

Research Article

Exploring Motivation for Engaging in Exercise During the First Six Months of Childhood Cancer Treatment: A Qualitative Study

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Purpose: To improve the understanding of what influences the motivation of children and adolescents diagnosed with cancer to engage in exercise during the first six months of treatment.

Materials and Methods: Qualitative design using semistructured interviews with children (6–17 years) diagnosed with cancer ($n = 12$) and their parents ($n = 12$). A deductive thematic analysis based on self-determination theory was applied.

Results: Three predefined themes described different aspects of motivation for exercise during treatment.

Amotivation: Treatment-related illness and fatigue causing amotivation was described as a dominant barrier. Exercise driven by negative reinforcements facilitated short-term exercise engagement but was perceived as amotivation.

Controlled Regulation: Exercise regulated by exercise professionals could facilitate and introject positive experiences with exercise (i.e., ameliorated side effects) and create confidence in physical capabilities.

Autonomous Self-Regulation: An autonomy-supportive approach using cocreation and age-appropriate and treatment-regulated exercise, facilitated trust, and confidentiality with exercise professionals.

Conclusion: Motivation for exercise is a dynamic interplay that can be facilitated or negatively affected by treatment, parents, peers, and external regulation. Exercise interventions should use an individual and autonomy-supportive approach, encompassing treatment-related daily variations of physical capacity. Externally regulated motivation can facilitate exercise on a short-term basis when children are inactive or hesitant to engage in exercise.

Keywords: motivation; pediatric exercise oncology; self-determination theory

1. Introduction

Early initiation of physical exercise limits the physical deterioration caused by inactivity and treatment-induced toxicities, such as muscle wasting, altered

body composition, balance deficiencies, and impaired gait during cancer treatment in children with cancer [1]. Motivation plays a crucial role in child engagement in exercise throughout the cancer treatment trajectory [2].

Cancer treatment is challenging for children; the physical and emotional toll of cancer and treatment (primarily chemotherapy, radiation, and steroids) severely impacts physical capacities (i.e., muscle strength, endurance, and physical competence) within weeks after treatment initiation alongside fluctuating periods of fatigue and lethargy throughout the treatment trajectory [1, 3–5]. Further, being hospitalized for long periods also causes social isolation, separating children from their peers. The psychosocial consequences include the loss of autonomy and reduced quality of life [6–8]. Supervised physical activity and exercise can counteract these adverse physical and social side effects of childhood cancer treatment across diagnoses, as shown in controlled trials [8–11]. However, the body of evidence shows that adherence rates to exercise interventions have substantial individual variability [8–11]. Motivation is a driver for adhering to and engaging in physical activity and exercise, and it might be a crucial variable for understanding how participating and engaging in exercise fluctuate throughout cancer treatment [12–14]. It is, therefore, relevant to explore the barriers and facilitators of motivation in children and adolescents during cancer treatment, as this influences their ability to potentially mitigate treatment-related side effects.

This study aims to improve our understanding of what influences the motivation of children and adolescents diagnosed with cancer (ages 6–17) to engage in an exercise intervention during the first 6 months of cancer treatment. In this study, motivation will be operationalized by the following three areas: amotivation, controlled regulation, and autonomous self-regulation.

2. Methods

2.1. Approach. This study used a qualitative design based on in-depth semi-structured interviews [15]. Data were analyzed using a deductive thematic analysis based on the principles of self-determination theory (SDT) [16–18]. The reporting of the study follows the Standards for Reporting Qualitative Research in Medical Education (SRQR) [19].

2.2. Context. The participants in this study were all enrolled and allocated to the intervention group in the Integrative Neuromuscular Training in Adolescents and Children Treated for Cancer (INTERACT) randomized controlled trial [20]. The INTERACT trial investigates the effects of a 6-month integrative neuromuscular training intervention in children and adolescents diagnosed with cancer (age 6–17 years) from three of four university hospitals in Denmark (Aarhus, Odense, and Copenhagen University Hospital—Rigshospitalet) compared with an active usual care group.

2.3. Intervention Components. In addition to usual care, the intervention group received a 6-month strength-based exercise intervention: integrative neuromuscular training. The exercise intervention started within 2 weeks of treatment initiation and was designed as games and play-based exercise

or performed as a structured strength-and-conditioning program, depending on the participant's age, gross motor skill level, and daily variations in side effects (e.g., nausea, fatigue, dizziness, pain). In contrast to more traditional forms of physical activity (e.g., walking, cycling), integrative neuromuscular training specifically targets neuromuscular deficits by stimulating neural plasticity, enhancing motor unit recruitment, firing frequency, and synchronization of motor unit activation [21–26]. This integrative neuromuscular training program is designed to improve physical fitness in children aged 6–17 during cancer treatment.

The intervention used an autonomy-supported approach; although exercise professionals designed and supervised the exercise sessions, the individual participant's decisions, perspectives, and interests were acknowledged and included. Consequently, the participant was encouraged to suggest exercises or activities in each session.

The children would receive supervised training when hospitalized or visiting the outpatient clinic. When at home, the participants were encouraged to do home-based exercises based on an individual program, or they could choose to do any type of physical activity (any bodily movement that would increase their heart rate), depending on the child's physical state. Elaborative descriptions of the components of the intervention are described elsewhere [20].

2.4. Sampling Strategy. A purposeful criterion-based sampling strategy was used [27, 28]. Participants and parents were interviewed between February 2022 and March 2023. Eligible for this study were children (participants) who were enrolled in the INTERACT intervention arm for at least 3 months (and their respective parents or guardians) from all three centers and who were no more than 2 months post-intervention termination.

