduate students, Simpson and Mazzeo (2017) found that activity-tracking, but not calorie-tracking, uniquely accounted for eating disorder symptomology after adjusting for gender and bingeing and purging behaviour within the past month. Individuals who used calorie-trackers also manifested higher levels of eating concern and dietary restraint than non-users. They concluded that activity-tracking may be a mechanism for promoting exercise for appearance rather than health reasons.

Linardon and Messer (2019) found almost 40% of their male survey participants perceived MyFitnessPal as a factor contributing to eating disorder symptoms. MyFitnessPal users also reported significantly higher levels of attitudinal (dichotomous thinking, shape, weight, and eating concerns) and behavioural (binge eating, dietary restraint) eating disorder symptoms than non-users. Users reported significantly higher scores on the Eating Disorder Examination Questionnaire (EDE-Q; Fairburn & Beglin, 1994), objective binge-eating frequencies and the Dichotomous Thinking in Eating Disorder Scale (DTES; Byrne, Allen, Dove, Watt, & Nathan, 2008) than non-users. Higher scores on the EDE-Q for health-tracking technology users was also observed in other papers (Plateau et al., 2018).

Lastly, compulsive exercise was also associated with health-tracking technology use (Gittus et al., 2020; Honary et al., 2019; Plateau et al., 2018). In their online survey of university students, Plateau et al (2018) found that health-tracking technology users reported significantly higher scores on the Compulsive Exercise Test (CET; Taranis, Touyz, & Meyer, 2011), indicating higher levels of compulsive exercise. Positive associations were detected between the frequency of activity-tracking and CET scores. Additionally, participants who reported using self-monitoring to manage weight and shape reported higher levels of eating and compulsive exercise psychopathology than those who reported using self-monitoring to improve health and fitness. Similarly, Gittus et al (2020) observed that participants in the Fitbit intervention group reported more exercise for appearance-related reasons than control participants, although these effects were nonsignificant. Finally, Honary et al's (2019) interviewees shared how activity goals offered by apps, such as hitting 10,000 steps a day, can overshadow intrinsic motivation for exercise, leading to completion of activity goals for data purposes rather than health benefits of exercise.

Overall, use of health-tracking technologies has been associated with a variety of maladaptive behaviours. Perceiving the technology as authoritative appears to influence acceptance of pre-set food and activity goals without question and focus on completion of goals as opposed to mindful engagement with eating or exercise to increase wellbeing. The ability to keep data private on a personal device may also serve as a risk factor for disordered eating and exercise regimes, particularly when the user withdraws from social situations that include food. Although research suggests that individual motivations for use, such as fitness or shape concerns, and type of health-tracking technology used, such as activity-tracking or calorie-tracking, impact the likelihood of negative outcomes, the findings offer contradictory conclusions. However, the prevalence of negative feelings, disordered

eating behaviours and compulsive exercise appears to be common within the literature when it is measured.

1.12.5 Goal Achievement and Positive Self-Appraisal

Several studies found that participants reported positive experiences of health-tracking technologies, with their experiences perhaps aligning more closely with the app or device developers intended aims.

In their cross-sectional survey study, Bracken and Waite (2020) found that greater MyFitnessPal use was positively associated with self-reported nutrition goal achievement, particularly for individuals with lower self-efficacy for healthy eating. This suggests that MyFitnessPal was a helpful tool for individuals who might otherwise feel unlikely to achieve their goals. Likewise, use of apps was reported by participants to be the reason behind goal achievement or progress regarding weight management and healthy eating (Honary et al., 2019; Lieffers et al., 2018; Plateau et al., 2018).

In addition to goal achievement, use of health-tracking technologies was associated with positive emotions, with participants reporting feeling physically and emotionally better on days when they stayed within the daily calorie recommendations (Hahn et al., 2021b). Similarly, some individuals reported that although the apps prompted obsessive exercise behaviours, they appreciated the push to do exercise even when tired (Honary et al., 2019). Sarcona and colleagues (2017) found that health-tracking technology use was related to participants feeling better about themselves, feeling like an athlete and motivating others to participate in physical activity and weight loss. App users also reported higher scores on the Eating Behaviour Inventory (O'neil & Rieder, 2005) than non-users, with higher scores indicating positive eating behaviours. Therefore, whilst health-tracking technologies can

positively impact eating behaviours, as measured by a standardised questionnaire, positive emotions elicited by app use are typically based on compliance with pre-set targets, which calls into question the apparent benefits of users persistently pursuing such targets.

However, two papers found that whilst health-tracking technology use did not have a markedly positive impact on eating behaviours, it also did not negatively impact eating behaviours. In their RCT of 262 women, Gittus et al (2020) found that participants wearing a Fitbit for ten days did not show any elevations in exercise engagement, motivations for exercise, state body satisfaction or disordered eating symptoms compared to the control group. Hahn et al's (2021a) RCT of 200 women found that MyFitnessPal use for one month did not change participants' likelihood of fasting, compulsive exercising, binge eating or food restriction. The intervention also did not affect secondary mental health outcomes including anxiety, depressive symptoms, body image or quality of life.

In general, the literature suggests that health-tracking technologies can assist users in achieving their health goals which is often linked to increased positive emotions and self-appraisal. However, in some cases this positive self-appraisal appears to be closely linked with daily goal achievement, rather than a shift in self-efficacy or wellbeing. That being said, research also suggests that health-tracking technology use can have a neutral impact on the individual, with neither positive nor negative outcomes as a result of self-monitoring.

1.13 Conclusions of Systematic Literature Review

This systematic review on experiences of health-tracking technologies in relation to users' relationship with food and eating identified 13 research studies. Of note, the review was limited to English language papers only using the specified databases; further research may be available in other languages and databases.

Overall, the reviewed literature suggests that the most common motivators for initiating use of health-tracking technologies are managing weight and shape. This occurs through use of calorie-tracking and activity-tracking, with fitness goals the second most common motivator. The literature is inconclusive in relation to motivating factors influencing app selection, particularly as the creation of a self-monitoring record appears to encourage some users to engage in additional self-monitoring to collect data on a wider range of behaviours. Financial context also understandably influences the choice of health-tracking technology, as food-tracking apps are often free whereas fitness-tracking devices can be costly. Relatedly, the primary motivator of managing weight and shape may be a preventative approach to health, aging or illness or it may be a reactive response to weight gain.

Several reviewed studies highlighted that practical aspects of self-tracking can influence the individual's eating habits. It appears that the process of logging foods can encourage individuals to pursue accuracy and efficiency, either through weighing food or choosing readymade meals that are quicker to input. Such an approach implies a focus on the calorific content, as highlighted by the app, rather than nutritional content. Similarly, the literature suggests that a proportion of health-tracking technology users afford high value to the maintenance of their self-tracking records, with a focus on total calories consumed or activity levels, which can encourage compulsive exercise rather than enjoyable movement.

Lastly, a significant proportion of the studies identified a range of unhelpful experiences associated with health-tracking technology use, at times associated with viewing the technology as an authoritative presence that states goals must be consistently achieved. The research offers contradictory conclusions regarding the influence of individual

motivators and app choice on maladaptive behaviours, but the prevalence of negative feelings, disordered eating and compulsive exercise appears to be common amongst users. However, there does appear to be a group of individuals for whom health-tracking technologies can have a positive influence on health, wellbeing and goal achievement, with users reporting positive experiences of technology use.

1.14 Rationale for the Current Study

This study aims to explore users' experiences of the FSL in relation to their relationship with food and eating behaviours. As previously emphasised, there is a paucity of research on the psychological impact of FSL use, specifically with regards to its impact on eating behaviours and relationship with food. This is an important gap to fill in the literature for several reasons.

Firstly, the National Institute for Health and Care Excellence (NICE) recommends that people with diabetes require eight annual basic health checks, but 57% of people with T1DM do not receive all eight each year (NHS Digital, 2018). In the absence of regular health checks, new self-management issues can arise when using new equipment. Typically, patients prescribed the FSL have a two-week trial followed by a review 6-12 months later, therefore there is ample time for maladaptive habits to develop. This could include excessive scanning, over-correction with bolus insulin and scan fatigue, which are issues previously identified as requiring further research (Whitehouse et al., 2020).

Secondly, the literature review highlighted that initiation of self-tracking using a device or app can lead to novel eating habits. Sometimes such novel habits appear to be helpful through promoting self-reflection on food intake and gaps in nutrition, however increased self-awareness seems to prompt some individuals to adopt rigid approaches to

food intake, including disordered eating behaviours. The introduction of detailed data regarding dietary consumption and activity levels has also been associated with an unhelpful focus on numbers as opposed to mindful engagement with food and enjoyable activity. The precision offered by many apps also conveys an unrealistic approach to human functioning, with the possibility of measuring portions to the gram and exercise represented as exact calorie equivalents.

Thirdly, the FSL generates a 24-hour graph of BG levels, plotted every 15 minutes, with shaded areas showing the boundaries of the ideal range, which can be an overwhelming amount of data to have at one's fingertips. The visual representation of BG levels over time may cause a sense of failure when the level inevitably falls outside the target 'green' range. The FSL also includes trend arrows that indicate if BG levels are stable, falling or rising and how fast they are doing so. There is evidence to suggest that trend arrows can influence decision making more than actual glucose values, causing people to overreact with hypoglycaemic avoidance strategies, leading to hyperglycaemic incidents (Overend et al., 2019).

Fourthly, current standardised diabetes questionnaires typically do not include detailed questions about relationship to food, eating behaviours, scanning habits or beliefs about the data. As questionnaires are often used to scaffold discussions during clinical reviews, this topic may not be consistently explored. Therefore, there is a need to explore these areas with patients using the FSL to gain further understanding of their experiences and areas of concern that are currently being missed by diabetes clinicians.

Lastly, as previously mentioned, some individuals with diabetes are at increased risk of developing disordered eating behaviours. The current study may help to identify potential risk factors and protective factors related to unhelpful eating behaviours following

FSL use, which may assist clinicians in their assessments of patient suitability for the device or when additional support may be required.

1.15 Aims for Current Study

Following on from the rationale outlined above, the aims and research questions for the current study are:

Aims

- To gain a better understanding of how the FreeStyle Libre might influence users' relationship with food and eating.
- To consider how FreeStyle Libre users' relationship with food and eating is currently being explored using standardised questionnaires in clinical practice.

Research Questions

- What are users' experiences of the FreeStyle Libre in relation to food and eating behaviours?
- How does the standardised questionnaire used in clinic facilitate exploration of users' relationship with food and eating?

2. Methodology

2.1 Overview

This chapter details the mixed methodology used in this study. Firstly, it details the qualitative methodology used to explore the impact of the FSL on users' eating behaviour and relationship with food. A rationale for selecting reflexive thematic analysis is provided along with information regarding participant recruitment and the interview process.

Secondly, it details the quantitative methodology used to investigate how the Problem Areas in Diabetes questionnaire (PAID; Polonsky et al., 1995), a measure of diabetes-related distress, facilitates exploration of users' relationship with food and eating. Further information is provided on the ethical considerations and quality appraisal for this study.

2.2 Design

The study utilised a sequential mixed methods design, with the primary qualitative aspect informing the secondary quantitative aspect. The qualitative aspect of the study included individual, semi-structured interviews with participants to explore their experiences of the FSL in relation to its impact on their relationship with food and eating. The quantitative aspect analysed routine questionnaire data collected by the Adult Diabetes Service before patients begin using the FSL and again six months later. The researcher's reflections and evaluation of the questionnaire are then offered in light of the qualitative analysis.

2.2.1 Epistemology and Positionality

As mentioned in Chapter 1, the current study is situated within a critical realist epistemology. I aim to understand, rather than merely describe, FSL users' experiences. Such experiences occur amongst broader contextual factors that can influence how

participants make sense of their relationship with food. Therefore, participants' language is conceptualised as reflecting their contextually situated, constantly changing realities. A qualitative approach is adopted to capture participants' language, to enable in-depth exploration of experiences. As critical realism recognises that knowledge is a subjective, discursively bound social construction, a qualitative methodology that utilises researcher subjectivity was deemed most appropriate. Therefore, reflexive thematic analysis (TA; Braun & Clarke, 2006, 2013, 2019) was used to interpret participant interview transcripts. In reflexive TA, researcher subjectivity is not considered an issue to be neutralised but a resource for research as the researcher actively adopts a values-aware stance (Gough & Madill, 2012). The use of qualitative data to then aid evaluation of the PAID questionnaire allows reflection on the multiple 'realities' of FSL users captured by various methods in clinical care.

My critical realist stance suggests the lens used to view participants' accounts shapes the interpretation of the reality each participant describes. As a person without diabetes, I was conscious that participants might view me as an outsider. This could be advantageous if I were interpreted as someone who could not critique their diabetes management, so would encourage honest sharing without fear of judgement. Additionally, this would acknowledge that people with T1DM are indeed often 'expert patients' (Allen, 2017). Conversely, my outsider researcher position could be a disadvantage if my lack of lived experience prevented prompts for insightful follow-up questions or if participants felt obliged to share at a descriptive, surface level without the assumption of a shared understanding. Occupying an outsider position in relation to participants means that my assumptions, values and understanding have an impact on my interpretations of participants' accounts, which encourages me to think reflexively throughout the research process.

2.2.2 Rationale for a Mixed Methods Approach

Qualitative

As described in Chapter 1, the body of research concerning users' experiences of the FSL in relation to food and eating is limited. Generally, the FSL literature has largely focused on its accuracy in replacing finger-prick testing and improving glycaemic control (Dover et al., 2017; Gleeson et al., 2019). Standardized measures are often used in health research to offer quantifiable data to clinicians, such as reduced HbA1c or percentage time in range, however measures such as these do not capture patients' experiences. Therefore, using a methodology that enables interaction with FSL users to explore their experiences of such processes offers a valuable contribution to the knowledge base.

Quantitative

As previously mentioned, research and clinical practice often involve the use of standardized outcome measures to measure change over time, or to assess clinical need. Investigating PAID questionnaire data that is routinely collected by the service offers an insight into how patient experiences are quantified. Analysis of questionnaire data collected before FSL use and at six-month review will offer insight into how the FSL might impact areas of diabetes-related distress covered by the measure.

Questionnaire data is often positioned within a positivist approach that frames the data as an objective truth and positions the researcher as an objective observer. However, investigating questionnaire data in light of qualitative data can highlight what is represented and what is missing regarding the complexities of patient experiences.

2.2.3 Expert by Experience Consultation

Experts by Experience were recruited from the North Bedfordshire Adult Diabetes Service. An advertisement poster was shared with patients via the principal supervisor, Dr Jen Heath, who discussed the research with several appropriate individuals. Three individuals expressed an interest and their email addresses were shared, with consent, with the researcher. The researcher contacted the Experts by Experience to arrange initial meetings via videocall or telephone to offer more information about the research proposal and discuss their preferred areas of consultation. Table 5 shows the identified and suggested tasks.

Table 5

Identified Tasks for Expert by Experience Consultation

Research Stage	Task
Methodology	<ul style="list-style-type: none"> • Helping to construct the interview schedule • Reviewing the interview schedule or assisting with a pilot interview • Reviewing the Participant Information Sheet • Reviewing the Consent Form • Reviewing the Study Advertisement Poster
Analysis	<ul style="list-style-type: none"> • Discussion of coding style to facilitate researcher reflexivity • Reviewing the construction of themes • Reviewing the Problem Areas in Diabetes questionnaire
Discussion	<ul style="list-style-type: none"> • Assisting with recommendations for service development
Dissemination	<ul style="list-style-type: none"> • Assisting with accessible dissemination outside academic journal articles

Qualitative Methodology

2.3 Why Reflexive Thematic Analysis?

Reflexive TA (Braun & Clarke, 2006, 2013, 2019) was considered alongside other qualitative approaches in terms of the nature of the approach in comparison to the research question and study aims, as summarised in Table 6.

Table 6

Rationale for Reflexive TA

Qualitative Methodology	Description	Reason for Rejection
Grounded Theory (Charmaz, 2014; Glaser, 1992; Strauss & Corbin, 1990)	<ul style="list-style-type: none"> • Theoretically informed • Focus on social processes, and the factors that influence, underpin and shape particular phenomena (Charmaz, 2014). • Output is typically core concept/ category. 	Research study does not intend to develop a grounded theory or model from the data set and analysis.
Content Analysis (e.g. Hsieh & Shannon, 2005)	<ul style="list-style-type: none"> • Theoretically flexible • Classifies text into categories • Often uses codebook or coding frame • Uses quality measures like calculating inter-coder agreement • More descriptive than interpretative 	Exploratory nature of study calls for deeper understanding of participant experiences, rather than surface-level description or focus on frequency of 'content'.

Interpretative Phenomenological Analysis (Smith et al., 2009)	<ul style="list-style-type: none"> • Theoretically informed (Phenomenology) • Research question focusing on personal experience • Small, homogenous sample • Dual analytic focus on thematic orientation and idiographic approach 	Exploratory nature of study calls for focus on themes across participants rather than analysis of unique details of each case, particularly considering complexity in T1DM diagnosis and management journey. Research question also focuses on how personal experiences are located within wider socio-cultural contexts (Braun & Clarke, 2021).
---	---	--

Reflexive TA was selected as a preferable approach because the method was deemed a best fit for the study's purpose, theoretical assumptions and research question. Reflexive TA involves themes developed from codes, with theme development requiring considerable analytic and interpretative work by the researcher. TA accommodates inductive (bottom-up) and deductive (top-down) approaches to developing and understanding themes, with the rationale that such positions exist on a continuum rather than a dichotomy. Therefore, as it is not possible to adopt a purely inductive approach within a theoretical vacuum (Braun & Clarke, 2020), I chose to analyse from a primarily inductive position where the themes are strongly grounded in the data. Data was coded on both a manifest (surface) level and latent (underlying meaning) level, as I aimed to interpret underlying patterns of meaning in participants' language, but in the context of diabetes care it was also appropriate to code

some language at face-value. A pre-existing coding template was not used as this is an exploratory study into an under-researched area.

2.4 Participants

2.4.1 Participant Criteria

Participants were patients from the North Bedfordshire Adult Diabetes Service with a diagnosis of T1DM. Participants had to have been prescribed the FSL for at least 12 months and therefore were likely to have settled into their own regime with the device. They needed to be able to consent to participate in the study and be able to converse in English, allowing for reasonable adjustments if necessary. Table 7 shows the participant inclusion criteria.

Table 7

Participant Inclusion Criteria

Inclusion Criteria
<ul style="list-style-type: none">• Over the age of 19• English speaking• Under the care of North Bedfordshire Adult Diabetes Service• Diagnosis of Type 1 Diabetes• Prescribed and used the FreeStyle Libre for at least 12 months

2.4.2 Recruitment

Recruitment took place via email advertisement and dissemination of study information via contact with the diabetes team. As clinics and outpatient appointments were either

cancelled or online due to the Covid-19 pandemic, no face-to-face recruitment was conducted.

The North Bedfordshire Adult Diabetes Service maintains a database of patients who are prescribed the FSL. Dr Jen Heath (Principal Supervisor and Senior Clinical Psychologist) worked in the service during the recruitment stage, therefore accessed this database to identify patients who had a documented email address and had been prescribed the FSL for at least 12 months. Email contact was chosen over mailing study invitations to reduce burden for the administration team. Email contact also enabled participants to return the Expression of Interest form quickly and easily, rather than posting a paper form back to the research team. Signing up the FSL app requires an email address, however clinicians in the diabetes team reported that some older patients offer their adult child's email addresses, therefore email contact may have excluded individuals with limited email access.

The study advertisement email was sent to 245 patients on 28th September 2021. The email included the study poster, the Participant Information Sheet and an Expression of Interest form (see Appendix E-G). A total of thirty patients responded with an Expression of Interest Form sent to the researcher's university email address within two weeks, all of whom were offered a phone call to ask any questions about the research or their role but no individuals requested this. Fourteen patients stopped replying to emails to organise an interview and 16 patients consented to an individual interview. As stated in the Participant Information Sheet, the recruitment process aimed to include a diverse sample as possible. The majority of patients who expressed an interest were White British and above 50 years old, therefore two patients who stated an ethnicity other than White British on their Expression of Interest form were prioritised, as were two younger patients in their 20s or 30s. Therefore, the last White British patient in their 60s to express an interest was

unfortunately not included in the study sample and received an email to reiterate this process of recruitment and thank them for their interest. When all interviews were complete, the 14 patients who had not responded to emails received an email to inform them that recruitment was complete and to thank them for their initial interest.

The method of recruitment used was effective in recruiting the desired number of participants who met the inclusion criteria. The aim was to recruit 15 participants based on the use of reflexive TA, the time limits and budgets of the project and the size of the research team. It has previously been recommended that qualitative studies require a minimum sample size of 12 to reach data saturation (Clarke & Braun, 2013; Guest, Bunce, & Johnson, 2006; Vasileiou, Barnett, Thorpe, & Young, 2018). However, the concept of data saturation in qualitative research is not universally applicable or theoretically neutral (Levitt et al., 2018). Varpio and colleagues (2017) highlight that unless data collection and analysis are conducted concurrently in iterative cycles, it is not possible to use saturation as an endpoint. Moreover, most research proposals require researchers to state the required sample size when securing ethical approval, thus describing the amount of data required to achieve saturation before commencing a study is essentially guesswork. Malterud and colleagues (2016) propose that sample sizes for qualitative studies depend on several key dimensions including the study aim, with narrow aims requiring fewer participants, and sample specificity, with studies that require a highly specific type of participant needing fewer participants. The current study used purposive sampling to deliberately seek 'information rich' participants (Patton, 2015) that have the potential to maximise understanding of the phenomena under investigation. With the caveat that reflexive TA is concerned with generating meaning through interpretation of data, rather than meaning being objectively extracted from data, the concept of data saturation and a specific

requirement for the number of participants cannot be determined in advance of analysis (Braun & Clarke, 2021).

2.4.3 Participant Demographics

Table 8 displays demographic information for the 15 interview participants. Occupation, education level or age at diagnosis of T1DM was not collected as the study's aims were to explore the impact of the FSL, rather than impact of demographic factors, on users' relationship to food and eating.

Table 8

Participant Demographic Information

Pseudonym	Age	Gender	Ethnicity
Bluebell	24	Female	White British
Sarah	26	Female	White British
Becky	30	Female	White British
Hayley	34	Female	White British
Madonna	42	Female	White British
Aisling	49	Female	White Irish
Katie	51	Female	White British
Dove	53	Female	White British
Hank	55	Male	White European
Mickey	58	Male	White British
Harrison	59	Male	Black Caribbean
Peter	61	Male	White British
Greg	63	Male	White British
Lottie	64	Female	White British
Sharon	66	Female	White British

2.4.4 Interview Modality

Individual semi-structured interviews were used to collect qualitative data. A semi-structured format offers flexibility in how the interview schedule is designed and conducted. The flexibility of this approach also provides a degree of freedom for interviewees to explain their thoughts and highlight areas of interest, and for the interviewer to explore certain responses in greater depth, including to elicit and resolve apparent contradictions (Horton, Macve, & Struyven, 2004).

Due to Covid-19 restrictions and social distancing guidelines, ethical approval was granted to conduct interviews remotely instead of face-to-face. Virtual interviewing removes geographic barriers to participation and participants may feel a greater sense of control over their responses as they can participate from the comfort of their own homes (Heath, Williamson, Williams & Harcourt, 2018). However, there were some disadvantages of interviewing virtually to consider prior to data collection. Firstly, some visual cues are used differently in virtual versus face-to-face conversations. For example, head nodding is less frequent in virtual interviews and speakers tend to take longer turns between speaker transitions, which results in more formal interactions (Sedgwick & Spiers, 2009). Body language is also limited so emotional cues may have been lost. Secondly, Covid-19 restrictions meant families were working and studying from home, which increased the likelihood of interruptions. Participants occasionally needed to refocus following interruptions, which might have impacted the richness of the data. Participants chose the date and time of their interviews and all stated they were in a private space for the interviews, however awareness of family members in the house may have impacted their level of disclosure.

Interviews were conducted remotely between 6th October 2021 and 5th November 2021 via Microsoft Teams (n=4), Zoom (n=7) or telephone (n=4). The method of remote interview was chosen by the participant to facilitate participation (Heath et al., 2018).

2.5 Ethical Considerations

This study has approved by the University of Hertfordshire's Health, Science, Engineering & Technology Ethics Committee (protocol number LMS/PGT/NHS/02963) (see Appendix H), and the Health and Social Care Research Ethics Committee B (HSC REC B 21/NI/0118) (see Appendix I).

This research required several considerations to establish ethical rigour. These were communicated through a Participant Information Sheet in line with the British Psychological Society's Ethical Guidelines (BPS, 2014).

Each participant was given opportunities to ask questions before participating in the research and, due to lack of face-to-face contact, gave verbal consent, which was audio recorded, to confirm they were informed of the research aims and what participation would involve. Participants were informed about the confidentiality policy, including that no identifiable information would be shared with the diabetes service. This was to encourage honest and open discussion and reduce worries about the researcher's ability to stop their access to the FSL. All participants were sent a Contacts for Further Support sheet (see Appendix J) and encouraged to contact the documented services should they disclose any potential harm to themselves or others. The participants were informed how interview data would be handled to maintain anonymity, including data storage, saving files separately to demographic information and using password-protected files. All participants chose their

own pseudonym and were informed they could withdraw their transcripts from the research until two weeks post-interview.

As this study asked participants about their experiences of living with a chronic physical health condition, it was important to consider how participation may evoke psychological distress. Participants were told that, should this happen during the interviews, the researcher would offer the opportunity to pause or terminate the interview if necessary, whilst responding with compassion and drawing on her skills and experience as a trainee clinical psychologist. This process is documented in the Distress Protocol (see Appendix K).

2.6 Data Collection

2.6.1 Resources

Interviews were conducted online using a laptop or via telephone and recorded using the Voice Recorder application on the laptop. The researcher kept a reflective journal to record thoughts and ideas after each interview. The researcher transcribed all interviews. NVivo 12 software (QSR International, 2018) was used to analyse the transcripts.

2.6.2 Interview Schedule

The researcher developed the interview schedule (see Appendix L) by generating a list of questions based on related research. This was shared with the supervisory team who offered additional questions and ensured it aligned with the research aims and questions. The interview schedule was also shared with the Experts by Experience who offered reflections on how it might feel to answer the questions and did not feel any changes were necessary. The interview schedule covered four main sections: general experiences and frequency of use of the FSL in comparison to finger-prick testing; eating habits since using

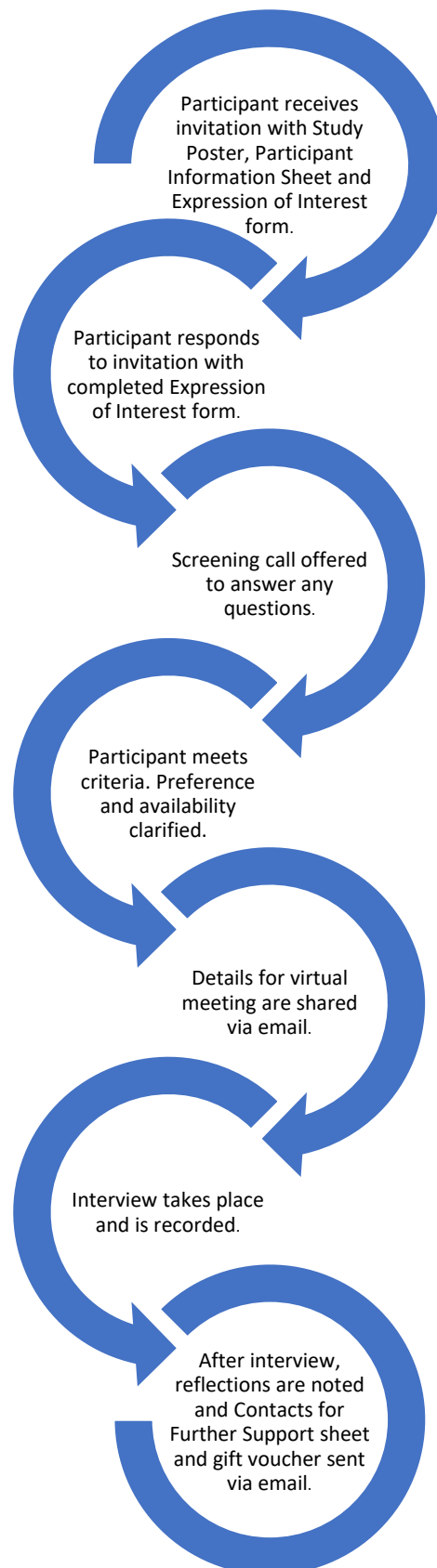
the FSL; changes in eating habits over time and following T1DM diagnosis; and experiences, use and interpretation of the FSL data.

2.7 Interview Procedure

To start, the researcher introduced herself and outlined the practicalities of virtual interviews and what should be done in case of disconnection. Participants were also reminded to find a confidential space in which to complete the interview. The researcher then provided contextual information about the study to build trust and rapport and disclosed that she does not have T1DM, therefore may ask follow-up questions to clarify jargon. The participant was then encouraged to ask any questions, choose their pseudonym and choose the shop from which they would like their £15 voucher. Verbal consent was then audio recorded before the interview commenced. In keeping with the reflexive TA approach, a fluid approach to interviewing was taken that more closely resembled the flow of a natural conversation. Therefore, the order of the interview schedule changed during some interviews as the researcher aimed to be “on target while hanging loose” (Rubin & Rubin, 1995, p. 42). Before the end of each interview, the researcher checked no sections were outstanding and encouraged the participants to talk on areas they felt relevant. When the interview was complete, the participant was informed that the recording had been stopped and they were offered the opportunity to comment on their experience of the interview if they wished. The researcher sent all participants a Contacts for Further Support sheet with details of services that could be accessed for further support and their £15 e-voucher within 24 hours of the interview. Figure 2 presents a summary of the interview procedure.

Figure 2

Flowchart of Interview Procedure



2.8 Data Analysis

The researcher used reflexive TA to analyse data using the qualitative software NVivo 12 (QSR International, 2018). The process of analysis, displayed in Table 9, fits with Braun and Clarke's (2006, 2013, 2019) six-phase process of reflexive TA, which aims to help the researcher identify and attend to the important aspects of the analysis. Extracts of coding and the theme development process is shown in Appendices M-N.

Table 9

Researcher's Six-Phase Process of Reflexive TA

Phase	Task
Phase 1: Data Familiarisation	The researcher listened to audio recordings and read transcripts multiple times to become familiar with the data and note information relevant to the research question. Transcription of all interviews aided this process of immersion in the data. The researcher made annotations to identify initial trends and points of interest in each interview.
Phase 2: Generating Initial Codes	A single coder, the researcher, was used. The researcher went through all transcripts, coding words or phrases relevant to the research question. Initial codes and musings were shared with Experts by Experience to facilitate reflection on how the researcher's biases might influence her interpretation of the data and choice of codes. Extracts of transcripts were also shared with another trainee working outside the topic area, to identify how another researcher might code the same transcripts. Extracts were coded separately then codes compared during a reflexive discussion, exploring points of similarity and difference. The coding phase required a prolonged period of engagement with the data, with codes evolving with shifts in insight and multiple layers of reflection (Braun & Clarke, 2021).
Phase 3: Generating Themes	The researcher used mind maps to experiment with different ways of grouping the codes to highlight potential relationships and patterns of shared meaning. This was an active process of construction to examine how the relationships between codes might inform the narrative of a given theme. During this process different themes were merged, discarded or sorted in subthemes. The generation of themes was the result of engagement with the data, the researcher's subjectivity, conceptual understanding and training and experience (Braun & Clarke, 2021).

