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“We don’t worry about diabetes that much”: A qualitative study exploring perceptions of physical activity among children with Type 1 Diabetes

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Abstract

Background: Despite the health benefits of physical activity, children across the population are insufficiently active. Physical activity is essential in the management of Type 1 Diabetes Mellitus (T1DM), therefore its promotion should be a priority, yet little research has explored the experience of physical activity from the viewpoint of children with this condition. This study sought to provide insight into how children with T1DM perceive and participate in physical activity to further the design of initiatives and clinical interventions that promote active lifestyles in this population.

Methods: Researchers collected data through in-depth interviews with twelve children aged 9-11 years with T1DM in the UK. Interviews were recorded, transcribed verbatim and data were analysed using thematic analysis.

Results: The overarching themes captured: children’s understanding of physical activity; children’s physical activity is motivated by friendship and social interaction; children’s physical activity is motivated by positive perceptions, fun and enjoyment; children describe how their family helps them to be active; school provides children with an opportunity to be active; children’s access to facilities and outdoor space encourages physical activity; children refer to personal mastery and competence in physical activity and; children perceive difficulties that make physical activity harder.

Conclusions: This study is the first to distinguish children’s perceptions toward physical activity from other key stakeholders. Listening to children has identified what they believe is important, for example enjoyment and socialisation, which should be considered when developing strategies to promote physical activity in this population.

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Introduction

Physical activity for children and young people with T1DM has benefits for glycaemic control, body composition and lipid profile [1]. Although accurate measurement of children's physical activity levels is inherently complex, a review of evidence suggests that children with T1DM may be insufficiently active to achieve these health benefits [2]. Since active children tend to become active adults [3], promoting physical activity in children is a major public health priority [4].

For children with T1DM, the transition between primary school and secondary school at around eleven years can be a critical period as diabetes management shifts from parental management to self-management [5]. Since physical activity is recognised as one of the cornerstones of T1DM management [6], developing our understanding of how children with T1DM perceive and experience physical activity may help inform the design of initiatives and clinical interventions to promote active lifestyle in this population.

Research suggests that children themselves perceive few disease-specific barriers to physical activity [7, 8], but that parents have concerns about physical activity-induced hypoglycaemia [9]. In Australia, Fereday et al. [7] were the first to use qualitative methodology to explore the experience of physical activity in twenty-five children aged 4 – 16 years with chronic conditions and their parents (including fourteen children with T1DM). Children in this study believed that they could do anything that their peers did in relation to physical activity.

More recently in Scotland, MacMillan et al. [8] interviewed sixteen children (aged 7 – 9 years and 12 – 14 years) sixteen parents, and nine diabetes professionals to determine what they as a group perceived to influence participation in physical activity, and what they considered to be important factors to consider when developing interventions to increase physical activity in youth with T1DM. Participants identified peers and parents as the most significant groups to target in physical activity interventions. They suggested that more could be done by teachers and diabetes professionals to

encourage physical activity. The researchers identified diabetes-related influencers for consideration in physical activity interventions that included: blood glucose levels, diabetes preparation and management, diabetes support, fear or anxiety related to diabetes, the occurrence of hypoglycaemia, insulin pump therapy, concerns about movement of the pump during activity, and patients being conscious of others knowing that they have a pump. However it was unclear to what extent these views were held by children. Deeper exploration of what children with T1DM perceive as influencers on their physical activity participation is needed [8].

Whilst these studies have developed our understanding of physical activity for children with T1DM, findings remain inconclusive. A narrative review concluded that the two main barriers to physical activity among children with T1DM were low fitness levels and fear of exercise-induced hypoglycaemia [10]. Exercise-induced hypoglycaemia refers to blood glucose levels lower than four millimoles per litre and is a common side-effect of physical activity in people with T1DM. Symptoms range from shaking and sweating (mild hypoglycaemia) to coma (severe hypoglycaemia) [11]. A questionnaire study identified fear of hypoglycaemia in children aged 8 – 18 years with T1DM [12]. Questionnaire methods enable a large sample size, but limit the depth of response a child can give. The questionnaire referred to hypoglycaemia in everyday life, making it unclear whether children had concerns about exercise-induced hypoglycaemia specifically.

Previous research has produced inconsistent findings and has failed to distinguish the insights of children from other key stakeholders to understand whether they have unique perceptions of diabetes in relation to physical activity. This paper will complement and advance previous studies by further exploring children's viewpoints, their experiences and opinions on participation in physical activity. Such findings will inform the development of supportive interventions to promote physical activity among children with T1DM.

