

A qualitative study exploring adolescents' perspectives of resilience trainings for chronic medical conditions

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Abstract

Background

Adolescents with a chronic medical condition (CMC) are often affected by mental health disorders coexisting with their physical conditions. Resilience-strengthening interventions can be beneficial for the adolescents' mental health. However, evidence-based programs among this target group remain scarce. Here, we evaluated the wishes and needs of adolescents with CMC for resilience trainings to improve adherence.

Methods

This qualitative study analyzed the experience of 46 adolescents aged 12–16 years receiving resilience training at a German University Hospital. They were randomly assigned to a combined app and cognitive-behavioral coaching intervention (CBT) or stand-alone resilience app game (REThink). Postintervention semi-structured qualitative interviews were conducted and analyzed by the standards of qualitative content analysis.

Results

Both the REThink game app and coaching were considered helpful by the participants. Adolescents' preferable resilience strengthening methods were coping skills training, mental health education, building of self-esteem and mindfulness exercises. Adolescents emphasized the importance of age-adapted difficulty levels, graphical design and native language content. Appointment scheduling was identified as a major barrier leading to a preference for online coachings.

Conclusions

This study highlighted key preferences of adolescents with CMC for resilience trainings. Adolescents acknowledged the value of both the app game and coaching format. Insights on coaching and app design preferences emphasize the importance of age-adapted and customizable interventions. The identified resilience training criteria provide a solid foundation for the development of forthcoming interventions.

Trial registration number:

DRKS00027870, registered 24.01.2022.

Background

Up to 20% of adolescents worldwide are suffering from mental health issues (1).

A particularly vulnerable group are adolescents with a chronic medical condition (CMC) who are often affected by mental health disorders coexisting with their physical conditions.

Good resilience can help adolescents master those challenges and increase their mental health (2). Resilience can be defined as a person's ability to cope with stress and adversities and thus, high levels of resilience are associated with better quality of life (3–6). Therefore, resilience-strengthening interventions can protect and improve adolescents' mental health.

However, evidence-based programs for this target group are still rare and often show a lack of adjustment to the adolescents' needs (7). In addition, even though mental health promoting programs exist, 60% of affected adolescents do not receive them due to stigmatization or institutional barriers (8–10). This urgently shows the need for new intervention approaches.

Digital interventions have become increasingly relevant due to their easy accessibility and show potential as mental health promoting tools (11–13). They may address the barriers of traditional programs and cater to the needs of adolescents known for ubiquitous smartphone use (14, 15). Nonetheless, increased smartphone use can also have negative implications such as sleep disorders or addictive behavior (16). The importance of responsible media use must therefore be taken into account. On the other hand, the growing importance of digital media in adolescents' life can offer new access to mental health topics. Offering carefully developed digital interventions can then be an opportunity to show adolescents healthier ways of digital media consumption.

As the integration of digital solutions in mental health continues to advance, the key challenge lies in tailoring interventions to the adolescent's need. While there is quantitative evidence supporting the efficacy of several digital interventions, it rarely includes adolescents' perspective on intervention design and content preferences (8, 17, 18). Commonly found implementation barriers for eHealth tools are low compliance and patients' dissatisfaction (19). The need for qualitative research is therefore becoming increasingly evident. It offers the possibility to gain deeper perspective into the needs of adolescents with CMC and to identify possible barriers (20). However, even though adolescents' participation has been thought to be a key feature in mental health research for a long time, their participation in form of qualitative research remains limited (21, 22). To tailor new interventions specifically to adolescents with CMC, their active inclusion in the development process and perspective is urgently needed.

This study therefore aimed to offer in-depth qualitative insights into adolescent's experiences and needs for resilience training interventions.

Methods

Study design

A semi-structured qualitative design was chosen to represent the thoughts and experiences of adolescents with CMC who had participated in a combined resilience-strengthening coaching and app game program (23, 24). Ethical approval of the study was granted by the Heinrich-Heine-University Düsseldorf ethics commission (no. 2021 – 1604). Written informed consent of parents and adolescents was obtained. The COREQ checklist can be found in the Supplementary Information.

Intervention

In a two-armed randomized controlled trial (RCT), participants were allocated to either the RETHink game app (A) or RETHink + Coaching group (B) (see Fig. 1). Detailed information on the intervention has been published previously (25).