Phase 4: Reviewing Potential Themes	Gradually, distinct themes were constructed from the data. The researcher continually reviewed themes and subthemes until it was felt the themes communicated a meaningful story behind the data that helped answer the research question. Themes were reviewed in relation to their coherence, their boundaries, and their ability to represent a useful interpretation of the data set as a whole.
Phase 5: Refining, Defining and Naming Themes	The researcher, supervisory team and Experts by Experience defined and refined themes to ensure the essence of each theme meaningfully reflected the data (Braun & Clarke, 2006). This involved organising quotations for each theme into a coherent account, ensuring that all participant voices were represented.
Phase 6: Writing Up	To construct a coherent, meaningful narrative of the themes and sub-themes, the researcher took time to reflect with the supervisory team on her own understanding and position in relation to the chosen themes. Quotations are presented both illustratively, providing a surface-level description of what participants said, and analytically, focusing on what has been interpreted to be important about what participants said in context (Byrne, 2021).

2.9 Quality, Validity and Self-Reflexivity

2.9.1 Assessing Quality and Validity of the Methodology

The researcher evaluated the qualitative aspect of this study using the Eight “Big-Tent” criteria for Excellent Qualitative research (Tracy, 2010), detailed in Chapter 4. To increase the rigour of the qualitative analysis, codes and themes were shared with the supervisory team and Experts by Experience to facilitate reflection on researcher subjectivity. Transcript extracts were also shared with another trainee for coding. This exercise was to aid reflection on the researcher’s coding process and style, rather than to come to an agreement on codes. An audit trail was also kept, documenting the research process and method of analysis, as well as a reflective journal to reflect on personal biases, assumptions, interests and contextual factors that may have influenced interpretation.

Investigator triangulation was considered to not align with the critical realist epistemology of the current study. With roots in measurement, the concept of triangulation

stems from positivist perspectives on rigour wherein multiple researchers ideally converge on 'the truth' (Varpio et al., 2017). Similarly, member checking² was not used as a strategy for assessing rigour. The use of reflexive TA asserts that analysis is an interpretive process in which the researcher is actively part of constructing conclusions. In this way, incongruence between researcher and participant interpretations is considered less problematic (Varpio et al., 2017). The coherence of member checking has also been questioned considering that participants are in different places in time and context when asked to validate the researcher's analysis; it is therefore likely that their responses when recounting their earlier interview can shift, as they view their interview through a different lens from a different place in time (Braun & Clarke, 2021).

2.9.2 Self-Reflexivity

My own experiences and assumptions will have influenced my approach towards the research topic. My lack of lived experience of diabetes may have encouraged participants to be clearer about their experiences and clarify processes of thought or action. However, it may have also hindered sharing difficult experiences on a deeper level. It was therefore pertinent to continue to develop my understanding of diabetes management practices and consult with the Experts by Experience to reduce misunderstanding or ambiguity that might interfere with my interpretation of patterns of meaning in the data. It also was important to remain mindful of how my own relationship to food and eating might influence the research and to be transparent about research decisions and processes when discussing these with

² Member checking is typically used to correct errors, such that if a member check identifies a contradicting opinion between participant and researcher interpretations, the researcher must change their analyses so participants agree that the interpretations are fair, which can result in a more surface-level analysis in order to reach consensus.

the supervisory team. I recorded my reflections, feelings and any contextual factors throughout the project in the reflective journal. As mentioned in Chapter 1, I also wore the FSL for two weeks in December 2021 and kept a separate reflective diary of my experiences of wearing it on my body, of interacting with the data and of my attempts to keep my BG levels in range. My supervisory team also encouraged me to write a short reflective piece entitled 'A Day in the Life of My Stomach' to prompt further reflection on my own eating habits. Reflexive TA requires deep and critically-open reflexivity throughout the project, with continual reflection on the researcher's expectations about the research, methodological choices and their disciplinary positioning (Braun & Clarke, 2021). As I was working clinically with children and adolescents with T1DM during the latter period of the study, I reflected on how clinical interactions may be impacting my biases and interpretations around that time.

Quantitative Methodology

2.10 PAID Questionnaire

This section details the methodology for the quantitative aspect of the study. The questionnaire routinely used by the North Bedfordshire Adult Diabetes Service is the PAID questionnaire (Polonsky et al., 1995), a 20-item questionnaire used to assess diabetes-related distress. Each item is measured on a five-point scale, from 0 (not a problem) to 4 (serious problem). The scores for each item are summed, then multiplied by 1.25 to generate a total score out of 100; with total scores of 40 or more indicating severe diabetes distress. The PAID has been shown to have satisfactory psychometric properties (Polonsky et al., 1995; Snoek et al., 2000).

2.11 Participants

2.11.1 Participant Criteria

PAID questionnaire data is collected for patients before commencing FSL use (time 1; T1), and again at their six-month review (time 2; T2). This routine practice was established in October 2019. Inclusion criteria included patients who completed the PAID questionnaire in full at both time points and had used the FSL for at least six months.

2.11.2 Recruitment

The questionnaire data had been routinely collected by the service, therefore a new sample did not need to be recruited as consent is not required when using anonymised clinical data that has been collected as part of routine clinical care (Health Research Authority, 2017).

Clinicians upload patient PAID scores to a shared service database after the review appointment.

2.11.3 Sample

The service database included 477 patients who were documented as using the FSL.

However, only patients with a recorded T1 and T2 PAID score were required. Dr Jen Heath

(Principal Supervisor) accessed the patient database and shared only anonymised PAID

scores and dates of completion with the researcher. All available PAID data from the service

was shared on 31st August 2021. Data was available for a total of 199 participants between

May 2019 and August 2021.

2.12 Ethical considerations

Only the required, anonymised data was shared with the researcher. Patient identifier numbers were used in place of name. This was shared via Dr Jen Heath and the researchers NHS email addresses to ensure data protection.

2.13 Data Collection

The review appointment does not consistently occur six months after initial FSL use, and during 2020 annual reviews were disrupted due to Covid-19, therefore in some cases the T2 questionnaire data was collected on a varied time scale. The intended and actual date of review was available within the dataset.

2.14 Data Analysis

The total PAID score at T1 and at T2 were compared using confidence intervals to assess the impact of FSL use on diabetes-related distress over time. The distribution of the data determined whether a parametric paired samples t-test or a non-parametric Wilcoxon Signed Ranks Test was used to compare means. SPSS Version 24.0 was used to analyse the data.

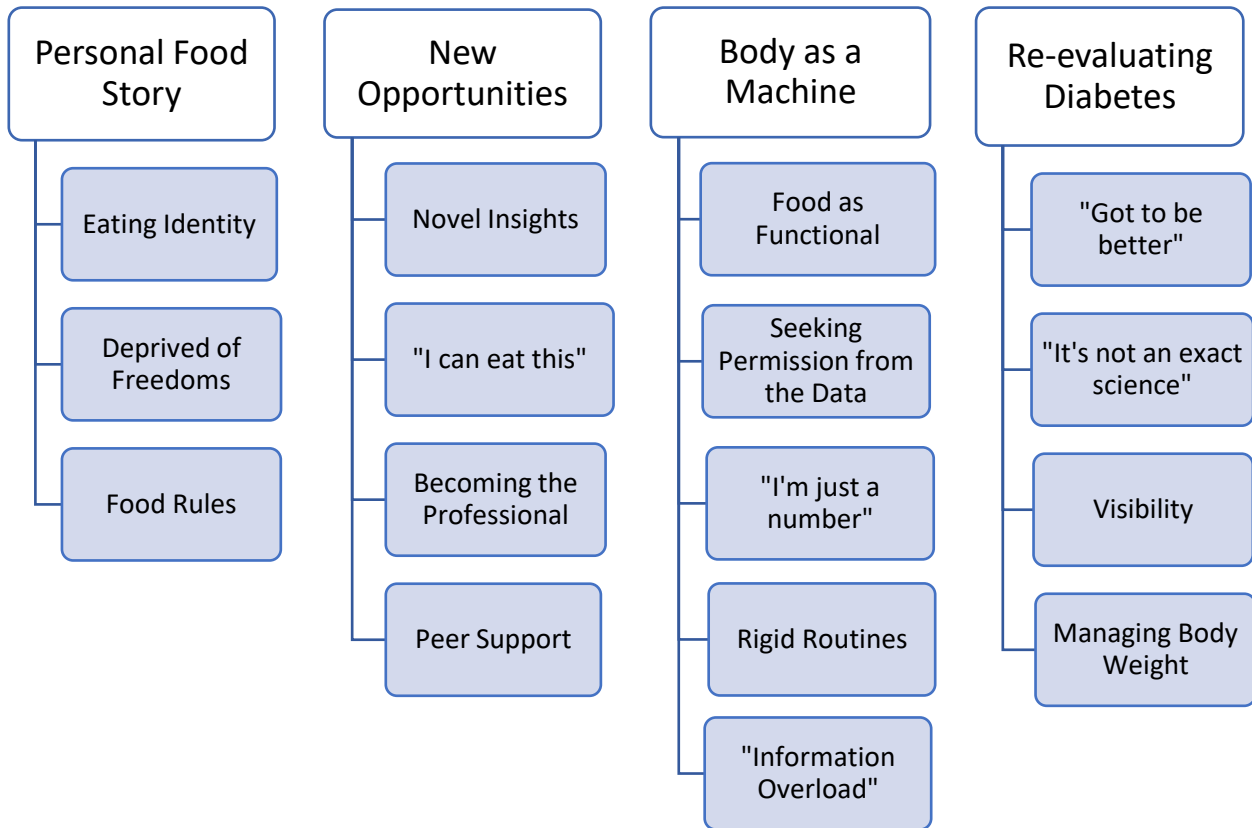
3. Results

3.1 Overview

This chapter first presents the qualitative analysis from fifteen semi-structured interviews. Four main themes were constructed through reflexive TA (Braun & Clarke, 2006, 2013, 2019) shown in Figure 3, representing users' experiences of the FSL in relation to its impact on their relationship with food and eating: *Personal Eating Story*, *New Opportunities*, *Body as a Machine*, and *Re-evaluating Diabetes*. Each theme comprises several subthemes, discussed in detail with quotations from transcripts. Selection of quotes was carefully considered to best portray the essence of the theme or subtheme, thus it has been necessary to omit extracts in the interview data for the purposes of being concise. Where words are omitted, this is demonstrated by three dots '...'. A quantitative analysis of 199 PAID (Polonsky et al., 1995) questionnaires is then presented, followed by the researcher's reflections on the PAID questions in light of the interview themes.

Figure 3

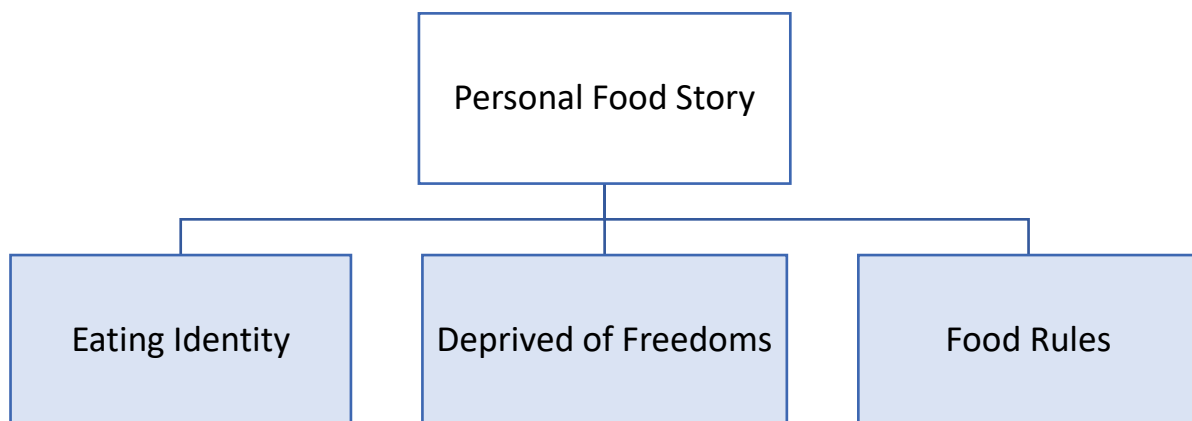
Themes and Subthemes for Users' Experiences of the FSL in Relation to Eating Behaviour and their Relationship with Food



3.2 Theme 1: Personal Food Story

Figure 4

Theme 1: Personal Food Story



This theme captures how participants described their experiences, attitudes and beliefs about food and eating prior to starting the FSL. This encompassed labels they used to describe their eating habits, periods of significant diet changes or food restriction following diabetes diagnosis, and beliefs or 'truths' about food and health. Participants' food journey thus far provided a context in which the FSL would be introduced.

3.2.1 Eating Identity

This subtheme illustrates how participants situated their current eating habits in relation to their eating backstory. It was apparent that participants had constructed an idea of who they are in relation to food, drawing on the role that food played in their upbringing and relationships with family members.

The labels that participants used to describe their eating habits and emotional relationship with food seemed to be well established, suggesting they had categorised themselves as a certain type of eater.

I've always been a big fan of my food anyway, so I've not been one to go with small portions if I'm being honest... (Bluebell)

I've always been a large person so always been dieting and told to diet... (Aisling)

I'm not a huge lover of food. (Sharon)

Participants alluded to societal expectations about food and body image, for example Aisling's statement suggested that being a 'large person' is an unacceptable way to be. For Aisling, food had always been associated with regulations. Similarly, Sharon and Bluebell imply they do not align with a perceived norm by specifying being a 'big fan' or 'not a huge lover' of food.

Participants shared memories from their youth that often focused on connections with others via food. Sharon recalled enjoying food with her sister, wherein cake was used to punctuate a moment, going into town, and was received as a treat. Mickey described sharing food with his brother but on this occasion, food represented a forbidden indulgence that had to be consumed quickly for fear of getting caught, which perhaps added to its pleasure.

...when I was much younger we would walk into town and get into town...and we'd go into Simmons, I remember where the shop is, and we'd go into Simmons and...we'd all get a cake and we'd all sit on one of the benches outside in the thoroughfare, and we'd all have cake. (Sharon)

...my mum loved to bake and cook...if she'd been baking in the afternoon, there was four or five loaves of bread on the side in the kitchen...and she'd often open the hatch and say "Leave that bread alone!" Because me and my brother would, if it was still warm, we'd be hacking into it and getting butter on it and marmite, you know, so we could demolish a couple of loaves between us [laughs]. (Mickey)

Other participants recalled comparing family members' meals and trying to make sense of differences.

...he was fed better quality food than myself and my other siblings were fed. Because he was diabetic. And it was really, it caused a lot of friction emotionally for us as children...so it did cause quite a bit of.. feeling of strangeness about food. Inequality. (Lottie)

For Lottie, food was indicative of status or special treatment. Lottie's use of the word 'strangeness' suggests she was hesitant to label her experience, but then identified her underlying feeling, 'inequality'.

Several participants also reflected on how the arrival of diabetes contradicted their established identity. They referred to their fitness levels, body shape or eating habits and appeared to express disbelief at the diabetes diagnosis based on their lifestyle.

I wasn't overweight, um I'm not active active but I'm more active than most people in the job that I do, so I was a little like, and I don't eat crap food all the time, so I was a little bit like "Okay, well fine." (Madonna)

I was very surprised...I was very slim, long-distance running, very active lifestyle... (Lottie)

3.2.2 Deprived of Freedoms

This subtheme relates to participants' past experiences of managing diabetes, focusing on post-diagnosis diet changes. Age at diagnosis varied significantly across participants, with

Hayley stating she “*couldn’t remember life without diabetes*” in comparison to several participants who were diagnosed in adulthood.

For participants who had lived with diabetes for several decades, initial diabetes management practices required precise approaches to food consumption to match food to the insulin profile.

When I was first diagnosed, I was measuring absolutely everything on scales. (Peter)

Peter’s emphasis of ‘absolutely everything’ implies that there was no room for intuitive eating; precision was key. Participants also described eating schedules which often involved eating the same thing at the same time every day or exclusion of certain foods.

I remember I had to have a snack at 11 o’clock in the morning, I used to have two rich tea biscuits [laughs], and that was whether I was at school or at home... (Hayley)

...my approach at the time was “I can’t have sugar in any respect ever.” It was like...one half teaspoon of sugar and that’s my lot. So it was really just, turned off anything sweet. Which is how I was educated by the doctors at that time. (Hank)

And from then on at seven I didn’t have anything.. sweets, chocolate or anything like that. (Katie)

Food restrictions experienced during childhood were associated with feelings of deprivation and unfairness, with participants having to say goodbye to special foods or watching others eat what they could not have.

I couldn't have like sugarpuffs or, which was I remember that being my favourite and I was never allowed to have it [laughs] I laugh now but it was probably quite sad at the time. (Hayley)

...I was actually in hospital Easter 1978...my brother and my parents were there visiting me at the time, and they obviously had volunteers visiting the hospital and um they were giving all the children crème eggs and they gave my brother crème eggs and not me...I can remember that like it was yesterday. Cos I couldn't understand it. I couldn't understand it. (Katie)

Katie's repetition of 'I couldn't understand it' gives a palpable, visceral sense of how present her experience still is.

When diagnosis occurred during childhood, many participants described parents controlling their diet therefore not having any choice in their diet. As a result, their parents' approach to their diet likely provided a template for how they would have to manage diabetes as an adult, and participants may have foreseen maintaining strict eating regimes forever.

I remember my mum being really quite strict about what I could and couldn't eat, um...which I totally appreciate and am grateful for her keeping me on the right path, um would sort of "Oh no you can't have that." (Becky)

Interestingly, participants diagnosed in adulthood shared similar experiences of post-diagnosis deprivation. Notably, participants typically commented how well they remembered these moments, implying they were experienced as significant shifts in their relationship to food due to beliefs that they would have to live with these restrictions forever.

It was horrible...I still remember it quite clearly. Um.. you know when everyone else is eating stuff, so we used to go um, once a month to my mother-in-law's, we used to go for Sunday dinner...she likes to shop at Marks and Spencers, and she'd have all these lovely puddings and I wasn't able to partake because, you know, I knew it would push my sugar up. (Dove)

3.2.3 Food Rules

This subtheme relates to statements participants made that implied certain 'truths' about food, health and eating.

Many participants described food choices that suggested a dichotomous view of 'good' and 'bad' foods. Generally, food that was high in carbohydrate or sugar was associated with cheating or feelings of guilt.

My, my diet is quite basic and straight forward and consistent things but I have been guilty of.. treats I suppose you would call them. You know having a Kiplings apple pie with custard for afters or something like that. (Harrison)

Several participants commented on the impact of certain foods on BG levels and therefore whether they should be eaten. It was unclear whether this was information shared by the diabetes team or speculation shared amongst the wider diabetes community.

...they say that meat can cause insulin resistance... (Hayley)

For some, eating outside of the home appeared to be historically or currently experienced as a risky or difficult to manage activity. This appeared to be related to uncertainty regarding people without diabetes being able to provide an appropriate meal.

I, I still sort of don't go round my friends house for tea and things, and um.. (Becky)

Or like going to my friends houses and they're always like careful in what they would, what their parents would give me and.. (Hayley)

Finally, participants also mentioned healthy food guidelines that they adhere to.

I spoke to the nutritionist there and she said that you should aim to have 50 grams of carbs and not really much more than that to live a health balanced diet... (Bluebell)

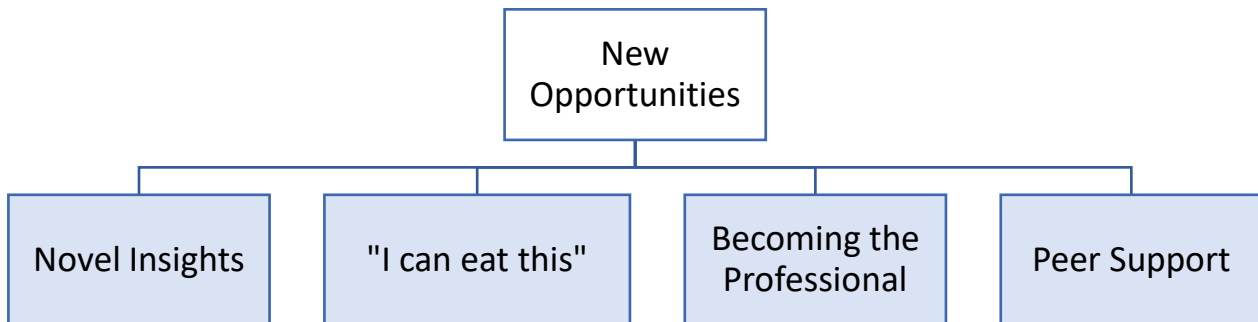
You know that healthy food plate thing that, a diagram of a plate with a third vegetables, a third this etc etc. I've tried to keep to that pretty much every day. And so, but everything I have is with salad. (Harrison)

Overall, this theme encompasses participants' relationship with food before and after diabetes diagnosis. Prior to diabetes, food memories predominantly alluded to food representing connection, treats and indulgence. Participants hinted at social norms about food and body shape and stated their position in relation to these. Following diagnosis, a sense of deprivation and unfairness was prominent in the data. The nature of the deprivation depended on age at diagnosis and diabetes practices at the time, in that for some individuals, strict food regimes were implemented by parents but for others, such choices had to be made themselves. Nevertheless, the introduction of diabetes appeared to be associated with a lack of freedom and novel judgements about food, including good or bad foods, healthy or unhealthy foods, and an individual responsibility to make 'good choices' based on advice from professionals.

3.3 Theme 2: New Opportunities

Figure 5

Theme 2: New Opportunities



This theme illustrates how participants viewed the FSL as a vehicle for new opportunities and discoveries. Through an increased sense of confidence to manage various situations, based on the reassuring presence of the FSL, participants were able to experiment with eating habits. This appeared to prompt a shift in their role within their diabetes management and a recognition of their expertise.

3.3.1 Novel Insights

This subtheme relates to various discoveries made possible by the FSL. There was a sense that participants had accessed a higher level of understanding of their BG levels and bodily processes.

Participants reflected on their experiences of reviewing food in terms of its effect on BG levels.

...I've evaluated foods really easily. So...if you ate this kind of bread on one day see what effect it has. Different kind of bread on another day, see what effect it has. And you can do that so easily... (Lottie)

Lottie's use of 'evaluate' suggests a meticulous review process, wherein perhaps she is evaluating whether certain foods are acceptable or meet her needs. In this way, Lottie appears to shift further away from a 'food eater' and closer to a 'food information processor', as though adopting a managerial role.

For other participants, the reviewing process included identifying restaurants or specific dishes that caused a sharp increase in BG levels. This new insight into food content changed where and what participants chose to eat when out.

...items of food that I think is healthy and is low-ish carb, isn't. And one thing that's been affected by that is when you have yoghurt with granola and a bit of honey and fruit. There's a lot more in that than you know, I thought was possible. But only when you're eating out. At home I make the choices and low sugar for everything... (Katie)

...Indian takeaway meals...I can have a curry from one takeaway and have no adverse reaction, and from another takeaway...and I know from experience, from the results I get, from having the same meal, my blood sugar shoots high because of the amount of sugar they use in their cooking. (Mickey)

The visual representation of BG levels on the graph appeared to offer the perception of control when participants ate high carbohydrate foods, in that participants felt able to supervise the situation rather than leaving it up to chance.

Unless I was sitting there pricking my finger every few minutes and plotting it myself on a graph, I wouldn't know. And I would never have done that. So yeh, I would say it has made a big difference being able to.. and even to the point where if we ever have a takeaway I can now monitor it more closely and correct along the way. (Hayley)

However, participants were conscious that their FSL would track their levels even when they were not thinking about diabetes. In some cases, the continual observation prompted participants to change their behaviour. Hank described his previous 'ignorance is bliss' approach to drinking alcohol.

...I'd had a few drinks, so you know it's easier to just sort of like think "Ah there's no point in doing a test." And I can be happy. Even if I don't do a Libre scan it's gonna show that eight-hour pattern, you know, in the morning when I do one it's gonna say "Oh, what happened to you last night?" So that is one thing, but I suppose the other thing is that it's made me think more about if I am going out for a beer, drink less. (Hank)

Hank's anthropomorphism of the FSL asking what happened to him last night implies he feels obliged to answer to the data, and therefore consumes less alcohol to try and stay in range.

Several participants commented on significant shifts in their diet that occurred around the same time as starting the FSL. It appeared that the device led to increased reflection on dietary intake which encouraged a healthy eating initiative, or enabled experimentation with new dietary approaches.

Since using the Libre, um not because of the Libre, I've, I've been trying to eat more plant based. I know that's like trendy now. Um I was advised by a doctor that I saw...She advised me she was like "Try plant based, try plant based." and she told me to look at this book called Mastering Diabetes... (Hayley)

I've tried to be eating healthier, so it's.. less fats, reducing the carbohydrates and increasing my vegetable portions basically...when you realise how much carbohydrates are in some things, when you're, you're taking insulin, you think "Oh my gosh, that's too many."...I think I became more aware of my health um.. and more conscious of what I was eating...this is a more permanent reminder on your arm, you know, it does make you think a bit more. (Aisling)

Despite several participants commenting that their diabetes diagnosis made them more conscious of what they ate, Aisling commented that the FSL caused this shift in awareness. It is unclear whether this was in addition to the shift caused by diabetes, or due to new priorities within her diet.

In contrast to Aisling's experience of the FSL as a permanent reminder of the diabetes, Lottie implied that the FSL allows her to be free to think about things other than food, as she can find answers to her questions immediately. The novel insights appeared to

offer peace of mind, as she relied less on guesswork and estimation, which was a view shared by other participants.

...before I would think, I would be constantly thinking about what I've eaten, what effect is it having, how do I feel, and it would be a real, almost like a nagging in the back of your mind. Whereas with the scanner, you don't, it doesn't have to. You know that with the touch of a phone you can just scan and there you are. It gives you the information. (Lottie)

3.3.2 "I can eat this"

This subtheme captures participants' descriptions of their increased confidence and self-efficacy in managing challenging foods because of the FSL, which allowed them to experiment with new ways of interacting with food.

The ability to review the data and make decisions seemed to increase participant's sense of control and ownership in relation to their diabetes management.

...it's given me the confidence and the ability to be able to just take it in my own hands and deal with it...being able to see those graphs and change things and whatnot, I just feel.. more confident and empowered with my diabetes rather than feeling like it controls me... it gives me happy, empowerment, confident kind of feelings. (Sarah)

...I'm doing a good job. (Mickey)

The increased sense of control appeared to offer freedom and flexibility to broaden their food options.

...there's a sort of "How much do you love eating it anyway?" and then secondly if it gives you a bit of grief, then your answer's going to be "No thank you." Now it's kind of, yeh actually I still maybe don't love it much more than I did before, but I might be more inclined to eat it because it doesn't give me the grief bit...it's given me a bit more flexibility about feeling that I can control stuff like that if I want to. (Greg)

...it's been less of a "Oh god I can't eat that, I shouldn't have that cos I'll have to take so much insulin." or "How much insulin will I have?" and it's more been "I can deal with this, I can eat this, because I know if I get the, the carbs wrong that the Libre will let me know". And I suppose it just instilled more confidence in me in being able to eat what I can. (Aisling)

This flexibility contradicted previous experiences of post-diagnosis deprivation discussed in the previous theme. Instead of certain foods being too dangerous to eat, participants appeared less fearful of complex foods. Interestingly, Greg even describes eating pasta, a food he is "*not a massive fan of*", perhaps simply because he can.

In addition to increased food options, participants described flexibility regarding timings. The data and trend arrows were used to assess if they could eat on occasions where they previously would not have done so, such as spontaneous social meals. By sometimes saying 'yes' to such invitations, it may be that participants felt less restricted by diabetes.

I suppose um if I'm having a main meal, and my wife has made a pudding which generally I wouldn't have any of, she may have made something which then she's intending to

have, then I may say "Actually my blood sugars were heading down, I'll have a little bit of that dessert." (Hank)

...I feel like I, there's a little bit more freedom to eat. Like if you go out with people you can eat when everybody eats rather than having to eat at midday or whatever. (Lottie)

The data was also associated with simpler, quicker eating preparation in comparison to finger-prick testing, which may also encourage spontaneous eating.

Whereas if you scan the Libre it takes seconds, I can inject from that within seconds and it's a lot quicker process and actually eating I guess with the Libre is a lot easier. Because everything is just more.. ready available... (Bluebell)

Two participants spoke about revisiting childhood favourites that they had not eaten since diagnosis. However, they had mixed results as expectations were not always met. Hank shared his disappointment when reality did not live up to the memory.

...when I first got it I was confident that I could go and eat uh, sweeter foods...just a childhood thing, the crunchy nut cornflakes I thought "Oh yeh" and we went out and bought some crunchy nut cornflakes and they were nice, they, well they kind of weren't as nice as my memory led me to believe, um but I thought "Yeh I could, I could eat those again." And then I quickly realised "Nah actually.. I can, but it's not worth it." Cos they're not as nice, and it does create that spike because of the um, the amount of sugars in it. (Hank)

Whereas for Mickey, his experience of revisiting a childhood favourite seemed to represent reconnecting with family traditions.

...do you know anything about raspberry vinegar?...It's like nectar. My parents used to make it, grandparents made it, my wife now makes it... it was always a treat just to have a big Yorkshire pudding drenched in it...Yeh, so those are the things that I, I can do now...(Mickey)

Aside from enabling exploration of novel food options, the FSL was associated with a returned enjoyment in food. In the absence of a painful finger-prick, the FSL allowed participants to view their meal as a source of pleasure as opposed to a reminder of the diabetes.

I probably eat more now...I would say that the Libre, because it makes it easier.. um actually eating is more enjoyable. Um whereas I think when I was doing the testing and everything, it sort of took away that "Oh I'm really looking forward to this meal."
(Bluebell)

This subtheme highlights the FSL boosting participants' sense of control which encouraged a more flexible approach to eating. Novel eating habits included sharing food and social events with others and eating high carbohydrate foods previously viewed as too challenging.

3.3.3 Becoming the Professional

This subtheme illustrates the shift that participants described in their diabetes management role. Equipped with their data and increased understanding, participants seemed to shift from 'patient' to 'professional'.

One aspect of their new role included analysing their data to identify trends and make sense of high or low glucose events.

...I might have a series of high glucose levels in the morning, and I think "Okay, what's, what's caused that, why has that happened." And I need to backtrack and think "Was it something I ate, did I forget to take fast-acting insulin, did I forget to take my long-acting insulin, my basal dose. Or did I not take enough to cope with what I've been doing or been eating." (Mickey)

The ability to analyse data offered participants the opportunity to safely adjust their insulin regimes instead of relying on the clinical team.

I think it's given me confidence to be able to do that, because before I think when it was just based on the odd blood sugar that I was doing and you bring those into the diabetes nurse...I wouldn't have had the confidence to do anything, I didn't really know much about it, and I wouldn't have known what those effects would have had... (Sarah)

Sarah describes an increased sense of ownership of her diabetes management, shifting from handing over snippets of information to the nurse and awaiting instructions to feeling competent to initiate and evaluate changes herself.

Several participants also discovered since using the FSL that their body responded in an idiosyncratic way to food or insulin and felt reassured by the presence of the data to evidence this. It seemed that this shift in understanding enabled participants to feel empowered and more able to bring these difficulties to their diabetes team.