We strived to select children and adolescents with different diagnoses, ages, sexes, and adherence rates to the exercise intervention.

2.5. Data Collection Methods and Instruments. An overall framework for the interview guides used in this study was specifically developed to collect insights from the participants and their parents concerning their experience with the intervention based on the principles of SDT: (1) autonomy (e.g., “Can you give an example of a physical activity decided during the sessions?” and “Did you do some of the components of the intervention on your own?”); (2) relatedness (e.g., “Are you good at motivating yourself to engage in physical activity, or do your parents/siblings/friends help motivate you? If so, how?”); and (3) competence (e.g., “Do you feel any change in your physical condition due to the intervention?”).

Three semistructured interview guides were developed: one for children (aged 6–10), one for adolescents (11–18), and one for parents (Supporting file 1). We divided the participants into two groups to accommodate potential differences in developed language and knowledge. For example, the interview guide for younger children would accommodate how young participants would not

understand terms like exercise and physical activity (would be translated to “movement that makes you sweat”) or would have prompting questions to help them distinguish side effects.

Parents’ questions were framed as proxies, and they were also asked to recollect how they viewed their own role during exercise and physical activity at the hospital and at home.

Participants and parents were interviewed separately, but the parents were present if requested by the child.

Both interviewers (NNB and PSA) had extensive experience with communicating with children diagnosed with cancer and their parents in the context of physical activity. None of the interviewers and participants had met previously. As one of the two interviewers (PSA) conducted the intervention in one center, interviewer (NNB) conducted these interviews. Interviews were scheduled with the parents and took place in a quiet, undisturbed environment (the patient’s room or a hospital conference room), and they were audio-recorded. Online, videoconference-based interviews were used and recorded if an interview at the hospital was impossible.

2.6. Ethical Considerations. The present study complies with the Helsinki II Declaration, and the handling of data has been approved by the Danish Data Protection Agency (jr. nr.: P-2021-14). Furthermore, the INTERACT study has been approved by the Danish National Committee on Health Research Ethics (Approval Number: H-20040897).

For the interviews, the participants all provided informed consent to participate and, independent of age, were asked if they would like their parents to be present during the interview.

2.7. Data Processing. In this study, the participants’ motivation, including facilitators and barriers to participation in physical exercise and physical activity during cancer treatment, is based on the principles of SDT and how they can be applied in the healthcare context [12, 14, 18]. SDT illuminates the dynamic interplay between intrinsic and extrinsic motivational forces (16–19): two distinct forms of motivation that drive human behavior. Intrinsic motivation arises within the individual, stemming from internal desires, interests, and personal satisfaction. The driving force behind intrinsic motivation is often the inherent pleasure, curiosity, or sense of accomplishment one experiences while engaging in the task itself. Conversely, extrinsic motivation originates from external factors and relies on external incentives, money, praise, social status, or even punishment, to encourage behavior.

The theory identifies three inherent intrinsic psychological needs: autonomy (“the feeling of being the origin of one’s own behavior”), competence (“feeling effective”), and relatedness (“feeling understood and cared for by others”) as a counterpart to extrinsic motivation, which shapes this interplay [12].

As a continuum, SDT spans from pure autonomy-driven or -supported motivation to strictly externally controlled behavior deprived of any autonomy, leading to amotivation.

This continuum, and how intrinsic (autonomy, relatedness, and competence) and extrinsic motivational factors are regulated into behavior, is addressed in this study as amotivation, controlled regulation, and autonomous self-regulation, as these domains broadly cover the whole continuum [12, 18]. This applied analytic approach favors internalization (i.e., how a regulated behavior can potentially develop a framework for sustained autonomous behavior).

2.8. Data Analysis. Participant and parent interviews were transcribed ad verbatim, separately, and PSA and NNB thematically analyzed the transcripts using a deductive approach, as described by Braun and Clarke [16].

The analysis consisted of five steps: (1) an overall framework for potential codes was written while listening through the recorded interviews; (2) coding the transcripts into meaning units, which would be categorized within the overall self-determination domains: autonomy, relatedness, competence, and extrinsic motivation; (3) transforming the meaning units into condensed units; (4) further categorizing the units within the three self-determination behavior regulation domains (amotivation, controlled regulation, autonomous self-regulation) and comparing the themes with the transcribed data to ensure accurate representation; and (5) the meaning units and categorization were iteratively discussed within the author group, and the themes were refined according to the discussion. See Figure 1 for a visual representation of the analysis, including identified themes and subthemes.

2.9. Techniques to Enhance Trustworthiness. In this study, trustworthiness is based on concepts of credibility, dependability, and transferability [29]. Measures taken to improve credibility and transferability are described in the sampling strategy, data collection methods, and analysis.

We continuously interviewed and analyzed data to assess the potential saturation of data if no new themes emerged. We were aware that interviewing and analyzing data simultaneously may have affected dependability, as the interviewers may have narrowed their focus. However, we did not alter the interview guide. Furthermore, the deductive approach dictates maintaining the scope of the study.

3. Findings

The data comprised 24 interviews with 12 participants paired with their parents. Ten interviews were conducted as online video consultations, and two interviews were conducted via telephone. We included nine boys and three girls with a median age of 11 (range 6–17). Six participants were diagnosed with acute lymphoblastic leukemia, six with different types of solid tumors, one of whom had a solid tumor in the central nervous system (see Table 1 for a description of the participants). Three participants—one girl (aged 8 years) and two adolescents (16-year-old boy, 17-year-old girl)—who had very low adherence rates to the supervised exercise sessions were approached but declined to participate or did not respond.