Methods

Design

The current study was embedded within a wider programme of research aiming to evaluate the feasibility of a physical activity programme for children with T1DM. Children in the current study were enrolled into a pilot randomised control trial (RCT). Children and parents consented to be randomised to a physical activity intervention and were informed that their involvement would include an interview with the researcher. Investigators collected baseline data using questionnaires and accelerometer assessments of physical activity prior to randomisation and delivery of a 6-week physical activity programme. The interview study took place post-intervention and employed qualitative research methods to collect data through semi-structured interviews. The interview study was informed by interrelated concepts of interpretivism balanced with pragmatism, seeking to understand the experiences and perceptions of children whilst having practical implications for those working with children who have T1DM. The whole study had been reviewed and approved by the local Research Ethics Committee and the respective National Health Service NHS Research & Development R&D department in March 2014 (REC reference number: 14/EM/0057).

Participants

Participants were recruited from a single UK paediatric diabetes clinic. To be eligible for the feasibility study, children had to: i) be aged 9 - 11 years; ii) be diagnosed with T1DM for at least three months; iii) be physically capable of participating in physical activity, at the discretion of the paediatric diabetes clinic staff; and iv) have a parent or carer who provided informed consent for the child to participate. Out of fifty children deemed potentially eligible, thirty expressed an interest to participate, thirteen of whom were recruited for the feasibility study. Informed assent was received from both children and their parents. Assent and consent were ongoing, thereby giving children and parents the opportunity to consider their right to refuse the interview. An interview was scheduled only if there was mutual agreement between the child and parent.

One child randomised to the intervention group did not engage with the intervention and refused the interview. The remaining twelve children agreed to participate in the interview (Table 1).

Table 1. Characteristics of study participants

Participant ID	Gender	Age (years)	Diagnosis (years)
P01	F	10.8	8.0
P02	M	11.4	10.6
P03	M	11.8	4.8
P04	M	11.1	3.0
P05	F	11.1	2.1
P06	F	9.4	3.3
P07	M	9.9	5.8
P08	M	11.3	0.4
P09	F	10.8	1.6
P10	M	9.8	0.8
P11	F	12.2	6.1
P12	M	9.4	5.6

Data collection

All interviews took place at the child's home. In late September 2014 and early October 2014, interviews were arranged at a mutually convenient time. Home-visits were made after school hours and face-to-face interviews were conducted by a female researcher aged 25 years who had been trained in qualitative research and interview techniques (HQ). There was no requirement for the parents to be present (or not) during the interview. Eight interviews were conducted whilst a parent was present and on four occasions the child was alone with the interviewer; although this may give rise to some inconsistency, it was deemed an appropriate ethical decision. With permission from the child and parent, on nine occasions the interviewer (HQ) was accompanied by a second researcher (female medical student RM, aged 20 years).

All children and parents agreed to the conversation being recorded on a Dictaphone. The Dictaphone was shown to the child and then placed out of sight during the interview. Before the interview commenced, the interviewer reassured the children that there was no right or wrong answer and of their right not to answer questions. Interviews adopted an informal conversational style. They were guided by an interview schedule to ensure that the same topics were covered across all interviews, yet the agenda was kept flexible. The interview guide had been previously pilot tested with a nine year old boy with T1DM. Broadly, the questions explored what the children perceived 'physical activity' to be, how being active made them feel, what they liked and disliked about physical activity and what or who helped and hindered their participation. Interviews utilised open questions, for example: "What does physical activity mean to you?" Prompts were used where necessary to elicit more details or clarify responses. The concept of 'physical activity' was not defined by the interviewer, instead the children were asked for their own interpretation. Investigators asked children about physical activity experiences only, any mention of health or diabetes came from the child.

According to Creswell [13] rapport between researcher and participant enables trust and confidence and elicits responses. The interviewer was known to the child because of the child's involvement in the feasibility study, thus rapport had been established. The interviewer situated herself in the room where the child preferred. Children could write down or draw their thoughts using visual prompts in the form of a thought-bubble sheet and an activity ruler whilst being verbally prompted to vocalise what they had written. Ten children utilised the thought-bubble worksheet.

Data analysis

The audio recordings of the interviews were transcribed verbatim. Participant anonymity was ensured in the transcripts by using the participant number as an identifier and using pseudonyms to replace names and place names in the transcript text. Transcribed documents were read in full repeatedly by HQ and RM and annotated based on recurring concepts and points of interest. The transcribed

interviews were transferred to the software package NVivo version 10 (Qualitative Solutions and Research International), which has been used in similar research [14]. NVivo facilitated the organisation of the codes (known as 'nodes' in the software), the development of sub-themes and overarching themes, and the identification of relevant quotations used to illustrate the themes.