I was always feeling that the results I was giving before the Libre were being doubted because my HbA1c was higher than my blood sugars pre-meal would suggest, but now I know that my body shoots my blood sugar up higher than it should when I eat carbohydrate...when I go to an appointment I am far more confident. Because the graphs can't be argued with, I can't make up a graph. (Katie)

3.3.4 Peer Support

This subtheme outlines participants' experiences of sharing their new expertise with friends or family members with diabetes.

Several participants described sharing experimental methods facilitated by the FSL, and peers trusted this advice.

I've got a friend who was diagnosed not that long ago...and he was saying to me "Oh I don't eat roast potatoes anymore because they completely screw up my control, if I have them in the evening I'm up in the middle of the night and it's dire." And I said to him "Look, I'm not telling you to do this, but this is what I do and it works for me." He then went away and did it and he came back and he said "Flippin' heck it works a treat." (Greg)

...one of my best friends...she's also diabetic and she also has the Libre...it's really nice cos if we're having a.. like if I'm having a problem I'll always say to her "Look, what's going on, why is my blood sugar doing this?" and then she'll give me her view on it and say "Well have you tried this." Um sometimes you're like "Ah yeh I didn't think of doing it that way." (Becky)

The data enabled celebrating successes with peers who would share an appreciation of 'a good day'. Of note, participants appeared to be more likely to share good days with peers than difficult days.

...definitely on Whatsapp. You know "Look at mine!" Yeh. I've been, or I've been messaging and I'll say, he'll say "I've looked at mine and I've been in target all day. I've had a really good day." He doesn't tell me when he's having a bad day [laughs]. (Sharon)

...we're forever sending each other pictures of our Libre graphs and you know, when we've had a good day we're really proud and pleased. And it's nice that she feels that excitement of what it's like to have a really good day with your blood sugars. Whereas other people are like "Oh well done." They don't really know, they don't really care kind of thing. (Becky)

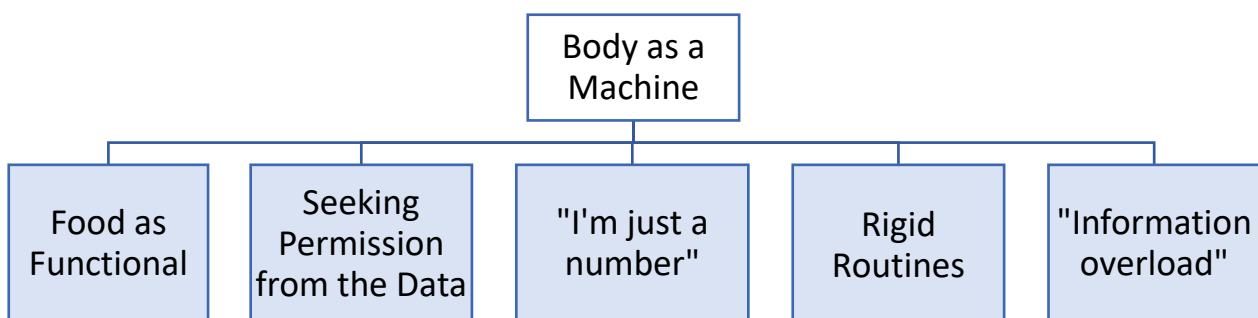
Overall, this theme outlines participants' journey of discovery following FSL use, and the resultant increased self-efficacy. The FSL data allowed dishes and restaurants to be reviewed and participants seemed to explore broader food choices. Moreover, there was a

sense that participants' increased knowledge allowed them to recognise their expertise and offer this to other people living with diabetes.

3.4 Theme 3: Body as a Machine

Figure 6

Theme 3: Body as a Machine



This theme illustrates how participants related to their body after the continuous FSL data offered a window into their inner workings. Participants appeared to view their body as a collection of complex processes, similar to a machine, with inputs and corresponding outputs.

3.4.1 Food as Functional

This subtheme introduces the notion that food is fuel. Some participants described only eating if it was required, not for pleasure, emphasising the fundamental nature of food as a resource for survival.

I don't tend to eat when I'm hungry. I eat when I, because food is a means to an end if you see what I mean...I don't unfortunately, I don't think "Oh I really fancy this", I will think

“I’m really hungry, maybe I fancy this but I don’t eat it because..” my blood sugar trend or you know it’s just not right, the time’s not right... (Katie)

...as a result of having that knowledge of my own body feeding itself, if you like, I now skip breakfast. I don’t bother with breakfast, I don’t need it. (Mickey)

Mickey’s comment that his body feeds itself, thus does not require his input, positions him as an observer of various internal processes.

Whilst some participants appeared content with viewing food as a necessity, others expressed frustration at necessity overriding desires or urges.

I have sometimes quite an antipathy towards having to eat. I don’t really want to eat. And yet I know I have to fuel, or I did prior to the pump, fuel the insulin that I’ve taken on board. (Lottie)

...this annoys me, and this really does get to me...I tend to, if I can see I’m on a downward trend and it’s heading below 4.5 basically, I’ll eat even though I don’t want to, I’m not hungry...I’m not hungry, it’s a bit inconvenient, I don’t want to eat anything, I don’t feel like eating anything and I have to eat because I know the blood sugars are gonna go down and then it’s gonna end up in a hypo... (Katie)

Lottie’s use of the word ‘fuel’ builds the concept of the body as a machine, which is exacerbated by Katie’s description of needing food but not wanting food. It is as though

Katie is describing her body as a separate entity, an object that requires maintenance and she is the designated engineer.

3.4.2 Seeking Permission from Data

This subtheme captures participants' use of the data to determine whether they were allowed to eat in the moment. This subtheme contradicted the sense of freedom described in the 'Novel Insights' theme as it highlighted that eating was still governed by the data.

Participants described scanning the FSL to determine if snacking was permitted. If BG levels were considered too high, the hunger urge would often be ignored.

...if I do a, a Libre test, and I'm too high, or I'm higher than I would like to be, and I was going to snack or something, then I won't eat it. The only time I eat when I'm high, if I am high, is when I'm having a meal. Because I will still eat the meal and make the appropriate adjustment. (Sharon)

If I had um, for instance a result of ten and um, with an upward pointing arrow I definitely wouldn't have a snack then, no. And um it would tend to be just on the straight up arrow, I'm thinking "It's heading in the wrong direction fast in the first place, I won't eat anything."...I'll have a black coffee. (Katie)

Disregarding hunger urges reinforced the concept of the body as an impassive machine whereby data is prioritised over natural instincts and social processes. Hayley commented that whenever she was making a food choice, the corresponding graph would automatically enter her mind.

...I can just see it in my head thinking about food. In a good way, not a bad way...I done it the other day I had bean chilli left in the fridge, or I could have made a, a sandwich...I would've looked at the bean chilli and seen like a straight line [laughs] and looked at the other and thought "Oh no it's going to fly up later." (Hayley)

Participants also used the data to determine portion sizes, ensuring precision where possible.

...the Libre would indicate which way your blood sugars are going and that could dictate if you're going to take more or less food. You know and it could be really subtle amounts of um, you know not like having five potatoes instead of three, but it could be like having four potatoes instead of three, or I'll have the three smallest potatoes. (Hank)

Foods that had been identified as responsible for significant spikes in BG were often avoided, despite participants enjoying these foods; keeping levels in range was prioritised over cravings.

...because I know it has a bigger impact I probably eat less, whereas before my husband would go "Oh do you...do you fancy Chinese tonight?" I'd go "Oh yeh that sounds great." Whereas now I'm a bit like "Mmm no." (Madonna)

It was notable that participants described feelings of deprivation due to restricted foods in their youth or initially after diagnosis, yet were echoing this following the FSL. However, the

autonomy associated with making these decisions themselves may have felt different to receiving instructions from parents or professionals.

3.4.3 “I’m just a number”

This subtheme highlights experiences of feeling judged solely by their BG level or HbA1c. The data was sometimes seen as a representation of who they were, regardless of their efforts or strengths elsewhere.

Katie described this experience powerfully through drawing attention to the inescapable role of numbers and calculations in her day-to-day life.

I tend to just think um, really I’m just a number. I’m just a graph, a number.. I can’t actually do anything about how my body reacts to carbs or you know, insulin, but it’s, yeh, it’s you know, I’m just completely looking at figures all day...non-diabetic people wouldn’t even know this happened... (Katie)

Others highlighted that other people could ‘log in’ to their data, which could be a welcome break but could also be experienced as intrusive.

...they know they can scan me, my son’s even got it on his, got the app on his phone so he’s quite happy uh to take charge, scan me and you know, um work the numbers out so. (Dove)

I’ve seen a girl who was who was diagnosed within the last 18 months...I think having all of that information and then her parents having all of that information at the same time

wasn't necessarily a positive.. thing because um.. they would be able to check and they'd be like "What have you eaten? Why.." like and, and that was a little bit I think.. kind of, a negative for her. (Madonna)

Additionally, participants noted that their diabetes team also had access. Whilst some participants found this helpful to promote collaborative care, others expected clinicians to regularly review their data. Harrison expressed the belief that the FSL collects medical data for medical professionals, rather than people living with diabetes, therefore did not feel as though it was his responsibility.

I knew they existed but I just didn't take the time to look at them. Because I thought that if they are doing their harvesting every week or every two weeks then they would notice a change or something's wrong and they would contact me...I assumed that somebody else was looking after it for me... (Harrison)

The data was felt to hold great importance during appointments, for example to represent the person's diabetes management efforts.

I'm always looking at my estimated HbA1c because I know that's what I'm judged on when I go to a um, a diabetes appointment. (Katie)

The phrase "*that's what I'm judged on*" suggests that Katie feels judged as a person, rather than the various diabetes management strategies being judged for their effectiveness.

Similarly, Bluebell felt that the data was prioritised over and above the user's experiences or wellbeing.

...if you're on the Libre the conversation is purely around the Libre. So, and I think what's difficult is the Libre doesn't always show the true extent of what you're experiencing, so the Libre may look brilliant in terms of your levels but actually you getting to that point might be quite stressful. But I think they sometimes look at it like "Oh the Libre's fine so that's great." They don't sometimes dive deeper into it... (Bluebell)

Overall, there was an impression that participants' complicated and messy human experiences were sometimes reduced to a number. This came across as somewhat cold and mechanical as it disregarded their emotional experiences and focused purely on output.

3.4.4 Rigid Routines

This subtheme relates to the routines participants created to consistently keep their BG levels in range. Several participants described their eating schedule, as though they had created a manual for optimal functioning.

...and the times, as I said to you, fairly regimented with our eating habits in certain respects and timings certainly. You know we have breakfast pretty much the same time every day. I have my lunch and evening meal within, generally within sort of like.. minutes of each other throughout the week. (Hank)

I eat the same breakfast, I know it sounds boring, but I have cereal and fruit for breakfast every morning. Maybe once in a blue moon I'll have a piece of toast instead. (Sharon)

I make sure I have four hours gap between each meal at least because that's how long an insulin injection will last...I can look on the graph, on the logbook and check the time I ate "Is it four hours ago? Yes, right time for the next meal." (Katie)

The maintenance of routines often required planning ahead. The desire to achieve certainty via carb counting seemed to contradict the experimental approach described in the 'I can eat this' subtheme.

I know that a jacket potato is gonna be so many units of insulin, so at lunch time if there's something random, if there's, if I'm looking at the food I'm like "Mm I'm not sure if that, I'm not sure about that" I'll go for something that I know I'm sure of.. or a bit more certain of... (Madonna)

Madonna's comment "*I know I'm sure*" implies trust in her existing knowledge, which perhaps feels safer or easier than calculating units for "*something random*" based on a reluctance to deviate from the certainty.

3.4.5 "Information overload"

This subtheme illustrates participants' experiences of feeling overwhelmed by the data.

There was a strong sense that participants found the adjustment to the data challenging. Due to ease of scanning, many described finding it hard to resist looking at the data.

I had a weird sort of experience of it initially because I had this new bit of tech and I was being a bit obsessive with it. So initially I think it was, it was better because I wasn't having to worry when I fell asleep which is what I was anxious about before, but in the initial stages I was anxious because I kept checking it so much more often. (Bluebell)

I found myself getting obsessed by it...I mean I, I get annoyed because I've done something I shouldn't have done, but I can see some people would be possibly trying to adjust their whole life just to keep the line flat in the middle of the range that they're supposed to be in. (Peter)

The word 'obsession' was frequently used and suggests that the FSL demanded their attention. Participants described noticing the urge to scan more when they knew their levels were out of range and at times, this process involved an internal dispute between logic and curiosity.

It's like test it, 30 minutes later test it again, "Oh it hasn't changed", 30 minutes later test it again, "Oh it's only changed a bit" and then, you know, that sort of almost um.. because there's no finger prick because there's no pain or it's just easy...and I even sort of like say to myself "Well you got to give yourself time." And then the other shoulder's

saying "No do another test, go on have another look, see if it's changed already." [laughs]

(Hank)

Moreover, processing and responding to the information was an arduous task that perhaps pulls focus to the details and away from the bigger picture.

...you're going from one extreme to another, and.. you're getting all of this information whereas when you finger prick, you just do it based on what you've eaten, how much insulin you need to go on, and then you don't know anything else. So there's a real information overload when you first start. (Madonna)

...I look at it on the big spreadsheet and I try and, you know cos there's various different options, try and find the right one, search around, find what I want to look at, and then I go "I'd rather look on my phone because it's a little bit more black and white." (Hank)

The emotional impact of dealing with the complexity was at times negative and caused increased worry.

...it does actually start to rule your life if you're not careful. Um it's the, it's the age old thing isn't it, one end of the scale is you barely ever tested your blood and you didn't really know what was going on, and the other end you're testing it every two minutes and you're thinking about what you should be doing and worrying about it and all the rest of it.. (Greg)

I honestly felt like I was being given a massive gift when I got the FreeStyle Libre, I thought "This is going to revolutionise my life." It has, it's given me a great deal of freedom, but it's also increased my anxiety really. Because you can't ignore it, it's there, looking at you all the time. If you look. And who doesn't look at their phone? (Lottie)

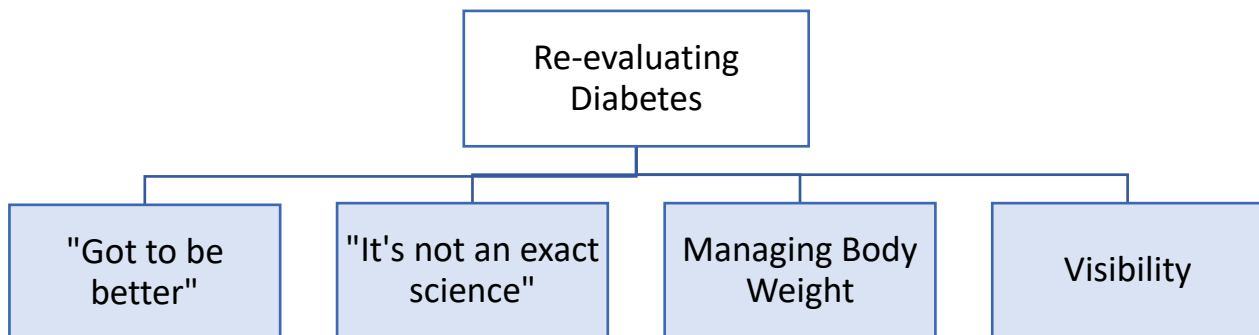
Lottie's description of the data "*looking at you*" reiterates that participants can feel under observation by the FSL, which feels critical or intimidating.

Overall, this theme outlined the ways in which participants were seen to relate to their bodies as machines requiring maintenance. Although none of the participants specifically used this metaphor, the way in which they described their experiences painted a picture of a meticulous, sometimes reluctant, engineer trying to maintain a complex system. Participants alluded to food as fuel, with natural urges being disregarded in favour of the system's requirements. In this way, approval had to be gained for food consumption. There was a sense that the data was a representation of the individual and therefore sometimes received as a negative judgement that disregarded the messiness of the human experience by reducing it to a number.

3.5 Theme 4: Re-evaluating Diabetes

Figure 7

Theme 4: Re-evaluating Diabetes



Within this theme, participants suggested that their relationship with diabetes had shifted because of FSL use. As a result of viewing their body as a complex data-producing system, participants expressed an expectation that well-controlled BG levels should be achievable. Conversely, others implied a realisation that despite their best efforts, perfect control is not possible. Participants also described feeling motivated and in control of diabetes, or feeling powerless in relation to diabetes and its dilemmas.

3.5.1 "Got to be better"

This subtheme illustrates participants' notion that failure to achieve perfect control is only through fault of their own.

Participants described the negative self-talk they experienced in relation to their diabetes control and food choices. There was an expectation that once they had instructions and equipment, they should be able to achieve the expected results.

I call it chatter, it chatters away at you all the time and sometimes it's not very nice chatter. It's saying "You've got to do this, you've got to do that, sort it out, why can't you just do that, it's so easy not to eat most things, blah blah blah." And you have all this going on whilst you're calm, doing everything that you've got to do in your day... (Lottie)

I blame on myself for everything. But it's my fault you know. I've been made aware of what I should be doing and the fact that I hadn't put it into place and put it into action, that's my fault. And I have to hold my hands up and say "Yes, that was me." (Harrison)

Participants blamed themselves for becoming distracted from diabetes' demands around mealtimes. However, Madonna implied that there was little utility in looking back, focusing instead on self-improvement.

...I've got a kid in a session for during lunchtime to go over an exam question...I was walking to my lesson, my alarm went off on my iWatch to say my glucose was high. And then I was like "Oh god I haven't put it in." So, but that's my fault...and I've kind of, I've kind of gone "Now it's gonna do that, I can't, I've just to be a bit more, I've got to be better, but I can't change it." (Madonna)

When the graph displayed unexpected results, frustration was rife amongst the data. All the planning and meal preparation did not feel worthwhile as the results implied participants' efforts were not good enough.

...there obviously is an explanation somewhere but, sometimes I just don't get it, because I'll think "I've worked out how many carbs are in the meal and I've done all the maths and the boring stuff.. and it's still.." yeh there's no.. I don't know if I put too much pressure on myself.. I don't really have an obvious explanation as to why I.. why it doesn't go to plan.
(Becky)

...you're making such an effort and you can still see on the graphs that it's not working. So, um. And you think "Oh for goodness sake, you know, I've done all this and I've made all this effort and there I am trying to make it work really well and it's still telling me that I'm not doing it right." (Sharon)

The data was therefore received as criticism at times. The colour-coded zones appeared to exacerbate this criticism, with several participants describing the colours having a significant impact on their mood and the out-of-range alarms nagging the individual to do better.

...if it's in the green, I scan it, it's like a sense of relief. It's a really strange thing to say, but I'm like "Oh yes, that's a relief." Because I was expecting the worse but actually I'm in range...But when I'm in amber, my mood, for that split second is not the same. It changes. So its like "Oh." You know and you can feel quite bad on yourself because you physically see the colour of amber and associating that to not being green which is good. (Bluebell)

...I suppose it gets me down a little bit, but so, you know, I can't.. if I want to have a lie in cos it's a Sunday morning and have Rice Crispies, I just know that doing that is.. it's going

to be beeping at me. Um but if I have the Weetabix then it won't, so it it's all.. Bit strange, it's strange... (Peter)

Bluebell's sense of relief suggests that each scan is an assessment of her competencies. Not only do levels in the green range offer her praise, they also perhaps allow her to return to her day, whereas amber levels belittle her attempts at control in addition to demanding further time and effort.

3.5.2 "It's not an exact science"

Conversely within this subtheme, participants acknowledged the many challenges associated with pursuing good control of their BG levels.

Participants appeared to express self-compassion through focusing on their efforts rather than outcome, as well as reminding themselves of the external factors³ that can impact their levels, thus moving from internal to external attribution.

I say that and I'm still not brilliant at it, but I'm doing as well as I can and I'm doing better than I did. (Lottie)

I always used to beat myself up about it before having the Libre because I'd think... "Maybe I made a mistake, maybe I didn't do that injection or the right amount of units or maybe there was more, you know, the carbohydrate content was higher than I

³ Factors such as temperature, stress, altitude, and hormone levels (menstrual cycle for females) can impact blood glucose levels (Brown, 2018).

bargained for.” But it’s kind of shown me that actually sometimes it’s not an exact science, so there’s so much other things that can influence those numbers and those graphs. (Dove)

Bluebell seemed to consciously reflect on her emotional state before approaching her data, so as not to punish herself if things were not going to plan, which seemed to be the expectation.

...I do actively try and look at it when I’m in sort of a balanced mindset. If I’m feeling worried about my diabetes I don’t tend to go and search all of the graphs to make myself feel worse...I don’t think sometimes it’s what you need to do. Um, I think, yeh I’ve always tried to approach it when I’m feeling quite calm and I’m able to accept that things aren’t going right... (Bluebell)

3.5.3 Managing Body Weight

This subtheme highlights participants’ relationship with their body shape and weight in the context of better control facilitated by the FSL. It was apparent that participants felt stuck in cycle of eating and insulin use that led to better control, but in turn impacted their ability to pursue their desired body weight.

I view insulin as fat juice. Because it does, it makes you fat. Um since being on the pump and I’ve got better control, um I’ve put on weight... So there’s always in the back of your mind “If I get really good control I’m going to live for longer but I’m actually going to be

fatter too.”...So it’s um, it’s a continual emotional, psychological battle, I think is the right word. And it is a battle. (Lottie)

...we’ve had these two weird years...life changed, it just became different and had to adapt, different foods because of the lack of exercise I think. Or do the opposite you know, find exercise.. different ways to do the exercise and if I couldn’t do that then I’d be needing to inject more insulin which then kind of is a vicious circle because then you put on more weight because you’re injecting more insulin. (Dove)

Lottie’s use of the battle metaphor implies that she recognises two opposing sides within herself, one which wants to pursue good control, and one which desperately wants to avoid feeling fat. The continual battle suggests that there is not a clear winner, as her priorities change over time.

3.5.4 Visibility

This final subtheme captures the impact of the FSL on the visibility of diabetes. Participants spoke about how wearing the FSL on their body influenced how they viewed themselves or were viewed by others.

Um I don’t particularly like wearing it, I feel like a robot because I’ve got a sensor and a pump, so I’ve got these things stuck to me. (Lottie)

So for me I didn’t ever want to be seen like.. as somebody that was ill. And in terms of you know being diabetic, people can’t.. you know people don’t know I’m diabetic when I walk

down the street. But people do know that there's something wrong when they can see my.. you know little machines and things attached to me. (Sarah)

The audible FSL alarms also increased others' awareness of the diabetes, which meant that participants had to explain diabetes more often. However, there was a sense that participants felt validated by people recognising the immense impact that diabetes had on daily life.

...my neighbour was round one time and my blood sugar alarm went off, I said "Oh it's just my blood sugar alarm" and she said "Oh, so actually it rules your life?" I said "Yeh it does." You know, people are getting the impact of it and socially wise. They are understanding what you're dealing with a little bit more. (Katie)

The audible alarms also meant that participants received novel prompts from others to manage levels. Although Aisling describes this light-heartedly, it is noteworthy that these voices add to the existing prompts from herself, the FSL, the diabetes team and any significant others.

...yeh even the girls are aware that if they hear my alarm go off that I, that I need to do something about it [laughs] so they're like "Aisling, take something!" or things like that. Or "Check your sugars!" (Aisling)

On the other hand, the FSL gave participants the option to hide the diabetes due to the reduced amount of equipment. They were able to scan themselves when eating in public

without having to feel self-conscious. It was unclear whether this simply made the process less laborious, or whether it made participants more likely to eat in public, or eat what they wanted in public.

I had quite a structured routine, a salad for lunch, hardly any carbs again so I didn't have to do too much injecting and stuff in the workplace because yeh I didn't want to make a fuss or whatever. (Dove)

It's so much more convenient...in social situations too. People don't even know when you're doing a scan... (Katie)

...you don't draw attention to yourself, you don't have loads of pens flying over the table and needles... (Bluebell)

Overall, the FSL had seemingly caused participants to reposition themselves in relation to the concept of good control and diabetes in general. At times, participants conveyed the impression that good control was an unreachable goal and their efforts were the most important thing, whereas at other times good control was portrayed as an exact science that required the correct calculations and consistency, and falling short of the goal was due to individual failures. For some, good control was associated with weight gain and feeling stuck in a vicious cycle.

3.6 Conclusion of Qualitative Analysis

Participants recalled memories from their life prior to diabetes that centred around food. For some, food appeared to be largely associated with social connections, pleasure and indulgence. For others, food already represented their identity or self-worth, particularly in relation to societal expectations around body weight and shape. The arrival of diabetes appeared to have a significant impact on participants' relationship with food, as food now represented survival, medication, and a sense of unfairness and deprivation, which typically meant a reduced enjoyment of food.

In many ways, the introduction of the FSL was experienced as liberating, as participants were able to quickly ascertain their BG levels without painful finger-prick tests. Participants gained novel insights into food and its impact on their BG levels which prompted a process of experimentation, reinforced by the ability to scan the FSL as often as needed. The shift from estimation and navigating snapshots of information to analysing trends and monitoring live feedback led to an increased sense of confidence and control regarding their diabetes management. Participants linked this new perspective with new eating habits, including revisiting previously loved but 'off-limits' foods, feeling able to eat with more freedom and flexibility, and viewing food as a source of pleasure. For some, a broader overhaul of eating habits occurred concurrently, including transition to a vegan diet or a healthy eating initiative.

Along with the new opportunities afforded by the FSL, the presence of the device on the body and the collection of continuous data highlighted the perpetual internal bodily processes. The metaphor of the body as a machine was used by the researcher to illustrate how participants appeared to view their body as a separate entity that required constant maintenance. Participants alluded to food as fuel with natural urges disregarded in favour of

the system's requirements; participants felt obliged to eat when they had no desire to, and some felt unable to eat when hungry. The data appeared to take an authoritative position whereby participants sought permission from the FSL in terms of when, what and how much to eat, and eating routines that prioritised consistency and predictability were often noted. Resultantly, it seemed the novel sense of freedom and flexibility had its limits. The ability of friends, family and professionals to scan users' bodies reinforced the notion of the body as a machine, and the reported focus on HbA1c and target ranges felt for participants as though their complex human experiences had been oversimplified.

The presence and impact of the FSL encouraged participants to re-evaluate their relationship with diabetes. Subtle swipes of the FSL offered users the choice to hide their diabetes when eating in public, which may enable an increasingly positive social experience centred around food. The accessibility of medical data meant that participants hoped for better control, and many shared the negative emotions that arise when such hopes do not materialise. An increased awareness of the many external factors that impact BG levels was apparent, as some participants acknowledged that control was not just about food and exercise. For some, better control was also associated with weight gain, which was an ongoing dilemma.

3.7 PAID Quantitative Analysis

The second research question aimed to explore how the standardised questionnaire used in clinic facilitates exploration of users' relationship with food and eating. Since October 2019, North Bedfordshire Adult Diabetes Service has used the PAID questionnaire (Polonsky et al., 1995) during review appointments to assess diabetes-related distress. Of the 20 questionnaire items, three questions reference food and eating:

Q4. Uncomfortable social situations related to your diabetes care (e.g. people telling you what to eat)

Q5. Feelings of deprivation regarding food and meals

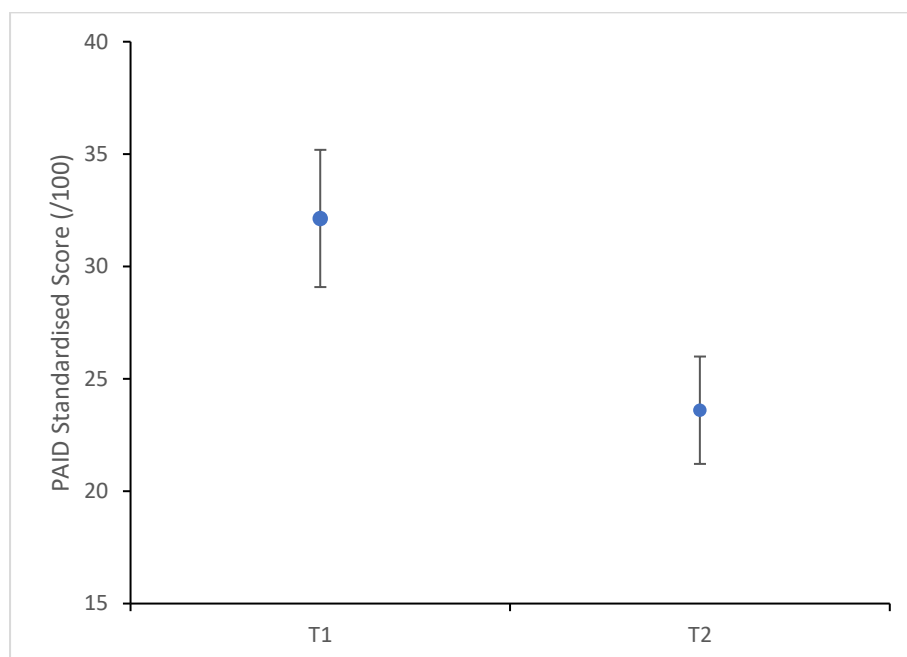
Q11. Feeling constantly concerned about food and eating

Figure 8 displays the mean standardised PAID scores, with 95% confidence intervals, completed by patients before using the FSL and approximately six months after⁴. After testing for normality, a paired samples t-test showed that scores at T1 (*Mean* = 32.14, *SE* = 1.55) were significantly higher than scores at T2 (*Mean* = 23.6, *SE* = 1.21), $t(198) = 6.83$, $p < 0.001$ (see Appendix O), demonstrating a significant reduction in diabetes-related distress after six months of FSL use. Unfortunately, as only total scores were available to the researcher, it was not possible to assess changes in scores over time for the food-related questions.

⁴ As clinics were on hold during the Covid-19 pandemic, regular contact was disrupted. Actual time of review appointment ranged from 4-13 months.

Figure 8

Standardised PAID Score Prior to FSL and at Six Month Review



Note: Figure 8 shows mean standardised PAID questionnaire scores with 95% confidence intervals for 199 adults with T1DM who completed the PAID questionnaire when commencing use of the FSL (T1) and again at their six-month review (T2). Data was collected between October 2019 and August 2021.

When comparing questionnaire data to the qualitative interview data, it is notable that despite the various challenges associated with FSL use identified by interviewees, there was a consensus that overall, it did have a positive impact on their diabetes self-management.

...it just makes um, like general day to day life a little bit easier. – Sarah

...such a positive impact on my daily management of it...I've not looked back. – Bluebell

...the Libre has helped manage life better. – Madonna

...it's really an amazing piece of equipment that has actually changed my life. – Becky

Regarding areas of difficulty identified by interviewees, it is likely that individual interpretation of the PAID questionnaire items and willingness of the patient to spontaneously offer further detail would have a significant impact on whether the questionnaire captured the patient's current relationship with food and eating. Table 10 shows the three food-related PAID items alongside experiences shared during interviews that could fall within the scope of interpretation.