REThink game app

Group A played the seven levels of the resilience-promoting RETHink game app developed by the DATA lab of at Babes-Bolyai University research team on their smartphone over seven weeks (English or German-subtitled version) (26, 27). Participants were instructed to complete one level per week and received reminders via E-mail once per week.

REThink game app and Coaching

Group B played the RETHink game app and additionally received two coaching sessions based on cognitive behavioral therapy (CBT), with a duration of 60–90 minutes each in small groups of 6–10 adolescents. Participants could choose between online or on-site sessions at the hospital. As there was low demand for on-site coaching sessions, all sessions were conducted online. Coaching manuals were developed by the study team in cooperation with pediatric psychologists and content was adapted to the app elements (25). The sessions were led by medical study team members and psychological undergraduate students via an online meeting tool using a combination of psychoeducational units, group discussions, quizzes, and interactive elements. In the first session, participants were introduced to the “ABC model” by Ellis for the identification of irrational thoughts and the connection to behavioral reactions (25, 28, 29). The second session focused on stress management and relaxation strategies.

Sample

Recruitment took place between April and July 2022 in the Children’s University Hospital Duesseldorf, Germany. 55 adolescents aged 12 to 16 years with CMC were recruited. Participants were included if (1) aged between 12 and 16 years old (2) having a CMC defined as having a disease for over a year, mandatory long-term medical care or a significant impairment of daily life routine, (3) adequate knowledge of German for app play and coaching participation (assessed by parents or treating clinician), (4) sufficient physical and mental condition for study participation (assessed with Lansky score (30)), (5) access to an Internet-enabled smartphone, (6) a signed informed consent form by both parents and participant (7) and no prior history of psychiatric or psychological treatment in the last three months or longer than three months.

Data collection

Post-intervention, a qualitative interview according to predefined guidelines was conducted with each participant either via telephone or on site. During the interview, a pseudonymized transcript was generated in which the answers to the respective questions were recorded as verbatim as possible. Non-verbal aspects such as long pauses, laughter, intonations, etc. were also included.

All interviews were held within the period from May to August 2022 and the duration varied from 20 minutes to approximately one hour depending on the participants answers. The interviews were conducted by the first author (L.S.) using a semi-structured interview guideline (see Supplementary Information, interview guidelines). The interviewer guided participants for to ensure their focus on the specific questions, and further asked probing questions to invite more detailed responses. There was no relationship established between interviewer and participants prior to the study and participants only knew the first author's occupation and goal to conduct this study. No repeat interviews were carried out and no audio or visual recording was made due to the pilot study character. Transcripts were not returned to participants for comments and/or correction.

Analysis

The interviews were analyzed qualitatively based on the principles of content analysis postulated by Mayring using the software QCAMap (31). The data was repeatedly evaluated by three independent coders (first author L.S., female pediatrician, male physician). The additional coders had no prior engagement in the study. Coders discussed to find a consensus and intercoder reliability reached 100% during afterwards.

For the analysis, a combination of inductive and deductive category formation was chosen. Data analysis included the following steps: (i) Reading of all transcribed material twice, (ii) Coding – each coder individually coded the available material and thereby categorized content to themes and motives, (iii) Clustering – common themes that could be identified in step (ii) were clustered into groups, (iv) Discussion of findings – emerging clusters and themes were discussed by all three coders to reach consensus. Coding agreements were only shared with the other coders for the deductive categories, inductive categories were formed by each coder individually. All texts were transferred anonymized to the software QCAMap. The 16 research questions were coded in each of the 46 texts by the first author (see Supplementary Information, coding guidelines). The second and third coders independently coded a randomly chosen sample of 10 interviews. After discussion of the coding and differing opinions on some codes, the coders agreed that saturation had not been reached and thus, three additional randomly chosen interviews were independently coded for higher consensus and saturation. The three authors then discussed again and agreed on a consensus and data saturation. During the whole analysis process, the authors scheduled regular meetings to reflect on codes and categories.

Results

Out of 46 participants, 59.57% identified as female. Age varied from 12 to 16 years with a mean age of 14 years. 57.5% had Type 1 Diabetes mellitus and 50% attended academic secondary school (see Table 1).

