# Testing the usability and acceptability of the NON-STOP app for children with Perthes' disease

*From School of Medicine, University of Leeds, Leeds, UK*

Correspondence should be sent to A. M. Galloway a.galloway@leeds.ac.uk

Cite this article: *Bone Jt Open* 2026;7(1): 66–72.

DOI: 10.1302/2633-1462.71.BJO-2025-0314

**A. M. Galloway,[1,2] D. J. Keene,[3] K. Cleary,[2,4] E. Gabriele,[2,5] C. Holton,[1,6] S. Pini,[7] A. C. Redmond,[2,8] H. J. Siddle,[1,2] S. Richards,[9] D. C. Perry[10]**

[1]Leeds Teaching Hospitals NHS Trust, Leeds, UK
[2]Leeds Institute of Rheumatic and Musculoskeletal Medicine, Chapel Allerton Hospital, Leeds, UK
[3]Royal United Hospitals Bath NHS Foundation Trust, Bath, UK
[4]Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust, Doncaster, UK
[5]Tyne and Wear NHS Foundation Trust, Newcastle upon Tyne, UK
[6]Management Offices, Leeds Children's Hospital, Clarendon Wing, Leeds, UK
[7]Leeds Institute of Health Science, University of Leeds, Leeds, UK
[8]Leeds Institute of Rheumatic and Musculoskeletal Medicine, University of Leeds, Leeds, UK
[9]Leeds Institute of Health Science, University of Leeds, Leeds, UK
[10]Children's Orthopaedic Surgery, Alder Hey Children's Hospital, Liverpool, UK

## Aims

Perthes' disease is a childhood hip condition that requires prolonged management, which often includes physiotherapy and education. Families and clinicians have highlighted a need for optimized self-management. The NON-STOP app was developed as a digital self-management intervention. The app incorporates exercises, educational content, and a reward system including a customisable avatar to motivate children to engage. This study assessed the usability and acceptability of the NON-STOP app in preparation for a definitive clinical trial.

## Methods

A mixed-methods study was undertaken, involving an observational before-and-after study, with a nested focus group study. Children with Perthes' disease from three UK NHS centres were recruited and used the Non-Surgical Treatment of Perthes' (NON-STOP) app for six weeks. Quantitative data included app engagement metrics, quality of life and function (for follow-up completion rates), physical activity levels (Children's Physical Activity Questionnaire), and app-usability (Health Information Technology Usability Evaluation Scale (Health ITUES)). Following this, focus groups with participating families explored their experiences to explore usability and acceptability in more detail and also inform refinement of the app.

## Results

A total of 31 children were recruited, 20 of whom completed post-trial data. Health ITUES scores demonstrated high usability, with particularly high scores in 'perceived ease of use' and 'usefulness'. Engagement was highest in the first three weeks, with a decline thereafter. Focus group participants described the app as more engaging than previous self-management tools (e.g. paper handouts), citing rewards, avatars, and a user-friendly layout as positive elements. Suggested improvements included further personalization and inclusion of videos in the education section of the app.

## Conclusion

The NON-STOP app was found to be both usable and acceptable by children with Perthes' disease and their families. Insights from this study have informed further refinements to the app in preparation for its integration in Op NON-STOP trial, the first randomized clinical trial comparing surgical and non-surgical treatment in Perthes' disease.

Bone & Joint Open

## Take home message

- This study demonstrates the potential of digital interventions to support children with Perthes' disease.
- By promoting self-management and engagement through innovative, child-friendly features, the NON-STOP app addresses a critical need for accessible, scalable tools in paediatric care.