Thematic analysis

The data were analysed using thematic analysis [15] which is a form of pattern recognition where emerging themes in the data become the categories for analysis [16]. The primary researcher (HQ, trained in thematic analysis), conducted the analysis of the data. HQ used six phases of thematic analysis based on Braun and Clarke [15]. Familiarisation with the data involved transcribing, reading and annotating interview transcripts. Generation of initial codes entailed listing ideas about what was interesting about the data and organising data into meaningful groups to form codes. Search for themes comprised of sorting codes into meaningful groups to form potential sub-themes. Review potential themes consisted of refining potential themes, ensuring codes within themes cohered together and ensuring clear distinction between themes. HQ grouped and labelled related sub-themes with an overarching theme name. Defining and naming themes in a codebook is explained below. In the final analysis and write-up phase the findings were written up with verbatim extracts to demonstrate themes. This was not a rigid, linear process, but an iterative process, moving backwards and forwards through the six phases as required.

Codes were defined as meaningful groups of data that captured the essence and richness of the data [17] and could be events (e.g., behaviour: sedentary pursuits), emotions (e.g., feeling happy) or beliefs (e.g., physical activity keeps you healthy). Codes were derived primarily from the data (inductive) but could also be theory-driven (deductive) [15]. Data analysis began with an inductive approach to ensure important aspects of the data were not missed. Inductive codes arose purely from the data and thus were not anticipated in advance of data analysis. Codes arose

through a deductive approach when the theoretical understanding found in literature review allowed the researcher to be sensitive to certain topics of interest that may arise in the data [18]. For example, an initial code; ‘hypoglycaemia’ was deductive as previous research suggested that hypoglycaemia could be a potential barrier to physical activity. Although the sample size was a purposeful, the researchers believed that data saturation had been reached because the last interviews did not provide additional understanding of children’s experience of physical activity (i.e., no more codes emerged).

Trustworthiness

Trustworthiness refers to the degree to which the research offers an authentic account of the subjects under study [19]. Yardley’s (2008) evaluative criteria were used as a guide to ensure methodological trustworthiness. The researchers showed sensitivity, commitment and rigour to theory, participants and data, were transparent with research decisions, and sought findings that would have practical implications. This was in addition to utilising a rigorous approach to establish the consistency and replicability of the themes [17]. The researcher was sensitive to the power imbalance between child participant and adult researcher. The researcher acknowledged that they may have influenced the children’s responses, regarded researcher preconceptions and subjectivities as something used creatively in the research process to advance knowledge, rather than as a problem of bias.

During analysis a codebook was developed. A codebook is a set of labels, descriptions, and examples used to define codes in the analysis of qualitative research [17]. Extracts from the data were selected at random and given to an unaffiliated independent coder to code using the codebook. A percentage of agreement was calculated to demonstrate the consistency of themes. Boyatzis [17] proposed that percentage agreement between two coders above 70% demonstrates acceptable consistency and replicability of the themes. The percentage agreement was 71%, suggesting that the theme analysis had been reliably conducted to a recommended standard [17].

Reflexivity

Reflexivity refers to the process of critically reflecting on the knowledge produced during the research process and the researcher’s role in producing that knowledge [15]. Through reflexive practice, the researcher critically reflected on her assumptions and role as the adult researcher, but also on the choice of data collection methods and their application. Reflections took place; prior to data collection (e.g., to reflect on personal values, beliefs and motivations), immediately after each interview with a second researcher when possible (RM) (e.g., to reflect on methodological decisions and impressions of the interview, the participants and emerging points of interest) and during data analysis (e.g., to reflect on early impressions of the data and to document rationale for assignment of codes and themes).

Findings

Twelve children were interviewed (five female, seven male). The mean age was 10.8 years \pm 0.9 and the mean duration of diagnosis was 4.3 years \pm 3.1 (range 5 months to 10.6 years) (see Table 1). The majority of the sample were White British (n=10), one participant self-identified as Black African and one as Mixed Race. Five children had a mother with undergraduate or above level of education and six children had a father with undergraduate or above level of education. Children had a mean HbA1c (glycated haemoglobin) of 55.1mmol/mol which ranged from 41mmol/mol to 72mmol/mol. Seven children used an insulin pump, four children used multiple daily insulin injections and one child used an insulin pen.

Evidence of the major themes are presented and supported with verbatim quotations from the raw data, using fictitious names where necessary.

Theme 1 Children’s understanding of physical activity

When children were asked to describe their interpretation of physical activity, they tended to list activity examples rather than provide a definition. One boy tried to recall a definition he had learnt in school, for example, “physical activity is doing

exercise and increasing your heart rate” (P03). Children chose to list their favourite activities first, and the predominant theme was sport, followed by more general concepts such as “moving around” (P09). Movement of the body was a common way of conceptualising physical activity. One boy suggested that “Xbox is active [because] it makes your fingers go fast” (P07). Less common responses involved references to health, such as “being healthy, keeping in shape” (P11). Some children found it helpful to explain what they would not describe as being active, such as “being active isn’t like, sitting around doing nothing” (P11).