Table 1
Sample characteristics

	Total	Male	Female	Other
n	46	18	27	1
Age (%)	9 (19.6)	3 (6.5)	5 (10.9)	1 (2.2)
12	8 (17.4)	4 (8.7)	4 (8.7)	0 (0.0)
13	7 (15.2)	2 (4.3)	5 (10.9)	0 (0.0)
14	14 (30.4)	7 (15.2)	7 (15.2)	0 (0.0)
15	8 (17.4)	2 (4.3)	6 (13.0)	0 (0.0)
16	14.10 (1.41)	14.06 (1.35)	14.19 (1.44)	-
Mean (SD)				
Disease	27 (58.7)	12 (26.1)	14 (30.4)	1 (100.0)
Type 1 Diabetes	5 (10.9)	2 (4.3)	3 (6.5)	0 (0.0)
Crohn's disease	3 (6.5)	0 (0.0)	3 (6.5)	0 (0.0)
Juvenile idiopathic arthritis	28 (41.3)	8 (10.9)	20 (30.4)	0 (0.0)
Others ₁				
School type	23 (50.0)	12 (26.1)	11 (23.9)	0 (0.0)
Academic secondary school	11 (23.9)	3 (6.5)	8 (17.4)	0 (0.0)
Comprehensive school	9 (19.6)	3 (6.5)	5 (10.9)	1 (2.2)
Secondary school	1 (2.2)	0 (0.0)	1 (2.2)	0 (0.0)
Secondary general school	1 (2.2)	0 (0.0)	1 (2.2)	0 (0.0)
Vocational college	1 (2.2)	0 (0.0)	1 (2.2)	0 (0.0)
Missings				

Abbr.: n = number, SES = socioeconomic status

¹ Other diseases (multiple responses possible): Adipositas, a-Thalassaemia minor, Biotinidase deficiency, Celiac disease, Eosinophilia, Familial mediterranean fever, Gastrointestinal reflux disease, Hashimoto thyroiditis, Hemochezia, Hyperbilirubinemia, Hypertension, Hypothyroidism, IgA deficiency, Lactose/Fructose intolerance, Meulengracht disease, Morbus Basedow, Neurofibromatosis Type 1, Pancolitis, Psoriasis,

Persistent congenital hyperinsulinism, Pseudotumor cerebri, Scoliosis, Undifferentiated collagenosis,

² Based on mother tongue. Other languages: Polish, Italian, Arabic, Russian, Turkish, Macedonian, Pakistan, Croatian

	Total	Male	Female	Other
SES	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Quintile 1 (low)	1 (2.2)	1 (2.2)	0 (0.0)	0 (0.0)
Quintile 2 (medium)	11 (23.9)	3 (6.5)	8 (17.4)	0 (0.0)
Quintile 3 (medium)	16 (34.8)	4 (8.7)	11 (23.9)	1 (2.2)
Quintile 4 (medium)	10 (21.8)	7 (15.2)	3 (6.5)	0 (0.0)
Quintile 5 (high)	8 (17.4)	3 (6.5)	5 (10.9)	0 (0.0)
Missings				
Heritage Mother ²	34 (73.9)	14 (30.4)	19 (41.3)	1 (2.2)
German	11 (23.9)	4 (8.7)	7 (15.2)	0 (0.0)
Other	1(2.2)	0 (0.0)	1 (2.2)	0 (0.0)
Missings				
Heritage Father ²	32 (69.6)	13 (28.3)	18 (39.1)	1 (2, 2)
German	11 (23.9)	5 (10.9)	6 (13.0)	0 (0.0)
Other	3 (6.5)	0 (0.0)	3 (6.5)	0 (0.0)
Missings				
Abbr.: n = number, SES = socioeconomic status				
¹ Other diseases (multiple responses possible): Adipositas, a-Thalassaemia minor, Biotinidase deficiency, Celiac disease, Eosinophilia, Familial mediterranean fever, Gastrointestinal reflux disease, Hashimoto thyroiditis ,Hemochezia, Hyperbilirubinemia, Hypertension, Hypothyroidism, IgA deficiency, Lactose/Fructose intolerance, Meulengracht disease, Morbus Basedow, Neurofibromatosis Type 1, Pancolitis, Psoriasis,				
Persistent congenital hyperinsulinism, Pseudotumor cerebri, Scoliosis, Undifferentiated collagenosis,				
² Based on mother tongue. Other languages: Polish, Italian, Arabic, Russian, Turkish, Macedonian, Pakistan, Croatian				

The participant's experiences with the coaching and app game program were divided into three categories: resilience status, evaluation of the application and evaluation of the coaching intervention (see Table 2).