## Introduction

Perthes' disease has a profound impact on the lives of affected children and their families. A recent nationwide consensus study has outlined recommendations for the non-surgical treatment of Perthes' disease, which includes guiding the physiotherapy management.[1] In recent years, clinicians, children with Perthes' disease, and their families have identified that self-management is an important part of non-surgical treatment.[2] As part of a larger programme of work to optimize the non-surgical care for children, a digital self-management intervention, the Non-Surgical Treatment of Perthes' (NON-STOP) app, was created. The aim of the intervention was to allow children with Perthes' disease and their families to engage with the app, to support self-management. The content of the app was derived from exploring the experiences of key stakeholders,[2] following the recommendations of the consensus statement.[1]

The app contains stretching and strengthening exercises for children to complete, which are commonly provided by UK NHS children's physiotherapists. There are sections of the app that provide education for the child/family regarding Perthes' disease and advice on other topics such as nutrition, lifestyle, and general wellbeing. The content of the NON-STOP app can be viewed in a previously published article in *Bone & Joint Open* regarding the intervention development.[3] The NON-STOP app was created based on psychological theory, including behaviour change theory which optimizes motivation.[4-6] When children engage with the app, and complete exercise sessions, they receive 'rewards' to unlock the opportunity to customise their avatar, called 'Bobby the Bone'.

The aim of this study was to carry out preliminary testing of this novel digital self-management intervention (the NON-STOP app) for children with Perthes' disease and their families in preparation for a definitive clinical trial.

## Methods

### Study design

A mixed-methods study was conducted to test the acceptability and usability of the NON-STOP app. The approach is consistent with an explanatory sequential mixed-methodology,[7] in which the qualitative element of the study looks to explain the quantitative findings. In the quantitative element, an observational study recruited children and families who used the NON-STOP app for six weeks. Relevant data were gathered before and after the app-use to explore usability and acceptability of the intervention. In the qualitative element, a focus group study was undertaken with a subset of the children and families who shared their experiences of using the NON-STOP app.

**Table I.** Sociodemographic characteristics of participants compared with national data.*

| Variable | Trial participants | National data |
|---|---|---|
| Total participants consented, n | 31 | N/A |
| Mean age at diagnosis, yrs (range) | 5.2 (2 to 10) | 5.4 (median) |
| Mean age at time of recruitment, yrs (range) | 7.8 (4 to 14) | N/A |
| Male sex, n (%) | 24/31 (77) | 77.6 |
| **Ethnicity, n (%)** | | |
| White British | 30/31 (97) | 90.6 |
| Asian/Asian British | 1/31 (4) | N/A |

*National data of 2020 epidemiological study by Perry et al.[9]
N/A, not available.

### Sample and recruitment

Children with Perthes' disease were recruited from three UK NHS centres (West Yorkshire, North West England, and North East England) who commonly treat children with Perthes' disease. Participants were recruited during orthopaedic clinic appointments. Participants were sampled purposively, based on characteristics such as age and sex, to ensure diversity within the sample. Participants were eligible if they were aged under 16 years, had been first diagnosed with Perthes' disease between one and five years ago, and had access to a smart device. Once a patient had been identified as eligible and interested in taking part, consent was taken by the lead researcher (AMG).

The sample size for this study was based on a realistic, achievable number that would effectively address the aims and objectives which were to assess usability and acceptability of an intervention. Previously literature supported similar sample sizes in this type of study.[8]

### Participant characteristics

Overall, 31 participants were recruited to the observational study. The majority (n = 29) of these agreed to receive more information about the focus group study, and nine were recruited to participate in focus groups.

In the observational study, 36 were approached and 31 participants were recruited. A summary of their sociodemographic characteristics is provided in Table I.

### Data collection

Demographic information including age, age at diagnosis, sex, and ethnicity were collected to ensure participants were representative of those within the British Orthopaedic Surgery Surveillance (BOSS) study.[9]

Participants took part in the observational study between May and July 2024. Data were collected at two time points to explore usability and acceptability listed in Table II.