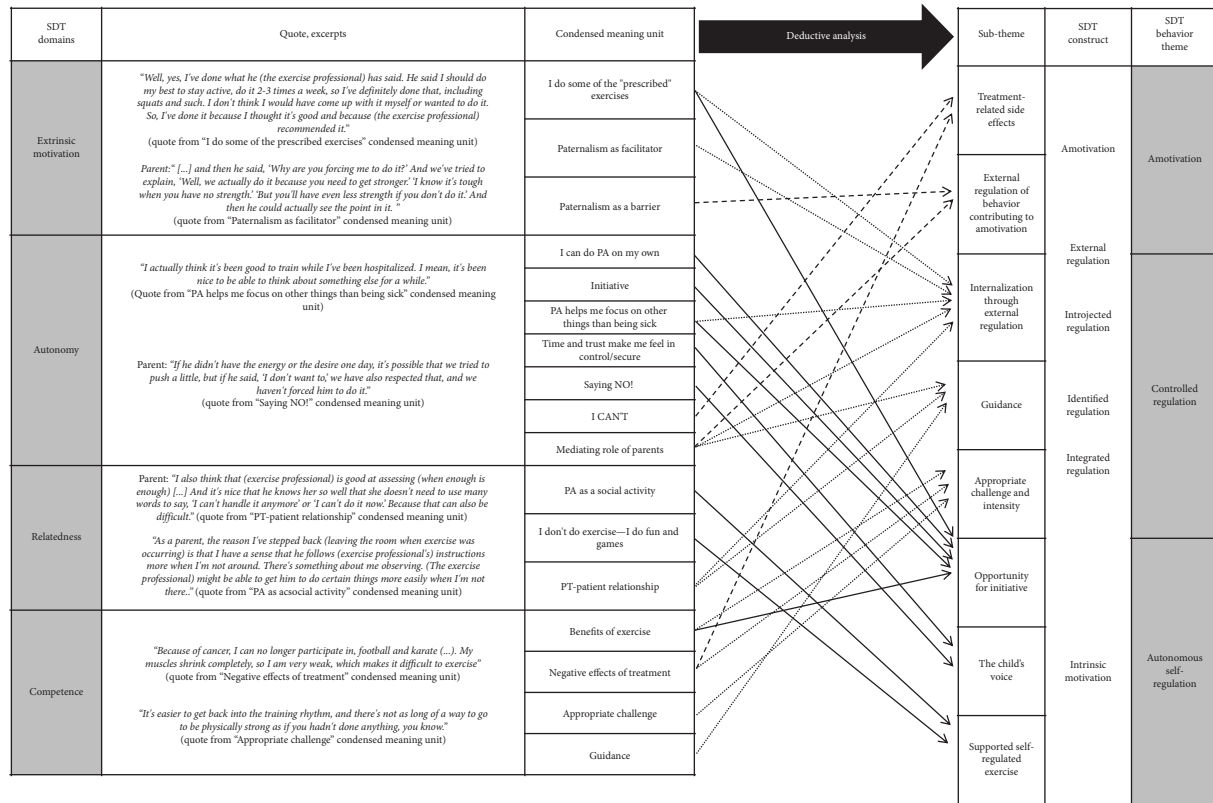


FIGURE 1: Visual illustration of the deductive analysis, including identified themes and subthemes. Subthemes identified within the four SDT domains —autonomy, relatedness, competence, and extrinsic motivation —were subsequently organized into the three SDT behavioral regulation domains: amotivation, controlled regulation, and autonomous self-regulation.

TABLE 1: Descriptions of participants and their parents.

Informants' characteristics	Children (n = 12)	Parents or guardians (n = 12)
Sex (male/female)	9/3	4/10*
Age (median, [range])	11 (6–17)	—
Combined**/separate interviews	5/7	5/7
Centers		
Copenhagen University Hospital	7	
Aarhus University Hospital	3	
Odense University Hospital	2	
Diagnosis		
Hematologic cancers	6	
Extracranial solid tumors	5	
CNS tumors	1	
Adherence to exercise during treatment		
High ^A	3	
Intermediate ^B	6	
Low ^C	3	
Habitual activity level		
High ^D	4	
Intermediate ^E	5	
Low ^F	3	

*Two sets of parents were interviewed together.

**Parent and child were present during the interview.

^AHigh: participated in ≥ 80% of expected supervised exercise sessions (24 sessions).

^BIntermediate: participated in 50%–79% of expected supervised exercise sessions.

^CLow: participated in < 50% of expected supervised exercise sessions.

^DHigh: > 8 active hours outside school activity per week.

^EIntermediate: between 3 and 7 active hours outside school activity per week.

^FLow: < 2 active hours outside school activity per week.

Several factors facilitating the initiative and, ultimately, autonomous exercise or barriers leading to amotivation were identified. Based on the analysis, these are described within the three SDT behavioral domains: amotivation, controlled regulation, and autonomous self-regulation. See Figure 1 for an overview of the analysis, themes, and subthemes. An overview of identified facilitators and barriers for motivation in each theme can be found in Table 2.

3.1. Theme: Amotivation

3.1.1. Treatment-Related Side Effects. Feeling ill and fatigued due to treatment was described as a dominant factor for amotivation. Participants explained that they would categorically decline exercise and physical activity during the most intensive cancer treatment periods or in the last periods of a treatment block. They described how the most strenuous parts of treatment would deprive them of their energy and motivation, keeping them bedridden due to fatigue or because they needed to conserve their energy.