Table 2
Research question categories and subcategories

Category	Subcategory
Resilience status	<ul style="list-style-type: none"> • Do the adolescents consider themselves resilient against stress? • Would adolescents like to become more resilient? • What do the adolescents think would help them to become more resilient?
Evaluation of the RETHink game app	<ul style="list-style-type: none"> • Is the RETHink game app considered as a good tool to increase adolescent's resilience? • Are apps in general considered as useful tools to improve resilience? • What is the probability that an app will be used again to increase mental resilience? • Which parts of the app are rated good and why? • Which parts of the app are rated poorly and why? • Which app components need refinement for improved usability? • Were the notifications and reminders to use the app considered useful? • What resources are needed for continued app usage?
Evaluation of the coaching intervention	<ul style="list-style-type: none"> • What coaching aspects did the adolescents rate as good? • What coaching aspects did the adolescents rate poorly? • What aspects of the coaching intervention can be improved for a more frequent participation? • Would the adolescents prefer the intervention on-site or as an online meeting?

The adolescents identified a broad range of benefits and barriers regarding the offered interventions (see Table 3).

Table 3
Preferences and barriers identified by participants

Theme	Subtheme questions	Codes
Resilience status	Do the adolescents consider themselves resilient against stress?	<ul style="list-style-type: none"> • Subjective good resilience
	What do the adolescents consider as helpful for becoming resilient?	<ul style="list-style-type: none"> • Coping skills • Mental health education • Building of self-esteem • Mindfulness exercises
App evaluation	Which parts of the app are rated good and why?	<ul style="list-style-type: none"> • Experiencing challenges • Recognizing emotions • Story content • Graphical design
	Which parts of the app are rated poorly and why?	<ul style="list-style-type: none"> • App language • Not enough levels • Not enough time for the levels • Technical issues
	Which app components need refinement for improved usability?	<ul style="list-style-type: none"> • App language • Graphical design • Notifications • Story content • Higher level of difficulty
	What resources are needed for continued app usage?	<ul style="list-style-type: none"> • Native language option • Age-adapted content • (In-app) rewards • Attractive illustrations
Coaching evaluation	What coaching aspects are rated as good?	<ul style="list-style-type: none"> • Social aspects • Knowledge gain • Interactive design

Theme	Subtheme questions	Codes
	What coaching aspects are rated as poorly?	<ul style="list-style-type: none"> • Not enough personal exchange/interaction • Technical issues
	What aspects of the coaching intervention can be improved for a more frequent participation?	<ul style="list-style-type: none"> • More flexibility in scheduling • Shorter meetings • One coaching session per app-level

Resilience status

Subjective resilience status of the participants

90% of the surveyed stated that they would consider themselves overall or somewhat resilient (see Supplementary Table 3). Some differentiated their resilience according to the circumstance:

- *“I don’t know, I think it depends on the situation. I’m totally stressed if it is too much at once because I like to check things of my list. If I fight with someone, I consider myself resilient, but if there is a lot to do at once and I have a lot to do it’s stressful.”* (female, 15 years)
- *“I would say I’m resilient, but it depends on where the stress is coming from and how intense it is. If the stress gets really intense, I tend to freak out but if it is something minor like fighting with my siblings or something like that, I can deal with that quite well.”* (female, 15 years)

Even though 90% of the adolescents stated that they considered themselves resilient, 29 out of 46 (63%) participants also wished to improve their resilience.

Preferred resilience building tools

An inductive category analysis led to the identification of the following main categories for effective resilience-building:

Coping skills training

A frequently mentioned factor was the practice of techniques taught during the intervention as well as self-organization skills. Examples mentioned were breathing techniques and the “5-4-3-2-1” -method where they learned to focus on their sensory surroundings (32):

- *“Whenever I’m in a stressful situation I remember the methods that were mentioned. [...] when I’m having negative thoughts, I think about the app and what I can do about it.”* (male, 16 years)
- *“If I am stressed out, I plan to do the breathing exercises or the 5 things (-exercise) to concentrate on. I found these very good exercises. I haven’t tried them yet, but I think they would help. [...] I could also*

write a list to organize things or talk to a friend, but I don't have much experience with that.” (female, 15 years)