Patient Reported Outcomes Measurement Information System (PROMIS) Mobility is validated for use in studies involving children with Perthes' disease[10,11] collecting lower limb function, which is part of the core outcome set for

Perthes' disease.[12] Children's Physical Activity Questionnaire (CPAQ) is commonly used to report physical activity levels in children as young as four years old.[13] These two outcome measures were collected at this stage of the project to ascertain follow-up/completion levels rather than provide insight into any treatment effect. Health Information Technology Usability Evaluation Scale (ITUES) is a validated outcome measure used to assess the usability of a digital tool.[14] In this tool, measures are scored out of five, where a higher score demonstrates a higher level of agreement with the statement. A cut off score of 4.32 has been validated as a cut-off score for 'usable'.[15]

Process measures were collected regarding real-time app use data, including:

- Number of app log ins per participant;
- App log ins per week per participant;
- Number of times met target for progress reward;*
- Average pain score (measured per log in using Wong-Baker Faces pain scale);[16] and
- Most popular activity (exercise) used

*In weeks one and two, reward granted after three uses a week, increased to four uses in weeks three and four, and five uses in weeks five and six.

Participants took part in the focus groups in August 2024. Data were collected in a face-to-face focus group at each of the recruiting sites. A non-clinical environment was selected in each of the locations to encourage an open conversation with participants. The focus groups were conducted by the lead researcher (AMG), with the support of an independent facilitator at each focus group (EG, KC) who collected field notes. Focus groups were recorded, exported, and transcribed verbatim.

Focus groups followed a topic guide (Supplementary Material) which was informed by relevant psychological theory. The topic guide also received input from existing Patient and Public Involvement (PPI) members that contributed at various stages of the programme of work from this team. Finally, the topic guide was informed by the findings of the quantitative component of the study.

A favourable ethical opinion was received from the NHS West Midlands Research Ethics Committee (23/WM/0251).

### Statistical analysis

In the observational study, descriptive statistics were used to describe the population characteristics and process measures regarding the use of the NON-STOP app.

In the focus group study, transcripts were organized using NVivo (Lumivero, USA)[17] and analyzed using the Framework method.[18] The Framework method has been previously used in research by this team with children with Perthes' disease and their families.[2] This approach is commonly used to analyze qualitative data, using predetermined 'codes' (seen in Table III) which are based on influences from theory and/or evidence.

## Results

Of the 31 participants recruited, 26 engaged with the app over the planned six-week period and five did not engage fully. In total, 20 completed the post-trial outcome data listed in Table II. The population recruited were broadly representative of the typical Perthes' disease.

**Table II.** Content and timing of assessments for the observational study.

| Data collected | Baseline | 6 weeks |
|---|---|---|
| Demographic info | X | |
| PROMIS Mobility | X | X |
| CPAQ | X | X |
| Health ITUES | | X |

CPAQ, Children's Physical Activity Questionnaire; ITUES, Information Technology Usability Evaluation Scale; PROMIS, Patient Reported Outcomes Measurement Information System.

Over the six-week period, the total number of logins was 254, with a median number of logins per user per week of 1.7 (IQR 2.3 to 13.3). In week one, there were 67 total logins, with a median of 2.1 logins per participant (IQR 2.75). Week two had 39 logins and saw a median of three logins per participant (IQR 3). Week three had 43 total logins, with a median of three logins per participant (IQR 2). In week four, there was a decline to 31 logins in total, and a median login per participant of 1.5 (IQR 3.5). Week five had 31 logins in total, but a median of two logins per participant (IQR 3.5). In the final week, logins increased to 43, with a median of three logins per participant (IQR 3.5). The mean pain score over the six-week period was 2.1 (SD 2.2). The most popular exercise used in the app was the abduction stretch.

The Health ITUES scores collected at six weeks are presented in Table IV. The NON-STOP app scored a usability score greater than the cut-off (4.63 overall), so it is possible to term it 'usable'. The highest score achieved was in the 'ease of use' domain, with a mean score of 4.8.

These observational study findings informed the focus groups. Questions regarding the optimal frequency that children/families would commit to using the NON-STOP app per week were added to focus group topic guides.

Three focus groups took place, with one at each recruiting site, with the demographic details of all participants in Table V.

The topics from coding framework (Table III) map to the themes that were discussed in the focus groups. The codes were influenced by prior evidence, PPI input, and the findings of the observational element of this study. The codes concerned usability, rewards, experience of using the NON-STOP app, comparison to previous care, and future use. The Framework Method also allowed for codes to emerge from the data that had not been predetermined. In the focus groups, a sixth code relating to aspects of app use not covered by the original codes emerged.