Table 10

Comparison of PAID Items and Interviewee Experiences

PAID Item	Interview Participants Experience
<i>Q4. Uncomfortable social situations related to your diabetes care (e.g. people telling you what to eat)</i>	Feeling unable to eat at friends' houses Feeling self-conscious whilst injecting or getting out equipment when eating in public Other people hearing FSL alarms and offering advice/instructions
<i>Q5. Feelings of deprivation regarding food and meals</i>	Lack of enjoyment of food Feeling stuck in a rigid food routine Feeling unable to eat when hungry Feeling unable to eat certain foods at all Feeling unable to join spontaneous social meals Feeling stuck within rigid portion sizes
<i>Q11. Feeling constantly</i>	Feeling unsure about the carbohydrate content of food

<i>concerned about food and eating</i>	<ul style="list-style-type: none"> Feeling the need to obsessively check the data Feeling worried about making a 'bad' food choice Feeling guilty about 'cheating'
<hr/>	
Not captured by PAID questionnaire	<ul style="list-style-type: none"> Worries about weight gain Feeling irritated by having to eat when not hungry Feeling overwhelmed by the data Not understanding the data Feeling disheartened by the data Worries about sharing data with clinicians

In all, the PAID questionnaire does not appear to robustly explore the individual's relationship with food and eating, or the impact of technology on food and eating. It is acknowledged that the PAID questionnaire is proposed as a screening tool for diabetes distress to prompt further discussion. However, for some participants, the interview process appeared to encourage deeper reflection and aided sense-making of such experiences or approaches to eating that may not be offered by patients during brief clinic appointments. In this way, questionnaires that do not specify a range of difficulties are unlikely to capture the richness of patient experiences.

4. Discussion

4.1 Overview

This chapter begins with a discussion of the four themes in relation to existing theory and research. Following this, the researcher's reflections on the PAID questionnaire (Polonsky et al., 1995) are offered in light of the qualitative analysis. A critical appraisal of this study is then presented followed by a consideration of clinical and research implications and concluding remarks.

4.2 Summary of Findings

This research set out to investigate adults with T1DM experiences of the FSL flash glucose monitor in relation to its impact on their eating behaviour and relationship with food, given the limited body of existing research. The following section discusses the main findings of this research in relation to first research question, which was:

What are users' experiences of the FreeStyle Libre in relation to food and eating behaviours?

Through reflexive TA (Braun & Clarke, 2006, 2013, 2019), four themes were constructed from interviews with fifteen participants. The four themes were 'Personal Food Story', 'New Opportunities', 'Body as a Machine' and 'Re-evaluating Diabetes'. Whilst this study did not seek to find or understand an objective 'truth' regarding users' experiences, the constructed themes and associated subthemes offer an insight into life with the FSL and users' attitudes towards eating.

4.3 Relevance of the Findings to the Literature

4.3.1 Theme 1: Personal Food Story

The stories that participants shared regarding the role of food in their lives thus far were rich and varied. It was apparent that diabetes was responsible for several twists and turns, particularly for those who had contended with several phases of diabetes management practices. Thus, in addition to the typical stages of food habit formation spanning childhood, adolescence and adulthood (Köster, 2009) each shift in diabetes management approaches prompted a re-appraisal of food, eating attitudes and habits. Lawton and colleagues (2011) reported similar findings in their qualitative explorative of adults with T1DM experiences of the Dose Adjustment for Normal Eating (DAFNE) programme (McIntyre, 2006). Participants reported feeling empowered due to their new freedom to make informed choices about food. However, most participants reported eating practices which were remarkably resistant to change and in some cases, flexible intensive insulin therapy resulted in greater dietary rigidity, such as having to simplify food choices to make carbohydrate estimation easier. Participants snacked less to avoid injecting extra insulin and low carbohydrate foods were viewed as the healthiest or safest options due to fear of miscalculation and injecting too much insulin, resulting in hypoglycaemia. When patients had been diagnosed in childhood, dietary inertia appeared to have been reinforced by a lack of interest in food, and hence a lack of motivation to explore new food options. Considering the relentless cognitive demands associated with diabetes, it may be that opting for the least demanding actions, specifically cutting out foods that seem unpredictable, feels simpler than exploring new recipes or embracing additional snacks with additional insulin injections. In general, it may

be that each shift in management technique offers a wider range of potential opportunities which then gets whittled down to habits that can be practically maintained given the individual's available resources.

Participants in the current study appeared to categorise themselves in terms of what type of eater they were, for example a long-term dieter, a lover of food or a sensible eater. It was somewhat unclear if participants felt this categorisation changed following FSL use, however it seemed that participants remained faithful to their self-reported eating identities. For example, Bluebell was diagnosed in adulthood and said she had always been *"a big fan of food"* and unlikely to go for small portions. She later commented *"I eat more now than I did"*, suggesting that whilst the FSL had influenced her eating habits, if anything it had reconnected her with her feelings towards food. Similarly, Mickey was diagnosed in childhood and described his eating behaviour as *"very regimented"* for many years as implemented by his parents, but expressed pride at his determination to maintain good control even during adolescence. He later described his current strict routine of eleven days eating little to no carbohydrates followed by three days of eating what he wants; a routine he had maintained for 18 months. It could be that a regimented routine offers Mickey reassurance that he is in control via close adherence to his plan. Becker's (1963) labelling theory proposes that, as members of society treat individuals based on an assigned label, the individual can start to accept this position and behave in accordance with the expectations associated with the label. In a similar way, participants may continue to live and eat in accordance with their eating identity label, despite the introduction of the FSL.

4.3.2 Theme 2: New Opportunities

There was a consensus that FSL use had made participants more conscious about what they were eating and the effect it had on their BG levels, as captured in the 'Novel Insights' subtheme. This aligns with the health-tracking technology literature, wherein users reported increased self-awareness of food consumption following dietary self-monitoring (Hahn et al., 2021b; Lieffers et al., 2018), and altered perception of food, specifically in terms of its calorific content (Didžiokaitė et al., 2018; Laing et al., 2014).

Participants in Lieffers and colleagues' (2018) study reported that app use and feedback held them accountable, thus prompted reflection on behaviours to encourage improvements. Although the nature of the 'improvements' was not detailed, this process resembles Lottie's process of 'evaluating' foods. The visual representation of the food's impact on BG levels seemed to determine food's value; a large spike meant it was a 'bad' food and a smaller curve meant it was a 'good' food. Such clear depiction of the rate and magnitude of BG level fluctuations had likely not been seen before FSL use. Likewise, a recent study of individuals with T2DM who used the FSL for six weeks found that the graph changed user's perceptions of foods (Whelan et al., 2021). Participants were surprised that fruit caused bigger spikes than chocolate, which challenged their previous ideas regarding which foods to avoid to manage their levels. This cognitive reconfiguration, as described by Lawton and colleagues (2011), prompts individuals to engage with food differently. They reported that participants' new understanding about carbohydrate content of food resulted in participants perceiving low carbohydrate, rather than low fat or calorie foods, as the healthiest options. Healthy foods equating to low carbohydrate foods meant that participants reported eating high fat foods as they did not have to inject for it, whereas before, high fat foods were seen as an unhealthy choice. It is apparent that gaining novel

insights into the content and impact of food within a diabetes context can change the concept of what 'healthy' means, which poses challenges when this differs from societal narratives of 'healthy' and 'unhealthy'. This was demonstrated by Katie's dilemma "*...items of food that I think is healthy and is low-ish carb, isn't.*" when food marketed as 'healthy' in shops was high in carbohydrate.

Participants described making changes to their diet since using the FSL, including revisiting complex foods and experiencing a sense of freedom regarding what, when and how much they could eat. This aligns with the limited FSL literature. Arnason and colleagues' (2022) online survey investigated changes in diet and activity since using the FSL, using yes/no and Likert scale questions. Ten of the 41 participants were adults, of whom 60% made changes to the types of food they ate, and 40% decreased their portion sizes. Unfortunately, due to the yes/no questions, data was not collected regarding the types of changes that participants made to their food choices. The current study adds to this research, with participants descriptions of avoiding high-sugar foods, experimenting with a plant-based diet and feeling able to manage complex foods such as pizza. Adjustment of food intake following FSL use has been reported in further studies, with participants reporting eating more regularly to prevent hypoglycaemia and feeling freer to experiment with food types and bolus timings (Gautam et al., 2020; Pickup, Holloway & Sami, 2015), as reflected by participants in the current study. Interestingly, one Japanese study reported no significant changes to diet following 12 weeks of FSL use by individuals with either T1DM or T2DM (Ida et al., 2020). A Dietary Variety Score (DVS) was used to assess dietary intake and the questionnaire included ten food items. For each item participants could select the following frequency categories: "almost every day (1 point)," "once every 2 days (0 points)," "1–2 times per week (0 points)," and "rarely (0 points)", with a total score of 10. However,

the sensitivity of the questionnaire is questionable as it does not identify changes to portion sizes, timings or frequency within a day.

Despite the literature suggesting that health-tracking technology use encouraged some users to consume ready meals as they are easier to log (Honary et al., 2019; Lieffers et al., 2018), one participant in this study clearly stated that she avoids processed ready meals as they cause a big BG spike. Lottie described her new habit of baking and cooking food from scratch for better control, which had become apparent since using the FSL. This approach contradicts findings of Lawton and colleagues' (2011) study, wherein participants with T1DM who had recently completed the DAFNE programme described gravitating to packaged foods due to the labelled carbohydrate content. However, it may be that people living with diabetes initially transition to packaged foods to support them in carb counting, but then a second transition occurs when they are able to determine if the impact of packaged foods on their BG levels is problematic. It seems that the FSL plays a role in this second transition, coupled with individuals' increased confidence in carb counting, which may allow them to return to homemade food as they can see the benefits on the graph and, by that time, feel more confident in their carb counting abilities.

Several participants reported initiating wider diet changes at the same time as starting the FSL but did not feel it was linked. These included starting a vegan diet or healthy eating initiatives. Although these changes were not directly linked to the FSL, there was a sense that the opportunity for a re-evaluation of dietary habits was seized. Indeed, research suggests that users of health-tracking technologies often start using more than one self-monitoring system, such as food tracking and activity tracking (Hahn et al., 2021b; Hahn et al., 2021; Sarcona et al., 2017; Simpson & Mazzeo, 2017). It may be that the increased

insights offered by the FSL prompted a wider consideration of the participants' dietary habits and preferences.

In line with the FSL literature, participants reported that their hopes and goals for the FSL, which typically included better control and reduced HbA1c, had largely been achieved (Gleeson et al., 2019; Overend et al., 2019). It is notable that unlike health-tracking technology use, goal achievement is not associated with termination of use. For health-tracking technology users, app use reportedly reduces once the goal has been achieved, meaning that self-monitoring is typically a temporary activity (Didžiokaitė et al., 2018; Lieffers et al., 2018; Régnier & Chauvel, 2018). This highlights that management of T1DM is life-long endeavour, and although participants could choose to discontinue use of the FSL, most suggested they would never want to be without it. Such long-term use contrasts with most research into the effects FSL use, which typically involves evaluation of two months to a year of use, and therefore this study adds an important perspective to this existing body of research.

Participants described a new sense of confidence and competence to handle complex foods or spontaneous eating and, consequently, felt able to offer tips to family and friends living with diabetes. Sharing tips within the community mirrors health-tracking technology users who seek engagement with public forums to exchange recipes and tips with other users (Park, Weber, Cha & Lee, 2016; Régnier & Chauvel, 2018). Offering tips to peers in pursuit of a shared goal may reinforce the individual's sense of confidence and expertise, which in turn may increase motivation to act in accordance with that label. However, it may be that FSL users who feel confident to share tips and expertise have self-selected for this research, and therefore do not represent FSL users who do not feel able to talk about their difficult experiences due to social stigma. For health-tracking technology

users, it has been suggested that digital data about food practices contributes to concepts of selfhood, embodiment, and social relations (Lupton, 2018). The appearance of personal data also holds great value, as highlighted by activity-tracker users who shared that failure of the technology to record an activity is met with great disappointment, as the data represents and publicises their achievements (Honary et al., 2019; Régnier and Chauvel, 2018).

Participants in the current study portrayed a similar perspective through their accounts of sharing their FSL graphs with peers to celebrate a good day in range. Sharing data with peers may act as an additional motivator to keep levels in range by limiting food intake, in that users may avoid foods that cause spikes in BG so that they can share their 'good day' graph with peers and receive positive reinforcement and praise. This mirrors wider social media use, wherein typically only 'positive' snapshots of users' lives are shared.

Relatedly, use of health-tracking technologies has been associated with positive emotions, with users reporting feeling physically and emotionally better on days when they stayed within calorie recommendations (Hahn et al., 2021b; Sarcona et al., 2017). For people with T1DM, clearly staying in range means they feel physically better due to lack of hypo- or hyperglycaemic symptoms, but psychologically it is likely a similar experience. Indeed, Mickey shared that when he looks at the data he thinks "*I'm doing a good job*" and Sarah described the data offering her "*happy, empowerment, confident kind of feelings.*" As well as using the FSL to evaluate foods, it may be that participants use the FSL to evaluate themselves, and in addition to re-classifying foods as 'good' or 'bad', they are re-classifying themselves as a 'good diabetic' or a 'bad diabetic'.

4.3.3 Body as a Machine

The body as a machine metaphor implies that the body should not be guided by feelings such as hunger or boredom or desire, but by calculations. The concept that food is fuel, described by several participants, was linked to ignoring hunger urges and only consuming food if it was absolutely necessary, including to prevent hypoglycaemia. In their online survey of undergraduate students, Hahn and colleagues (2021) found that individuals who engaged in high amounts of weight-related self-monitoring were more likely to report fasting and skipping meals. A comparable perspective was described by Mickey as he explained not eating breakfast since learning that his body does not 'need' it, referencing the Dawn Phenomenon (Bolli & Gerich, 1984). Bluebell also described only eating if the time was right, specifically if it had been more than four hours since the last snack, and how the FSL had aided this regimented process. Such accounts tended to highlight a sterile, restrained, and ambivalent relationship with food. As identified in health-tracking technology literature, the increasingly detailed data on bodily functions can make it easier to place more importance in the numbers rather than bodily sensations (Lupton, 2013). This also offers strong links with eating disorder presentations, wherein signals from the body, such as hunger and pain, are ignored.

Rigid eating routines have also been described in a qualitative study of five focus groups of 30 people with T1DM, 40% of whom were using CGM (Martyn-Nemeth, Duffecy, Fritschi & Quinn, 2019). Their participants described eating the same things Monday-Friday to be sure of the required insulin amount and one participant commented that they knew too much about food, and that it is hard to have a healthy relationship with food because they associate food with its consequences. Moreover, another participant shared "*When I see a plate of food, I see a plate of numbers*" (p.14). Conversely, some reported that

hypoglycaemia offered permission to eat as much and whatever they wanted. It is clear that previous research supports current participants' experiences of the FSL reinforcing the perception of food as a mathematical problem. Viewing food as consequences echoes Hayley's description of the graph popping into her mind when she looks at food, as though threatening her with a steep peak or giving her the nod of approval with a steadier curve. The FSL data therefore appears to hold an authoritative position with participants seeking permission to eat. This relates to health-tracking technology research that found that users generally follow the calorie and nutrient limit offered by the technology without question (Didžiokaitė et al., 2018; Lieffers et al., 2018). This careful, calculated approach to food appears to be at the opposite end of the spectrum to viewing food as a source of pleasure. Following the novel insights into carbohydrate or sugar content of food facilitated by the FSL, the FSL appears to encourage a data-heavy, sterile approach to food and eating.

Continual collection of data creates the impression of being under constant observation. This was reflected in Lottie's comment regarding the data "*looking at you*" and Hank's account of feeling as though he has to answer to the data when his levels are out of range. Participants seemed aware that they could have no secrets from the data. In their online survey study of 100 participants using CGM, Pickup, Holloway and Samsi (2015) found that anxieties associated with CGM were commonplace, including the stress of seeing poor results and participants feeling as though they have "*no hiding place*". In contrast, users of food-tracking apps often report cheating the data by not logging 'bad' foods (McCaig et al., 2020), even though data can be kept private. FSL users do not have this privilege, which perhaps exacerbates the felt need to cut out problematic foods or not respond to hunger cues or desires, as it will be added to their permanent record and investigated by the diabetes team.

4.3.4 Re-evaluating Diabetes

Participants suggested that their relationship with diabetes had shifted because of FSL use. For some, the FSL encouraged a perfectionistic attitude towards optimal diabetes control and created the impression that due to the large amounts of accessible data, it should be possible to keep BG levels in range, if they tried hard enough. This is in addition to a perfectionistic approach to food reportedly caused by diabetes in general (Goebel-Fabbri, Copeland, Touyz & Hay, 2019). Deviations in BG levels were interpreted as a failure of the individual, which had a negative impact on mood and motivation. This resembles health-tracking technology literature, wherein highlighted discrepancies between desired and actual achievement can reportedly reduce users' motivation to pursue their goals (Dennison et al., 2013).

The colour coded data was also interpreted as praise when levels were in the green zone, but as criticism when levels were in the amber or red zones. Bluebell described the drop in her mood when a scan reveals her levels are in the amber range, which can feel discouraging. This is similar to food-tracking technologies that display calorie consumption as red or green, creating a dichotomous 'succeed or fail' scenario which can negatively impact self-esteem (Eikey & Reddy, 2017). There is also no acknowledgement of efforts or small improvements.

The rationale behind self-tracking is not the passive collection of data but the process of self-reflection, which acts as a catalyst for positive changes and self-knowledge (Eikey et al., 2021). Lengelle, Luken and Meijers (2016) defined self-reflection as "an active and intentional process of becoming conscious of and understanding experiences in order to learn from them in the future." Reflection can therefore assist individuals to problem-solve,

driven by a genuine curiosity or interest in the self. However, self-reflection can at times lead to negative thought and emotion cycles when failure is attributed to internal factors and self-worth. Rooksby and colleagues (2014) interviewed 22 users of activity-trackers and identified that for most people, tracking was directly related to self-esteem. For some, it tied into pride at completing sporting events, but for others it seemed that, instead of gaining a new understanding about themselves, they were reinforcing negative thought patterns about themselves through tracking. This is similar to Harrison's comment about struggling with consistency and not being able to maintain new habits for more than a fortnight, which he described as a failing on his part and seemed to be highlighted by the FSL data.

Li, Dey and Forlizzi (2010) have proposed the Stage-Based Model of Personal Informatics Systems, wherein self-tracking consists of five distinct yet iterative stages: preparation, collection, integration, reflection and action. Notably, self-criticism was identified to be a barrier to reflection across a wide variety of self-tracking habits. Adults with multiple chronic conditions report experiencing negative emotions and moral judgements from tracking, including being reminded of their illnesses and feeling guilty after seeing their data (Anker et al., 2015). Anker and colleagues found that, for their interview participants, data was not discussed as value-free facts but instead carried strong emotional and evaluative connotations. Therefore, because the outcomes of self-tracking are largely dependent on the reflection process, when users do not engage in self-reflection but rather self-criticism, the expected benefits of self-monitoring are less likely to be achieved.

The emotional impact of the data was highlighted by many participants including Becky, who commented "*the more pressure I put on myself to try and sort of, stay semi within target, it all goes completely wrong*", implying that increased self-criticism and stress

did indeed undermine her efforts to stay in range. In their qualitative study, Boucher and colleagues (2020) noted one participant who scanned their FSL but did not read the result due to being upset by anticipated high readings and would only look at the data later when they felt emotionally ready. This is mirrored by Bluebell's comment that she only attempts to review her data when in a balanced mindset, otherwise it feels like punishment.

Avoiding looking at data because the user fears it to be out of range could lead to avoidance of scanning and therefore not responding with insulin when required. This could lead to high BG levels and missed insulin doses, which would cause weight loss, which could be positively reinforced by comments from others or the individual's own appraisal. A study exploring momentary predictors of insulin restriction among adults with T1DM and eating disorder symptomology found that individuals were more likely to restrict insulin when experiencing increases in anxiety, guilt or shame before eating, or when breaking a dietary rule such as 'no desserts' (Merwin et al., 2015). This highlights that perceiving eating as bad or wrong can have significant implications for diabetes care. Although it is not uncommon for individuals with T1DM to follow rules and routines, if deviations from these self-imposed guidelines feel like a personal failure, they may lead to maladaptive responses such as insulin restriction. Participant's perceptions of food as 'good' or 'bad', or feeling guilty of 'cheating', imply that instead of food representing sustenance and nourishment, it can symbolise moral transgression.

In the current study, no participants reported omitting insulin but two female participants reported knowledge of this as a weight loss technique and several participants shared frustrations about feeling unable to control their weight. Lottie's comment that she views insulin as fat juice is similar to previous studies wherein injecting insulin has been described by people with diabetes as similar to injecting fat or lard (Staite et al., 2018). This

is concerning considering that it is estimated that by the age of 25, up to 60% of females with T1DM will have experienced an eating disorder (Colton et al., 2015). In addition to better education regarding what insulin does and its association with weight, one possible way to mitigate rumination and self-criticism in response to self-tracking data would be practicing self-compassion. The subtheme 'It's not an exact science' illustrated participants' acknowledgement of their efforts despite the outcomes, and the view that due to the multiple external factors that influence BG levels, they may never be able to achieve perfect control.

Self-compassion can be considered as treating oneself with care and concern especially during painful experiences or feelings of inadequacy (Smeets, Neff, Alberts & Peters, 2014), and has been shown to be negatively associated with self-criticism, depression, anxiety and perfectionism (Neff, Rude & Kilpatrick, 2007). Eikey and colleagues (2021) proposed that designers could incorporate the principles of self-compassion into self-tracking technologies, for example by offering a self-compassionate message if the user does not reach their goal that day. Encouraging self-compassion via contact with the diabetes team and even through the FSL could be of great benefit to the mental health of people living with diabetes, for example via attempts to refute the concept of 'good' and 'bad' foods by re-classifying them as 'everyday' and 'sometimes' foods, thereby giving users permission to eat without the associated moral judgement.

The 'Visibility' subtheme highlighted that participants felt able, at times, to choose to hide the diabetes, as swiping the FSL was less obvious to the lay person than conducting a finger-prick test. This seemed to make social eating and eating in public easier, as participants felt less self-conscious and were able to enjoy their meal due to less required preparation. In their qualitative study, Overend et al (2019) explored forty participant

responses to the FSL audit questionnaire following six months of use and found an increased feeling of confidence and empowerment was common among users, and for some this confidence was significant in reducing social isolation as it gave them the confidence to go out without friends or family. Similarly, for participants in this study, the FSL seemed to offer novel freedoms from social stigma, as highlighted by comments from Katie “*People don’t even know when you’re doing a scan...*” and Bluebell “*...you don’t draw attention to yourself...*”, implying relief at not having to announce their health condition to other customers.

4.4 Reflections on the Problem Areas In Diabetes (PAID) Questionnaire

This section discusses the second research question, which was:

How does the standardised questionnaire used in clinic facilitate exploration of users’ relationship with food and eating?

Within the 20-item PAID questionnaire (Polonsky et al., 1995), three questions focus on food and eating:

Q4. Uncomfortable social situations related to your diabetes care (e.g. people telling you what to eat)

Q5. Feelings of deprivation regarding food and meals

Q11. Feeling constantly concerned about food and eating

In light of the themes resulting from the qualitative analysis, it was concluded that the PAID questionnaire does not appear to robustly explore the individual's relationship with food and eating, or the impact of technology on food and eating. Although the three food-related questions may be interpreted in a variety of ways, the simple statements did not capture the various areas of difficulty shared by interview participants, and are unlikely to prompt reflection on the rich and varied experiences and challenges related to food and eating in the context of FSL use.

The PAID questionnaire has high internal reliability and good concurrent validity (Welch, Jacobson & Polonsky, 1997) and its psychometric properties have been deemed acceptable for use in a range of countries, including Sweden, Norway, Iceland, the Netherlands and the U.S.A (Arnsberg et al., 2008; Graue et al., 2012; Sigurdardottir & Benediktsson, 2008; Snoek et al., 2000). However, the sensitivity of the questionnaire to detect changes in distress levels is questionable when considering the literature. In their RCT of forty adults with T1DM, Reddy and colleagues (2018) randomised participants to either the Dexcom or the FSL to explore their impact on hypoglycaemic awareness. After eight weeks, time spent in hypoglycaemia and fear of hypoglycaemia significantly reduced, with greater reductions in the Dexcom group. However, PAID scores for both groups at eight weeks did not change, despite a significant decrease in hypoglycaemia fear. In their pilot service evaluation, Whitehouse et al (2020) offered the FSL to eleven adults with T1DM to assess its impact on diabetes-related distress as measured by the PAID. After three months, there was no change in the PAID score despite improved glycaemic control. However, participants' weight significantly increased over the three months, which may have undermined the psychological benefits of improved control.

The more recently developed Diabetes Distress Scale (DDS) (Polonsky et al., 2005) is a 17-item measure that utilises four subscales to identify issues related to Emotional Burden, Physician-related Distress, Regimen-related Distress and Interpersonal Distress. This measure has two questions related to food or eating:

Q7. Feeling that friends or family are not supportive enough of self-care efforts (e.g. planning activities that conflict with my schedule, encouraging me to eat the “wrong” foods)

Q12. Feeling that I am not sticking close enough to a good meal plan

Schmitt and colleagues (2016) compared the PAID and the DDS to discriminate their psychometric capabilities and functions. Authors proposed that the PAID covers a greater variety of emotional concerns (including diabetes-related emotional burn-out and diabetes non-acceptance), which is supported by its higher associations with depressive symptoms and undesirable coping skills. More recently, Fenwick and colleagues (2018) also examined the psychometric properties of the PAID and the DDS and suggested that the PAID is the most psychometrically robust tool to assess diabetes distress in clinical settings. Considering that diabetes distress has been associated with psychological wellbeing regardless of age, with individuals in high diabetes distress reporting significantly greater concerns about eating, shape and weight and lower self-esteem than those with low or moderate distress (Powers, Richter, Ackard & Craft, 2017), measures that accurately detect changes in distress levels are vital.

As both the PAID and the DDS were developed and validated using data from mixed (T1DM and T2DM) samples, diabetes type-specific measures of diabetes distress have since

been proposed. Indeed, Fisher and colleagues (2015) explored unique sources of diabetes distress for adults with T1DM via interviews with 25 adults with T1DM and ten diabetes healthcare providers. Survey items were then developed and analysed using a large sample of adults in America and Canada, which informed the T1DM Distress Scale (T1-DDS). Seven sources of distress were identified: Powerlessness, Negative Social Perceptions, Physician Distress, Friend/Family Distress, Hypoglycaemia Distress, Management Distress, and Eating Distress. Interestingly, feelings of Powerlessness and Eating Distress had the highest mean levels in the survey sample. The T1-DDS is a 28-item scale which includes three items related to eating distress:

Q2. Feeling that I don't eat as carefully as I probably should

Q16. Feeling that thoughts about food and eating control my life

Q23. Feeling that my eating is out of control

It seems that focus on food and eating is not prioritised or has been overshadowed by alternative diabetes-related issues, and is an area not covered in detail by measures of diabetes distress. However, measures such as the T1-DDS may be a better option to identify a difficult relationship with food and eating. In the case of reported distress associated with eating, it is considered that a screening questionnaire specifically aimed at disordered eating in diabetes be used, such as the Diabetes Eating Problem Survey-Revised (DEPS-R) (Markowitz et al., 2010) or the mSCOFF (Zuijdwijk et al., 2014). However, these cover weight loss and insulin omission rather than solely disordered eating behaviours or an unhealthy relationship with food that does not meet clinical cut-offs.

4.5 Clinical and Research Implications

Whilst the themes from this research are situated within its context of time, place and co-constructions between all who were involved, the researcher proposes that it can offer a significant contribution towards improving the experiences of FSL users. Clinical and research implications are offered in Table 11.

Table 11

Clinical and Research Implications

By Whom	Approach Used
FreeStyle Libre Users	<ul style="list-style-type: none"> • Participants described the importance of peer support and user perspectives of the FSL. As well as completing the required online modules before commencing FSL, it may be beneficial for users to hear balanced and informed accounts of FSL benefits and challenges, for example in the form of video testimonials or blogs. This could include advice to not overreact to the data or sharing emotional responses to the data, to reduce new users' potential sense of shame or isolation. These could be shared online, e.g. Diabetes UK and Digibete websites.
Diabetes Specialist Clinicians	<ul style="list-style-type: none"> • It was apparent that insulin can represent weight gain or "<i>fat juice</i>". Considering the risks associated with insulin omission, increased awareness of the psychological barriers to insulin use is pertinent (Hendrieckx, Halliday, Beeney & Speight, 2019). Screening tools, such as the Insulin Treatment Appraisal Scale (ITAS) (Snoek, Skovlund & Pouwer, 2007) can be useful for eliciting individual barriers to use. Similarly, increased education regarding the function of insulin and its association with weight gain could be beneficial in reducing shame and negative body image perceptions.

-
- Type-specific measures of diabetes distress, such as the T1-DDS (Fisher et al., 2015) are recommended as a conversation scaffolding tool to support discussion about the patient's perception of food and emotional response to eating.
 - A brief questionnaire, such as the modified SCOFF adapted for diabetes (mSCOFF) (Zuijdwijk et al., 2014), can be used as a first step screening questionnaire for disordered eating.
 - Flash glucose monitoring (FGM) is recommended in new guidelines for managing eating disorders within T1DM (Royal College of Psychiatrists, 2021), therefore increased awareness of the impact of FGM on users' relationship with food and eating is crucial, of which this thesis is a starting point, particularly considering the impact of the data on those with eating disorder symptomology who may present with perfectionist tendencies.
 - Participants who had been recently diagnosed expressed challenges associated with adjustment to the diabetes diagnosis, adjustment to flexible intensive insulin therapy and adjustment to the FSL within a short space of time. These participants reflected that they perhaps found the data more overwhelming as they were still trying to process information and the short-term and long-term risks associated with suboptimal diabetes management were fresh in their mind which increased their anxiety. It may be beneficial to offer these individuals additional support or more frequent review appointments in relation to FSL use, focusing on stress and anxiety levels.
 - Language matters: due to the FSL offering novel insights into the effect of food on blood glucose levels, clinicians should be mindful of categorising food as 'good' or 'bad', which can be interpreted as the user being a 'good' or 'bad' person. Similarly, although awareness of HbA1c is important, drawing attention to efforts, small achievements and enquiring about user wellbeing holds equal importance to increase resilience and reduce feelings of guilt and shame.
-

Abbott (FreeStyle Libre designers)	<ul style="list-style-type: none"> • Research has identified the responsibility of app and device designers to protect users, particularly those at risk of disordered use (Eikey et al., 2021; Honary, Bell, Clinch, Wild & McNaney, 2019). The FSL could offer a notification if the user has scanned more than 20 times a day to highlight potential obsessive scanning. If time in target is lower than expected, the FSL could offer the user a compassionate self-reflective message or question, for example enquiring about relevant external factors or challenges overcome that day. Alternatively, the FSL could offer messages highlighting small positive changes or achievements in relation to the data. • Involve experts by experience in the FSL design process.
---	--

Researchers	<p>To the researcher's knowledge, this is the first study to explore the impact of the FSL on users' relationship to food and eating using qualitative methodology. Application of the same research question to novel populations is recommended, specifically:</p> <ul style="list-style-type: none"> • Recruit participants diagnosed with T1DM in the past five years, whose experiences are not based on historic, rigid self-management practices spanning previous decades that likely impact their relationship with food and their point of comparison for the FSL. • Recruit young women with T1DM who are more at risk of disordered eating (Grylli, Darwautz, Hafferl-Gattermayer & Schober, 2003; Nielson, Emborg & Molbak, 2002; Starkey & Wade, 2010). • Recruit participants who have already been identified as presenting with disordered eating who may show perfectionistic approaches to the data. • Recruit parents of children with T1DM who make decisions about the child's diet and eating habits. • Recruit adolescents with T1DM who may be practicing more independence with their diabetes self-management and making decisions about food and eating habits.
-------------	--

-
- Given previous research highlighting differences in diabetes technology use amongst racially minoritized groups (Boucher et al., 2020) recruit participants from racially minoritized backgrounds who may have different experiences of technology or different cultural influences in relation to food and eating.
-

4.6 Critical Appraisal

As a predominantly qualitative study, traditional ‘quality’ criteria such as generalisability, objectivity and validity are less relevant (Guba & Lincoln, 2005); nevertheless, it is important to evaluate the robustness and integrity of all research. Tracy’s (2010) “Big-Tent” criteria has been chosen to appraise the qualitative side of the study. Table 12 summarises how the study addresses each criterium, given that the quality assessment has been a dynamic, continual process of interrogation throughout the research project.