When you're here, it's because you're undergoing treatment or going through a particularly tough time. During that month when I had pneumonia, my energy was very low. And then they came in and asked, "What do you say to a little exercise? Just getting up, out of bed, standing up, sitting down, stepping once, up and down?" And I said, "No, I can't do it anymore!" All my energy is being used to fight cancer. So right now, I really need all my energy.

(Participant, 16 years)

During such periods, because of the magnitude of side effects (e.g., fatigue, nausea, dizziness), the participants declined to participate in exercise and physical activity, leaving the exercise professional and parents with limited options to facilitate the intervention.

If I've been feeling really awful, then I haven't been able to do anything [...] I mean, it was like I couldn't do anything at all.

(Participant 17 years)

Even though parents described how they would see improvement in physical competencies, they could not distinguish if this improvement was due to exercise or simply treatment-related side effects (or toxicities) subsiding.

Physically, I think it's difficult to find something measurable—because [girl] has been very ill during certain periods. So, you could say there may have been a period where we thought it was working. And when we have been here many times, she has received a lot of training. And she thought she could do a lot. And then suddenly, she had a setback, and we're back to square one. It's hard to say whether it's the training itself that makes it better or if it's the side effects of the medication that are wearing off.

(Father to participant, 9 years)

Experiencing these fluctuating periods of either feeling ill and being sedentary versus active and closer to usual self was a source of frustration and amotivation for parents and participants alike.

3.1.2. External Regulation of Behavior Contributing to Amotivation. If the participants had prolonged periods with sedentary behavior, parents or exercise professionals would turn to a more externally regulated approach (e.g., pressure or negative reinforcement). Children would describe how they would do the "prescribed" exercises at home simply because they were pressured to do so or ultimately sanctioned by their parents.

Child: I hate it [doing exercise]. I don't like it. It's my mother's idea.

Mother: Every time, right? Well, it's really serious. I say, "If you don't come now, I'll unplug the internet." That's when he goes, "Okay, okay." And then we go.

Interviewer: But you still do it?

Child: Yes. [...] Because there are consequences if I don't.

(Mother and participant, 10 years)

Although this approach facilitated exercise on a short-term basis, the activity was perceived as irrelevant with a lack of value that would lead to amotivation for the participants. Exercise was therefore seen as a necessary but tiresome, daunting, and even agonizing activity. Ultimately, this would compromise the intensity and duration of exercise, limiting the potential physical benefits of exercise as children would describe how these benefits on physical competencies were unachievable when parent used this impersonal approach.

It's mostly just my dad who kind of pushes me because I don't really enjoy exercising [...] He just scolds me [...] And, well, it's not like it makes me want to exercise more. It's just like that. Well, I do want to get stronger, but maybe that's not the best motivation.

(Participant, 17 years)

Children would respond by further declining physical activity and exercise unless they experienced more intrinsically motivated drivers (e.g., feeling a perceived improvement of physical competencies).

3.2. Theme: Controlled Regulation

3.2.1. Internalization Through External Regulation. Parents described extrinsic motivation through external regulation as a necessary tool to facilitate physical activity and exercise; otherwise, the children would be inactive. This could eventually introject and internalize insight into being

TABLE 2: Overview of identified facilitators and barriers for perceived motivation for exercise.

Mediating factor	Facilitator	Barrier	Described in theme
Contextual factors	Treatment	Feeling able to counteract treatment-related physical decline Exercise perceived as a positive part of treatment—a welcome break from routines and procedures	Treatment-related side effects Demotivation due to recurring physical regression after each treatment cycle Amotivation Controlled regulation Controlled regulation
	Structured support for physical activity and exercise	Autonomy support: - Co-creation of exercise sessions - Ability to say no - Feeling heard and having concerns acknowledged Creating a foundation of activity that can be introjected and internalized	External controlled regulation: - Negative reinforcement or sanctions - Perceived pressure to comply Amotivation Controlled regulation Autonomous self-regulation
	Content of physical activity and exercise	Appropriate, challenging and fun activities initiated by exercise professionals Clear boundaries and guidelines Novelty and variety of exercise and physical activity	Unclear expectations Lack of structure and direction Monotony and predictability with minimal personal engagement and ownership Autonomous self-regulation Controlled regulation Supported-self-regulated exercise
Social support	Parents	Sensing child's readiness and needs Supporting exercise and PA at home	Unintentional undermining of autonomy Exercise depends solely on parents Controlled regulation
	Exercise professional	Feeling safe and supported Balanced use of authority Feeling connected, valued, and supported	Using authority to hardline exercise Controlled regulation
	Peers	Peers serve as realistic role models for what is possible	Peers highlight what the child cannot do or should be able to do Autonomous self-regulation

Note: Overview of identified facilitators, barriers, and explanatory factors within each theme.

Abbreviation: PA = physical activity.

able to improve their physical competence and facilitate intrinsically motivated behavior.

At home, we've said: "You have to do this before you continue watching your screen." He has been a bit grumpy about it, but he has done it. And then he himself actually said at one point: "It was good that you told me to do it because I can feel that I'm getting stronger."

(Mother to participant, 8 years)

Even though the children described the side effects as being a dominant factor for amotivation, they also experienced exercise as being able to counter the treatment-related deficiencies, as they felt that they were getting physically stronger and could endure longer activities by doing exercise. The thought of improving physical competencies would make the transition from going back and forth between the hospital and home environment easier.

I can actually participate in a lot more. Today, we're even going up [the stairs] to the 13th floor. I've come a long way. I've improved a lot. And there's a lot more I can do.