Participants recounted their experience including the following quotes. The entire quote dataset can be seen in Supplementary Material.

Regarding usability, a parent described how the NON-STOP app had instructions, but also highlighted that the timer included in the exercises created a fun and challenging motivator to engage.

**Table III.** Analytic framework developed to support focus group coding.

| Coding label | Notes/ideas | Child description | Family description |
|---|---|---|---|
| 1. Usability | Ease with downloading, logging in, instructions/training package, reminders and time-consuming | • Ability to use it by themself.<br>• Recall of any elements of the training package (videos, cartoons, etc.) | • Identification of child using the NON-STOP app independently. For example using a parent/guardian's phone without help.<br>• Mention of reminders being used/ helpful |
| 2. Rewards | Child-specific reward, such as avatar for completing exercises | • Child highlighted rewards gained, or how they customized their avatar after doing their exercises. | - How the reward system influenced the use of the NON-STOP app |
| 3. Experience of the app | Fun or not? What was liked/disliked (with specifics) | • Aspects of the NON-STOP app discussed in either a positive or negative way. | - Specific experiences relating to exercises/activities or learning section. |
| 4. Different to normal/ previous care | Comparisons relating to time taken to complete exercises and their frequency completed on average week | • Comparison in the use of the app, compared to existing care/routine physiotherapy programme or information about their Perthes' disease. | - Information around compliance/adherence and whether child found it more/less fun and engaging. |
| 5. Future use | Opportunities to enhance future care with or without app | • Ideas for the future of the NON-STOP app such as new characters, exercises.<br>• Changes to the layout/structure of the NON-STOP app. | • Similar to child description |
| 6. Additional points for app use | Considerations around the use of the NON-STOP app | • Anything about use of the app that was not covered by the codes. | • Discussions of things such as dosage/frequency of using the app<br>• Inclusion of other members of the psychosocial make-up such as school, clubs, etc. |

"The app was showing you how to do it. Again, I felt like it was more of a game for him, it was more entertaining, it was like a race, how many can you do before the time runs out."

*Mother of five-year-old male*

Rewards were built into the NON-STOP app to motivate children with Perthes' disease to engage such as completing exercises to earn stars. The impact of receiving stars for completing exercises on any given day did not only motivate the children; one mother described how the motivation was felt across the family.

"I think when we knew there were the stars, it's a goal for everybody and I think you need that in life, don't you, with everything."

*Mother of four-year-old male*

Participants shared their feelings towards how they found the NON-STOP app in comparison to their previous methods of self-management.

"I definitely think he got more benefit from the app than us looking at a piece of paper and trying to figure it out, where the app was showing you how to do it."

*Mother of five-year-old male*

The focus groups presented a positive opportunity to gain insight from app-users around areas for refinement prior to further implementation. For instance, in one focus group, participants discussed among themselves functionality suggestions.

Father: "I think having videos in the learning section would be good, yeah…"

Mother: "Yeah, it could be useful."

*Interaction between father of six-year-old male and mother of five-year-old male*

Additional example regarding functionality and suggestions for refinement.

"I would've liked to have something on where I could write in when he's had a bad day, so I could document it all in one area … [such as] looking back on where it [the app] brings the faces [Wong Baker] on how he's feeling on that day…"

*Mother of five-year-old male*

Insights from users highlighted issues for refinement around dual-logins for households where children may use the app with more than one parent.

"If I was working or he was at his dads', you couldn't use it on different devices. Dad had it on his phone but then when he went on, he had to restart. If child already had, say, three stars that week, it didn't connect."