In relation to the PAID data, the sample represents patients receiving support from one adult diabetes service predominantly during the Covid-19 pandemic, a time where diabetes-related distress may have been elevated. As patients without complete PAID data for T1 and T2 were excluded, the sample does not represent patients who did not or were unable to attend appointments, which may be associated with diabetes-related distress or challenges.

Table 12

Critical Appraisal of the Study

Critical Appraisal of Research Using “Big-Tent” Criteria for Qualitative Quality (Tracy, 2010)			
	Description of Criteria	Strengths	Limitations
Worthy Topic	The topic chosen for research is relevant, timely, significant and interesting.	<ul style="list-style-type: none"> • The recent and increasing availability of the FSL on the NHS means that research and findings are timely and highly relevant. • Research is significant given the lack of research on experiences of the FSL in relation to eating behaviour using qualitative methods. 	
Rich Rigour	Sufficient richness and abundance of data sources, samples. Rigorous data analysis procedure which is sufficiently complex and in-depth to be able to describe phenomena being studied.	<ul style="list-style-type: none"> • Although the analysis of participants experiences was informed by the lens through which the researcher views the world, this research attempts to convey the voices of people living with T1DM using the FSL. • A good sample size (15) comprising individuals of different backgrounds, ages and genders supports research to achieve data sufficiency. 	<ul style="list-style-type: none"> • Though the researcher made attempts to have representation from people living with T1DM from diverse backgrounds, it was difficult to recruit participants under age 30 and from outside the White British demographic. • Due to Covid-19 restrictions, the recruitment happened online through email, impacting recruitment of

		<ul style="list-style-type: none"> • Rigorous recruitment procedures were used to ensure abundant data collection. Interviews were offered during working hours, evenings and weekends via participants' preferred method e.g. phone/video. • Complex and appropriate analysis (reflexive TA) used, with consistency checks (e.g., by supervisors, expert by experience and peer) and reported in a transparent manner within the study. 	<p>individuals who do not regularly access their emails or have limited IT skills.</p>
<p>Sincerity</p>	<p>Self-reflexivity about researcher's biases, goals. Honesty, transparency about research process including challenges.</p>	<ul style="list-style-type: none"> • The voice of the researcher is present with the use of the first person where appropriate and reflexive accounts including excerpts from the research diary, documented in Appendix A. • Outsider researcher position enabled the researcher to approach the project with a deeper curiosity, whilst clinical experience in a diabetes service offered 	<ul style="list-style-type: none"> • Due to DClInPsy time constraints, only participants who responded promptly were recruited. Had there been a second recruitment attempt, a more diverse sample may have been recruited. • Due to Covid-19 restrictions, interviews were conducted online or via telephone. Emotional cues were likely lost during telephone interviews, however the

		<p>some insights into the challenges faced by participants.</p> <ul style="list-style-type: none"> • Self-reflexivity was practiced in several ways including the reflective diary, wearing the FSL for two weeks and keeping a reflective diary, and writing and reflecting on the researcher’s own relationship with food and eating. • Transparency achieved through describing the research process in detail, honestly and reflectively. 	<p>anonymity offered by telephone may have encouraged participants to share their experiences more freely.</p>
Credibility	<p>Study demonstrates trustworthiness and plausibility of research findings.</p>	<ul style="list-style-type: none"> • Participant quotations from multiple transcripts included in results to thicken descriptions and provide rich narratives. • Analysis of themes from different perspectives, including supervisors and experts by experience. 	<ul style="list-style-type: none"> • Participants receive support from one diabetes service, therefore experiences of other adult diabetes services or clinical teams are not represented. • Did not enquire about occupation or other members of the household which may influence participants eating habits.
Resonance	<p>Study’s ability to influence or move reader by presenting text</p>	<ul style="list-style-type: none"> • It is difficult to objectively comment on whether this research moves people or 	<ul style="list-style-type: none"> • Participants had all been diagnosed with T1DM in the UK and so likely to have had

	<p>which is clear, evocative, and promotes empathy and identification. Study’s ability to generate knowledge resonance for different contexts, situations, audiences.</p>	<p>is evocative, but supervisory input increased the chances of a clear and meaningful study. Research has transferability as readers may find it resonates with their own personal experiences.</p> <ul style="list-style-type: none"> • A significant amount of quotes are used to allow the reader to connect with the participant accounts. • Inconsistencies between participants accounts were highlighted and interpreted. • Within the discussion the resonance of the findings are explored and linked to theory and research. 	<p>similar experiences of support from services.</p>
<p>Significant Contribution</p>	<p>Study makes important contribution to the field by improving/extending knowledge, theoretical understandings, or clinical practice.</p>	<ul style="list-style-type: none"> • This research project contributes to a very limited literature regarding FSL users experiences in relation to their relationship with food, and provides insight into the opportunities and 	

		challenges they faced. The discussion makes recommendations for how diabetes services can support FSL users.
Ethical	Adherence to professional/research ethics guidelines, responding ethically to issues which arise in research process.	<ul style="list-style-type: none"> • Ethical approval was granted by the University of Hertfordshire’s Health, Science Engineering & Technology Ethics Committee and the NHS Health and Social Care Research Ethics Committee B (HSC REC B). • Ethical considerations are adhered to throughout the research project. • The supervisory team and experts by experience meant that different viewpoints regarding ethics were considered. • Findings will be disseminated via academic journals, local diabetes and eating disorder services, research conferences and in accessible format for people living with T1DM.

Meaningful Coherence	Whether study achieves its stated aims. Coherence between epistemological position of research and research design, data collection, and analysis.	<ul style="list-style-type: none">• Attention given to coherent use of critical realist epistemology, interviews, and TA methodology, which are compatible and align to the project goal.• Existing literature, findings of this study, and interpretations are interconnected (see discussion), and meaningful implications and recommendations discussed.	<ul style="list-style-type: none">• Participants voluntarily shared both positive and negative experiences associated with the FSL and no participants reported or appeared to have alternative agendas for taking part in the research.
---------------------------------	--	--	--

5. Conclusion

This thesis has provided a critical review of current knowledge in relation to the use of health technology and has contributed an in-depth understanding of the impact of the FSL on users' relationship with food and eating, whilst considering the strengths and limitations of this method of enquiry. This original in-depth study has increased understanding, an important endeavour, not only as diet and lifestyle factors are vital components of diabetes self-management, but also to encourage consideration of a healthy relationship with food and quality of life among individuals using the FSL. It is important to include assessment of eating disturbances and body dissatisfaction when seeking to reduce diabetes distress and improve mental health of individuals living with T1DM. This work has demonstrated an ability to conceptualise, design and implement a project for the generation of new knowledge with the potential to influence developments in NHS diabetes and eating disorder services across England, as well as to raise awareness and even inspire action at the community and individual level.

References

- Abbott Diabetes Care. (2022). *FreeStyle Libre*. <https://www.freestylelibre.co.uk/libre/>
- Al Hayek, A. A., Robert, A. A., & Al Dawish, M. A. (2020). Effectiveness of the freestyle libre flash glucose monitoring system on diabetes distress among individuals with type 1 diabetes: a prospective study. *Diabetes Therapy*, *11*(4), 927-937.
- Alderisio, A., Bozzetto, L., Franco, L., Riccardi, G., Rivellese, A. A., & Annuzzi, G. (2019). Long-term body weight trajectories and metabolic control in type 1 diabetes patients on insulin pump or multiple daily injections: a 10-year retrospective controlled study. *Nutrition, Metabolism and Cardiovascular Diseases*, *29*(10), 1110-1117.
- Allan, J. (2017). Diabetes and eating disorders: update to the NICE guideline. *Journal of Diabetes Nursing*, *21*(3), 103-107.
- Allan, J. A. (2019). *Understanding, measuring and treating eating disorders in those with type 1 diabetes* (Doctoral dissertation, Birkbeck, University of London).
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington: American Psychiatric Publishing.
- Amsberg, S., Wredling, R., Lins, P. E., Adamson, U., & Johansson, U. B. (2008). The psychometric properties of the Swedish version of the Problem Areas in Diabetes Scale (Swe-PAID-20): scale development. *International Journal of Nursing Studies*, *45*(9), 1319-1328.
- Ancker, J. S., Witteman, H. O., Hafeez, B., Provencher, T., Van de Graaf, M., & Wei, E. (2015). "You get reminded you're a sick person": personal data tracking and patients with multiple chronic conditions. *Journal of Medical Internet Research*, *17*(8), e202.

- Anderson, E. S., Winett, R. A., & Wojcik, J. R. (2007). Self-regulation, self-efficacy, outcome expectations, and social support: social cognitive theory and nutrition behavior. *Annals of Behavioral Medicine, 34*(3), 304-312.
- Arnason, T., Cameron, A., Nour, M., Inman, M., & Mansell, K. (2022). A survey of reported changes in diet and activity with the FreeStyle Libre flash glucose monitor: a pilot study. *Practical Diabetes, 39*(1), 12-17a.
- Aure, C. F., Kluge, A., & Moen, A. (2020). Promoting dietary awareness: Home-dwelling older adults' perspectives on using a nutrition application. *International Journal of Older People Nursing, 15*(4), e12332.
- Aure, C. F., Kluge, A., & Moen, A. (2021). Older Adults' Engagement in Technology-Mediated Self-Monitoring of Diet: A Mixed-Method Study. *Journal of Nursing Scholarship, 53*(1), 25-34.
- Becker, H. S. (1963). *Outsiders: Studies in the sociology of deviance*. Free Press.
- Bolinder, J., Antuna, R., Geelhoed-Duijvestijn, P., Kröger, J., & Weitgasser, R. (2016). Novel glucose-sensing technology and hypoglycaemia in type 1 diabetes: a multicentre, non-masked, randomised controlled trial. *The Lancet, 388*(10057), 2254-2263.
- Bolli, G. B., & Gerich, J. E. (1984). The "dawn phenomenon"—a common occurrence in both non-insulin-dependent and insulin-dependent diabetes mellitus. *New England Journal of Medicine, 310*(12), 746-750.
- Boucher, S., Blackwell, M., Galland, B., de Bock, M., Crocket, H., Wiltshire, E., ... & Wheeler, B. (2020). Initial experiences of adolescents and young adults with type 1 diabetes and high-risk glycemic control after starting flash glucose monitoring—a qualitative study. *Journal of Diabetes & Metabolic Disorders, 19*(1), 37-46.

- Boutaud, J. J., Becuț, A., & Marinescu, A. (2016). Food and culture. Cultural patterns and practices related to food in everyday life. *International Journal of Reviews and Research in Social Sciences*, 6(1), 1-3.
- Bracken, M. L., & Waite, B. M. (2020). Self-Efficacy and Nutrition-Related Goal Achievement of MyFitnessPal Users. *Health Education & Behavior*, 47(5), 677-681.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
- Braun, V., & Clarke, V. (2012). Thematic analysis. In Cooper, H., Camic, P.M., Long, D.L., Panter, A.T., Rindskopf, D., Sher, K.J. (Eds.), *APA Handbook of Research Methods in Psychology, Research Designs, Vol. 2* (pp. 57–71). American Psychological Association.
- Braun, V., & Clarke, V. (2013). *Successful qualitative research: A practical guide for beginners*. Sage Publications Ltd.
- Braun, V., & Clarke, V. (2014). Thematic analysis. In Teo, T. (Ed.), *Encyclopedia of Critical Psychology* (pp. 1947–1952). Springer.
- Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4), 589-597.
- Braun, V., & Clarke, V. (2021). Can I use TA? Should I use TA? Should I not use TA? Comparing reflexive thematic analysis and other pattern-based qualitative analytic approaches. *Counselling and Psychotherapy Research*, 21(1), 37-47.
- Braun, V., & Clarke, V. (2021). One size fits all? What counts as quality practice in (reflexive) thematic analysis?. *Qualitative Research in Psychology*, 18(3), 328-352.
- Braun, V., & Clarke, V. (2021). Thematic analysis. In Coyle, A., & Lyons, E. (Eds.), *Analysing Qualitative Data in Psychology* (pp, 128-147). Sage Publications Ltd.

Braun, V., & Clarke, V. (2021). To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. *Qualitative Research in Sport, Exercise and Health, 13*(2), 201-216.

Braun, V., & Clarke, V. (2022). Conceptual and design thinking for thematic analysis. *Qualitative Psychology, 9*(1), 3-70.

Brown, A. (2018). *42 Factors That Affect Blood Glucose?! A Surprising Update*. Diatribe Learn. <https://diatribe.org/42-factors-affect-blood-glucose-surprising-update>

Bryden, K. S., Neil, A., Mayou, R. A., Peveler, R. C., Fairburn, C. G. & Dunger, D. B. (1999). Eating habits, body weight, and insulin use. A longitudinal study of teenagers and young adults with type 1 diabetes. *Diabetes Care, 22*(12), 1956–1960

Byrne, D. (2021). A worked example of Braun and Clarke’s approach to reflexive thematic analysis. *Quality & Quantity, 56*, 1391–1412.

Ceci, L. (2022). *Number of mHealth apps available in the Apple App Store from 1st quarter 2015 to 1st quarter 2022*. Statista. <https://www.statista.com/statistics/779910/health-apps-available-ios-worldwide/>

Chen, J., Gemming, L., Hanning, R., & Allman-Farinelli, M. (2018). Smartphone apps and the nutrition care process: current perspectives and future considerations. *Patient Education and Counselling, 101*(4), 750-757.

Clarke, V., & Braun, V. (2013). Thematic analysis. In A. C. Michalos (Ed.), *Encyclopedia of Quality of Life and Well-Being Research*. Springer.

Critical Appraisal Skills Programme. (2020). *CASP Randomised Controlled Trial Checklist*. <https://casp-uk.net/casp-tools-checklists/>

De Solier, I., & Duruz, J. (2013). Food cultures: Introduction. *Cultural Studies Review, 19*(1), 4-8.

- Dennison, L., Morrison, L., Conway, G., & Yardley, L. (2013). Opportunities and challenges for smartphone applications in supporting health behavior change: qualitative study. *Journal of Medical Internet Research, 15*(4), e86.
- Diabetes UK. (2020). *Diabetes: The Basics*. <https://www.diabetes.org.uk/diabetes-the-basics>
- Diabetes UK. (2017). *The Future of Diabetes*. https://www.diabetes.org.uk/resources-s3/2017-11/11111B%20The%20future%20of%20diabetes%20report_FINAL_.pdf
- Diabetes.co.uk. (2019, January). Cost of Diabetes. <https://www.diabetes.co.uk/cost-of-diabetes.html>
- Didžiokaitė, G., Saukko, P., & Greiffenhagen, C. (2018). The mundane experience of everyday calorie trackers: Beyond the metaphor of Quantified Self. *New Media & Society, 20*(4), 1470-1487.
- Dover, A. R., Stimson, R. H., Zammitt, N. N., & Gibb, F. W. (2017). Flash glucose monitoring improves outcomes in a type 1 diabetes clinic. *Journal of diabetes science and technology, 11*(2), 442-443.
- Eikey, E. V., Caldeira, C. M., Figueiredo, M. C., Chen, Y., Borelli, J. L., Mazmanian, M., & Zheng, K. (2021). Beyond self-reflection: introducing the concept of rumination in personal informatics. *Personal and Ubiquitous Computing, 25*(3), 601-616.
- Eisenhauer, C. M., Hageman, P. A., Rowland, S., Becker, B. J., Barnason, S. A., & Pullen, C. H. (2017). Acceptability of mHealth technology for self-monitoring eating and activity among rural men. *Public Health Nursing, 34*(2), 138-146.
- El Khoury, C. F., Karavetian, M., Halfens, R. J., Crutzen, R., Khoja, L., & Schols, J. M. (2019). The effects of dietary mobile apps on nutritional outcomes in adults with chronic diseases: A systematic review. *Journal of the Academy of Nutrition and Dietetics, 119*(4), 626–651.

- Evans, D. (2017). MyFitnessPal. *British Journal of Sports Medicine*, 51(14), 1101-1102.
- Fairburn, C. G., Peveler, R. C., Davies, B., Mann, J. I., & Mayou, R. A. (1991). Eating Disorders in young adults with insulin dependent Diabetes mellitus: a controlled study. *British Medical Journal*, 303(6793), 17-20.
- FDA. (2019, September) General Wellness: Policy for Low Risk Devices. <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/general-wellness-policy-low-risk-devices>
- Fenwick, E. K., Rees, G., Holmes-Truscott, E., Browne, J. L., Pouwer, F., & Speight, J. (2018). What is the best measure for assessing diabetes distress? A comparison of the Problem Areas in Diabetes and Diabetes Distress Scale: results from Diabetes MILES–Australia. *Journal of Health Psychology*, 23(5), 667-680.
- Fisher, L., Polonsky, W. H., Hessler, D. M., Masharani, U., Blumer, I., Peters, A. L., ... & Bowyer, V. (2015). Understanding the sources of diabetes distress in adults with type 1 diabetes. *Journal of Diabetes and its Complications*, 29(4), 572-577.
- Flury, R., & Solomons, L. (2019) *Too Often Missing. Making emotional and psychological support routine in diabetes care*. https://www.diabetes.org.uk/resources-s3/2019-05/Full%20Report_Too%20Often%20Missing_Diabetes%20UK_May%202019.pdf
- Gautam, A., Philip, S., MacLeod, M. J., Cadzow, A., & Graveling, A. J. (2020). Real-world user acceptability of the FreeStyle Libre: A pilot study on human factors and technology acceptance. *Diabetic Medicine*, 37(1), 106-107.
- Gittus, M., Fuller-Tyszkiewicz, M., Brown, H. E., Richardson, B., Fassnacht, D. B., Lennard, G. R., ... & Krug, I. (2020). Are Fitbits implicated in body image concerns and disordered eating in women?. *Health Psychology*, 39(10), 900-904.

- Gleeson, A., Davies, M., Roberts, B., & Nugent, A. (2019). A qualitative evaluation of patients' perspectives of the FreeStyle Libre flash glucose monitor. *British Journal of Diabetes, 19*(2), 105-109.
- Goebel-Fabbri, A. (2017). *Prevention and recovery from Eating Disorders in type 1 Diabetes: Injecting Hope*. Routledge.
- Goebel-Fabbri, A., Copeland, P., Touyz, S., & Hay, P. (2019). Eating disorders in diabetes: Discussion on issues relevant to type 1 diabetes and an overview of the Journal's special issue. *Journal of Eating Disorders, 7*(1), 1-3.
- Gough, B., & Madill, A. (2012). Subjectivity in psychological science: From problem to prospect. *Psychological Methods, 17*(3), 374-384.
- Graue, M., Haugstvedt, A., Wentzel-Larsen, T., Iversen, M. M., Karlsen, B., & Rokne, B. (2012). Diabetes-related emotional distress in adults: reliability and validity of the Norwegian versions of the Problem Areas in Diabetes Scale (PAID) and the Diabetes Distress Scale (DDS). *International Journal of Nursing Studies, 49*(2), 174-182.
- Grylli, V., Darwautz, A., Hafferl-Gattermayer, A., & Schober, E. (2003). Eating disorders and type 1-diabetes mellitus in adolescence. *Eating and Weight Disorders – Studies on Anorexia, Bulimia and Obesity, 8*(2), 88-94.
- Guba, E. G., & Lincoln, Y. S. (2005). Paradigmatic controversies, contradictions and emerging confluences. In Denzin, N. K. & Lincoln, Y. S. (Eds.), *The Sage handbook of qualitative research* (pp. 191-215). Sage Publications Ltd.
- Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods, 18*(1), 59-82.
- Hahn, S. L., Kaciroti, N., Eisenberg, D., Weeks, H. M., Bauer, K. W., & Sonnevile, K. R. (2021a). Introducing Dietary Self-Monitoring to Undergraduate Women via a Calorie

Counting App Has No Effect on Mental Health or Health Behaviors: Results From a Randomized Controlled Trial. *Journal of the Academy of Nutrition and Dietetics*, 121(12), 2377-2388.

Hahn, S. L., Linxwiler, A. N., Huynh, T., Rose, K. L., Bauer, K. W., & Sonnevile, K. R. (2021b). Impacts of dietary self-monitoring via MyFitnessPal to undergraduate women: A qualitative study. *Body Image*, 39, 221-226.

Hahn, S. L., Sonnevile, K. R., Kaciroti, N., Eisenberg, D., & Bauer, K. W. (2021). Relationships between patterns of technology-based weight-related self-monitoring and eating disorder behaviors among first year university students. *Eating Behaviors*, 42, 101520.

Health Research Authority (2017) http://www.hra-decisiontools.org.uk/research/docs/DefiningResearchTable_Oct2017-1.pdf

Heath, J., Williamson, H., Williams, L. & Harcourt, D. (2018). "It's just more personal": Using multiple methods of qualitative data collection to facilitate participation in research focusing on sensitive subjects. *Applied Nursing Research*, 43, 30–35.

Hendrieckx, C., Halliday, J. A., Beeney, L. J., Speight, J. (2019) *Diabetes and emotional health: a practical guide for healthcare professionals supporting adults with Type 1 and Type 2 diabetes*. (2nd Edition). Diabetes UK.

Hevelke, L. K., Albrecht, C., Busse-Widmann, P., Kranz, J., Lange, K., Markowitz, J. T., ... & Saßmann, H. (2016). Prevalence of disturbed eating behavior in children and adolescents with type 1 diabetes: Assessment and comparison to healthy peers--results of a multicenter questionnaire-based study. *Psychotherapie, Psychosomatik, Medizinische Psychologie*, 66(3-4), 128-135.

- Honary, M., Bell, B. T., Clinch, S., Wild, S. E., & McNaney, R. (2019). Understanding the role of healthy eating and fitness mobile apps in the formation of maladaptive eating and exercise behaviors in young people. *JMIR mHealth and uHealth*, 7(6), e14239.
- Hong, Q. N., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., ... & Pluye, P. (2018). The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Education for Information*, 34(4), 285-291.
- Ida, S., Kaneko, R., Imataka, K., Okubo, K., Shirakura, Y., Azuma, K., ... & Murata, K. (2020). Effects of flash glucose monitoring on dietary variety, physical activity, and self-care behaviors in patients with diabetes. *Journal of Diabetes Research*, 9463648, 1-7.
- Ipjian, M. L., & Johnston, C. S. (2017). Smartphone technology facilitates dietary change in healthy adults. *Nutrition*, 33, 343-347.
- Ish-Shalom, M., Wainstein, J., Raz, I., & Mosenzon, O. (2016). Improvement in glucose control in difficult-to-control patients with diabetes using a novel flash glucose monitoring device. *Journal of Diabetes Science and Technology*, 10(6), 1412-1413.
- Jospe, M. R., Roy, M., Brown, R. C., Williams, S. M., Osborne, H. R., Meredith-Jones, K. A., ... & Taylor, R. W. (2017). The effect of different types of monitoring strategies on weight loss: a randomized controlled trial. *Obesity*, 25(9), 1490-1498.
- Juvenile Diabetes Research Foundation. (2020). *Information and support about Type 1 diabetes*. <https://jdrf.org.uk/information-support/about-type-1-diabetes/>
- Kilpatrick, E. S., Rigby, A. S., & Atkin, S. L. (2007). Insulin resistance, the metabolic syndrome, and complication risk in type 1 diabetes “double diabetes” in the diabetes control and complications trial. *Diabetes care*, 30(3), 707-712.
- Köster, E. P. (2009). Diversity in the determinants of food choice: A psychological perspective. *Food quality and preference*, 20(2), 70-82.

Laing, B. Y., Mangione, C. M., Tseng, C. H., Leng, M., Vaisberg, E., Mahida, M., ... & Bell, D. S.

(2014). Effectiveness of a smartphone application for weight loss compared with usual care in overweight primary care patients: a randomized, controlled trial. *Annals of Internal Medicine*, *161*(10), 5-12.

Lawton, J., Rankin, D., Cooke, D. D., Clark, M., Elliot, J., Heller, S., & UK NIHR Dafne Study

Group. (2011). Dose Adjustment for Normal Eating: a qualitative longitudinal exploration of the food and eating practices of type 1 diabetes patients converted to flexible intensive insulin therapy in the UK. *Diabetes Research and Clinical Practice*, *91*(1), 87-93.

Lee, J. M., Kim, Y., & Welk, G. J. (2014). Validity of consumer based physical activity

monitors. *Medicine and Science in Sports and Exercise*, *46*(9), 1840-1848.

Lengelle, R., Luken, T., & Meijers, F. (2016). Is self-reflection dangerous? Preventing

rumination in career learning. *Australian Journal of Career Development*, *25*(3), 99-109.

Levinson, C. A., Fewell, L., & Brosof, L. C. (2017). My Fitness Pal calorie tracker usage in the

eating disorders. *Eating Behaviors*, *27*, 14-16.

Levitt, H. M., Bamberg, M., Creswell, J. W., Frost, D. M., Josselson, R., & Suárez-Orozco, C.

(2018). Journal article reporting standards for qualitative primary, qualitative meta-analytic, and mixed methods research in psychology: The APA Publications and Communications Board task force report. *American Psychologist*, *73*(1), 26-46.

Li, I., Dey, A., & Forlizzi, J. (2010). A stage-based model of personal informatics systems.

ACM Conference on Human Factors in Computing Systems, 557–566.

Lieffers, J. R., Arocha, J. F., Grindrod, K., & Hanning, R. M. (2018). Experiences and

perceptions of adults accessing publicly available nutrition behavior-change mobile

apps for weight management. *Journal of the Academy of Nutrition and Dietetics*, 118(2), 229-239.

Linardon, J., & Messer, M. (2019). My fitness pal usage in men: Associations with eating disorder symptoms and psychosocial impairment. *Eating Behaviors*, 33, 13-17.

Lu, X., Chen, Y., & A. Epstein, D. (2021, June). How Cultural Norms Influence Persuasive Design: A Study on Chinese Food Journaling Apps. In *Designing Interactive Systems Conference 2021*, 619-637.

Lupton, D. (2013). Quantifying the body: monitoring and measuring health in the age of mHealth technologies. *Critical Public Health*, 23(4), 393-403.

Lupton, D. (2018). Cooking, eating, uploading: Digital food cultures. In N. Lebesco & P. Naccarato (Eds.), *The Bloomsbury handbook of food and popular culture* (66-75). Bloomsbury Publishing.

Lyzwinski, L. N. (2014). A systematic review and meta-analysis of mobile devices and weight loss with an intervention content analysis. *Journal of Personalized Medicine*, 4(3), 311-385.

Malterud, K., Siersma, V. D., & Guassora, A. D. (2016). Sample size in qualitative interview studies: guided by information power. *Qualitative Health Research*, 26(13), 1753-1760.

Markowitz, J. T., Butler, D. A., Volkening, L. K., Antisdel, J. E., Anderson, B. J., & Laffel, L. M. (2010). Brief screening tool for disordered eating in diabetes: internal consistency and external validity in a contemporary sample of pediatric patients with type 1 diabetes. *Diabetes Care*, 33(3), 495-500.

Martyn-Nemeth, P., Duffecy, J., Fritschi, C., & Quinn, L. (2019). Challenges imposed by hypoglycemia in adults with T1DM. *Clinical Nursing Research*, 28(8), 947-967.

- Mathieu, J. (2008). 'What Is Diabulimia?' *Journal of the Academy of Nutrition and Dietetics*, 108(5), 769-770.
- McCaig, D., Elliott, M. T., Prnjak, K., Walasek, L., & Meyer, C. (2020). Engagement with MyFitnessPal in eating disorders: Qualitative insights from online forums. *International Journal of Eating Disorders*, 53(3), 404-411.
- McDonnell, M. E., & Umpierrez, G. E. (2012). Insulin therapy for the management of hyperglycemia in hospitalized patients. *Endocrinology and Metabolism Clinics*, 41(1), 175-201.
- McIntyre, H. D. (2006). DAFNE (Dose Adjustment for Normal Eating): structured education in insulin replacement therapy for type 1 diabetes. *Medical Journal of Australia*, 184(7), 317-318.
- Merwin, R. M., Dmitrieva, N. O., Honeycutt, L. K., Moskovich, A. A., Lane, J. D., Zucker, N. L., ... & Kuo, J. (2015). Momentary predictors of insulin restriction among adults with type 1 diabetes and eating disorder symptomatology. *Diabetes Care*, 38(11), 2025-2032.
- Michie, S., Yardley, L., West, R., Patrick, K., & Greaves, F. (2017). Developing and evaluating digital interventions to promote behavior change in health and health care: Recommendations resulting from an international workshop. *Journal of Medical Internet Research*, 19(6), e232.
- Morris, S. L. (2021). *The lived experience of Diabulimia. Individuals with Type 1 Diabetes using insulin for weight control* (Doctoral dissertation, Middlesex University/Metanoia Institute).
- MyFitnessPal. (2019, December). *2019 MyFitnessPal Year in Review*.
<https://blog.myfitnesspal.com/2019-myfitnesspal-year-in-review/>

- Nash, J., & Skinner, T. C. (2005). Eating disorders in type 1 diabetes. *Practical Diabetes International*, 22(4), 139-145.
- National Institute for Health and Care Excellence. (2022, March). *Type 1 diabetes in adults: diagnosis and management*. <https://www.nice.org.uk/guidance/ng17>
- Neff, K. D., Rude, S. S., & Kirkpatrick, K. L. (2007). An examination of self-compassion in relation to positive psychological functioning and personality traits. *Journal of Research in Personality*, 41(4), 908-916.
- NHS (2019, July) *Diabetes*. <https://www.nhs.uk/conditions/diabetes/>
- NHS Digital. (2018). *National Diabetes Audit Report 1 Care Processes and Treatment Targets 2017–18*. <https://digital.nhs.uk/data-and-information/publications/statistical/national-diabetes-audit/report-1-care-processes-and-treatment-targets-2017-18-short-report>
- NHS. (2019). *The NHS Long Term Plan*. <https://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf>
- Nielsen, S., Emborg, C., & Mølbak, A-G. (2002). Mortality in concurrent type 1 diabetes and anorexia nervosa. *Diabetes Care*, 25(2), 309-312.
- Olafsdottir, A. F., Attvall, S., Sandgren, U., Dahlqvist, S., Pivodic, A., Skrtic, S., ... & Lind, M. (2017). A clinical trial of the accuracy and treatment experience of the flash glucose monitor FreeStyle Libre in adults with type 1 diabetes. *Diabetes Technology & Therapeutics*, 19(3), 164-172.
- O'neil, P. M., & Rieder, S. (2005). Utility and validity of the eating behavior inventory in clinical obesity research: a review of the literature. *Obesity Reviews*, 6(3), 209-216.
- Overend, L., Simpson, E., & Grimwood, T. (2019). Qualitative analysis of patient responses to the ABCD FreeStyle Libre audit questionnaire. *Practical Diabetes*, 36(2), 45-50.

- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *International Journal of Surgery, 88*, 105906.
- Park, K., Weber, I., Cha, M., & Lee, C. (2016, February). Persistent sharing of fitness app status on twitter. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*, 184-194.
- Patton, M.Q. (2015). *Qualitative research and evaluation methods* (4th edition). Sage Publications Ltd.
- Pickup, J. C., Ford Holloway, M., & Samsi, K. (2015). Real-time continuous glucose monitoring in type 1 diabetes: a qualitative framework analysis of patient narratives. *Diabetes Care, 38*(4), 544-550.
- Plateau, C. R., Bone, S., Lanning, E., & Meyer, C. (2018). Monitoring eating and activity: links with disordered eating, compulsive exercise, and general wellbeing among young adults. *International Journal of Eating Disorders, 51*(11), 1270-1276.
- Polonsky, W. H., Anderson, B. J., Lohrer, P. A., Welch, G., Jacobson, A. M., Aponte, J. E., & Schwartz, C. E. (1995). Assessment of diabetes-related distress. *Diabetes Care, 18*(6), 754-760.
- Polonsky, W. H., Fisher, L., Earles, J., Dudl, R. J., Lees, J., Mullan, J., & Jackson, R. A. (2005). Assessing psychosocial distress in diabetes: development of the diabetes distress scale. *Diabetes Care, 28*(3), 626-631.
- Powers, M. A., Richter, S. A., Ackard, D. M., & Craft, C. (2017). Diabetes distress among persons with T1DM: associations with disordered eating, depression, and other psychological health concerns. *The Diabetes Educator, 43*(1), 105-113.

QSR International. (2018). *NVivo qualitative data analysis software (Version 12)*.

<https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home>

Reddy, M., Jugnee, N., El Laboudi, A., Spanudakis, E., Anantharaja, S., & Oliver, N. (2018). A randomized controlled pilot study of continuous glucose monitoring and flash glucose monitoring in people with type 1 diabetes and impaired awareness of hypoglycaemia. *Diabetic Medicine*, *35*(4), 483-490.

Régnier, F., & Chauvel, L. (2018). Digital inequalities in the use of self-tracking diet and fitness apps: interview study on the influence of social, economic, and cultural factors. *JMIR mHealth and uHealth*, *6*(4), e9189.

Rentko, E. (2015). Calorie counting application feedback: Potential impact on the teenage female psyche. *Journal of Student Science and Technology*, *8*(1), 49-54.

Rodin, G., Olmsted, M. P., Rydall, A. C., Maharaj, S. I., Colton, P. A., Jones, J. M., Biancucci, L. A., & Daneman, D. (2002). Eating disorders in young women with type 1 diabetes mellitus. *Journal of Psychosomatic Research*, *53*(4), 943-949.

Rooksby, J., Rost, M., Morrison, A., & Chalmers, M. (2014, April). Personal tracking as lived informatics. In *Proceedings of the SIGCHI conference on human factors in computing systems*, 1163-1172.

Royal College of Psychiatrists. (2021). Guidance on Recognising and Managing Medical Emergencies in Eating Disorders, Annexe 2 : Type 1 diabetes and eating disorders (T1DE). [https://www.rcpsych.ac.uk/docs/default-source/improving-care/nccmh/guidance-on-recognising-and-managing-medical-emergencies-in-eating-disorders-\(replacing-marsipan-and-junior-marsipan\)/annexe-2---type-1-diabetes-and-eating-disorders-\(t1de\)---consultation-draft-july-2021.pdf?sfvrsn=3b47b669_2](https://www.rcpsych.ac.uk/docs/default-source/improving-care/nccmh/guidance-on-recognising-and-managing-medical-emergencies-in-eating-disorders-(replacing-marsipan-and-junior-marsipan)/annexe-2---type-1-diabetes-and-eating-disorders-(t1de)---consultation-draft-july-2021.pdf?sfvrsn=3b47b669_2)

- Rubin, H. J., & Rubin, I. S. (1995). *Qualitative interviewing: The art of hearing data*. Sage Publications Ltd.
- Ruckenstein, M., & Pantzar, M. (2017). Beyond the quantified self: Thematic exploration of a dataistic paradigm. *New Media & Society, 19*(3), 401-418.
- Ryan, J., Edney, S., & Maher, C. (2019). Anxious or empowered? A cross-sectional study exploring how wearable activity trackers make their owners feel. *BMC Psychology, 7*(1), 1-8.
- Sarcona, A., Kovacs, L., Wright, J., & Williams, C. (2017). Differences in eating behavior, physical activity, and health-related lifestyle choices between users and nonusers of mobile health apps. *American Journal of Health Education, 48*(5), 298-305.
- Schmitt, A., Reimer, A., Kulzer, B., Haak, T., Ehrmann, D., & Hermanns, N. (2016). How to assess diabetes distress: comparison of the Problem Areas in Diabetes Scale (PAID) and the Diabetes Distress Scale (DDS). *Diabetic Medicine, 33*(6), 835-843.
- Shaban, C. (2013). 'Diabulimia: Mental health condition or media hyperbole?' *Practical Diabetes, 30*(3), 104-105.
- Shlomowitz, A., & Feher, M. D. (2014). Anxiety associated with self monitoring of capillary blood glucose. *British Journal of Diabetes, 14*(2), 60-63.
- Siddaway, A. P., Wood, A. M., & Hedges, L. V. (2019). How to do a systematic review: a best practice guide for conducting and reporting narrative reviews, meta-analyses, and meta-syntheses. *Annual Review of Psychology, 70*, 747-770.
- Sigurdardottir, A. K., & Benediktsson, R. (2008). Reliability and validity of the Icelandic version of the problem area in diabetes (PAID) scale. *International Journal of Nursing Studies, 45*(4), 526-533.

Simpson, C. C., & Mazzeo, S. E. (2017). Calorie counting and fitness tracking technology:

Associations with eating disorder symptomatology. *Eating Behaviors, 26*, 89-92.

Smarr, L. (2012). Quantifying your body: A how-to guide from a systems biology perspective.

Biotechnology Journal, 7(8), 980-991.

Smeets, E., Neff, K., Alberts, H., & Peters, M. (2014) Meeting suffering with kindness: Effects

of a brief self-compassion intervention for female college students. *Journal of Clinical Psychology, 70*(9), 794-807.

Snoek, F. J., Pouwer, F., Welch, G. W., & Polonsky, W. H. (2000). Diabetes-related emotional

distress in Dutch and US diabetic patients: cross-cultural validity of the problem areas in diabetes scale. *Diabetes Care, 23*(9), 1305-1309.

Snoek, F. J., Skovlund, S. E., & Pouwer, F. (2007). Development and validation of the insulin

treatment appraisal scale (ITAS) in patients with type 2 diabetes. *Health and Quality of Life Outcomes, 5*(1), 1-7.

Staite, E., Zaremba, N., Macdonald, P., Allan, J., Treasure, J., Ismail, K., & Stadler, M. (2018).

'Diabulima' through the lens of social media: a qualitative review and analysis of online blogs by people with type 1 diabetes mellitus and eating disorders. *Diabetic Medicine, 35*(10), 1329- 1336.

Starkey, K., & Wade, T. (2010). Disordered eating in girls with type 1 diabetes: examining

directions for prevention. *Clinical Psychologist, 14*(1), 2-9.

Steinert, A., Haesner, M., Tetley, A., & SteinhagenThiessen, E. (2016). Self-monitoring of

health-related goals in older adults with use of a smartphone application. *Activities, Adaptation & Aging, 40*(2), 81-92.

Tracy, S. J. (2010). Qualitative quality: Eight "big-tent" criteria for excellent qualitative

research. *Qualitative inquiry, 16*(10), 837-851.

- Tse, J., Nansel, T. R., Haynie, D. L., Mehta, S. N., & Laffel, L. M. (2012). Disordered eating behaviors are associated with poorer diet quality in adolescents with type 1 Diabetes. *Journal of the Academy of Nutrition and Dietetics, 112*(11), 1810-1814.
- Varpio, L., Ajjawi, R., Monrouxe, L. V., O'Brien, B. C., & Rees, C. E. (2017). Shedding the cobra effect: problematising thematic emergence, triangulation, saturation and member checking. *Medical education, 51*(1), 40-50.
- Vasileiou, K., Barnett, J., Thorpe, S., & Young, T. (2018). Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period. *BMC medical research methodology, 18*(1), 1-18.
- Wang, K. Y., Bublitz, M. G., & Zhao, G. T. (2021). Enhancing dieters' perseverance in adversity: How counterfactual thinking increases use of digital health tracking tools. *Appetite, 164*, 105261.
- Welch, G. W., Jacobson, A. M., & Polonsky, W. H. (1997). The Problem Areas in Diabetes Scale: an evaluation of its clinical utility. *Diabetes Care, 20*(5), 760-766.
- Wharton, C. M., Johnston, C. S., Cunningham, B. K., & Sterner, D. (2014). Dietary self-monitoring, but not dietary quality, improves with use of smartphone app technology in an 8-week weight loss trial. *Journal of Nutrition Education and Behavior, 46*(5), 440-444.
- Whelan, M. E., Denton, F., Bourne, C. L., Kingsnorth, A. P., Sherar, L. B., Orme, M. W., & Esliger, D. W. (2021). A digital lifestyle behaviour change intervention for the prevention of type 2 diabetes: a qualitative study exploring intuitive engagement with real-time glucose and physical activity feedback. *BMC Public Health, 21*(1), 1-11.
- Whicher, C. A., O'Neill, S., & Holt, R. G. (2020). Diabetes in the UK: 2019. *Diabetic Medicine, 37*(2), 242-247.

Whitehouse, P., Kadis, T., & Jayagopal, V. (2020). FreeStyle Libre and diabetes distress: a pilot analysis in a real-life secondary care clinic setting. *Practical Diabetes*, 37(3), 91-92.

Young-Hyman, D. L., & Davis, C. L. (2010). Disordered eating behavior in individuals with diabetes: importance of context, evaluation, and classification. *Diabetes Care*, 33(3), 683-689.

Zuijdwijk, C. S., Pardy, S. A., Dowden, J. J., Dominic, A. M., Bridger, T., & Newhook, L. A. (2014). The mSCOFF for screening disordered eating in pediatric type 1 diabetes. *Diabetes Care*, 37(2), e26-e27.

Appendices

Appendix A

Reflective Research Journal Extracts

Extract from Diary Following Interviews

09.10.21	<p>Interview with PE teacher. She was expecting me to ask more specifically about what she eats. Why was she expecting this? Perhaps similar to when the diabetes nurses or dietician ask about what she's been eating? She's a PE teacher who teaches GCSE 'health', maybe she wanted to tell me what she eats so she could demonstrate her expertise? If she expected me to ask about what she eats but was still prepared to do the interview, what does that say about her perception of her diet? Nothing to hide, happy to share, or knows she's the expert in her own diet so it doesn't matter what I think? Consider who is self-selecting for interviews, people who feel comfortable talking about their eating habits with a 'healthcare professional'. So then who doesn't feel comfortable interviewing? Am I missing out on something by not asking details about what people eat? Feels a bit too idiosyncratic, I'm not a diabetes dietician, I don't know enough about it to know about how their food choices influence their levels. Sharing food diaries would be more quant focus (and generally isn't a true reflection of what people actually eat) I'm more interested in how people feel about what/when/how they eat and their own perceptions about how this fits into their life, rather than my judgement on what they 'should' be eating. 'Should' be eating goes against DAFNE ethos. But do ppts feel as though they 'should' be eating certain things?</p>
----------	--

Extracts from Diary Following Discussions with Experts by Experience

19.2.21	<p>Phone call with [REDACTED] She said she has become more aware of what she's eating since using the FSL, and since getting a pump there's no negative associations with food as she doesn't have to inject. Pump changed relationship with food. Should I be looking at people who are using the FSL without the pump? Does using the FSL mean that you're more likely to have both, or neither? More likely to embrace all the technology or don't want anything on your body? Are the negative associations with food to do with the injection, or the likelihood that it will push the person out of range, or the need to do maths, or something else?</p>
---------	--

26.2.21	<p>Video call with Elliott Libre has 10-minute delay so can be inaccurate, feels like you have to work harder and keep improving your diabetes management because you have to manage two sets of data. After the 14 days he might have a break for a few days, back to basics. Fear of not having it (like losing your phone) but then remembers he always used to manage with just finger-pricking. Easy to overreact. On days where you exercise and have to manage the inaccuracy it can be a big part of your life, lots of thinking and working out needed. Marketed as a replacement for finger-pricking but do people actually see it like that? Makes sense that he takes a break in between sensors as it's not taking anything away, just adding? Assumed ppts would see it as replacement but perhaps not, will be interesting to see if they still finger-prick, how many sets of data they're trying to manage. And fear of not having it, once you start using it, how do you envisage your future with it? Does anyone discontinue use and why?</p>
26.3.22	<p>Conversation with ██████ Talking about people starting health kicks or going vegan at the same time as starting the Libre sensor but it not being connected to the libre sensor, but I seem to think it is. ██████ said that everyone has cycles of changes and health kicks and changes to lifestyle. Not everything is about the diabetes. But the Libre makes things easier, it's a safety net. It allows you to see the results of eating quickly so you can have a better idea of which foods do what. So libre has an indirect effect? What else am I assuming is tied to the diabetes but might not be?</p> <p>Asked about desire to hide diabetes, ██████ explained that he would be reluctant to finger-prick in public, would prefer to hide it, not because he is ashamed or embarrassed, more because he can't be bothered to deal with people watching or asking questions or commenting that he's had blood on his finger and has he cleaned it up properly. He'd notice thoughts like 'what if that person says x' that would make him want to keep it private. Less shame and more hassle in presence of people who don't have diabetes. Maybe more so nowadays when people take pictures, film things, put them on facebook to complain? Why had I assumed it was about shame/embarrassment? Ppts talk about finger-pricking under the table, going to the toilets, one spontaneously says she's not ashamed. Some ppts might feel embarrassed or like ██████ it might just be 'desire to hide' rather than 'ashamed of'.</p> <p>Clinical practice links – currently supporting newly diagnosed YP with type 1 who is very worried about classmates finding out she has diabetes because she doesn't want them to think she has type 2. Doesn't want others to think she's overweight, that it was 'her fault'. Different associated between shape and type of diabetes? She says she does feel embarrassed of her diabetes. Am I thinking of her when I'm coding?</p>

Extract from Diary During Transcribing and Coding

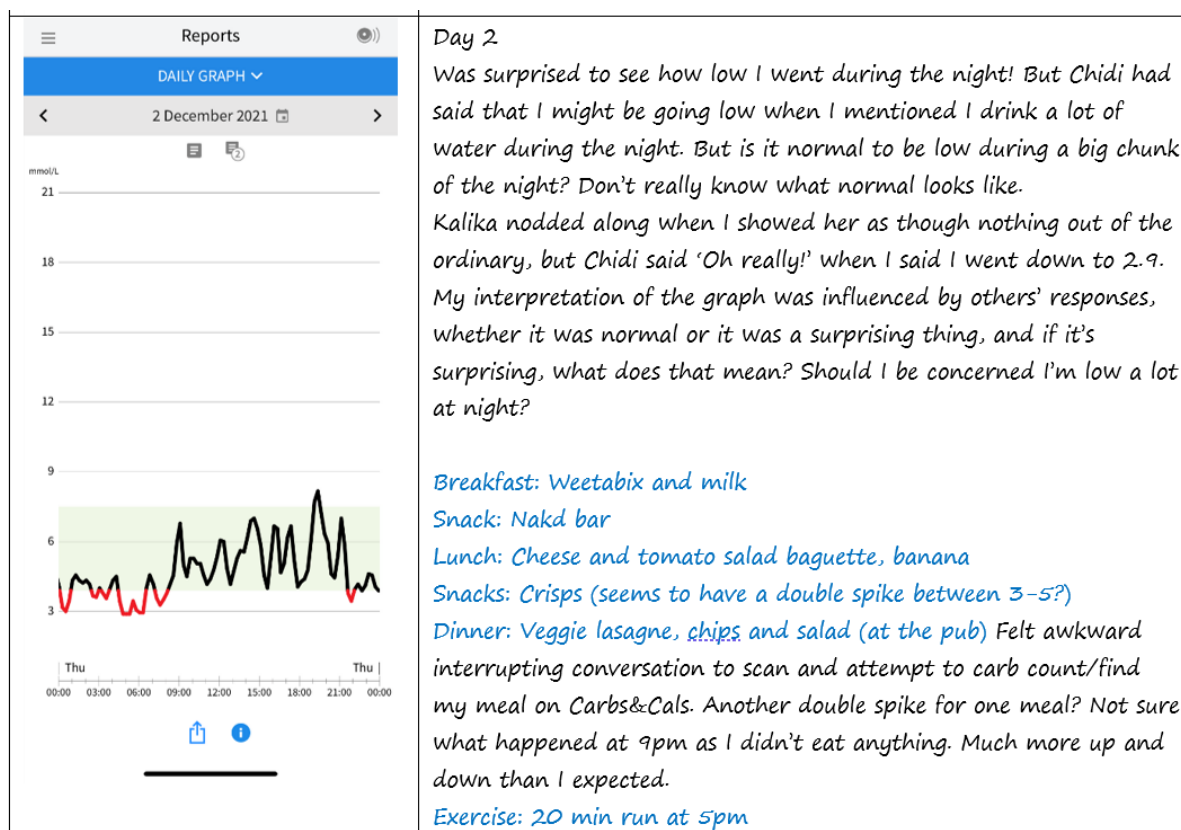
07.01.22	<p>Coding Mickey's interview and thinking about his diet plan- low/no carb most of the time and then a few 'days off' to eat what he wants. Very active, sporty individual with very good self-reported control. During the interview his diet plan came across as the plan of someone who said they wanted to lose some lockdown weight, thought about how their food fuels their exercise, and on videocall looked like someone who was physically able and in good shape. But now just reading the words, would I have interpreted his diet plan differently if he was female? Or younger? Or on the phone so I had no point of reference for body shape? Would I have interpreted his diet as more like a restrict/binge cycle? Who/what do I think of when I think about disordered eating? So much research about a certain demographic (younger women) does that make it harder to pick up on in others (older men)? Or is that my own experiences in clinical settings supporting predominantly young women. Or measures that are mostly validated on women and skewed to detect the female version of disordered eating. Will go back through transcripts and try to separate the vision of the person from their words, do the words alone leave me with a different impression of their eating style without thinking of who they are/how they talked about it.</p>
02.11.21	<p>All interviews are done and lots of transcribing to do! Have been aware that so many ppts have so much healthcare/diabetes expertise in their families. A lot of ppts had siblings or parents with diabetes, parents who are nurses, spouses who are diabetes nurses, friends with diabetes, teach Health, keen interest in research. Was I expecting that? I wasn't not expecting it, but think I hadn't considered ppts social diabetes network. Focusing on the individual's relationship with food, but prior health knowledge/understanding, influence of eating habits of other people in family, narratives about health and illness in family all play a role. Is this a coincidence that a lot of ppts have diabetes networks, who is self-selecting for the research? Would people without those networks, managing it in isolation or with less foundational knowledge be having more challenges and therefore not want to talk about it? Also role of other peoples' knowledge and advice impacting food practices, how does the Libre impact their food choices and how does this fit with their existing schemas around health and eating and looking after their body? My perceptions of health and eating habits branch off into my own preferences but have roots in eating practices in my family and friends' values about food. Are people with diabetes already in the family at an advantage or disadvantage?</p> <p>Clinical practice links – Assessed newly diagnosed YP with type 1 who has grandparent with type 1 who has had lower leg amputation. Lots of fear about bad control and consequences, despite reflection on how different diabetes management practices are now vs then and their own values, strengths, support systems. Point of reference likely to lead to more rigid, anxious approach to food?</p>

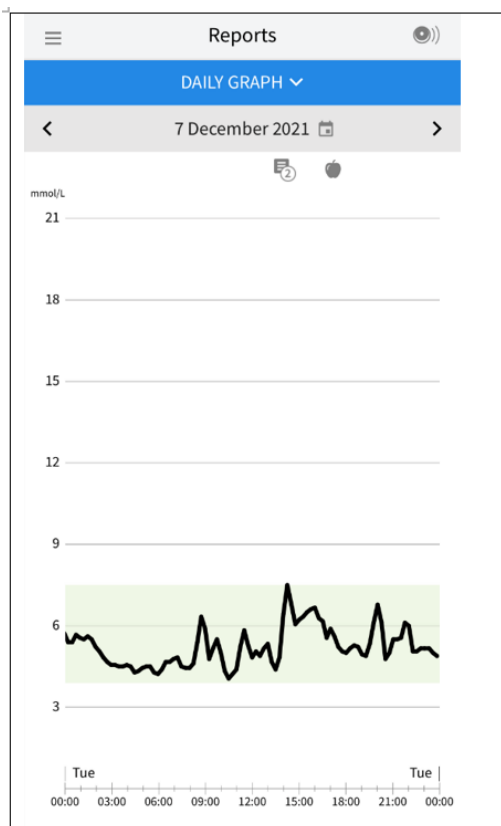
Extract from Diary Following Exchanging Transcripts with another Trainee

7.4.22	Swapped transcript extracts with Sarah. Offered sections that I'm finding hard to code or wondering if my coding is too simplistic, am I missing something or am I just trying to find something that isn't there?
	Her codes are often quite long sentences, which make mine feel succinct. How did I get to the succinct version of my codes? Is it a phrase that has popped into mind while reading the transcript, is it the ppts own words? Am I missing anything by focusing on smaller chunks of meaning?
	Sarah has often referred to existing literature from the codes – obviously very good knowledge of the evidence base informing a deeper understanding? Should I be holding the literature in mind more? Aiming to be immersed in the transcripts but revisiting the literature could highlight additional connections or things I've disregarded, but also aim to highlight contradictions to the literature, not aiming to just map on to the existing literature. Also consider what my participants aren't saying, if they are doing something for this reason, why not the other reasons?
	Sarah's questions: Do participants who have been diagnosed for longer have better overall control/management? I don't know ppts' HbA1c's or time in range so I can't quantify their control, only what they choose to tell me about their perception of their control. Is the FSL annoying for ppts? Seems to be for some, why those and not others? Is the FSL annoying or it the reminder of diabetes annoying? Or is it annoying to have to respond? Aim to look for where no changes were made as well as when changes to eating have occurred. Sounds like a double-edged sword in that it's designed to give them freedom but they have to be more responsive? Do professionals have to rethink their biases now that people have data to back up their idiosyncratic responses to insulin etc? How has their understanding of diabetes changed? Does the way ppts approach life in general (neurotic/chill) affect the way they engage with the diabetes and the FSL?

Appendix B

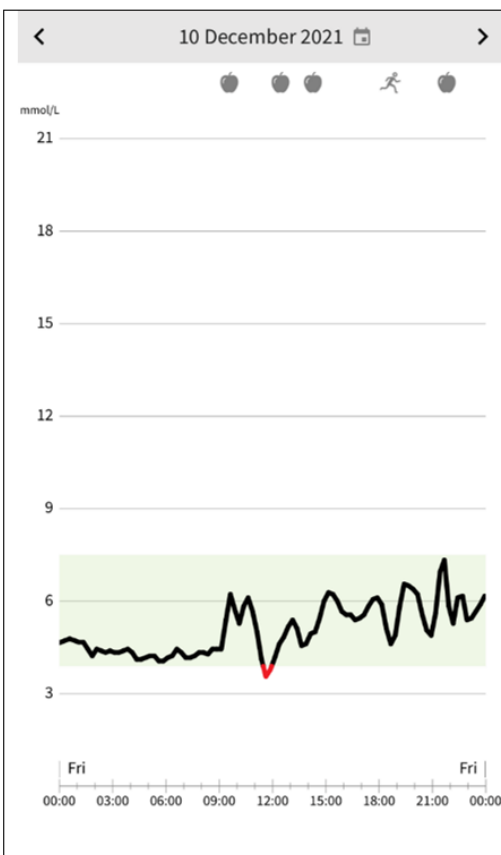
FreeStyle Libre Reflective Journal Extracts





Day 7
 Trying really hard to keep it in the green.
 Rushed morning so nibbled dry bran flakes in the car on the way to work. Very dry and boring, regretted it. But thought about slower release of carbs and/if eating slowly?
 Grazed at my lunch during afternoon instead of in one go to see if that avoids a big spike. Kind of worked – stayed green.
 But was a bit peckish all afternoon so not very enjoyable.
 Should I focus on what I'm eating or how I'm eating it? Graze at home but difficult to graze at work but lunch is a quick opportunity. Would I have to change my daily routine?
 Low carb/no carb makes a big difference (dinner) which is probably easier in summer but in winter I want warming comfort food, not salad.
 Feel like I'm gradually figuring it out but it's taking a lot of thought/effort.

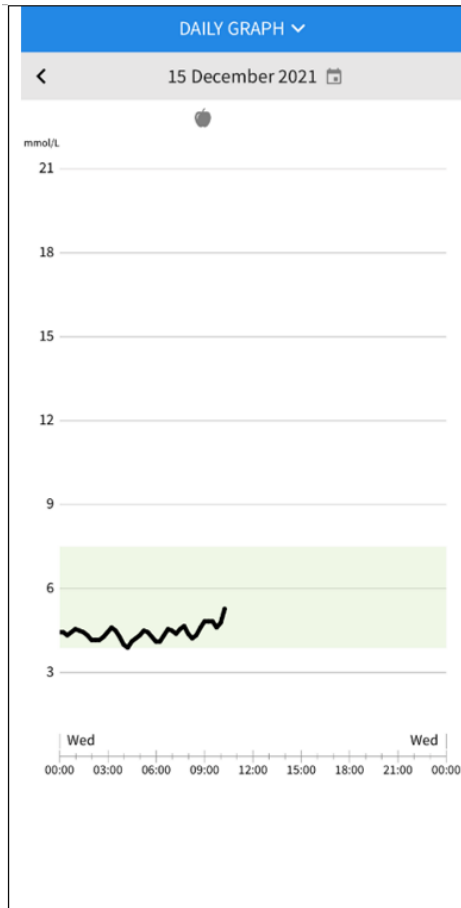
- Breakfast: Bran flakes
- Snack: Nakd bar
- Lunch: Goats cheese and tomato focaccia
- Dinner: Chicken, guacamole, roasted veggies, salad
- Snack: Satsuma



Day 10
 Not sure why I've gone low before lunch? Bit annoying that it's one red bit in the middle of my green day.
 Chicken fajita bowl for lunch – I do tend to repeat certain meals I've really enjoyed but I think if I were to continue with this I would be tempted to repeat the meals I know don't make big spikes? Or maybe create my own recipe book of meals that prevent spikes. If someone didn't enjoy variety and cooking, I could see how diet could become limited.
 Friday night sushi – surprised I didn't go higher but perhaps my run helped? You can never have those 'screw it' nights where you get a takeaway and just chill out and indulge. You always have to be doing maths and be sensible, feels boring. I like being able to not think. Maybe I'd have to find another way to switch off/indulge?

- Breakfast: Bran flakes and banana
- Snack: Nakd bar
- Lunch: Chicken, guacamole, roasted veggies
- Dinner: Sushi

45 min run at 5:30pm



Day 15
 Was relieved to take it off! Immediate thought was 'now I can eat what I want' and treated myself to a cookie and a coffee at work.
Breakfast: Bran flakes and banana
Snack: cookie
 Week 1 I averaged 11 scans a day and week 2, 8 scans a day. Novelty wore off and it was interesting but a bit of a chore/part-time job. Understandably exhausting if it was a necessity/full-time job.
 I heard the nurses say that young people complain the sensor hurts if they're quite skinny, it can feel more uncomfortable on their arms as they have less fat. I wasn't worried about it hurting because I don't mind needles (giving blood, piercings, tattoos etc) but it didn't hurt me at all, so then felt aware of having extra fat? Perhaps a gendered/societal norms response, wonder if a male would be pleased it didn't hurt? Made me think of conversations in clinic about areas of the body with more or less fat when talking about insulin injections, medical perspective of body as muscle and fat and bones and organs, and my interpretation of fat is socially constructed.
 Has been hard work, thought about food choices more, deviated from my normal eating because I was trying to keep it in the green and December is usually an indulgent month. Guesswork was a bit frustrating, but if I had type 1 I would know more about food. Highlighted the ways I use food- relaxing, treating myself, festive celebrations, boredom- aside from just sustenance, most of which took me out of range.

Appendix C

'A Day in the Life of My Stomach' Extracts

Breakfast

First conscious thought of day is 'What day is it/when do I need to get up?' and second thought is always 'What shall I have for breakfast?'. Breakfast is my favourite meal of the day and breakfast foods are my favourite type of food (I would happily eat breakfast foods for breakfast, lunch and dinner and sometimes do). Quality of breakfast can set the tone for the day and is likely to be my healthiest meal of the day before I gradually go downhill throughout the day. Weekday breakfast is fruity porridge, peanut butter and banana bagel, cereal or a protein smoothie, weekend breakfast is usually eggs with various accompaniments and hot sauce. I often laugh at myself when I make a smoothie for breakfast on a weekday as this feels like somewhat of an achievement, something only a very competent adult would do. That being said, a healthy breakfast makes me feel as though I'm investing in my wellbeing, which makes me feel optimistic about the day ahead. Breakfast highlights my love of variety in my diet and a way to practice self-care through nourishment.

The backstory:

A very positive period of my life was when I was living by myself, eating planned, healthy meals and regularly exercising. It was the first time in my life that I'd lived by myself so for the first time, everything in the fridge was mine and I could make choices that purely met my needs. I consciously thought about what I wanted my diet to be and what I wanted/didn't want in the house. Because of this experience, 'healthy' foods represent nourishment, fuelling the body for exercise and feeling strong, and contributing to my '5-a-day'. Nowadays, eating 'healthy' foods feels like a conscious investment in my physical and mental wellbeing as it connects me to this preferred version of myself.

The backstory:

Growing up, both my brothers were very fussy eaters for many years, with a repertoire of perhaps 10 foods they would eat. However, I would eat everything, like my dad. I enjoyed trying new foods with my dad; as a child it felt adventurous and I was pleased to share this interest with him. My willingness to eat anything also meant that when we occasionally went out to eat, I could pick anything from the menu whereas my brothers often struggled or had to ask for amendments, which seemed to irritate my parents. In this way, exploring and embracing a variety of foods was associated with sharing moments with my dad, feeling superior to my brothers and viewing myself as a brave explorer of food.

The current study:

I associate food with a way to connect with others and disconnect from others. Considering the many social functions of food, this is likely a common view. For my participants, this will likely encourage me to listen out for how food influences their social relationships and identities. As an able-bodied person without any physical health conditions or food allergies, I have been able to use and enjoy exercise and food with few restrictions. My passion for exercise and planning fulfilling meals may influence my perspective on the spectrum of disordered eating, for example in relation to routines or rigidity.

Dinner

I'm usually ravenous by the end of the workday so think about what to have for dinner during the entirety of my commute. I do the majority of the cooking in my household, which means the first job when I get in is cooking dinner. Whereas breakfast is a solo activity, dinner is generally for both my partner and I which means deciding on a meal that will satisfy both of us. Dinners vary greatly but typically include a portion of protein (meat or Quorn-type substitute), a portion of carbs and several portions of vegetables (or more if I can include them before my partner protests). Our cooking styles differ significantly; he is a lover of a recipe book whereas I am much more experimental, using what we have and hoping for the best. Luckily, my love of cooking means the outcome generally receives positive reviews. As I cook, I snack, which means that often I am no longer hungry by the time the meal is ready. However, the practice of sitting and sharing a meal is important so I eat the whole meal and feel too full afterwards, regretting my impulsive snacking. Dinner often punctuates the end of the workday and a moment to rest and recharge before the evening's activity. At times it also highlights mine and my partner's differing food habits.