Children were asked, ‘how much physical activity should a child like you do?’ to which there was a variety of responses. Some children could not answer the question whilst others provided vague answers such as, “quite active” (P01) and “quite a bit...just a lot” (P10). One boy who gave a vague response expanded his answer suggesting, “Adults, they don’t need to do as much” (P10). Among the children who provided a definitive answer, some suggested 30 minutes and others suggested one hour or more. One boy who did not agree with a 30 minute recommendation stated, “I read that about 30 minutes every day, but I don’t really think that. I don’t think it’s necessary to do that every day” (P03) and another boy said, “about 60 minutes a day, at least...but if you can’t manage it all, it doesn’t need to be 60 [minutes]” (P03).

Theme 2 Children’s physical activity is motivated by friendship and social interaction

Physical activity was regarded as a social experience, with some children considering themselves part of an active social group and describing activities that were dependent on other children being involved.

Co-participation in physical activity with friends is important for children

The majority of children conceptualised physical activity as a social experience, often regarding it as something they did in the company of friends. Socialisation was a common rationale for participating in activities, such as walking to school,

“I walk with my friends” (P08). Children mentioned social benefits such as “working as a team” (P08). One girl suggested that her active friends were important in the initiation or maintenance of physical activity, “because all my friends, they’re running across fields and well, since all my friends are active, I am. Just makes me want to be like them” (P11). Children specifically identified school friends or neighbourhood friends as important.

Sometimes peers limit physical activity

Whilst friends were influential in children’s enjoyment of physical activity, for some, the importance of identifying with their social group sometimes limited their physical activity participation. For example, some children would co-participate in sedentary activities at school break time if that was the social norm, for example, “I sit and talk to friends” (P08) and “we play Pokémon [cards]” (P06). One boy expressed a desire to do trampolining, yet his rationale for not joining a trampolining club was, “but none of my friends do that” (P08). This group of children distinguished ‘other people’ (i.e., school peers or other children in the neighbourhood) who were detrimental to their enjoyment of the activity. Children described how these ‘other people’ would “be mean”, “tease” (P09), “be really annoying” (P03), “make fun” (P07), and be “horrible to my friends” (P08) in physical activity contexts. And one boy chose to describe these people as “acquaintances” (P03) rather than friends.

Theme 3 Children’s physical activity is motivated by perceived positive outcomes, fun and enjoyment

Children’s positive perceptions of physical activity as being healthy and fun provided their rationale for enjoyment, and often the reason for participation.

Children have positive perceptions of physical activity and its outcomes

Overall, this group of children spoke positively about physical activity and many reported being active because of the perceived “fun” (P09) or because they “enjoy” or “like” it (P02, P03, P11, P08). When

probed, children often found it difficult to express why physical activity was fun, but friendships was offered by some children as a reason for enjoyment, for example, “because I get to play with my friends” (P01). Generally, children valued having fun and they perceived it as a good reason to be active.

The children also had positive perceptions of physical activity outcomes. These fell into two broad categories; i) physiological outcomes such as health and fitness, and ii) psychosocial outcomes such as teamwork. The physiological health benefit of physical activity was the predominant belief, with phrases such as, “it keeps you healthy and fit” (P01), “when you do sport you can be healthy” (P12) and “longer to live and when you don’t do exercise you have a shorter life” (P08). Some children also acknowledged the preventive effect of physical activity, such as, “so you don’t get fat” (P05) and “because otherwise you could have a heart attack” (P08). When questioned further, many children could not elaborate on the link between physical activity and health outcomes. Only one child acknowledged that physical activity could benefit diabetes control, for example, “my blood sugar gets better” (P09), whilst it was more common for children to cite outcomes not related to diabetes. Children did not often mention psychosocial outcomes, but examples included, “if people aren’t happy, physical activity makes them feel better I suppose” (P11) and, “it can help teamwork” (P02).

Children derive positive feelings from physical activity

As well as perceiving physical activity as something healthy and fun to do, the children described positive feelings derived from participation, mostly feeling “happy” (P01, P05, P06, P08, P10, P12), for example, “I feel quite happy when I’m doing it [playing football]...like I’ve enjoyed it” (P10). Explaining why physical activity makes him feel happy, one boy stated, “Sometimes it makes me feel happy because it’s not about winning or losing, it’s just fun and having a great time, that’s what it’s all about” (P07). Other positive feelings derived from physical activity included satisfaction, for example, “I feel quite satisfied” (P03), “cheerful” (P12), and relaxing, for

example, “I like walking because it really relaxes me” (P11).

Theme 4 Children describe how their family helps them to be active

Children often mentioned family members and when prompted about the influence of their family, all children described how family members helped them to be active.