(Participant, 14 years)

If this internalization happened (i.e., by introjecting a perceived benefit on physical competencies), exercise was described as a positive aspect during hospitalization and as an intrinsic motivational driver for going to the hospital.

[...] as a caregiver, you need to have different things that can motivate [the participant to go to the hospital]: There is pampering. There are things you can buy. And this exercise has been one of the things that we could use as motivation.

(Father to participant, 14 years)

Further, parents explained that being a part of an exercise intervention facilitated physical activity as a part of hospitalization. At home, it would create routines for physical activity and exercise, which benefitted the whole family. By presenting the children with a framework, either by aligning expectations or scheduling physical activity, the children were kept in an active everyday life, which the parents described as benefiting the course of treatment.

I think it makes so much sense. I easily believe that you can fall into a mindset where, when your child gets ill, there are many hospitalizations. And, well, that's what we experienced. Almost from one day to the next, he was lying in a hospital bed most of the time. Trying to get him up and moving early on, I believe, has been crucial for his progress, and he had a really good treatment trajectory because he was out of that bed early on and active. He almost didn't have a chance to just lie there, because then [the exercise professional] would come, and they would do all sorts of things, play and exercise, and whatever they were up to.

(Mother to participant, 6 years)

Controlled regulation was therefore a necessary tool to ultimately introject and internalize the importance of physical activity and exercise and to facilitate motivation.

3.2.2. Guidance. The parents and children all described how outside help and guidance from exercise professionals was necessary to promote and facilitate exercise. Parents felt that their own resources were limited, as they were adjusting their everyday lives to the different demands and concerns relating to caring for a child with a cancer diagnosis. As parents, they had certain responsibilities (e.g., showing up to appointments, adhering to fasting regimes, administering medication) usually facilitated through extrinsically regulated behavior. Accordingly, they described how, in their current role as a parent to a child with cancer, they could not facilitate exercise; at least not in the same way as an exercise professional without such controlled obligations. As one parent described:

It's really fantastic [the training]. It's great to have someone with enthusiasm and motivation that we as parents don't possess. And having someone external who connects well with [girl] and enjoys working with her is very positive [...] because it gets her going—maybe more than what we would do. We're all caught up in our duties and "must-do" tasks. So it's really cool to have someone come from the outside with an "excitement task" [...] Dad is very into being active and thought it was a great idea. I also think it's a really great idea, because we don't currently have that same enthusiasm and motivation. So it's nice to have some external help.

(Mother to participant, 7 years)

Some parents experienced that their presence during exercise was a barrier for their child, as the child would be reluctant and show less initiative. However, parents also described how observing or even taking part in the exercise sessions provided inspiration which could be adapted to the home environment.

The reason I've stepped back [leaving the room when exercise was occurring] is that I have a sense that he follows [the exercise professional's] instructions more when I'm not around. There's something about me observing. [Exercise professional] might be able to get him to do certain things more easily when I'm not there.

(Mother to participant, 8 years)

The parents also possessed insight into their child's unique body language and behavior, being able to read signals and signs, which would not only ensure the child's well-being during exercise but also provide guidance and push their boundaries. For example, one parent described how it was important that they were present, as the child would be reluctant to say "Stop," because he would not disappoint the exercise professional.

Actually, he struggles with saying “No” sometimes. We’ve practiced it a lot—the ability to say “No.” That he doesn’t disappoint others, you know? When he really wants to do something, I also tell him that if he’s feeling nauseous, he should say “No.” And it’s not like he isn’t active at home.

(Mother to participant, 12 years)

A positive relationship with the exercise professional facilitated motivation for physical activity and exercise. If activities were considered fun for the child, it facilitated motivation, as the exercise sessions were perceived as a break or diversion from some of the strenuous parts of treatment. Guidance from an exercise professional made children and parents aware of the children’s physical abilities, which would further facilitate exercise and physical activity at home and help to set boundaries.

I think it makes a difference that I see [girl] being able to do certain things with [exercise professional] that she may not always be able to do with me. It also gives me more courage as a mother to push a little and say, “Oh, you can squat down.” Because in the beginning, when [girl] was really unwell and kept pulling on me and falling many times, I became incredibly worried. Every time we were out, I held onto her all the time. But when you see that she can crawl around on the floor and do all sorts of things with [exercise professional], you also realize that if I relax a bit, she might relax more, too. I think it has definitely made a difference, especially at home.

(Mother to participant, 9 years)

In that sense, guidance and a good relationship with the exercise professional facilitated motivation. This relationship would also be essential to adjusting the intensity or challenge of exercise.

3.2.3. Appropriate Challenge and Intensity. The parents and participants described how adjustments of intensity to accommodate variations in side effects and motivation were facilitating, as it meant that the child felt acknowledged in terms of expressing their current state and physical symptoms. This approach in exercise sessions fostered positive experiences.

I think that [exercise professional] has been quite good at doing something that [boy] found fun and varied, and a bit more playful than just boring training. And [exercise professional] has also, as far as I have experienced, been good at meeting [boy] where he was each day. . . I mean, where he was on the motivation scale, and also accepting that, “OK—today you’re not up for much.”

(Mother to participant, 8 years)

If the exercise professionals were attentive to the current state of the individual participant, offering appropriate exercise according to side effects, this could eventually spark interest and curiosity, which would facilitate exercise and physical activity in situations where children would otherwise decline physical activity and exercise.