The backstory:

Whilst my partner would happily go a whole day without eating fruits or vegetables, for me they are a crucial element. To him, they are a chore, but to me, they are delicious, nutritious and colourful. My persistent quest to sneak as many vegetables as possible into our meals again highlights my desire to nurture my body. Although my partner is a keen runner and conscious of his health and fitness, I continue to notice that our perceptions of 'healthy' differ. To him, 'healthy' is low sugar and an absence of 'sweet treats' whereas for me, 'healthy' is a food rainbow.

The backstory:

Growing up, I lived in a house where you did not leave the table until you had cleared your plate. Nowadays, I still enforce this rule upon myself and will eat past the point of feeling full. I hate leaving food as this feels wasteful, likely a product of growing up in a financially unstable household where food budgets were tight and everything was own-brand. As a child I associated food with status- the popular children at school always had interesting, branded food: Dairylea Lunchables, Cheese Strings, Fruit Winders. However my lunchbox only ever contained 'Tesco's own' versions, which was noticed by the other children and questioned, which made me feel excluded.

The current study:

My idiosyncratic perception of 'health' may differ from participants' view of health. Although health is a commonly used concept, I will aim to be mindful of what this means to my participants, in a diabetes context.

My childhood experiences of meal etiquette continue to influence my eating habits today, which may be similar for my participants. Although childhood eating practices may not be closely related to the research question, they still may influence participants' eating habits as adults.

Appendix D

Quality Appraisal Tools

Qualitative Studies Assessed Using “Big-Tent” Criteria for Qualitative Quality (Tracy, 2010)

Author/ Authors & Year	Didžiokaitė, Saukko & Greiffenhagen (2018)	Hahn, Linxwiler, Huynh, Rose, Bauer & Sonnevile (2021b)	Lieffers, Arocha, Grindrod & Hanning (2018)	Régnier & Chauvel (2018)
Worthy Topic	Yes	Yes	Yes	Yes
Rich Rigour	Yes	Yes	Yes	Yes
Sincerity	No – no evidence of self-reflexivity or transparency about methodological challenges.	Some – Evidence provided through transparency of the challenges, no evidence of self-reflexivity.	Yes – details of self-reflexivity were provided and transparency about methods and challenges.	Some – Evidence provided through transparency of the challenges, some evidence of self-reflexivity.
Credibility	Yes	Yes	Yes	Yes
Resonance	Yes	Yes	Yes	Yes
Significant Contribution	Yes	Yes	Yes	Yes
Ethical	Yes	Yes	Yes	Yes
Meaningful Coherence	Some – links research findings with wider literature but paper lacks clear structure.	Yes	Yes	Yes

Quality Assessment of Mixed Methods Study Appraisal Tool (MMAT), version 2018 Table

Honary, Bell, Clinch, Wild & McNaney (2019)

Category of study designs	Methodological quality criteria	Responses			
		Yes	No	Can't tell	Comments
Screening questions (for all types)	S1. Are there clear research questions?	X			
	S2. Do the collected data allow to address the research questions?	X			
	<i>Further appraisal may not be feasible or appropriate when the answer is 'No' or 'Can't tell' to one or both screening questions.</i>				
1. Qualitative	1.1 Is the qualitative approach appropriate to answer the research question?	X			
	1.2 Are the qualitative data collection methods adequate to address the research question?	X			
	1.3 Are the findings adequately derived from the data?	X			
	1.4 Is the interpretation of results substantiated by data?	X			
	1.5 Is there coherence between qualitative data sources, collection, analysis and interpretation?	X			
2. Quantitative randomised controlled trials	2.1 Is randomisation appropriately performed?				N/A
	2.2 Are the groups comparable at baseline?				N/A
	2.3 Are there complete outcome data?				N/A
	2.4 Are outcomes assessors blinded to the intervention provided?				N/A
	2.5 Did the participants adhere to the assigned intervention?				N/A
3. Quantitative non-randomised	3.1 Are the participants representative of the target population?				N/A
	3.2 Are measurements appropriate regarding both the outcome and intervention (or exposure)?				N/A
	3.3 Are there complete outcome data?				N/A
	3.4 Are the confounders accounted for in the design and analysis?				N/A
	3.5 During the study period, is the intervention administered (or exposure occurred) as intended?				N/A
4. Quantitative descriptive	4.1 Is the sampling strategy relevant to address the research question?	X			
	4.2 Is the sample representative of the target population?	X			
	4.3 Are the measurements appropriate?	X			
	4.4 Is the risk of nonresponse bias low?	X			
	4.5 Is the statistical analysis appropriate to answer the research question?	X			

5. Mixed methods	5.1 Is there an adequate rationale for using a mixed methods design to address the research question?	X			
	5.2 Are the different components of the study effectively integrated to answer the research question?	X			
	5.3 Are the outputs of the integration of qualitative and quantitative results adequately addressed?	X			
	5.4 Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	X			
	5.5 Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	X			

Appraisal tool for Cross-Sectional Studies (AXIS)

Quantitative Cross-Sectional Studies Critical Appraisal Table

Abbreviations: N/A – not applicable; N/S – not stated

Author/Authors & Year	Bracken & Waite (2020)	Hahn, Sonnevile, Kaciroti, Eisenberg & Bauer (2021)	Linardon & Messer (2019)	Plateau, Bone, Lanning & Meyer (2018)	Sarcona, Kovacs, Wright & Williams (2017)	Simpson & Mazzeo (2017)
1. Were the aims/objectives of the study clear?	Yes	Yes	Yes	Yes	Yes	Yes
2. Was the study design appropriate for the stated aims?	Yes	Yes	Yes	Yes	Yes	Yes
3. Was the sample size justified?	N/S	N/S	N/S	N/S	N/S	N/S
4. Was the target/reference population clearly defined?	Yes	Yes	Yes	Yes	Yes	Yes
5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?	Yes	Yes	Yes	Yes	Yes	No
6. Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?	Yes	Yes	Yes	N/S	No – recruited walking round university with healthy snacks as incentives	No – recruited from psychology undergrads at one university
7. Were measures undertaken to address and categorise non-responders?	Yes	Yes	Yes	N/S	N/S	Yes
8. Were the risk factor and outcome variables measured appropriate to the aims of the study?	Yes	Yes	Yes	Yes	Yes	Yes

9. Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?	Yes	Partly – used modified version of standardised measure	Yes	Yes	Partly – used a modified version of the EBI	Yes
10. Is it clear what was used to determine statistical significance and/or precision estimates (e.g. p-values, confidence intervals)	Yes	Yes	Yes	Yes	Yes	Yes
11. Were the methods (including statistical methods) sufficiently described to enable them to be repeated?	Yes	Yes	Yes	Yes	Yes	Yes
12. Were the basic data adequately described?	Yes	Yes	Yes	Yes	Yes	Yes
13. Does the response rate raise concerns about non-response bias?	No	N/S	No	N/S	N/S	No
14. If appropriate, was information about non-responders described?	N/A	N/S	Yes	N/S	N/S	N/A
15. Were the results internally consistent?	Yes	Yes	Yes	Yes	Yes	Yes
16. Were the results presented for all the analyses described in the methods?	Yes	Yes	Yes	Yes	Yes	Yes
17. Were the authors' discussions and conclusions justified by the results?	Yes	Yes	Yes	Yes	Yes	Yes
18. Were the limitations of the study discussed?	Yes	Yes	Yes	Yes	Yes	Yes
19. Were there any funding sources of conflicts of interest that may affect the authors' interpretation of the results?	No	No	N/S	N/S	N/S	N/S
20. Was ethical approval or consent of participants attained?	Yes	N/S	Yes	Yes	Yes	Yes

Critical Appraisal Skills Programme (CASP) Checklist for Randomised Controlled Trials (CASP, 2020)

Quantitative Randomised Controlled Trials Studies Critical Appraisal Table

Recommended responses: Yes/No/Can't tell

Author/Authors & Year	Gittus et al., (2020)	Hahn et al., (2021a)
1. Did the study address a clearly focused question? <i>CONSIDER:</i> <ul style="list-style-type: none"> Was the study designed to assess the outcomes of an intervention? Is the research question 'focused' in terms of: <ul style="list-style-type: none"> Population studied Intervention given Comparator chosen 	Yes	Yes
2. Was the assignment of participants to interventions randomised? <i>CONSIDER:</i> <ul style="list-style-type: none"> How was randomisation carried out? Was the method appropriate? Was randomisation sufficient to eliminate systematic bias? Was the allocation sequence concealed from investigators and participants? 	Yes	Yes
3. Were all participants who entered the study accounted for at its conclusion? <i>CONSIDER:</i> <ul style="list-style-type: none"> Were losses to follow-up and exclusions after randomisation accounted for? Were participants analysed in the study groups to which they were randomised (intention-to-treat analysis)? Was the study stopped early? If so, what was the reason? 	Yes	Mostly – 8% of intervention group lost to follow up.
4. <ul style="list-style-type: none"> Were the participants 'blind' to intervention they were given? Were the investigators 'blind' to the intervention they were giving to participants? Were the people assessing/analysing outcome/s 'blinded'? 	Not possible Can't tell No	Not possible Yes No
5. Were the study groups similar at the start of the randomised controlled trial? <i>CONSIDER:</i> <ul style="list-style-type: none"> Were the baseline characteristics of each study group (e.g. age, sex, socio-economic group) clearly set out? <p>Were there any differences between the study groups that could affect the outcome/s?</p>	Yes Apart from age which was included as a covariant	Yes
6. Apart from the experimental intervention, did each study group receive the same level of care (that is, were they treated equally)? <i>CONSIDER:</i>	Yes	Yes

<ul style="list-style-type: none"> • Was there a clearly defined study protocol? • If any additional interventions were given (e.g. tests or treatments), were they similar between the study groups? <p>Were the follow-up intervals the same for each study group?</p>		
<p>7. Were the effects of intervention reported comprehensively? <i>CONSIDER:</i></p> <ul style="list-style-type: none"> • Was a power calculation undertaken? • What outcomes were measured, and were they clearly specified? • How were the results expressed? For binary outcomes, were relative and absolute effects reported? • Were the results reported for each outcome in each study group at each follow-up interval? • Was there any missing or incomplete data? • Was there differential drop-out between the study groups that could affect the results? • Were potential sources of bias identified? • Which statistical tests were used? • Were p values reported? 	Yes	Yes
<p>8. Was the precision of the estimate of the intervention or treatment effect reported? <i>CONSIDER:</i></p> <ul style="list-style-type: none"> • Were confidence intervals (CIs) reported? 	Yes	Yes
<p>9. Do the benefits of the experimental intervention outweigh the harms and costs? <i>CONSIDER:</i></p> <ul style="list-style-type: none"> • What was the size of the intervention or treatment effect? • Were harms or unintended effects reported for each study group? <p>Was a cost-effectiveness analysis undertaken? (Cost-effectiveness analysis allows a comparison to be made between different interventions used in the care of the same condition or problem.)</p>	Yes	Yes
<p>10. Can the results be applied to your local population/in your context? <i>CONSIDER:</i></p> <ul style="list-style-type: none"> • Are the study participants similar to the people in your care? • Would any differences between your population and the study participants alter the outcomes reported in the study? • Are the outcomes important to your population? • Are there any outcomes you would have wanted information on that have not been studied or reported? <p>Are there any limitations of the study that would affect your decision?</p>	Yes	Yes
<p>11. Would the experimental intervention provide greater value to the people in your care than any of the existing interventions?</p>	Can't tell	Can't tell

<p><i>CONSIDER:</i></p> <ul style="list-style-type: none"> • <i>What resources are needed to introduce this intervention taking into account time, finances, and skills development or training needs?</i> • <i>Are you able to disinvest resources in one or more existing interventions in order to be able to re-invest in the new intervention?</i> 		
---	--	--

Appendix E

Study Advertisement Poster

04/07/21

IRAS ID: 299070

Version 1.0

Have you used the FreeStyle Libre flash glucose monitor for over 12-months?

If you have Type 1 Diabetes and are using the FreeStyle Libre flash glucose monitor, then you may be interested in taking part in this study.

I am looking for adults 19 years and over who have experience using the FreeStyle Libre flash glucose monitor to take part in a research study. The study will explore whether the FreeStyle Libre influences users' relationship with food and eating.

This research study is aiming to improve the understanding of people's experiences of using the FreeStyle Libre and may help to improve the support offered in relation to the FreeStyle Libre.

Participants will be asked to take part in a short interview that should take no more than 60 minutes, depending on how much you would like to share.

Participants will receive a £15 voucher of their choice to reimburse them for their time.

Whether you chose to participate or not, this will not affect your clinical care in any way.

That means this will not affect your current or future therapy/diabetes care with the service or any other service you may need.

Location

The interview will be conducted remotely, via video call or telephone.

Are you eligible?

- 19 years or older
- Diagnosis of Type 1 Diabetes
- Used the FreeStyle Libre for over 12 months
- Currently under the care of the North Bedfordshire Adult Diabetes Service

This research is part of a Doctorate in Clinical Psychology training course at the University of Hertfordshire, therefore there are time limits to complete the project.

If you would like any more information about the study or to ask any questions, please contact via email:

Tamara Wallace: tw18aag@herts.ac.uk
Dr Jennifer Heath: j.heath@herts.ac.uk

This study has been checked and approved by Health and Social Care Research Ethics Committee B (HSC REC B). It has also been reviewed and approved by the University of Hertfordshire (LMS/PGT/NHS/02963).

Appendix F

Participant Information Sheet

02/07/21

IRAS ID: 299070

Version 1.1

University of
Hertfordshire **UH**

NHS
Bedfordshire Hospitals
NHS Foundation Trust

NORTH BEDFORDSHIRE DIABETES CENTRE
South Wing
Kempston Road
Bedford
MK42 9DJ

Participant Information Sheet

The Impact of Flash Blood Glucose Monitoring on Eating Behaviour and Relationship with Food for Adults with Diabetes

You are being invited to take part in a research interview. Before you decide whether or not to take part, it's important that you understand why the research is being done and what it would involve for you. Please take time to read this information and discuss it with others if you wish to. If there is anything that is not clear, or if you would like more information, please ask us.

What is the purpose of the study?

The study aims to explore whether the FreeStyle Libre flash glucose monitor influences users' relationship with food and eating.

Why have I been invited?

You have recently seen a member of the diabetes team and have been prescribed the FreeStyle Libre. Tamara Wallace (Trainee Clinical Psychologist from the University of Hertfordshire) is asking service users under the care of the diabetes team who use the FreeStyle Libre to participate.

Do I have to take part?

No – taking part in this study is entirely voluntary. You have the right to withdraw at any time before or during the interview without giving a reason. Even if you have participated you can still change your mind and ask for your data to be withdrawn up to two weeks after your interview. Unfortunately, after this time, your anonymous data will have been analysed and it will not be possible to remove it. Whether you chose to participate or not, this will not affect your clinical care in any way. I.e., this will not affect your current or future therapy/diabetes care with the service or any other service you may need.

What will happen if I decide to take part?

If you decide to take part, I will ask you to take part in a short interview that should take no more than 60 minutes, depending on how much you would like to share. This will be facilitated remotely, via video call or telephone, depending on your preference and to adhere to any Covid-19 social distancing guidelines.

If more than the required number of people express an interest in taking part in the study, I cannot guarantee that everyone expressing an interest will be interviewed. This is due to time constraints of the study. If more than 15 people express an interest, a diverse sample

02/07/21

IRAS ID: 299070

Version 1.1

will be selected to reflect a range of ages, genders and ethnicities in order to capture a range of lived experiences.

Are there any possible disadvantages or risks from taking part?

No significant disadvantages have been identified for taking part in this study beyond the time it will take you to attend the interview discussion. However, it is important to consider that reflecting on your experiences could bring you into contact with negative thoughts or feelings and this might be uncomfortable. If you do notice that you are experiencing any level of distress about the topics discussed, you can seek support from the diabetes team, your GP, or you may find some of the other sources of support helpful – these are provided on the Contacts for Further Support sheet which will be shared with you after the interview.

Are there any possible benefits of taking part?

There are no individual benefits for participants in this study. However the outcome of the study may impact on the support offered in relation to the FreeStyle Libre to better the care given to service users in the future.

Will my taking part in the study be kept confidential?

Yes – Confidentiality will be maintained; it will not be possible to identify you based on the information we will include in the final report. It is also important to note that nothing you share with the researcher (Tamara) will be shared with the diabetes team. The services' psychologist, Dr Jen Heath, is the supervisor for this project and will have access to the data but this will be anonymised before she is able to see it.

What will happen to my data?

All data obtained in this study, including consent forms and interview transcripts, will be stored securely in a personal access only drive. This data will be kept for five years, as advised by the University of Hertfordshire School of Life and Medical Sciences.

What happens at the end of the study?

I would like to use the findings to improve patient care and to do this I intend to share the results of the study with Bedfordshire Adult Diabetes Services, the Bedfordshire and Luton Community Adult Eating Disorders team and the University of Hertfordshire. The findings of the study may also be shared with commissioners, other service users, and the general public (e.g. conferences). Anonymised quotes may be used but you will not be identified in any report or publication placed in the public domain. The study will also contribute to the fulfilment of an educational requirement (doctoral student major research project).

What if there is a problem?

If you wish to complain, or have any concerns about any aspect of the way you have been approached or treated during the course of this study, you should contact Dr Jen Heath via email: j.heath@herts.ac.uk

You can also contact the Patient Advice and Liaison Service (PALS) on 0800 013 1223.

Who has reviewed the study?

02/07/21

IRAS ID: 299070

Version 1.1

This study has been checked and approved by Health and Social Care Research Ethics Committee B (HSC REC B). It has also been reviewed and approved by the University of Hertfordshire (LMS/PGT/NHS/02963).

Further information and contact details:

For any further information, please contact either:

Tamara Wallace – tw18aaq@herts.ac.uk

Dr Jen Heath – j.heath@herts.ac.uk

Thank you for reading this information and for considering taking part.

Appendix G

Expression of Interest Form

04/07/21

IRAS ID: 299070

Version 1.0

EXPRESSION OF INTEREST FORM

'The Impact of Flash Blood Glucose Monitoring on Eating Behaviour and Relationship with Food for Adults with Diabetes'

Please make sure you have first read the Participant Information Sheet.

This study is part of Tamara's doctoral training, and therefore there are time limits to complete the project. As more than the required number of participants may register their interest to take part, it may be that not everyone who expresses an interest can take part in the research. We want to make sure we include people from a range of backgrounds. We hope that this will contribute to the literature and may inform better understanding and support for people using the FreeStyle Libre in the future.

PLEASE COMPLETE SECTIONS IN BLUE

First and last name:	
Age:	
Gender: (<u>e.g.</u> male, female, non-binary, etc)	
How would you describe your ethnic <u>background?</u>	
Any other information you think is important:	

If you would like to take part, and you have read the Participant Information Sheet, please email this completed form to tw18aag@herts.ac.uk

Tamara will assume that the email address you send the form from is the preferred email address for contact.

What happens to this information?

Regardless of whether you are chosen to be interviewed, the above information you have provided will be kept **strictly confidential** in accordance with the General Data Protection Regulation 2018 (GDPR). Electronic documents will be password protected and stored in a personal University of Hertfordshire drive that can only be accessed by Tamara. If you are selected to take part in the research, then you will be invited to choose a pseudonym (a different name) so that you cannot be identified.

Thank you for your time.

Appendix H

University of Hertfordshire Ethical Approval and Sponsorship



John M Senior
BSc MSc DSc PGCE CEng FIET FRSA FHEA
Professor of Communication Networks
Pro Vice-Chancellor (Research and Enterprise)

University of Hertfordshire
Higher Education Corporation
Hatfield, Hertfordshire
AL10 9AB

Telephone +44 (0) 1707 284000
Fax +44 (0) 1707 284115
Website www.herts.ac.uk

Dr J Heath & Ms T Wallace
Dept of Psychology, Sport & Geography
School of Life & Medical Sciences

13 August 2021

Dear Dr Heath & Ms Wallace

Re: UNIVERSITY OF HERTFORDSHIRE SPONSORSHIP IN FULL for the following:
RESEARCH STUDY TITLE: The Impact of Flash Blood Glucose Monitoring on Eating Behaviour and Relationship with Food for Adults with Type 1 Diabetes
NAME OF CHIEF INVESTIGATOR (Supervisor): Dr Jennifer Heath
NAME OF STUDENT: Ms Tamara Wallace
UNIVERSITY OF HERTFORDSHIRE ETHICS PROTOCOL NUMBER: LMS/PGT/NHS/02963
HEALTH RESEARCH AUTHORITY REFERENCE: 21/NI/0118

This letter is to confirm your research study detailed above has been reviewed and accepted and I agree to give full University of Hertfordshire sponsorship, so you may now commence your research.

As a condition of receiving full sponsorship, please note that it is the responsibility of the Chief Investigator to inform the Sponsor at any time of any changes to the duration or funding of the project, changes of investigators, changes to the protocol and any future amendments, or deviations from the protocol, which may require re-evaluation of the sponsorship arrangements.

Permission to seek changes as outlined above should be requested from myself before submission to the Health Research Authority (HRA) Research Ethics Committee (REC) and I must also be notified of the outcome. It is also essential that evidence of any further NHS Trust or other site permissions is sent as soon as they are received. Copies of annual reports and the end of study report as submitted to the HRA also need to be provided. Please do this via email to research-sponsorship@herts.ac.uk

Please note that University Sponsorship of your study is invalidated if this process is not followed.

In the meantime, I wish you well in pursuing this interesting research study.

Yours sincerely

A handwritten signature in black ink, appearing to read 'J M Senior', written over a horizontal line.

Professor J M Senior
Pro Vice-Chancellor (Research and Enterprise)



Appendix I

Health Research Authority Ethical Approval



Dr Jennifer Heath
 Doctorate in Clinical Psychology
 Health Research Building, College Lane Campus
 University of Hertfordshire
 AL10 9AB

Email: approvals@hra.nhs.uk
HCRW_approvals@wales.nhs.uk

28 July 2021

Dear Dr Heath

**HRA and Health and Care
Research Wales (HCRW)
Approval Letter**

Study title:	The Impact of Flash Blood Glucose Monitoring on Eating Behaviour and Relationship with Food for Adults with Type 1 Diabetes
IRAS project ID:	299070
Protocol number:	to be confirmed
REC reference:	21/NI/0118
Sponsor	University of Hertfordshire

I am pleased to confirm that [HRA and Health and Care Research Wales \(HCRW\) Approval](#) has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications received. You should not expect to receive anything further relating to this application.

Please now work with participating NHS organisations to confirm capacity and capability, in line with the instructions provided in the "Information to support study set up" section towards the end of this letter.

How should I work with participating NHS/HSC organisations in Northern Ireland and Scotland?

HRA and HCRW Approval does not apply to NHS/HSC organisations within Northern Ireland and Scotland.

If you indicated in your IRAS form that you do have participating organisations in either of these devolved administrations, the final document set and the study wide governance report (including this letter) have been sent to the coordinating centre of each participating nation. The relevant national coordinating function/s will contact you as appropriate.

Please see [IRAS Help](#) for information on working with NHS/HSC organisations in Northern Ireland and Scotland.

How should I work with participating non-NHS organisations?

HRA and HCRW Approval does not apply to non-NHS organisations. You should work with your non-NHS organisations to [obtain local agreement](#) in accordance with their procedures.

What are my notification responsibilities during the study?

The standard conditions document "[After Ethical Review – guidance for sponsors and investigators](#)", issued with your REC favourable opinion, gives detailed guidance on reporting expectations for studies, including:

- Registration of research
- Notifying amendments
- Notifying the end of the study

The [HRA website](#) also provides guidance on these topics, and is updated in the light of changes in reporting expectations or procedures.

Who should I contact for further information?

Please do not hesitate to contact me for assistance with this application. My contact details are below.

Your IRAS project ID is **299070**. Please quote this on all correspondence.

Yours sincerely,
Damilola Odunlami

Approvals Specialist

Email: approvals@hra.nhs.uk

Copy to: Ms Elaine Hubbard

Appendix J

Contacts for Further Support Sheet

04/07/21

IRAS ID: 299070

Version 1.0

Contacts for Further Support

'The Impact of Flash Blood Glucose Monitoring on Eating Behaviour and Relationship with Food for Adults with Diabetes'

Talking about eating and diabetes management can be difficult and bring up uncomfortable feelings or worries. Everything you discussed as part of the research interview is kept confidential and will not be shared with the diabetes team in any identifiable way.

The professional code of conduct and ethical approval for this study means that Tamara Wallace cannot personally support individuals with support beyond the remit of the study. This is why we have created this debrief sheet with a list of contact details for further support.

We hope that some of the resources or services will be helpful should you find yourself needing some extra support.

Your GP

Your Diabetes Service

Diabetes UK

https://www.diabetes.org.uk/about_us/what-we-do/care-and-support

Helpline: 0345 123 2399, Monday to Friday 9am to 6pm

A confidential help to talk to highly trained advisors who have counselling skills and an extensive knowledge of diabetes. They can provide information about the condition, take the time to talk things through and explore emotional, social, psychological or practical difficulties. You don't need a question about diabetes to call them.

Email: helpline@diabetes.org.uk

Diabetes UK can also help you find a local support group. Follow the link on the Care and Support page and enter your region to find local groups. These groups offer people living with diabetes a chance to meet and share experiences with others. They are all run by volunteers and typically meet on a monthly basis, often with a speaker on a topic like diet or exercise.

Diabetics With Eating Disorders (DWED)

<http://dwed.org.uk/>

The DWED website has links to resources, videos, discussions and much more. They also have UK specific support groups on Facebook where members post new topics for discussion and links to events or videos.

For people with diabetes and eating disorders: <https://www.facebook.com/groups/T1EDUK/>

For friends, family and carers: <https://www.facebook.com/groups/T1EDFFCsupport/>

Please note: *This debrief sheet should not be considered equivalent to consultation with a professional – please do seek support should you feel you need it.*

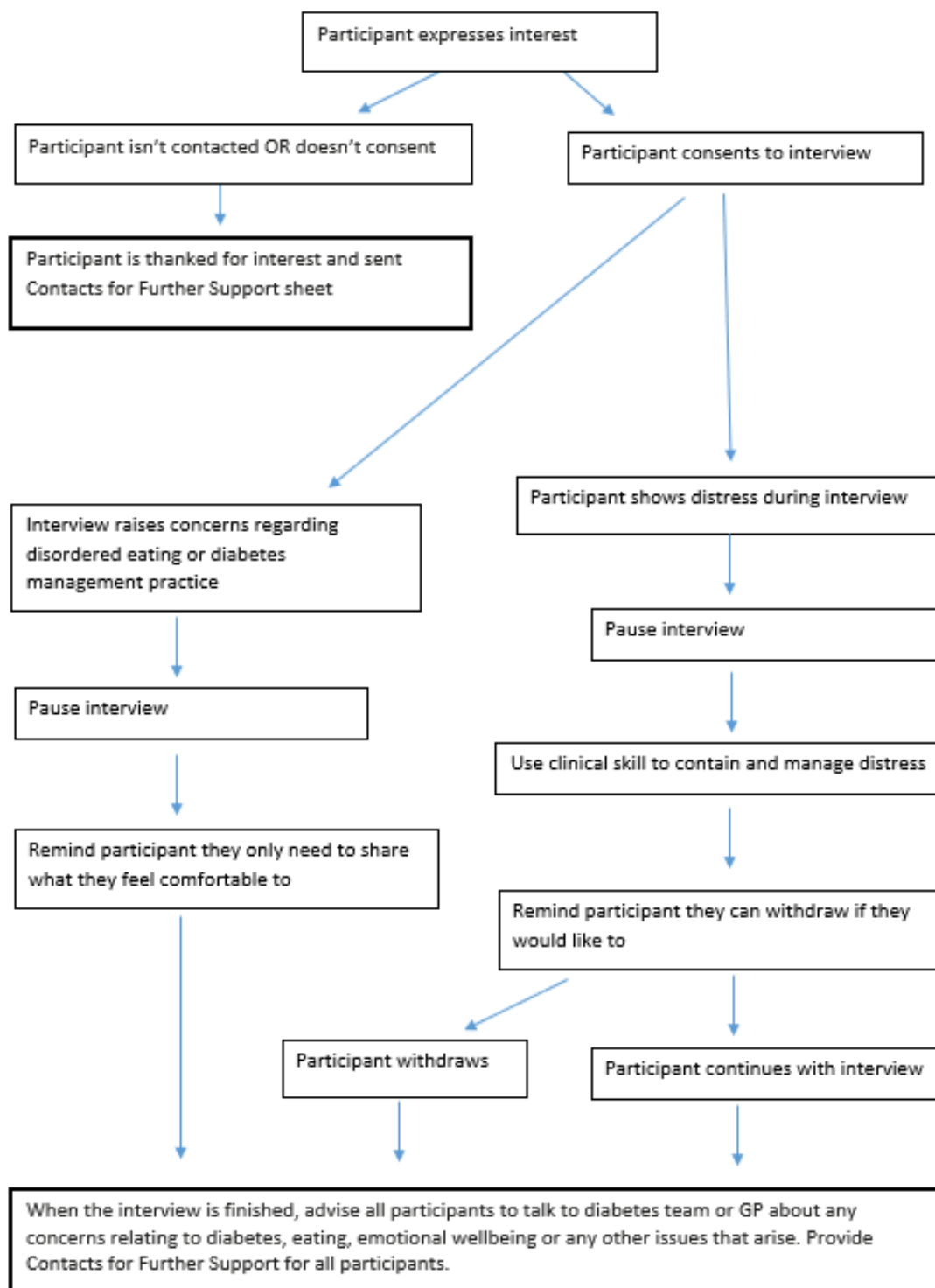
Appendix K Distress Protocol

13/07/21

IRAS ID: 299070

Version 1.0

Distress Protocol



Appendix L

Interview Schedule

14/06/21

IRAS ID: 299070

Version 1.0

Introduce self, context of the research

Pseudonym

Voucher

Contacts for further support.

Interview Schedule

What attracted you to the idea of using the FreeStyle Libre?

In what ways have you found the FreeStyle Libre to be helpful?

In what ways, if any, have you found the Freestyle Libre to be unhelpful?

On average, how often do you scan the FreeStyle Libre per day to check your blood sugar, and how often might you finger-prick?

How does this compare to how often you would finger prick per day before using the FreeStyle Libre?

Can you tell me any more about what motivates or urges you to scan?

Have you been doing anything differently since using the FreeStyle Libre? E.g. regarding broader diabetes self-management and daily life

Since using FreeStyle Libre, has your awareness of your blood glucose level changed? E.g. have you been more aware of when your glucose is high or low?

Since using Free Style Libre, have you changed anything about your eating habits? E.g. what you eat, when you eat, portion sizes, preparation techniques, etc.

Have you noticed any new thoughts or feelings about food?

If you are able to think back to when you were diagnosed with diabetes, can you remember how, if at all, your eating habits were affected by the diagnosis?

Were there new foods you started eating, anything you avoided?

Did you feel differently about any foods?

Have these changes been maintained?

Can you tell me about the graph and the trend arrows that the device produces?

Is it helpful/unhelpful?

How does it make you feel?

Do you notice any thoughts when you look at it?

Based on your experience of what you have found helpful and unhelpful, is there anyone that you would not recommend the FreeStyle Libre to? E.g. people of certain ages, personality types, physical issues etc.

Anything else you would like to mention before we finish?