Children describe family involvement in physical activity

Children often referred to parents or siblings being directly involved and co-participating in physical activity with them. It was more common for children to describe being active with parents or grandparents than it was for them to describe being active with siblings and some described whole family activities. For example, “my two brothers play on the trampoline and what we got to do is see who jumps the highest” (P09), “sometimes I play football with my dad...Sometimes golf, my granddad’s teaching me (P07) and, “family bike ride” (P02).

Children describe parental encouragement of physical activity

Children perceived parental encouragement as a motivation for them to participate in physical activity, for example, “[mum] she keeps motivating me, so if I’m on my bed lying down she’s like ‘ok do you wanna, ok you should go out. Gemma don’t lie down on your bed all day, go out’” (P11). Parental encouragement was not only verbal; children felt encouraged if they believed their parents were in favour of physical activity, for example, “they [parents] want me to be healthy” (P12) and “My mum’s all for it” (P03). One boy acknowledged how his mum encouraged him to be active by allowing him to go outside to play, “not many people just let them [their children] go out, but mum lets me go out quite a lot” (P08), similarly a girl stated, “they [parents] don’t stop me from doing it” (P06).

Children are dependent on parents for some physical activities

Children's participation in physical activity sometimes depended on parents for logistical support such as fees, transport and accompanying them to the activity. One boy acknowledged the logistical support received from his parents helped him to be active, "Parents driving me to places to play football" (P03). It was more common for children's descriptions to indicate logistical support, for example, "We spent fifty pounds on new jodhpurs" (P03), "My mum or her [friend's] mum takes me [ice skating]" (P11) and "She [mum] takes me to the park" (P05). Some children also described times when their parents were not available, were ill, or could no longer fund the activity, which had a detrimental effect on the child's activity, for example, "mum wasn't well, so we didn't go [horse riding]" (P03). Children did not commonly talk about their parent's role in diabetes management. One child described a school activity holiday and mentioned how her mother had "travelled an hour and a half to get there every day" and when probed added, "she's really like OTT [over the top] about me checking my blood sugar and stuff. So she'll always be like talking to the teacher, 'has she done her blood glucose?'" (P11).

Theme 5 School provides children with an opportunity to be active

Most of the children volunteered details about physical activity in school. Researchers also prompted children to describe how they felt about being in active in school. Overall, children associated school with opportunities to be physically active.

Children are influenced by physical education (P.E.) and extracurricular activities provided by school

The majority of children mentioned physical education (P.E.) as an example of how they keep active. Those children who had started secondary school (aged 11 years) distinguished P.E. lessons (e.g., gymnastics, fitness) and "Games" lessons, such as rugby, football, badminton, hockey and netball. Children spoke positively about P.E. and enjoyed the chance to try "different stuff every time" (P10).

Extracurricular activities were also mentioned as physical activity opportunities, including indoor games club, cheerleading, athletics and basketball. One boy justified his opinion about the importance of P.E. by saying, "I feel [P.E.] it's good to actually do it in the curriculum and having clubs and stuff afterschool and that's encouraging people to do sport" (P03).

Children believe teachers can help them to be active

Most of the children who talked about P.E. spoke positively about the encouragement they received from their P.E. teachers. For example, "there's an assistant called Mr Rogers at P.E. ...He helps you get healthy and make it, make you really want to do it" (P12) and, "Mrs Patterson does netball with us and she shows us the perfect way to do it and helps us try and get better at it" (P06). One girl used the phrase "people I trust" to describe the teachers in school, and when probed clarified that this was to do with "diabetes and in general" (P09). Two other children referred to diabetes, reporting that their P.E. teachers were helpful when they had to test their blood glucose level. Few children had anything negative to say about P.E. teachers; three children expressed concern about, "strict" teachers at Secondary school (P11), teachers "focusing on other people" in class (P06), and teachers giving afterschool detention "if you accidentally forget your P.E. kit" (P03). One boy did not feel influenced by P.E. teachers, "no, they [teachers] don't help me to be active" (P07) and another boy seemed indifferent when asked about his P.E. teachers, "they're fine" (P03).

Theme 6 Children's access to facilities and outdoor space encourages physical activity

Children referred to aspects of their physical environment at home and within the broader local neighbourhood, including access to facilities, equipment, and outdoor spaces that influence their physical activity.

Children talk about facilities that encourage physical activity

A common facility mentioned was a swimming pool, but children also mentioned ice skating, hockey and football pitches, and horse stables. When asked what helps them to be active, children could appreciate that having equipment available, for example, a football, a trampoline, or a bicycle made it easier for them to be active. Children also referred to attempts to find activity clubs or facilities in their local community, for example, “I’m just trying to look for a [trampolining] club” (P05) and, “Maybe if find a Zumba club” (P09).