- *“(…) to write lists and organize things (…).” (female, 15 years)*

Mental health topic education

Some adolescents mentioned that the mere contact with mental health and resilience content was helpful to increase their resilience:

- *“To talk about what resilience is and how it is defined. Then you can learn methods to increase it.” (female, 15 years)*
- *“I think it would help me if I dealt more with the topic.” (female, 15 years)*

Self-esteem and mindfulness exercises

The participants gave examples that self-esteem building would be useful to increase resilience. Further aspects mentioned were better concentration skills, self-regulation skills and tackling fears:

- *“To dare to ask strangers for help. It's not easy, but if it's done more frequently it gets easier. If you are scared to do something it sometimes helps to just overcome it and see that it's not so bad.” (male, 15 years)*
- *“(It would help me) to become calmer, because sometimes I'm very hectic.” (male, 12 years)*
- *“(It would help me) not to listen to what other people say.” (female, 13 years)*
- *“I think it might help me to be more self-confident.” (male, 13 years)*

Evaluation of the RETHink-app

Perceived usefulness of resilience training apps

78% of the participants found the RETHink app useful. Four participants (9%) differentiated the app as useful for other adolescents while it was not relevant for them. Six adolescents (14%) did not consider the app useful or did not know. 56% stated the future re-use of such an app to be very probable or probable, while 31% would not use an resilience training app again (see Supplementary Table 1–3).

Identified positive aspects of RETHink game app

Answers varied from specific level features to the graphical design and storyline:

- *“(I liked) the structure of the levels and that you had to complete one level in order to enter the next one.” (male, 12 years)*
- *“The main character was a constant companion.” (female, 13 years)*

- *“There was a storyline. The structure was relatively simple and self-explaining. I thought it was really good and really creative how the idea was implemented.”* (male, 14 years)
- *„The level with the birds in the tree was good because it was a game that really helped. [...] this really helped because it was about not letting negative thoughts into your head or shy them away and let the positive thoughts come through.”* (male, 15 years)
- *“I liked the face recognition level where you had to know from the mimics if the people were well or not and what kind of problems they might have.”* (male, 15 years)
- *“(I liked) the level with the breathing technique because I felt like it really reduced stress.”* (male, 15 years)

Levels that were considered more challenging reached higher ratings with some of the adolescents:

- *“(I liked) tasks that were more challenging like for example the level with the tree because I had to concentrate.”* (male, 13 years)
- *“Level four with the magic poisons was fun because you always had to find something positive. It also was cool because the difficulty was more appropriate for my age, a bit more challenging.”* (female, 15 years)

Identified disliked aspects of REThink game app

The participants criticized certain levels, the English audio language, difficult explanations, not sufficient levels, short explanation time, technical issues, and the design.

- *“I didn’t like the level where you had to click on the birds. The sounds were really agitating.”* (male, 13 years)
- *“I’m not sure if it’s me, but the seventh level used terms that were weird and that was confusing because I couldn’t understand the terms right away.”* (female, 15 years)
- *“[...] in the beginning everything was in English that was stupid.”*(female, 14 years)
- *“I didn’t like that there were only seven levels.”* (female, 12 years)
- *“It didn’t save (my progress) well. When I left the app, the game kept on playing in the background.”* (female, 13 years)
- *“There wasn’t enough time to think or if you didn’t understand something on the first try.”* (female, 13 years)
- *“My sister always had to explain to me what I had to do. On my own I wouldn’t have understood it.”* (female, 12 years)

Suggested app adaptations for improved usability

Using inductive categories, the following main aspects were identification for improved app usability:

Language options

Participants foremost requested audio explanations in their native languages:

- *“Languages other than English should be offered because some children can’t speak English that well.”* (female, 14 years)

Content and level updates

Adolescents foremost wished for more levels with more variation and age-adaptable difficulty levels:

- *“(…) and that there are more levels so that you can learn more.”* (male, 15 years)
- *“I would say (to use the app more often) it would be good if you could choose a level of difficulty or an age group so that the older users get more challenging levels that are adapted to their prior knowledge.”* (female, 15 years)

Instruction time

Adolescents wished for more time to read the explanations and play the game.