In the beginning, both [exercise professional] and I together assessed that [boy] was too tired and unenthusiastic and had too much of a negative attitude towards the training. And I think it has been so great that acknowledging that was an option. But gradually, it’s as if [boy] has become more and more curious and interested in it because he started feeling better and better. So I believe it has definitely made a difference in the course of the treatment.

(Mother to participant, 6 years)

Naturally, adhering to exercise became easier as symptoms and treatment-related side effects were reduced and vice versa: if symptoms progressed, children would become less motivated to do exercise. One mother explained how she felt her son was less motivated to participate in exercise sessions during hospitalization, as his symptoms would only progress throughout treatment,

In the beginning, every time [exercise professional] said, “Now squeeze a little, now jump, now throw that ball,” it was more fun at the start, but he also had more energy. Towards the very end [of treatment], he became so weak and affected by the treatment that he didn’t find it as enjoyable anymore. But overall, I think it has been good.

(Mother to participant, 10 years)

Conversely, the children also described how the feeling of being able to complete a training session despite feeling ill made them feel as though they were actively combating the negative effects of treatment, and the thought of further improving their physical competence was motivating. Therefore, they acknowledged that a little push was necessary.

Well, there are times when, to be honest, I don’t really feel like it. But of course I’ve thought to myself, “Oh no, it sounds tough.” But then I’ve gone ahead and done it. And afterwards I’ve been really satisfied with myself for actually doing it.

(Participant 14 years)

To facilitate motivation and engagement in exercise, the exercise professionals therefore needed to tailor their approach to suit the child’s age and physical capabilities. This would foster a meaningful intervention for parents and participants, emphasizing the child’s autonomy.

3.3. Theme: Autonomous Self-Regulation

3.3.1. Opportunity for Initiative. The hospital was described as a controlled and regulated environment, with many “must-do activities” with little or no co-determination regarding treatment and treatment-related procedures or examinations. Having an intervention using an autonomy-supported approach was therefore important to facilitate initiative and motivation.

He [the exercise professional] would say: "Today, you can try doing this activity or game, or something like that. It's also okay if it doesn't happen." You shouldn't feel like you must do it because it can ruin your motivation. There are already enough "must-do-activities" in this process, I'd say.

(Father to participant, 9 years)

This meant that having a say regarding the level of participation, having the opportunity for co-creation during the exercise sessions (i.e., being offered different options for exercise, activities or games), and even being in charge of the exercise sessions was described as motivating. As one child explained:

Child: Yesterday, I simply made a whole program. Just to get "revenge" of [exercise professional] after he trained with me [laughs]. So, I made a program for the two of us to do together. He actually said it was really tough, so I'm really happy about that.

Interviewer: Awesome, good that you can push him a bit [laughing].

Child: Yeah, I did! Well, he also often lets me decide what we do, you know.

Interviewer: Yeah, so he might ask, "What do you feel like doing?"

Child: Yes, he does that every time. Like, how do I feel, what do I want to do. It's also a good thing.

(Participant, 14 years)

Therefore, being attentive to the child's current situation, making them speak their mind and providing them with a choice and options are necessary for facilitating self-determined exercise.

3.3.2. The Child's Voice. Parents and participants described that having a voice and being heard, that is, being able to say "No" to exercise if they were feeling too ill or extensively tired, was an important facilitator. This "contract" was an important framework for sustaining exercise during the 6 months of intervention.

Mother: Actually, we often say "yes" [to exercise while hospitalized].

Child: As far as I can recall, we've only said "No" once. I was furious.

Mother: It was a bad day.

Child: It was a really bad day.

(Mother and participant, 7 years)

Children reported that they eventually would learn which periods were ideal for partaking in exercise and physical activity and felt it was motivating if they, together with the exercise professional, could regulate the exercise sessions according to their current needs and status. This

would improve self-reliance and would facilitate exercise even though they felt tired or motivate them to be active on their own.

Interviewer: Do you sometimes end up doing some of the exercises, even when you're tired?

Child: I say, "I can do a little bit."

(Participant, 6 years)

Sometimes we say "No." For example, if I'm really tired, you know [...] When I've just had chemotherapy, my numbers are down, and I can't handle anything. But when my numbers are up, I can easily do it.

(Participant, 14 years)

3.3.3. Supported-Self-Regulated Exercise. Whether doing activity at home or at the hospital, children described doing exercise and physical activity with someone, whether it is a peer, sibling, exercise professional, or parent; was a facilitator for exercise and physical activity during treatment. If peers showed interest in the prescribed activities, it was generally described as a facilitator, as they would emphasize relatedness, social closeness, and belonging. Further, participants would use them as a physiological proxy: as a normal reference, illuminating disabilities and seclusion, which can be regarded as a barrier. However, this would also show which physical competencies the child needed to regain through exercise and would be a facilitator for self-determined exercise. Waning peer and sibling interest would influence the participant's motivation.

Your older brother even said, "Oh man, we're going to become really strong doing this!" But over time, their [siblings] interest in it has waned, and that might mean it's not as fun for him anymore. [...] So, I think he found it more fun in the beginning, but he's still participating and still wants to do it."

(Mother to participant, 6 years)

Being at home, with limited contact with exercise professionals or peers, would lead to sedentary behavior, and parents noticed that as boredom would set in, showing the necessity for varied stimuli through social interactions or supervised exercise and physical activity.

It's definitely the hardest when it's just me and [girl] there. I mean, when her siblings are at school and [mom] is at work, it's tough to facilitate physical activities. It's nice when her siblings come home from school, and we can be together. And if they want to go for a walk, or sit and play on the floor, or play tickle games, or anything else—she wants to join in. But when it's just me and her, we get bored.