Location and outdoor space foster physical activity

Children also referred to aspects of their geographical location that influenced their access to physical activity opportunities. Examples included being in close proximity to physical activity opportunities, such as being able to walk to or from school, and having friends live nearby. Living in a location far away from school friends limited one child’s opportunities to be active with friends, “I can’t really have friends round after school because lots of them live far away” (P06), which also reinforced the importance of friends for children’s physical activity. Children also mentioned their proximity to outdoor spaces such as a garden, local parks and fields, for example, “it’s quite a nice place [to live] and there’s a park” (P08).

Theme 7 Children refer to personal mastery and competence in physical activity

Children expressed a desire to learn, practice and develop competence in physical activities, demonstrating a desire for skill mastery.

Children value physical activity practice and learning to master skills

Children seemed to value the experience of learning about physical activities, for example, “I like doing my street dance because I know stuff about street dance I didn’t know about street dance before” (P01). One stated, “I do it to get better” (P02) and another boy valued the opportunity to try handball in school, “I knew nothing about handball, and now I do” (P07).

Mastering skills through practice was important to children, for example, “I really like skipping because it helps you jump and I’m not a very good jumper, but skipping makes me better” (P07). Children would recall situations in which they had mastered a physical activity successfully, and how that made them feel, for example, “Ice skating it’s just, you do the tricks and you feel like, ‘wow, I can actually do that’ and then, it’s just really good I guess” (P11).

Children talk about their perceived competence at physical activities

Linked to the mastery of skills, children had an awareness of their competence or level of ability to perform certain activities. It was more common for children to mention a perceived lack of competence in an activity rather than proclaiming themselves as good at an activity. One boy assessed his competence in comparison to others, “There’s a coach and a few people [at tennis lessons] but the people are quite good, so I’m quite challenged because I’m not as good as them” (P03); another boy assessed his competence based on his own performance, “I’m not that good at gymnastics so I’m not sure, roly-polys... I don’t like hitting my head” (P08). A girl implied that she enjoyed physical activity regardless of perceived competence, “I like it [basketball], but I don’t know if I’m good at it... just as long as you have fun” (P09).

Theme 8 Children perceive difficulties that make physical activity harder

Children were asked what makes it harder for them to be physically active and this theme captures three issues raised.

Children recall difficulties related to their diabetes

Half of the children mentioned hypoglycaemia, four of whom perceived it as something that could impede their participation; however, it was not common for this group of children to talk in depth about the impact of T1DM on their physical activity. One boy alluded to physical activity having negative consequences for blood glucose control, “it sort of burns off calories and unfortunately carbs and

sugar...if it burns off the carbs, you go hypo” (P02). Episodes of hypoglycaemia were perceived as a practical inconvenience by children who would miss part of the activity whilst they waited for a quick-acting carbohydrate (e.g., energy drink) to take effect on blood glucose level. Children described how this made them feel, “awkward” (P10), “annoyed” (P03) and “sad” (P09). For example:

Sometimes with football when my bloods go low and stuff ...I have to you know, come off or not go on or don't go on, just need to wait for them to come back up. [H: How does that make you feel?] Annoyed because not so long ago, there was a football match and I was supposed to be coming on at half-time, so I had to delay that as well, so I ended up not playing as long. (P03)

Three children referred to their insulin pump, suggesting that sometimes the pump could be an inconvenience during times of physical activity, especially if it needed to be taken off during the activity, “we don't worry about it [diabetes] that much apart from swimming where I have to take my pump off because it's not waterproof” (P03). Another boy suggested that taking off his pump and finding somewhere safe to keep it made physical activity harder, “I have to find somewhere safe to put it because I can't play rugby with it on” (P03).

Children can be distracted by sedentary activities

When asked what got in the way of them being active, over half of the children mentioned screen-time activities such as television, video games, mobile phone and electronic book reading. Children acknowledged that sedentary activities were a “distraction” (P10) from being active, for example, “when I'm away from home I think I am a bit more active, because there's not the screen to distract me!” (P03) and “if I see something really good on television, I'll really want to watch it even though I'm supposed to be going out on my bike. So that's kind of hard to say like ‘oh don't watch it’” (P11). However, sedentary behaviour was not always perceived as a negative barrier to physical activity, but rather something that co-exists within an active lifestyle. For example, “When our 45 minutes

[outside being active] is over, we come in and play Minecraft, which is an Xbox game” (P07).