Appendix M

Transcript Extract with Coding in NVivo

T: Okay. And since using the Libre sensor do you think you're more aware of your blood sugar levels has changed at all? So have you felt any more or less aware when you go low or high?

B: Um... I wouldn't say too much, my body's quite good at sort of giving me the warning signs of both, um... it's just, it's helped reduce, I mean I can't say my bloods are perfect because they're not, but it has helped reduce the highs and the lows because I'd get sort of an earlier warning than I would without.

T: Right. And you said your body is quite good at letting you know, um so does that mean the symptoms of the highs and the lows have sort of stayed quite stable? Like before and after the Libre sensor?

B: Yeah, yeh there's not really been a lot of change.

T: Okay. And since using the Libre sensor, have you changed anything about your eating habits? So for example what you eat or when you eat, or portion sizes or how you prepare food?

B: Um, I wouldn't say massive, but I have, I follow this lady on Instagram and she's not a diabetic but she wears the Libre for sort of, I guess research, she's quite, she has some really good tips and I do try and follow them. So I always try to put protein with my food, um... and any vegetables I would always try to eat the vegetables first. I can't say I've seen a massive difference, but I do bear that in mind because she puts like um... again it's visual representation it catches my eye, um sort of her glucose readings with sort of, the veg tables first, or not eating vegetables at all, and you can see it reduce the rise of the blood sugar, but I yeh I can't say that I've changed anything massively.

T: Right, okay. Is it alright if I ask you how you found that person on Instagram?

B: I actually don't know how I found her, um... um... I don't know. I might have just been looking, looking at diabetics, I don't know, I've been following her for a while.

T: Mm, I was wondering if you'd deliberately looked for someone using the Libre sensor or if you'd just stumbled across it, or a friend recommended it.

B: I think I probably stumbled across it and as I started reading and gained a bit of interest I thought...

trust in own body
feeling different
inconvenience of sensor falling off
preventing hypo snacking
scanning frequency
not over-reacting to the data
changes to insulin habits
improved blood sugar control
sensor offering peace of mind
scanned by friends and family
respite for fingertips
post-diagnosis diet rigidity
anxiety at forbidden foods
reduced checking due to reliance on alarms
self-criticism regarding control
Libre sensor as quick and easy
appreciating, understanding the data
unpredictable levels, frustration
filling in the gaps
previous finger prick routine
trust in the sensor
finger pricking as last resort
seeing the Libre in the media
graph: stopping desired food consumption
post-diagnosis diet changes
reviewing the data
celebration of a good green day
criticism by the data
scanning as an automatic process
pre-sensor over-corrections
childhood food memories
diet controlled by parents
inherited by sensor
sharing tips with peers
visual representation of blood sugar patterns

B: I think I probably stumbled across it and as I started reading and gained a bit of interest I thought "Oh these are actually quite helpful tips that, that she's giving." Yeh I think I stumbled across it, I didn't sort of go out of my way to find... oh I might of... I can't remember. I think I stumbled across it.

T: Yeh that's really interesting, I didn't realise that people without diabetes might use it just for research, or investigating those things.

B: Yeh she's not diabetic, she's just... I don't know why, it is for research but, she wears the Libre and does different trials of food. I don't think her blood sugars like dramatically rises as much as a diabetic's would but you can kind of see the impact of certain foods, even raise her blood sugar slightly and, yeh it is interesting.

T: Mm. And since using the Libre sensor, have you noticed any new thoughts about food popping into your mind, or any new images about food popping into your mind, or any emotions?

B: Um... honestly I do for a split second think "Oh god I'm gonna eat that and my blood sugar's gonna go high." Um, something sort of heavy, like I'll have pizza or pasta or something, I know that there's no real way that I'm going to not get a rise in my graph, um... but I know that it is only temporary and it will, it will come down. Um but I can't say that my eating habits have changed all that much really. It's just helpful to know that I know that I can sort of see what's going on with my blood sugars and then I can react with the insulin because I can see on the graph, sort of my, on the graph, if that makes sense.

T: Yeh, yeh definitely. So you mentioned when you might eat something like pizza, there's a thought that briefly skims through your mind that's something like "Ah this is going to make my sugars go up." Is that a thought that's kind of always been there when you've eaten pizza, or is that something since the Libre sensor?

B: No, it has always been there.

T: Right, okay. Um so if you're able to think back to when you were diagnosed with diabetes, can you remember how, if at all, your eating habits were affected by the diagnosis?

B: Um I remember my mum being really quite strict about what I could and couldn't eat, um... and...

trust in own body
feeling different
inconvenience of sensor falling off
preventing hypo snacking
scanning frequency
not over-reacting to the data
changes to insulin habits
improved blood sugar control
sensor offering peace of mind
scanned by friends and family
respite for fingertips
post-diagnosis diet rigidity
anxiety at forbidden foods
reduced checking due to reliance on alarms
self-criticism regarding control
Libre sensor as quick and easy
appreciating, understanding the data
unpredictable levels, frustration
filling in the gaps
previous finger prick routine
trust in the sensor
finger pricking as last resort
seeing the Libre in the media
graph: stopping desired food consumption
post-diagnosis diet changes
reviewing the data
celebration of a good green day
criticism by the data
scanning as an automatic process
pre-sensor over-corrections
childhood food memories
diet controlled by parents
inherited by sensor
sharing tips with peers
visual representation of blood sugar patterns

B: Um I remember my mum being really quite strict about what I could and couldn't eat, um... and it's hard to really remember, um... like detail but I know that my mum was, which I totally appreciate and am grateful for her keeping me on the right path, um would sort of "Oh no you can't have that." And um, because back when I was first diagnosed it was, technology's come a long way since um, since I was diagnosed. Um, and I always remember having two biscuits before going to bed um and my mum would check my blood sugar and that would sort of be it. Um but other than the biscuits and the odd treat I don't remember really um... yeh it's... yeh... I can't really remember too much. I just know that my mum was strict.

T: Mm, what was that like, when your mum was being strict?

B: Well, I guess I was probably not the happiest, well I say not happy, I think that I was, my mum always says that I was really good and I um, I, I just took it on the chin and got on with it, um but I guess there were times when I'd see my brother sort of having sweets and, and that sort of thing. But I can't remember really feeling... I suppose I was different in a way, to my friends and children my age, but it, it never really stopped me, I, I still sort of don't go round my friends house for tea and things, and um... yeh I mean like lots of [inaudible] I just think that I was restricted on certain things that I could eat and couldn't eat.

T: Mm, yeh. Do you remember if there were any new foods that you started eating after you were diagnosed?

B: Oh god, um, I actually couldn't tell you, I can't even think of the foods that I was eating before.

T: Fair enough, really hard to remember. Can you remember if there was anything that you avoided or didn't have anymore?

B: Oh I tell you what I did actually have, my mum used to buy me the sugar free, um sweets, that had laxatives in. Yeh they were definitely something new, they were um like diabetic sweets and I think she would get diabetic biscuits as well. And chocolate, yeh, yeh.

T: Right, okay. What was that like? Are they things you still have now or was that a post-diagnosis change?

B: Um they were... I don't have them now, no, and in fact I think I've learned that I can have things in...

trust in own body
feeling different
inconvenience of sensor falling off
preventing hypo snacking
scanning frequency
not over-reacting to the data
changes to insulin habits
improved blood sugar control
sensor offering peace of mind
scanned by friends and family
respite for fingertips
post-diagnosis diet rigidity
anxiety at forbidden foods
reduced checking due to reliance on alarms
self-criticism regarding control
Libre sensor as quick and easy
appreciating, understanding the data
unpredictable levels, frustration
filling in the gaps
previous finger prick routine
trust in the sensor
finger pricking as last resort
seeing the Libre in the media
graph: stopping desired food consumption
post-diagnosis diet changes
reviewing the data
celebration of a good green day
criticism by the data
scanning as an automatic process
pre-sensor over-corrections
childhood food memories
diet controlled by parents
inherited by sensor
sharing tips with peers
visual representation of blood sugar patterns

trust in own body
eating outside the home is risky
feeling different
inconvenience of sensor falling off
preventing hypo stacking
scanning frequency
not over-reacting to the data
changes to insulin habits
improved blood sugar control
sensor offering peace of mind
scanned by friends and family
respite for fingertips
post-diagnosis diet rigidity
sulfiness at bedtime foods
reduced checking due to reliance on alarms
self-criticism regarding control
like sensor as quick and easy
appreciating, understanding the data
unpredictable levels, frustration
filling in the gaps
previous finger prick routine
trust in the sensor
finger pricking as last resort
seeing the line in the media
graph stopping desired food consumption
post-diagnosis diet changes
reviewing the data
celebration of a good green day
criticised by the data
scanning as an automatic process
pre-sensor over-corrections
visual representation of blood sugar patterns
childhood food memories
diet controlled by parents
inherited by sensor
sharing tips with peers

Coding Density

B: Um they were... I don't have them now, no, and in fact I think I've learned that I can have things in moderation, normal food, um because they actually didn't taste all that nice. Um, and like the sweets, they used to, once you'd had a few, they'd give you an upset tummy and yeh, yeh they weren't the best.

T: Mm, yeh. Do you remember if you felt differently towards any foods after you were diagnosed?

B: No cos I think I was quite young and I think, because I was six when I was diagnosed so I guess I was just sort of starting to... I guess before then, everything that I was given was kind of what my mum and dad would give me, it wasn't sort of a choice, it was sort of that's what I had. And I don't think really a lot changed, it was just, there was more sort of my mum sort of watching me and, you know, if you wanted to get a chocolate bar or something from the shop it was quite a, quite a big deal, but I still had, um, I ate carbohydrates, but I know that my mum was quite good at sort of limiting the portions. It wasn't like I didn't have a plateful, it was, I used to have whole wheat, I can't even, like the brown pasta... but I don't eat brown pasta anymore because it reminds me of... the sort of, childhood, if I get it, yeh.

T: Hmm, could you say a bit more about that, would that be okay?

B: Yeh that's fine. Um, I'm really racking my brains here, but um, yeh I think... because my mum was sort of in charge, I was too young to really make these decisions, um but, brown rice, brown bread, brown pasta... and I know that they still say it now, it's sort of slow releasing carbohydrates so you don't get such a, um... spike in, in your blood sugar. And it was just sort of then making those adaptations, and there's nothing wrong with brown pasta, I still eat brown rice actually, um there's something about the pasta I just, I just feel "Eugh no, I can't."

T: Mm. And you said "I don't eat the brown pasta because it kind of reminds me of that time, of childhood" so I'm wondering if that's like a flavour thing and it's like "Eugh I just don't really like it, I just generally don't want to eat it." Or if it kind of brings up certain memories or certain feelings that makes you think "Eugh no, I don't wanna go there."

B: Yeh, I dunno, it is, it is, it is a tricky one. I don't know cos like brown pasta's not offensive, there's nothing really like... but yeh I just don't, don't eat it, I won't eat it. And also mushrooms I won't eat, because... I think I was not long diagnosed and I come home and I had um, half a Cornish

trust in own body
eating outside the home is risky
feeling different
inconvenience of sensor falling off
preventing hypo stacking
scanning frequency
not over-reacting to the data
changes to insulin habits
improved blood sugar control
sensor offering peace of mind
scanned by friends and family
respite for fingertips
post-diagnosis diet rigidity
sulfiness at bedtime foods
reduced checking due to reliance on alarms
self-criticism regarding control
like sensor as quick and easy
appreciating, understanding the data
unpredictable levels, frustration
filling in the gaps
previous finger prick routine
trust in the sensor
finger pricking as last resort
seeing the line in the media
graph stopping desired food consumption
post-diagnosis diet changes
reviewing the data
celebration of a good green day
criticised by the data
scanning as an automatic process
pre-sensor over-corrections
visual representation of blood sugar patterns
childhood food memories
diet controlled by parents
inherited by sensor
sharing tips with peers

Coding Density

B: eat, because... I think I was not long diagnosed and I come home and I had um, half a Cornish pastry and it had mushrooms in it and I was really sick and ended up in hospital and ever since, I can't eat mushrooms. And I don't know if that just is a feeling that takes me back to them, then days or, yeh, it's like the only thing I won't eat, mushrooms and brown pasta.

T: Right, right. Thank you for spending on that, that's really helpful. Um can you tell me a bit about the graph and the trend arrows that the sensor produces?

B: Um, yeh so... um... you have... Sorry I've lost my train of thought now... So you can obviously set targets to, everyone's targets will be slightly different, but you kind of have like a um... green bar, on the graph, and throughout the day it, it is like a fully-fledged graph, every time you scan it will mark, mark where you go. Um, and some days my graph is like awful to look at, it's embarrassing. It's up and then it's down, but the arrows I find really, really helpful. And also you get the different colours, um so if it's, if you're blood sugar's in target it'll be green, if it's just above it'll be amber, and if it's high it'll be red. No... it is red or is it... oh gosh um... yeh so you get different colours um reading, I think red's actually low, red's low, um... and the arrows... if your blood sugar's stable you'll get a nice um, horizontal line that's sort of saying "Oh you're smooth, sailing along." Um if it's sort of at an angle pointing up it means it's risen but not, not really quick, if it's dead straight vertical going up or down it means it's either rising really quickly up or rising really quickly down, and I do, I do find them really, really helpful on what I'm doing with my insulin and what I'm eating basically. Cos if I know it's shooting up high I'm gonna avoid carbs and sugar for a bit until it's, it's straightened itself out a bit.

T: Mhmm, okay. Is there anything else about the graphs or the trend arrows that you find particularly helpful?

B: Umm... um... well I mean it can give you sort of an average, you can um, it will calculate sort of over the month, over the week, over the day, sort of down to the hour what your average blood sugar has been. Um and when I look at, sort of, the data that has been collected, I think "Oh I'm always, sort of higher at this time of the day." I think "I can alter my insulin, see if I can bring that average down a bit." It, it, it collects your data and it sort of, it will review um, sorry I feel like I'm really waffling.

T: No, not at all, it's really helpful.

trust in own body
eating outside the home is risky
feeling different
inconvenience of sensor falling off
preventing hypo stacking
scanning frequency
not over-reacting to the data
changes to insulin habits
improved blood sugar control
sensor offering peace of mind
scanned by friends and family
respite for fingertips
post-diagnosis diet rigidity
sulfiness at bedtime foods
reduced checking due to reliance on alarms
self-criticism regarding control
like sensor as quick and easy
appreciating, understanding the data
unpredictable levels, frustration
filling in the gaps
previous finger prick routine
trust in the sensor
finger pricking as last resort
seeing the line in the media
graph stopping desired food consumption
post-diagnosis diet changes
reviewing the data
celebration of a good green day
criticised by the data
scanning as an automatic process
pre-sensor over-corrections
visual representation of blood sugar patterns
childhood food memories
diet controlled by parents
inherited by sensor
sharing tips with peers

Coding Density

T: No, not at all, it's really helpful.

B: And then you get the estimated um, HbA1c which is pretty accurate, which I like. Cos I was a bit unsure at first, when it said it can estimate your um, HbA1c which is the sort of long-term figure that they give you for your overall um sort of, run of diabetes. And I was pleasantly surprised that when having the blood test done compared to what's on the Libre, they were pretty much spot on, which was, was really good. Um cos you can kind of trust a little bit that it is correct and I do go back and forwards and look at things and think "Oh I can tweak that here..." and um, because I've got an insulin pod as well which is a whole other piece of electronic equipment that I can adjust, and... so yeh, it is really um, a great bit of equipment to be honest.

T: Mm. So I'm hearing that the re's something helpful about the kind of reviewing process, so you can notice when certain things happen at the same time of day, or like there's patterns, or you're able to go back and look at what happened, is that right?

B: You did, yeh. That was a better way of explaining it [laughs]. You summarize it perfectly.

T: [Laughs] Ah thank you. Is there anything about the graphs or the trend arrows that is not so helpful?

B: Um, to be honest I actually don't think there is, um... I'm... really a fan of the Libre. Um, I can't say that there's anything that I don't like.

T: Mhmm, okay. And when you open the data, when you look at the graphs, do you ever notice any particular thoughts that come into mind, or any images that pop into your mind, or any feelings that come up?

B: Um I usually... it's gonna sound weird when I say this, the more I try and get a perfect... I, I very, very rarely get a perfect graph, it's, there are highs, there are lows, but the more pressure I put on myself to try and sort of, stay semi within target, it all goes completely wrong, um, for whatever reason. Sometimes I open the phone and I think "Oh my god why, why is it high, I've done everything that I should, I haven't really eaten anything naughty." Some days it's just stubborn. And yeh sometimes I feel down looking at it, I think "Oh why can't it just be simple and..." but, yeh, it's... everyday is different and sometimes I'm not bothered and I'll just deal with what it is some days I'll be thinking "I need to try harder to get things better." And yeh, it's

trial in own body
eating outside the home is risky
feeling different
inconvenience of sensor falling off
preventing hypo snacking
scanning frequency
not over-reacting to the data
changes to insulin habits
improved blood sugar control
sensor offering peace of mind
scanned by friends and family
respite for fingertips
post-diagnosis diet rigidity
satiety at forbidden foods
reduced checking due to reliance on alarms
self-criticism regarding control
libre sensor as quick and easy
appreciating, understanding the data
unpredictable levels, frustration

filling in the gaps
previous finger prick routine
trial in the sensor
finger pricking as last resort
seeing the libre in the media
graph stopping desired food consumption
post-diagnosis diet changes
reviewing the data
celebration of a good green day
criticised by the data
scanning as an automatic process
pre-sensor over-corrections
visual representation of blood sugar patterns
childhood food memories
diet controlled by parents
inherited by sensor
sharing lip-sweat peeps

Coding Density

about... but, yeh, it's... everyday there are sometimes I'm not sure or I'm just not sure what it is, some days I'll be thinking "I need to try harder to get things better." And yeh, it's really a rollercoaster.

T: Mhm. Those days where you said you try your best to keep it with in range but actually those might be the days where it's a bit more variable, what do you think that's about? How do you make sense of that?

B: I don't, I don't know. I, I can't fully explain things because one of my best friends, we've worked together for a long time, she's also diabetic and she also has the Libre and we have many, many conversations about our Libres. And when we've had a good day it's like we've won the lottery, we'll send pictures to each other and say "Oh my god, look at my blood sugar today!" And other times it'll be like "Oh my god look at my blood sugar today, it's been terrible." And there'll be no real, there obviously is an explanation somewhere but, sometimes I just don't get it, because I'll think "I've worked out how many carbs are in the meal and I've done all the maths and the boring stuff... and it's still..." yeh there's no... I don't know if I put too much pressure on myself... I don't really have an obvious explanation as to why... why it doesn't go to plan.

T: Mhm. And you mentioned that one of your best friends has got diabetes as well and also has the Libre, is it alright if I ask you about that?

B: Yeh, sure, yeh.

T: It's just that's such an interesting point that you've made, um so if it feels okay to answer, I was just curious about what it's like to have someone to share those experiences with, or compare those experiences or just talk together about those things? I wonder if you can say anything about that?

B: Yeh, definitely, it's, it's like we have this bond, we're like the Diabetic Sisters. We're just... it's... we, we, it's really nice cos if we're having a... like if I'm having a problem I'll always say to her "Look, what's going on, why is my blood sugar doing this?" and then she'll give me her view on it and say "Well have you tried this." Um sometimes you're like "Ah yeh I didn't think of doing it that way." And like, it is, it is just, we've got that diabetes bond and we can literally talk, and although we can get on each other's nerves and be like "Ah it's sh*t being diabetic, I don't want to talk about it anymore." It, it's so nice that she knows exactly what I'm feeling and what I'm talking

trial in own body
eating outside the home is risky
feeling different
inconvenience of sensor falling off
preventing hypo snacking
scanning frequency
not over-reacting to the data
changes to insulin habits
improved blood sugar control
sensor offering peace of mind
scanned by friends and family
respite for fingertips
post-diagnosis diet rigidity
satiety at forbidden foods
reduced checking due to reliance on alarms
self-criticism regarding control
libre sensor as quick and easy
appreciating, understanding the data
unpredictable levels, frustration

filling in the gaps
previous finger prick routine
trial in the sensor
finger pricking as last resort
seeing the libre in the media
graph stopping desired food consumption
post-diagnosis diet changes
reviewing the data
celebration of a good green day
criticised by the data
scanning as an automatic process
pre-sensor over-corrections
visual representation of blood sugar patterns
childhood food memories
diet controlled by parents
inherited by sensor
sharing lip-sweat peeps

Coding Density

about it anymore." It, it's so nice that she knows exactly what I'm feeling and what I'm talking about, whereas like my partner, I'll talk to him and he'll be so black and white "Oh well did you do the right amount of insulin and dadada" but with my friend it's like she knows what I'm talking about, and can feel, and has felt all these sort of feelings and emotions that, that I've felt and yeh, its, we do support each other and there's always... we're forever sending each other pictures of our Libre graphs and you know, when we've had a good day we're really proud and pleased. And it's nice that she feels that excitement of what it's like to have a really good day with your blood sugars. Whereas other people are like "Oh well done." They don't really know, they don't really care kind of thing. But she... fully gets me, what I'm talking about and yeh its, it is, it is really nice that I have someone so close to me who, we can go through this experience together.

T: Mm, yeh. Ah thank you for expanding on that, that feels like a really precious insight into, into something special. Um and my last question, based on your experience of what you've found helpful and not so helpful about the Libre sensor, is there anyone that you wouldn't recommend it to? So for example, people of certain age groups, or people with certain personality types or lifestyles?

B: Um... I, I see a lot of children wearing sensors now and I think it's really nice that they haven't got to prick their fingers and it's brilliant that kids can wear them, um I don't know how young they start, when they're allowed to wear them from actually, I mean I don't know... um... I don't think there is to be honest, I think because you can use your phone but you also get the machine and that's like so simple, even someone who's not really in to technology could, could scan. Um... yeh I, I think it's very um, versatile and, and accessible for um, sort of everybody, every age. Yeh, I mean, unless there's sort of someone with a disability or isn't able to sort of get in the position to scan, but again if there's an adult or a carer or someone who's able to scan it for them, yeh I don't think there really is anybody that it's not suitable for.

T: Mm, yeh okay. Alright, so that's the end of my questions, is there anything else that you would like to mention before we finish, like anything else that's popped into your mind or anything that feels important to say or for me to know?

B: Um, I don't think there is, I think we've covered... covered pretty much all things Libre. Um, yeh!

trial in own body
eating outside the home is risky
feeling different
inconvenience of sensor falling off
preventing hypo snacking
scanning frequency
not over-reacting to the data
changes to insulin habits
improved blood sugar control
sensor offering peace of mind
scanned by friends and family
respite for fingertips
post-diagnosis diet rigidity
satiety at forbidden foods
reduced checking due to reliance on alarms
self-criticism regarding control
libre sensor as quick and easy
appreciating, understanding the data
unpredictable levels, frustration

filling in the gaps
previous finger prick routine
trial in the sensor
finger pricking as last resort
seeing the libre in the media
graph stopping desired food consumption
post-diagnosis diet changes
reviewing the data
celebration of a good green day
criticised by the data
scanning as an automatic process
pre-sensor over-corrections
visual representation of blood sugar patterns
childhood food memories
diet controlled by parents
inherited by sensor
sharing lip-sweat peeps

Coding Density

like to mention before we finish, like anything else that's popped into your mind or anything that feels important to say or for me to know?

B: Um, I don't think there is, I think we've covered... covered pretty much all things Libre. Um, yeh! just think it's really an amazing piece of equipment that has actually changed my life.

T: Yeh, okay. And was there anything that you expected me to ask you, but that I didn't ask?

B: No, I think your questions have been really good and um... I think you have covered pretty much everything around the Libre. I can't think of anything... yeh.

T: Okay, great. Alright I'll stop recording.

Appendix N

Example of Theme Development Process

Examples of Grouping Initial Codes

▲ peer support, understanding

Sharing tips with peers	Celebration of good levels, a good day	Motivated to use FSL by family members
40	41	42

▲ individual diabetes management context

Historic diabetes practices	Libre use quickly after diagnosis	Pre-sensor over corrections	Diabetes related increased understanding of food	Post-diagnosis diet changes
43	44	45	46	47

▲ times in life with lack of control over food

misdiagnosis	Diet controlled by parents	Post-diagnosis diet rigidity
48	49	50

▲ data inhibiting eating

Graph stopping desired food consumption	reduced portion sizes	reduced variety of food	increased rigidity around eating times/schedules	avoiding foods that make blood sugar go high
51	52	53	54	55

▲ connection to your body

Scanning in response to body signals	Trust in own body	Better understanding of symptoms	Learning about your own body
--------------------------------------	-------------------	----------------------------------	------------------------------

▲ outside of control

The right mindset to look at the data	Self-compassion, different perspective on control
84	85

▲ want to control

Unpredictable levels, frustration	Self-criticism, not meeting expectations	Individual responsibility, possibility to be in control (if work hard enough?)
86	87	88

▲ data offerings

appreciating, understanding the data	Visual representation of blood sugar patterns	Motivated by data	Filling in the gaps	Improved blood sugar control
89	90	91	92	93

▲ sacrifices

Better control vs weight gain	Rigid routine	Sadness at forbidden foods	Food planning, predictable schedule	Compensating for sugar with exercise
94	95	96	97	98

▲ new food insights

Rating or judging foods	Hidden sugar when eating out	Insights into effects of different foods on blood sugar	Changing preparation styles, home cooking
-------------------------	------------------------------	---	---

Example of Developing and Linking Themes

overview

THEME: Where are we starting from/previous food journey

What are users' experiences of the FreeStyle Libre in relation to food and eating behaviours?

- Eating identity
- Individual diabetes management context
- Food rules
- Times in life with lack of control over food

Pats all had their own backstory for their relationship with food over time. This included labels they used to describe themselves regarding their eating habits and attitude towards food, periods of food restriction following diabetes diagnosis (more likely the older pats), beliefs about food and health, and periods of their lives where they weren't in control of their, often restricted, diet so just had to accept it.

Provides a context for the FSL to be introduced. Whether or not the FSL allows them to live in line with that eating identity or does against it. Does it feel similar/freedom compared to previous diabetes management practices or restrictive controls to normal eating for most diagnosed other in the UK. Are pats able to resist old foods they were told by parents they couldn't have, when they weren't in control of what they ate.

THEME: Body as a machine, inputs and outputs

What are users' experiences of the FreeStyle Libre in relation to food and eating behaviours?

- Sacrifices for better control
- Data determining whether eating can happen
- Information overload
- Perfect control is/should be possible
- "I'm just a number"
- Food as functional

Pats described the FSL offering a lot of information that is constantly available, so they can 'see' all the inner workings (processes of their body being displayed on the graph. All the information implies that they can/should be able to keep their levels in range. Because there are no longer guessing/trying to count carbs don't worry, they are able to chase the graph and gain tighter control via more informed insulin amounts and food choices. - choosing types and quantities of carbs or avoiding foods that peak and then constantly trying to input the right amount of fuel (food) into the machine, because they can see how the machine is processing it.

THEME: Liberation from restrictions, burdens and equipment

What are users' experiences of the FreeStyle Libre in relation to food and eating behaviours?

- Sensor encouraging eating
- Sensor lightening the mental load
- Practical freedoms

The data offered by the FSL and the ability to keep checking give pats the option to have a more flexible approach to eating, so eating was more enjoyable, instead of having to finger prick to have a snack, they could see and so long as it was covered again, they just ate the snack and made any adjustments later. They were able to resist old food habits because they could see the rise on the graph but sometimes this was a relief. The graph and the trend arrow gave them permission to eat of more a bigger portion if they were in range enough, or if they were high but the arrow was going down. The reassurance of the alarm meant they didn't have to worry about checking all the time, and they could sleep better because they knew the alarm would wake them up if they could check easily during the night. The ease of scanning and meant they could travel without all their finger pricking equipment and were less self-conscious when out and about, including eating out, because counting can be tricky.

THEME: A shift in roles, perspectives, power

What are users' experiences of the FreeStyle Libre in relation to food and eating behaviours?

- Becoming the professional
- Perfect control isn't possible
- Feeling empowered/motivated

Pats reported accepting, understanding and reviewing the data offered by the FSL, instead of waiting for professional advice at appointments, they were able to review the data themselves, notice patterns and make informed adjustments to their insulin regimes or their eating habits. At times this included going against guidance and figuring out things that worked for them. Some pats also demonstrated self-compassion when describing their data and their approach to control, comparing to the many external factors that are out of their control that impact their levels, as evidenced by the graph. The increased 'self-efficacy' because of their ability to manage their diabetes more independently meant that for some, it changed their relationship with the diabetes, in that diabetes felt more manageable and less of a problem, (which encourages more freedom to eat how they want) or less worry about food (or a more restricted diet to maintain better control).

THEME: Increased awareness

What are users' experiences of the FreeStyle Libre in relation to food and eating behaviours?

- New insights
- Visibility
- Connection to your body
- Peer support, understanding

Pats described discovering the impact of certain foods and exercise on blood sugar levels that they were not previously aware of due to the visual representation of the graph. The graphs also fitted in the gap between checks and some discovered what happened to their levels during the night. For some, the novel data coincided by changes to their diet, (going vegan), health kicks, weight loss however. Metabolic changes also occurred for other reasons (Covid, heart attack). Pats also described learning more about their bodies or increased awareness due to the sensor/batter control. The visibility of the sensor on the pats arm or the sound of the alarms meant that surrounding people were more aware of the diabetes and the pats able to manage it. Data was also shared with friends or family who also had diabetes, to share tips or encourage good diet.

- Theme: where are we starting from, previous food journey
 - ▶ eating identity (3 slides)
 - ▶ individual diabetes history (11 slides)
 - ▶ food rules (5 slides)
- Theme: body as a machine, inputs and outputs
 - ▶ sacrifices for better control (4 slides)
 - ▶ data determining whether eating can happen (3 slides)
 - ▶ information overload (8 slides)
 - ▶ perfect control is/should be possible (5 slides)
 - ▶ "I'm just a number" (6 slides)
 - ▶ food as functional (3 slides)
- Theme: liberation (from restrictions, burdens and equipment)
 - ▶ sensor encouraging eating (6 slides)
 - ▶ sensor lightening the mental load (5 slides)
 - ▶ practical freedoms (4 slides)
- Theme: a shift in roles, perspectives, power?
 - ▶ becoming the professional (6 slides)
 - ▶ perfect control isn't possible (5 slides)
 - ▶ feeling empowered/motivated (4 slides)
- Theme: increased awareness
 - ▶ visibility (3 slides)
 - ▶ new insights (8 slides)
 - ▶ connection to your body (3 slides)
 - ▶ peer support, understanding (4 slides)
- Theme: overpowered by diabetes/"Diabetes is oppressive" (10 slides)
 - ▶ rebelling against diabetes (4 slides)
 - ▶ Default Section (6 slides)
 - ▶ interesting but not related to research question (16 slides)
 - ▶ negative reviews of sensor (5 slides)

Appendix O

SPSS Output

Statistics

		T1_PAID_score	T2_PAID_score
N	Valid	199	199
	Missing	0	0
Mean		32.1357	23.6024
Skewness		.744	.957
Std. Error of Skewness		.172	.172
Kurtosis		-.253	.592
Std. Error of Kurtosis		.343	.343

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T1_PAID_score	32.1357	199	21.84063	1.54824
	T2_PAID_score	23.6024	199	17.09083	1.21154

Paired Samples Test

		Paired Differences							Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	
					Lower	Upper			
Pair 1	T1_PAID_score - T2_PAID_score	8.53329	17.63281	1.24996	6.06836	10.99823	6.827	198	.000