*Mother of four-year old male*

## Discussion

In recent years, this research group has used a mix of methods to optimize the non-surgical treatment of Perthes' disease.[1,2,19,20] It has led to the design, development, and early testing of the NON-STOP app, a digital-self management intervention for children with Perthes' disease and their families. Compared with traditional paper-based home exercise instructions, the app provided a more engaging, accessible, and visually supported format, which families reported as enhancing understanding and adherence. The

**Table IV.** Health ITUES scores for the NON-STOP app.

| | Domain | Mean score (out of 5) |
|---|---|---|
| | **Impact** | 4.77 |
| 1 | I think the NON-STOP app would benefit persons living with Perthes' disease | 4.9 |
| 2 | I think the NON-STOP app would improve the quality of life of persons living with Perthes' disease | 4.8 |
| 3 | The NON-STOP app is an important part of meeting my information needs related to my health | 4.6 |
| | **Perceived usefulness** | 4.64 |
| 4 | Using the NON-STOP app will make it easier for me to monitor and learn about my health | 4.8 |
| 5 | Using the NON-STOP app will enable me to monitor and learn about my health | 4.75 |
| 6 | Using the NON-STOP app makes it more likely that I will track my health | 4.6 |
| 7 | Using the NON-STOP app will be useful for receiving reminders about my health | 4.75 |
| 8 | I think the NON-STOP app presents a more equitable process for managing my health | 4.6 |
| 9 | I am satisfied with the NON-STOP app for helping me monitor and learn more about my health | 4.65 |
| 10 | I will monitor my health in a timely manner because of the NON-STOP app | 4.45 |
| 11 | Using the NON-STOP app will increase my ability to track my health | 4.55 |
| 12 | I will be able to track my health whenever I use the NON-STOP app | 4.65 |
| | **Perceived ease of use** | 4.8 |
| 13 | I am comfortable with my ability to use the NON-STOP app | 4.75 |
| 14 | Learning to operate the NON-STOP app is easy for me | 4.85 |
| 15 | It will be easy for me to become skillful at using the NON-STOP app | 4.7 |
| 16 | I find the NON-STOP app easy to use | 4.9 |
| 17 | I can always remember how to log on to and use the NON-STOP app | 4.8 |
| | **User control** | 4.25 |
| 18 | The NON-STOP app gives error messages that clearly tell me how to fix problems | 3.85 |
| 19 | Whenever I make a mistake using the NON-STOP app, I recover easily and quickly | 4.25 |
| 20 | The information (such as on-line help, on-screen messages, and other documentation) provided with the NON-STOP app is clear | 4.65 |
| | Total mean score for Health ITUES for NON-STOP app | 4.63 |

The two statements that did not pass the threshold for 'usable' were related to user-errors or after users had made a mistake. Both of these elements were rated 'neither agree or disagree' (which scores '3') by participants, because error messages and mistakes were not possible when using the NON-STOP app.
ITUES, Information Technology Usability Evaluation Scale.

**Table V.** Characteristics of participants in the focus group.

| Variable | Data |
|---|---|
| Total participants, n | 9 individuals (4 children, 5 parents) |
| Mean child age at diagnosis, yrs (range) | 4.4 (2 to 9) |
| Mean child age at time of recruitment, yrs (range) | 6.9 (4 to 11) |
| Child male sex, n (%) | 5 (55.5) |
| Child ethnicity White British, n (%) | 8 (100.0) |

app was created with a training package for children and parents in order to support users from the typical age range of children with newly diagnosed Perthes' disease. It is important to consider the differences in understanding and engagement across age ranges like this, for instance, in this study, the age range was four to 11 years old.

This study has demonstrated good levels of usability and acceptability of the NON-STOP app, with insights from both quantitative and qualitative data helping to explain why. There were fair levels of engagement demonstrated in the observational study, with children and families explaining factors affecting this in the focus groups. Results presented in this study suggest that users found the NON-STOP app usable and well-received. Health ITUES scores exceeded the validated usability threshold, and participants described the NON-STOP app as more engaging than traditional paper-based materials.