Children perceive time demands

Some children perceived other commitments impeded on their opportunity to be more active, for example, school and homework, “I'm stuck in my room doing homework and I can't really go outside” (P11) or other activities, “I gave up dancing because it on the same night as clarinet...but I did want to carry on [dancing]” (P03). One girl discussed how desirable activities would compete against each other for her time, “I'm thinking of taking up netball but...I don't know whether I'd rather play with my friends, or do netball” (P06). One boy implied that an active lifestyle constituted a busy lifestyle, “I don't get back until 5 [o'clock] from school, it's quite a rush to get to swimming at 6 [o'clock]” (P03).

Discussion

This study sought to understand how children with T1DM perceive and experience physical activity. The children in this study understood physical activity mainly in terms of sports, and also the concept of ‘moving’, which supports previous research [20]. However, children had limited knowledge of physical activity recommendations, which has also been found in young people with [8] and without T1DM [21]. This suggests that there is scope to develop children's knowledge of recommended levels of physical activity and further research should seek to explore effective ways of doing this among children with T1DM.

Children acknowledged friends as a key influence on their physical activity participation, implying that co-participation is important for the initiation, maintenance, and enjoyment of active lifestyles in children with T1DM. The importance of social interaction and friendship in physical activity has previously been identified in children with [8] and without T1DM [14, 22, 23]. And yet parents of children with T1DM have not placed the same emphasis on the influence of peers on their child's level of physical activity [9]. Our findings add to the literature by showing that peers are perceived to not

only facilitate physical activity, but also to inhibit a child's enjoyment and participation in physical activity. Teasing amongst children in relation to physical activity has been identified previously in qualitative studies with children without diabetes [24]. Whilst our findings suggest that strategies to promote physical activity in children with T1DM could utilise peer groups, this requires careful consideration and there may be scope for research to explore peer's perceptions of physical activity for those with T1DM in order to understand how best to utilise friendship groups and networks.

Overall, the children in this study had positive perceptions of physical activity. Their awareness of the physiological health benefits of physical activity is encouraging; however there was little elaboration on the link between physical activity and health, and a lack of understanding of the specific benefits of an active lifestyle for diabetes. This suggests that more could be done to promote physical activity health messages to children with T1DM. Exploring children's interpretation of physical activity provides a basis for developing techniques to facilitate physical activity discussions in clinical practice.

As well as valuing its outcomes, children reported liking physical activity because it provided opportunity for fun and enjoyment, which were amongst the main reasons cited for being active. Children seemed intrinsically motivated by the positive feelings derived from participating in physical activity such as satisfaction, happiness and cheerfulness. It is encouraging that children did not demonstrate outcome-oriented thinking, captured by the comment, "it's not about winning or losing, it's just fun and having a great time, that's what it's all about". The findings concur with previous research exploring the perceptions of children with [8] and without T1DM [25]. MacMillan et al. (2016) identified enjoyment as a strong influencer of physical activity in children with T1DM and associated this with the idea of children being given 'ownership' to choose activities they enjoy [8]. Research suggests that enjoyment should be prevalent in physical activity experiences for prolonged participation [26] and in other chronic conditions enjoyment has been shown to be a key facilitator of physical activity [27; cystic fibrosis]. Enjoyment of

physical activity is likely to play a key role in the physical activity choices of children with T1DM and therefore children's individual preferences should be addressed in attempts to promote active lifestyles in this population.

Children spoke positively about the role their family, especially their parents, had in their physical activity participation. Children described how parents provided encouragement that was facilitative to their engagement in an active lifestyle and valued the perception of being allowed to go outside and play. Indeed, longitudinal research has demonstrated that early parental encouragement and positive attitudes towards physical activity in children of 10 years was associated with higher levels of physical activity in adolescence [28]. Parents of children with T1DM have additional responsibilities resulting from the management of their child's condition, which is likely to have repercussions on children's physical activity behaviour. The children in this study did not relate parental support to diabetes management, but rather acknowledged parents for transport, funding and accompanying the child. Previous research has identified parental support as integral to physical activity in children with T1DM, with parents' perceiving their child's active lifestyle to be dependent on parental planning, management, and supervision [7-9]. Children's perceptions of the role of family support and the influence of friends suggests that the social environment is an important factor to be considered in the promotion of active lifestyles with children who have T1DM.

Children referred to the school environment as instrumental in their engagement in physical activities, particularly through P.E. lessons. Most children valued the variety of activities offered through P.E. and the support and encouragement received by P.E. teachers. Having trust in teachers supervising physical activities was touched upon and has been identified as important in previous research [8, 9]. Teachers have an important role in children's initiation and maintenance of physical activity. The positive perceptions of these children toward teachers and school activities with regards to physical activity engagement is encouraging, especially given research indicating that diabetes support in schools is inadequate and that there is a need for improved

diabetes knowledge and confidence in teachers' ability to support youth with T1DM in P.E. [29, 30]. Parents of children with T1DM have previously reported positive attitudes towards the support received for their child's physical activity participation in school, although many could recall specific occasions when schools had been less supportive [9]. Overall, teachers influence children's experience of physical activity and should be supported to promote and encourage physical activity in children with T1DM.