(Father to participant, 7 years)

Therefore, novelty and variety were key to sustaining motivation, as exercise introduced an active, engaging

contrast to the typically passive nature of cancer treatment. Unlike medical procedures, exercise empowered children to take charge of their well-being, fostering a sense of autonomy. Activities like playful obstacle courses or hopping like a kangaroo made movement fun while sparking curiosity and exploration, reinforcing novelty. However, variety was crucial to maintaining interest, as repetitive exercises risked disengagement—especially if children lacked interaction with an exercise professional or a stimulating environment.

...I don't think exercising just for the sake of exercising motivates him. Being told, "We have to do this because we have to", makes it even harder, especially in a hospital room—worse when we've been in isolation. Having to get up and walk around—just because—feels forced. But when it's turned into different types of play, it's different. You asked if he enjoyed it—I definitely think he did.

(mother to participant, 6 years)

4. Discussion

This study explored how the motivation of children with cancer to be physically active in an exercise intervention during the first 6 months of cancer treatment is affected and how the motivation for physical exercise and activity can be both facilitated and negatively affected by treatment, parents, peers, and exercise professionals.

Externally regulated behavior, primarily through parents, nurses, doctors, and exercise professionals, is inherently present from the beginning of hospitalization [30, 31]. Therefore, impersonal, compulsory, externally controlled behavior is expected and naturally occurring in pediatric health care [30, 31]. This study demonstrates how these opposing poles of autonomous self-regulated behavior versus externally controlled regulation do not constitute a binary explanation as either facilitating or inhibiting motivation for exercise and physical activity but should be regarded instead as a spectrum, where more externally regulated approaches can be necessary relative to the situation and level of motivation of the participants [14].

As our results illustrate, downright externally regulated behavior may lead to amotivation, but it can also introject positive experiences with exercise; i.e., children can eventually experience the benefits and joy of exercise if basic intrinsic needs such as autonomy, relatedness, and competence are facilitated. In SDT, this is known as internalization: “the active transformation of controlled regulation to a more autonomous form of self-regulation” [12]. Therefore, externally regulated behavior should not be considered a universal negative influence, causing amotivation, but more likely a necessary tool for introducing exercise and physical activity within the early stages of cancer treatment. According to SDT, external and introjected regulations are mainly unrelated to long-term adherence, and therefore, approaches to make participants identify and integrate this behavior must be further supported [14].

An autonomy-supported approach, being attentive to the child's current situation and addressing exercise and

physical activity, accordingly, can facilitate self-determined exercise. In line with the findings by Götte et al., being offered exercise is, in its entirety, facilitating [2]. This study further adds how participating in the decision-making process of regulating exercise (i.e., being able to decline, postpone, and plan exercise sessions) can further facilitate motivation. Novelty and variety were key to sustaining motivation, as exercise provided an engaging contrast to the passive nature of cancer treatment, fostering autonomy through playful and exploratory movements. However, maintaining variety was crucial, as repetitive exercises risked disengagement, particularly without professional guidance or a stimulating environment. Novelty has been recognized as a fundamental psychological need [32] and has been proposed as a fourth component of SDT, alongside autonomy, relatedness, and competence [33]. Our study reinforces this perspective, highlighting how novelty facilitates intrinsic, autonomous behavior [34].

As a healthcare authority, the exercise professional is an effective—albeit extrinsic—motivator and an important bystander to the parents to facilitate more exercise and physical activity. As stated by the consensus-based recommendations from the ActiveOncoKids Network: building a basis of trust between exercise professionals and children by actively involving children based on voluntariness is a key component for keeping children physically active throughout the treatment trajectory [34]. Based on our findings, we would argue that voluntariness may not be an accurate term when conducting physical activity and exercise intervention in children with cancer, as none of the included children described that they were performing systematic exercise and physical activity without at least some regulatory motivation from parent, peers, and/or exercise professionals. Instead of “voluntariness,” we believe that “autonomy-based approach” is a more accurate term, as a regulatory approach is necessary to a varying degree throughout cancer treatment. In line with the ActiveOncoKids and the International Pediatric Oncology Exercise Guidelines [34, 35], such regulatory approaches can be suggesting different intensities, exercises, or scheduling at different times for exercise, if the initial offer of physical exercise is declined. Our results demonstrate that exercise professionals can extrinsically push through exercise. Although effective, this should be used with a focus on internalizing physical behavior without compromising the child's autonomy and the exercise professional's confidentiality with the participants and parents to facilitate motivation and the potential long-term self-determined physically active behavior. In a clinical setting, we would advise aligning expectations with parents and relevant clinical staff when using a more regulatory approach.

The result of this study describes how parents can facilitate motivation for exercise by participating in and promoting exercise—but also how they can hinder physical activity and exercise by subconsciously undermining the child's autonomy and limiting physical activity due to over-protective safety concerns. Nonetheless, parents or guardians constitute an important stakeholder. They have unique insight into their child's signals and behavior, which can

ensure the child's safety and well-being during exercise and further promote exercise in a home setting. Grimshaw et al. [36] have described how parents regard themselves as an "underutilized resource." We suggest that parents be included in planning and systemizing physical activity throughout the treatment trajectory, and potential barriers should be addressed (e.g., whether they should be present during exercise sessions).