Overall, 31 of the 36 families invited to take part in the NON-STOP app testing agreed. Of these 31 families, only 26 engaged with the use of the app. For a clinical use of the app, it will be necessary to carry out refinements to the delivery of the intervention in terms of training packages

for local clinicians. Engagement declined over time, which suggests a need for ongoing motivation such as achievable intervention dosage and personalized features. This would be of particular relevance to the exercise section of the app, rather than the educational videos in the app which may not require repeated viewing. While engagement was varied, most participants used the app at least once, which met feasibility-stage expectations for this novel digital self-management intervention in this population. Understanding variations in engagement was important to refine the NON-STOP app in preparation for the development of a definitive clinical trial. For example, engagement reduced as the demand on the user increased throughout the testing period. Using this data, the intervention dose (i.e. the frequency the children are required to complete their exercises to gain a reward) can be adapted. There was a considerable reduction in follow-up patient-reported outcome measure (PROM) completion in this study; over a quarter of the participants failed to complete the PROMIS Mobility. This may reflect the burden of completing PROMs without additional support and is something that could be improved using trial admin support, reminders, and small incentives.

The qualitative element had some limitations which the authors acknowledge. The use of focus groups potentially introduced selection bias, with participants who engaged with the app more likely to take part in the focus groups. Individual interviews with less-engaged participants could have provided insight into barriers to use. Nonetheless, the participants offered invaluable insights for refinement; for example, issues with dual-logins for families where two different devices were being used for one child, as a child may live between two parents' due to separation. This has been rectified following the study.

Findings from this study will inform refinements to the NON-STOP app in preparation for a definitive clinical trial which will be aimed at sustaining engagement over the longer term. These will include changes to intervention dose (i.e. a reduction in how many times a week a child must engage with the app to earn a reward) as well as more resources with which to engage within the app for longer periods of time given the chronicity of the condition. Refinements related to this will include videos and animations for the educational section of the app, as well as more rewards and customizations for the children to maintain engagement over longer periods of time.

In conclusion, in this mixed-methods study, the acceptability and usability of the NON-STOP app for children with Perthes' disease and their families have been explored. Valuable insights from this study have directly informed refinements to the NON-STOP app in preparation for the Op NON-STOP study.[21] In this trial, the first randomized clinical trial for the management of Perthes' disease,[22] the NON-STOP app is an integral part of the active containment intervention, providing self-management for children randomized to non-surgical treatment.

## Social media

Follow the NON-STOP app on X @NONSTOPPhD
Follow A. M. Galloway on X @GallowayAdam
Follow C. Holton on X @HoltonColin
Follow H. J. Siddle on X @HeidiSiddle
Follow D. C. Perry on X @MrDanPerry

## Supplementary material

Topic guides and participant information sheets for the study explaining involvement to participants, along with a quote table showing the data collected during the study.