In-app rewards

Adolescents frequently requested in-app rewards for increasing motivation:

- *“Some apps offer coins or something like that that you can collect to get clothes or so to individualize your character.”* (female, 16 years)
- *“(…) maybe to get rewards for finishing levels and that you can use those rewards in the app.”* (female, 15 years)

Graphical design

An age-adapted design and graphics were considered motivational especially by the older participants:

- *“Improve the interface and menu and make it more graphically appealing.”* (male, 13 years)

Usefulness of notifications

Participants received a weekly e-mail reminder to play the app and prior to coaching appointments. 72% of participants considered the notifications as useful, 7% did not need reminders and for 4% the parents received them without forwarding them (see Supplementary Table 4). They also rated in-app notifications as useful.

Evaluation of the coaching intervention

Identified positive aspects of coaching

Adolescents frequently mentioned the benefit of social interaction, including meeting other adolescents with CMC and talking about problems in a safe environment. They enjoyed learning about stress management techniques and mental health topics as it helped them to better understand their emotions. The coaching's interactive design was rated as positive and enjoyable.

- *"I liked the ABC method and that there were many examples for it (in the coaching) and that in general it was really interactive."* (female, 14 years)
- *"I liked that I got to meet new people and the group work was fun."* (female, 13 years)
- *"I liked the coaching and especially that both meetings had different people in it. The topic was interesting, and I liked that we got to see the three possibilities of the ABC method and that we had a vote on how we are feeling today."* (male, 15 years)

Identified disliked aspects of the coaching

Points of criticism were mainly focused on technical issues due to the online format. Participants disliked presenting themselves on camera, while others criticized the format as impersonal. Others disliked the session length and pauses made within. 61% of participants stated that there was nothing to be improved.

- *"One guy had problems with his internet connection and my microphone didn't work what was annoying because I had to use the chat the entire time."* (female, 14 years)
- *"(...) I know this was due to Corona virus, but it felt very non-familiar over Teams if you know what I mean."* (male, 13 years)
- *"Sometimes it took a long time. Maybe reduce one or two examples of the ABCDE method."* (male, 16 years)
- *"I didn't like that I had to turn on my camera the entire time. That was embarrassing."* (female, 13 years)
- *"(...) Nothing (could be improved). If I was given the option, I would do another coaching."* (male, 12 years)

Suggested coaching adaptations for improved attractiveness

Suggested improvements included more flexible scheduling, shorter appointments, and content expansions. Participants asked for a stronger connection to the app's topics. Two interviewees even asked for one coaching session per level. They stated that it would help them to discuss directly learned topics.

- *"I don't always have time for it because of school and also for personal reasons, but you can't do anything about that. Maybe (it would help to) get told two or three weeks in advance about when the*

appointment is so that you know and can give notice that you don't have time and that you might be able to postpone the appointment again.” (female, 14 years)

- *“A coaching for each level. Then you can also ask more quickly if you haven't understood something in a level.” (female, 12 years)*
- *“Perhaps take up more topics. “ABCDE” is now completed, so more new topics like for example other ways of reducing stress.” (male, 16 years)*
- *“(I would include) more topics and not just one for one and a half hour. Or make it shorter coaching appointments if it's just one topic.” (female, 15 years)*

Coaching location preferences

All participants were offered the opportunity to participate online or on site, but there were no in-person meetings due to low demand. After the intervention, participants were asked again for their future location preference. In contrast to the pre-intervention assessment, 43% would have preferred the in-person format due to technical difficulties and a less personal exchange online. However, they also mentioned long travel distances as a barrier. 52% still preferred the online format due to higher flexibility and the opportunity to participate from home (see Supplementary Table 5):

- *“I would prefer on-site meetings, but it is difficult for me because it takes me one hour to go to Düsseldorf and return every time, therefore I chose the online option.” (female, 13 years)*

Discussion

This study identified preferences of adolescents with CMC for resilience trainings, enabling improved accessibility and adherence. Adolescents with CMC expressed the wish to improve their resilience through resilience trainings. They further voiced the need for external support and motivation for successful resilience strengthening.

Adolescents generally considered digital app and group coaching based resilience trainings as useful and attractive tools for resilience training. While a recent quantitative evaluation of this feasibility trial already supported the combination of a gamification approach with online group coaching, the qualitative insights into adolescents' experiences further supported this approach (25).