In line with previous studies, we found several intrinsic motivational factors (e.g., improving physical competencies, maintaining self-reliance, coping with treatment-related side effects) that facilitate initiative and, ultimately, autonomous exercise [2, 36, 37]. Similar to findings presented by Petersen et al., we found peers to be an essential mediator for exercise, mostly positively by participating and thereby promoting the social benefits of exercise, including engagement, as a distraction and combatting loneliness [37]. However, the individual preference of the child is crucial; the current well-being of the child affects their incentives to be physically active with peers, as these children prefer to do physical activity alone when treatment-related side effects are high [38]. Our findings showed that peers could be used as a proxy for the competencies they were missing, which could be both a facilitator and a barrier. In situations where treatment-related side effects are highly present, it may, therefore, be more beneficial for the child to focus on small improvements in physical competence instead of how far they are from achieving normality. This highlights the need to include children in the planning of exercise sessions and whether peers should participate.

4.1. Strengths and Limitations. In this study, we used a deductive approach using SDT, which can be regarded as both a strength and a limitation, as we may have omitted factors pertaining to psychological well-being that this theory does not account for, such as emotional regulation, self-acceptance, and resilience [12]. However, we chose SDT because of its high heuristic value, being widely applied to the study of motivation in children [28, 38] and a healthcare setting [12]. We could have applied other motivational theories, such as stages of change [39] or behavioral change wheel, previously used in childhood cancer populations [40]. However, these theories apply an approach specifically for behavioral change, which is beyond the exploratory purpose of this study.

Novelty-variety was not included in our deductive analysis alongside autonomy, relatedness, and competence, which may be a limitation. While our findings did reflect the importance of novelty and variety, this need could have been explored more deeply, within the context of pediatric oncology exercise, had it been an integral part of our analysis.

Using semi-structured interviews with open-ended questions can be challenging for children and adolescents. With some of the younger children, the interviewer was required to facilitate a narrower approach, as younger children would sometimes give short or one-word answers, and the interviewer could end up asking close-ended questions (e.g. "Do you think it was fun?"), which risks

introducing interviewer bias. If the child was uncomfortable with the interview situation, they could request that a parent be present. To make children feel more comfortable in the interview situation, facilitating longer vivid answers, we could have chosen interviewers who were known to the participants, such as the exercise intervention staff [41]. However, to minimize response bias (i.e., participants giving answers they think are "correct"), we chose an interviewer with limited knowledge of the participants [41].

We employed a purposeful, criterion-based sampling strategy to ensure diversity in age, diagnosis, and exercise adherence. We approached three children: one who withdrew from the intervention after 3 months and two with very low adherence to supervised training during hospitalization. These children either declined participation in the interviews due to lack of interest or did not respond. While this may raise concerns about the sample's representativeness, other children with low adherence did participate and provided recurring insights into amotivation and barriers, such as a general lack of interest in physical activity and exercise throughout treatment. To further contextualize adherence within the study population, findings on acceptance, attrition, and adherence to the intervention and physical assessments have been published elsewhere [42].

4.2. Contributions to the Field. Although exercise interventions may be challenging to conduct in children during the first 6 months of cancer treatment, with fluctuating side effects and hospitalization, children can be motivated to participate. A clinical environment that reinforces physical exercise offers supervised exercise and uses an autonomy-supportive and age-appropriate approach, i.e., key for facilitating motivation and reducing sedentary behavior. For children who are sedentary or reluctant to participate in exercise, a more external regulatory approach may be useful but should be used with the intent of introjecting and ultimately internalizing behavior through autonomy support. To do so, facilitating principles such as co-creation, diverting attention from treatment-related side effects through fun activities, and social interactions should be incorporated to make children with cancer identify and integrate exercise and active behavior into their everyday lives.

Supporting autonomy does not mean that exercise and physical activity during hospitalization should be regarded as purely voluntary, as regulatory approaches are needed and can facilitate motivation. Similarly, adjusting exercise to treatment-related side effects should not compromise the intensity of exercise, as this secures the long-term effectiveness of the exercise interventions. Clinical knowledge of treatment and treatment-related procedures and close cooperation with parents, nurses, and doctors are therefore necessary to conduct meaningful and effective exercise and physical activity interventions in the fluid nature of treatment-related side effects. When oncologists and nurses actively support physical activity, they serve as key social agents who can promote adherence and help shift motivation toward

more self-regulated behavior. Appropriate intensity and challenge do not necessitate exercise being regarded as exhausting or daunting but rather as an important factor to maintain and increase motivation.

5. Conclusion

Treatment-related side effects are key barriers to participation in the exercise; strategies for motivating children to be physically active during treatment are therefore crucial to counteract the adverse physical and social side effects of childhood cancer treatment across diagnoses. Externally regulated motivation (e.g., through supportive use of professional authority) is a necessary tool, as it can facilitate exercise on a short-term basis when children are sedentary and hesitant to engage in physical activity and exercise. However, more internally regulated approaches, supporting the child's autonomy, and acknowledging concerns and the current physical state through appropriate and personalized exercise can all contribute to motivation and long-term engagement. Factors such as parents and peers can be engaged to facilitate motivation further. Being trained by a familiar exercise professional can establish secure boundaries and create a foundation for staying motivated throughout cancer treatment—even when side effects are considerable.

Data Availability Statement

The datasets generated and/or analyzed during the current study are not publicly available due to Danish and EU personal data legislation but are available from the corresponding author on reasonable request.

Disclosure

None of the funders had any role in the design of this study, in the collection of data, the analysis, the interpretation of data, or the dissemination of data.

Conflicts of Interest

The authors declare no conflicts of interest.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. (*Supporting Information*)

Supporting File title: Supporting File 1 Interview Guide for Children, Adolescents, and Parents. (Legend: Interview guide for children, adolescents, and parents [translated from Danish]).

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