## References


1. **Galloway AM**, **Keene DJ**, **Anderson A**, **et al**. Clinical consensus recommendations for the non-surgical treatment of children with Perthes' disease in the UK. *Bone Joint J*. 2024;106-B(5):501–507.
2. **Galloway AM**, **Pini S**, **Holton C**, **et al**. "Waiting for the best day of your life". A qualitative interview study of patients' and clinicians' experiences of Perthes' disease. *Bone Jt Open*. 2023;4(10):735–741.
3. **Galloway AM**, **Anderson AM**, **Casimir E**, **et al**. From theory to practice: insights into intervention development of the NON-STOP app for children with Perthes' disease. *Bone Jt Open*. 2025;6(7):822–827.
4. **Mehtälä MAK**, **Sääkslahti AK**, **Inkinen ME**, **Poskiparta MEH**. A socio-ecological approach to physical activity interventions in childcare: a systematic review. *Int J Behav Nutr Phys Act*. 2014;11(1):22.
5. **Michie S**, **van Stralen MM**, **West R**. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci*. 2011;6(1):42.
6. **Teixeira PJ**, **Carraça EV**, **Markland D**, **Silva MN**, **Ryan RM**. Exercise, physical activity, and self-determination theory: a systematic review. *Int J Behav Nutr Phys Act*. 2012;9(1):78.
7. **Ivankova NV**, **Creswell JW**, **Stick SL**. Using mixed-methods sequential explanatory design: from theory to practice. *Field methods*. 2006;18(1):3–20.
8. **Eldridge SM**, **Lancaster GA**, **Campbell MJ**, **et al**. Defining feasibility and pilot studies in preparation for randomised controlled trials: development of a conceptual framework. *PLOS ONE*. 2016;-11(3):e0150205.
9. **Perry DC**, **Arch B**, **Appelbe D**, **et al**. The British Orthopaedic Surgery Surveillance study: Perthes' disease. *Bone Joint J*. 2022;104-B(4):510–518.
10. **Luo W**, **Ali MS**, **Limb R**, **Cornforth C**, **Perry DC**. Use of the PROMIS Mobility score in assessing function in adolescents and adults previously affected by childhood hip disease. *Bone Jt Open*. 2021;2(12):1089–1095.
11. **Matsumoto H**, **Hyman JE**, **Shah HH**, **et al**. Validation of pediatric self-report patient-reported outcomes measurement information system (PROMIS) measures in different stages of legg-calvé-perthes disease. *J Pediatr Orthop*. 2020;40(5):235–240.
12. **Leo DG**, **Jones H**, **Murphy R**, **et al**. The outcomes of Perthes' disease. *Bone Joint J*. 2020;102-B(5):611–617.
13. **Corder K**, **van Sluijs EMF**, **Wright A**, **Whincup P**, **Wareham NJ**, **Ekelund U**. Is it possible to assess free-living physical activity and energy expenditure in young people by self-report? *Am J Clin Nutr*. 2009;89(3):862–870.
14. **Yen PY**, **Wantland D**, **Bakken S**. Development of a customizable health IT usability evaluation scale. *AMIA Annu Symp Proc*. 2010;2010:917–921.
15. **Loh KP**, **Liu J**, **Ganzhorn S**, **Sanabria G**, **Schnall R**. Establishing a usability cut-point for the health information technology usability evaluation scale (Health-ITUES). *Int J Med Inform*. 2022;160:104713.
16. **Wong DL**, **Baker CM**. Pain in children: comparison of assessment scales. *Pediatr Nurs*. 1988;14(1):9–17.
17. **No authors listed**. NVivo software. 2020. https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/enabling-research/nvivo-getting-started-bundle (date last accessed 22 December 2025).
18. **Gale NK**, **Heath G**, **Cameron E**, **Rashid S**, **Redwood S**. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol*. 2013;13(1):117.
19. **Galloway AM**, **Holton C**, **Parnami V**, **et al**. A case review to describe variation in care following diagnosis of Perthes' disease. *Bone Jt Open*. 2020;1(11):691–695.
20. **Galloway AM**, **van-Hille T**, **Perry DC**, **et al**. A systematic review of the non-surgical treatment of Perthes' disease. *Bone Jt Open*. 2020;1(12):720–730.
21. **No authors listed**. Op NON-STOP. 2025. www.opnonstop.org (date last accessed 22 December 2025).

22. **Galloway AM**, **Nicolaou N**, **Perry DC**. Surgery versus the NON-surgical treatment of Perthes' disease (Op NON-STOP): the journey to a definitive randomized controlled trial in Perthes' disease. *Bone Joint J*. 2025;107-B(3): 280–282. . Erratum in *Bone Joint J*. 2025;107-B(4):501. doi: 10.1302/0301-620X.107B4.BJJ-2025-00055.

## Author information

**A. M. Galloway**, PhD, MSc, BSc (Hons), MCSP, Clinical Doctoral Research Fellow, University of Leeds and Specialist Children's Physiotherapist
**H. J. Siddle**, PhD, Professor of Musculoskeletal Health, University of Leeds and Consultant Podiatrist
Leeds Teaching Hospitals NHS Trust, Leeds, UK; Leeds Institute of Rheumatic and Musculoskeletal Medicine, Chapel Allerton Hospital, Leeds, UK.

**D. J. Keene**, PhD, MCSP, Professor of Trauma Rehabilitation, University of Oxford and Clinical Specialist Physiotherapist, Royal United Hospitals Bath NHS Foundation Trust, Bath, UK.

**K. Cleary**, BSc (Hons), MCSP, Specialist Children's Physiotherapist, Leeds Institute of Rheumatic and Musculoskeletal Medicine, Chapel Allerton Hospital, Leeds, UK; Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust, Doncaster, UK.