This is in accordance with several other studies findings. In general, blended approaches gain increasing significance and popularity (33). One study found a beneficial effect of mobile based interventions on self-efficacy of adolescents with CMC. The resilience training app “Grow it!” showed a positive effect on mental well-being, at least in healthy adolescents (34). The large number of participants (n = 1282) reflects adolescents' demand for resilience trainings, which was reflected in our results. However, the 64% loss to follow-up rate underlines the need to include adolescents' perspectives into the development of interventions for improved adherence (34). A systematic review concluded that adolescents want to address mental health, but found barriers to accessibility of appropriate interventions similar to those

identified here (35). Fulfilling a basic set of requirement criteria as identified here should therefore be a priority for future intervention studies.

We identified essential resilience training app components for adolescents with CMC. Audio app content offered in the native language was considered essential which is in line with a study showing the importance of linguistic context for adolescents using resilience training apps (36).

Another study highlights the relevance of age-adaptability (37). This observation aligns with our findings indicating the importance of personalized content design. Participants' opinions on location, design, explanation time and content contradicted each other several times. As preferences already differed in our study with an age range of four years, an age adaptation in even smaller steps such as every two years may improve attractiveness. We did not find relevant preference differences by gender. Studies previously conducted on acceptance and effectiveness of the RETHink game app showed high potential for healthy adolescents (38). Our findings support these results with adolescents with CMC generally finding the app useful. In addition, this qualitative analysis was able to identify areas of importance to adjust for meeting adolescents' with CMC needs. This underlines again the importance of integrating qualitative research into intervention design.

The adolescents with CMC further expressed specific needs for group coaching formats. Generally, the digital group coaching program was evaluated positively by the participants. Identified advantages of the group coaching format were the possibility to openly exchange worries and problems with each other and to learn about resilience topics. Another important criterion for successful coaching implementation was an interactive, gamified design of the sessions. Some studies have demonstrated similar results for resilience coachings, but mainly focus on the experiences of healthy children(7, 39).

The question whether coaching should be offered in-person or online yielded varied results. Although participants did not make use of the in-person format during the study, some participants retrospectively would have preferred this format due to technical issues and a feeling of unfamiliarity. On the other hand, coaching scheduling emerged as a major barrier. Online meetings offered more flexibility in scheduling and enabled easier accessibility which is also a criterion for adolescent-friendliness as recommended by the WHO (40). We thus conclude, that when opting for online formats for improved scheduling flexibility, interventions should ensure personal interaction and exchange possibilities, e.g. through group discussions and smaller group meetings in breakout rooms.

For better adherence, participants requested email or telephone reminders as well as shorter duration of the sessions (preferably less than one hour).

Yet, the interviewees also stated that they would like to continue with coaching sessions and preferred to meet more often. They suggested offering one coaching session per app level, pointing to the strong connection app and coaching had in terms of participants' motivation. Coachings should thus be conducted on a more frequent basis to offer the opportunity for exchange with peers and health care professionals on a low threshold basis.

Strengths and limitations

A main strength of this study was to address the lack of evidence of adolescent's perspective on resilience interventions. In addition, adolescents were interviewed individually so that peer pressure to give the most consensual answer did not bias our findings.

However, our study is not without limitations. Even though our sample represented different age groups and had a balanced gender distribution, most participants were adolescents with Type 1 Diabetes or inflammatory bowel disease. Thus, the given opinions might not be generalizable to adolescents with other CMC, although the participants mentioned similar themes among all included diseases. Moreover, the RETHink game was used in the English audio version which might have influenced the adolescents' content comprehension and experience. We provided German subtitles; however, the feedback shows that future versions should integrate an additional native language audio version for better comprehension.

Nonetheless, our study provides important reference points for future researchers to conduct further investigations.

Conclusion

In summary, our study affirms the utility of both resilience app games and digital group coaching. We were able to identify several essential criteria for successful digital resilience intervention design: a) resilience training apps should offer adjustable difficulty levels, age-appropriate gradations, and native language content. b) adolescents showed a huge interest in coaching sessions with the voiced preference of more frequent offers. Ideally, both remote and on-site options should be offered to enhance accessibility and foster a personal connection.

By integrating these newly identified resilience training criteria, future interventions can benefit from improved adherence and acceptability and thus, ultimately enhance adolescent's resilience.