The findings suggest that the neighbourhood and home environment play a role in shaping children's perceptions towards physical activity. Having access to parks within their neighbourhood and proximity of physical activity facilities to their home influenced their perceived opportunities to be active. In previous research, the physical environment at home, and within the broader local neighbourhood, has been identified as one of the main factors assisting children without T1DM to be active [14]. Our findings align with previous findings by demonstrating the importance of a facilitative physical environment for children with T1DM, suggesting that it should be considered alongside the social environment in attempts to promote active lifestyles in this population.

Children enjoyed learning and mastering physical activity skills, which empowered them with a sense of competence. A similar finding has been demonstrated in youth with cystic fibrosis who perceived the opportunity to experience mastery as a key motivator to engagement in physical activity [27]. These findings suggest that a mastery-oriented environment, through enabling success, could increase children's enjoyment of physical activity and promote a sense of competence.

Children provided less detailed responses when asked to describe what makes it harder for them to be physically active. Our interview questions were framed positively and none asked the children specifically about diabetes, for example, "what or who helps you to be active?" and "does anything ever get in the way of you being active?", which may explain the positive nature of their responses and lack of depth in children's negative perceptions of physical activity.

Whilst diabetes-related influencers were mentioned by half of the children, overall the children did not perceive diabetes to hinder their participation in physical activity, which aligns with the previous research [7, 8]. When referring to diabetes, children mentioned hypoglycaemia and times when they had missed part of an activity due to low blood glucose levels. Although these issues were perceived negatively by the children, they were regarded as a practical inconvenience rather than a deterrent to further participation. None of the children in this group implied that they had worries or concerns about future hypoglycaemic episodes. This finding differs to questionnaire research which implied that children aged 8 – 18 years with T1DM fear hypoglycaemia [12], however this may reflect an older sample and/or larger age range than that used in our study. It also differs from the parents' perspective, which suggested that parents of children with T1DM worry about exercise-induced hypoglycaemic episodes, especially during the night after active days [9]. The findings suggest that initiatives to promote active lifestyles in children with T1DM should consider the different perceptions held by children and their parents toward physical activity and its side-effects.

The children described sedentary behaviours such as screen-time activities as something that might distract them from participating in physical activity. Children were not concerned about sedentary pursuits, but considered them to co-exist with their active lifestyle. Sedentary behaviour has become a major public health concern, with research suggesting that the detrimental effects of sedentary lifestyles in children are independent of whether the individual is meeting physical activity guidelines [31]. Only one previous study has explored perceptions of sedentary behaviour in children with T1DM [8]. MacMillan et al. [8] found children, parents and professionals as a group identified positive and negative effects of sedentary behaviour on blood glucose levels. In addition, parents of children with T1DM have alluded to minimising their child's physical activities in attempt to manage blood sugar levels [9]. Thus, a broader package of initiatives to promote active lifestyles in this population may benefit education around sedentary behaviour.

Children also perceived time constraints limited their engagement in physical activity, suggesting that other commitments such as homework would get in the way of them partaking in more activities. Parents' existing commitments may be influential too, thus strategies to promote active lifestyles in children with T1DM should consider the practical issues and other responsibilities that may limit children from engaging.

We hope to have been sufficiently transparent in conducting and reporting methods and delineation of the analytical processes for the reader to discern for themselves the themes identified in the interviews with children. Themes were supported by excerpts from the raw data to ensure that the interpretation of the data remained directly linked to the words of the children [16]. However, the findings must be considered in light of some methodological considerations. Children were purposefully recruited from one diabetes clinic in the UK and had self-selected to enrol onto a physical activity research study. It is possible therefore that these children had an existing interest in physical activity and although these data are not available, may have been more active than those who declined to take part.

These findings have important implications for our understanding of active lifestyles in children with T1DM. If clinicians, researchers and physical activity providers are to be in a position to promote active lifestyles, they need to be sensitive to modifiable influencers and respond to children's physical activity-related needs and desires. The findings would suggest that children with T1DM would value; i) fun opportunities to be active with their friends, ii) support from their parents and opportunities to be active with family members, iii) a school environment in which teachers promote and foster a variety of physical activity opportunities, iv) facilities that are readily accessible, v) environments that support physical activity practice and mastery and vi) support for those children and families who face difficulties with blood glucose control and hypoglycaemia.

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HQ conducted the study, collected and analysed the data, and drafted the paper. RM assisted in the collection and analysis of data. CG and HB were involved in the design of the study and contributed to the drafting of the paper. All authors contributed to the study design, drafting, reviewing and approving the article.

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