**E. Gabriele**, BSc (Hons), Assistant Psychologist, Leeds Institute of Rheumatic and Musculoskeletal Medicine, Chapel Allerton Hospital, Leeds, UK; Tyne and Wear NHS Foundation Trust, Newcastle upon Tyne, UK.

**C. Holton**, MSc (Mech Eng), BSc (Anatomy Hons), MBChB, FRCS (Tr & Orth), Consultant Orthopaedic Surgeon, Leeds Teaching Hospitals NHS Trust, Leeds, UK; Management Offices, Leeds Children's Hospital, Clarendon Wing, Leeds, UK.

**S. Pini**, PhD, Associate Professor, Leeds Institute of Health Science, University of Leeds, Leeds, UK.

**A. C. Redmond**, PhD, Professor of Biomechanics, Leeds Institute of Rheumatic and Musculoskeletal Medicine, Chapel Allerton Hospital, Leeds, UK; Leeds Institute of Rheumatic and Musculoskeletal Medicine, University of Leeds, Leeds, UK.

**S. Richards**, PhD, Professor of Health Services Research, Leeds Institute of Health Science, University of Leeds, Leeds, UK.

**D. C. Perry**, FRCS, PhD, Professor of Children's Orthopaedic Surgery, University of Liverpool and Consultant Orthopaedic Surgeon, Children's Orthopaedic Surgery, Alder Hey Children's Hospital, Liverpool, UK.

## Author contributions

A. M. Galloway: Conceptualization, Investigation, Validation, Visualization, Writing – original draft.
D. J. Keene: Conceptualization, Investigation, Validation, Visualization, Writing – review & editing.
K. Cleary: Investigation, Writing – review & editing.
E. Gabriele: Investigation, Validation, Visualization, Writing – review & editing.
C. Holton: Conceptualization, Writing – review & editing.
S. Pini: Conceptualization, Investigation, Validation, Visualization, Writing – review & editing.
A. C. Redmond: Conceptualization, Writing – review & editing.
H. J. Siddle: Conceptualization, Writing – review & editing.
S. Richards: Conceptualization, Investigation, Validation, Visualization, Writing – review & editing.
D. C. Perry: Conceptualization, Investigation, Validation, Visualization, Writing – review & editing.

## Funding statement

The author(s) disclose receipt of the following financial or material support for the research, authorship, and/or publication of this article: This work was completed as part of A. M. Galloway's National Institute for Health and Care Research (NIHR)/ Health Education England Clinical Doctoral Research Fellowship (NIHR301582).

## ICMJE COI statement

A. M. Galloway discloses that this work was completed as part of a National Institute for Health and Care Research (NIHR)/ Health Education England Clinical Doctoral Research Fellowship (NIHR301582). C. Holton receives unrelated payments from Arthrex and DePuy for lectures and courses. D. J. Keene reports that this research is funded by the NIHR and that he has been supported by the NIHR Exeter Biomedical Research Centre and the NIHR Oxford Biomedical Research Centre via grants to the University of Exeter and the University of Oxford; he also sits on several publicly funded clinical trial steering and data monitoring committees. D. C. Perry discloses NIHR Research Professorship funding from the NIHR Academy (NIHR301655). S. Pini reports an advanced fellowship and two PhD fellowships as a supervisor from the NIHR, a research grant from Leeds Hospitals Charity, and PhD funding as a supervisor from the Economic and Social Research Council (ESRC).

## Data sharing

All data generated or analyzed during this study are included in the published article and/or in the supplementary material.

## Acknowledgements

The authors would like to thank the participants for their involvement, as well as input from the NIHR Generation R PPI group Young Research Owls at Leeds Children's Hospital. The authors would also like to thank the app development group at HMA, particularly Emma, Steve, and Chris for their work in creating the NON-STOP app.

## Open access funding

The open access fee was acquired as part of A. M. Galloways's National Institute for Health and Care Research (NIHR)/Health Education England Clinical Doctoral Research Fellowship (NIHR301582).

## Trial registration number

ISRCTN14517832.