Declarations

Ethics approval and consent to participate

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Ethical approval of the study was granted by the Heinrich-Heine-University Düsseldorf ethics commission (no. 2021-1604). Written informed consent of parents and adolescents was obtained.

Consent for publication

Publication has been approved by all co-authors. All participants and their guardians signed informed consent regarding publishing their data.

Availability of data and materials

The interview transcripts and analysis data are available from the corresponding author on request.

Competing interests

Not applicable.

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Authors' contributions

TM and AB conceptualized the study idea. Data collection was performed by LS and AB, LS transcribed all interviews. JK, DS, LS and AB performed the data analysis. The first draft of the manuscript was written by LS. All authors contributed to a critical revision of the paper, read and approved the final manuscript.

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Figures

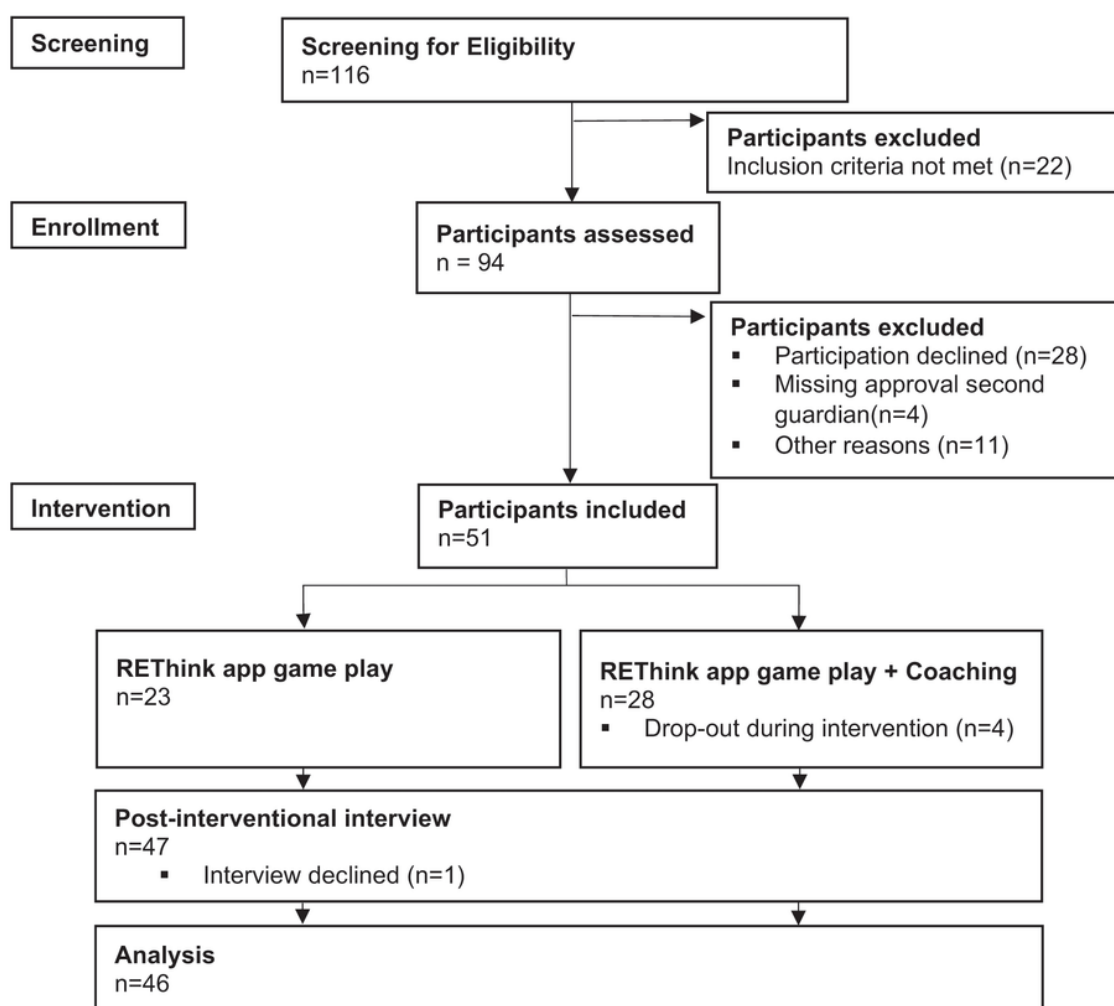


Figure 1

Supplementary Files

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