


Time cost associated with sports participation for athletes with high support needs: a time-motion analysis of tasks required for para swimming

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ABSTRACT

Objectives People with cerebral palsy and high support needs (CP&HSN) are profoundly inactive but also under-represented in studies evaluating physical activity interventions. Reasons for their exclusion have not been evaluated. We hypothesised that CP&HSN would be associated with high time costs of preparatory activities (eg, getting dressed/undressed), possibly contributing to low participation and under-representation. Accordingly, this pilot study aimed to: (1) evaluate whether the time required for preparatory activities was extremely different (≥ 3 SD) between swimmers with and without CP&HSN; and (2) provide a qualitative indication of the preparatory tasks undertaken by swimmers with CP&HSN.

Methods Each of three experienced (5 years) para swimmers with CP&HSN and 20 non-disabled swimmers were timed entering and then exiting the pool on three occasions. Mean entry and exit time for each para swimmer was compared with the group mean for non-disabled swimmers, and differences of greater than 3.0 SD were considered extreme. A qualitative description of the tasks completed by the para swimmers was recorded.

Results The differences in time costs between para and non-disabled swimmers met the criterion of extreme. Pool entry times for para swimmers were 8–13 times greater (Effect size = 4.1–8.7). Pool exit times were 6–10 times greater (ES=7.0–9.5). 90% of tasks completed by para swimmers required personal assistance or wheeled mobility.

Conclusions This pilot study suggests that, compared with non-disabled swimmers, time costs for preparation to commence or depart training are extremely high for swimmers with CP&HSN. Further research is required to evaluate the veracity of these findings.

BACKGROUND

Cerebral palsy (CP) is an umbrella term for a heterogeneous group of neurological disorders, caused by a non-progressive injury to the infant or fetal brain.¹ Impaired motor control is the defining feature of CP although the type and severity of motor impairment varies widely. The functional effects of the impaired motor control also vary widely² and are most

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ People with cerebral palsy and high support needs (CP&HSN) are profoundly inactive but also under-represented in studies evaluating physical activity interventions. It is possible that CP&HSN may be associated with extremely high time costs of preparatory activities, which could contribute to low participation and under-representation.

WHAT THIS STUDY ADDS

⇒ This pilot study suggests that, compared with non-disabled swimmers, time costs for preparation to commence or depart training are between 6 and 13 times higher for swimmers with CP&HSN.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The extreme time costs associated with participation for people with CP&HSN may present unique barriers and increases in research cost, due to the extra time required for intervention delivery and physical assessment of participants. Novel research methods using small samples may be required to overcome this issue. Further research is required to evaluate the veracity of these findings.

commonly classified using Gross Motor Function Classification System (GMFCS),³ a five-level, hierarchical classification system ranging from GMFCS level I (highest gross motor function) to GMFCS level V (lowest gross motor function). Individuals in GMFCS level IV and level V are similar in that both rely on wheeled mobility for daily functioning and require personal assistance with one or more fundamental activities of daily living (eg, mobility, feeding or toileting), and here we use the term people with CP and high support needs (CP&HSN) as a collective descriptor for people in either classification.

Although people with CP&HSN comprise approximately 35% of the CP population,⁴ they have received very little scientific attention in the physical activity and disability



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literature. For example, of the 1359 people with CP who have participated in randomised controlled trials evaluating leisure time physical activity interventions in people with CP, only 140 (~10%) were CP&HSN.⁵ The paucity of studies in this population is particularly striking because evidence indicates they are at near-maximum risk of diseases of inactivity—they are sedentary more than 95% of the time, and the majority of the remaining 5% comprises light-intensity activity.⁶ In para sport, participation rates are lowest among athletes with HSN,^{7,8} and although increasing participation is a strategic priority of the International Paralympic Committee,⁹ events for athletes with HSN continue to be removed from the Paralympic programme because of low participation rates.⁸ In Australia, there are 2716 classified para swimmers, but only 39 (<1.5%) have a disability resulting in HSN.⁸

To date, studies that aim to understand the factors that contribute to the very low rates of participation and scientific neglect of people with CP&HSN have not been conducted but are required if these inequities are to be addressed.¹⁰ Our experience running the ParaSTART programme led us to posit that one contributing factor may be that, compared with the general population, the time cost associated with physical activity participation is high for people with CP&HSN.

This study is part of a larger programme of research entitled *ParaSTART*—a longitudinal intervention study which originally began to evaluate physical and psychosocial responses of people with CP&HSN to a performance-focused swimming training programme. The original protocol is published,¹¹ but in summary, participants were three young people with CP&HSN (two male, one female) aged 15–16 years at time of enrolment who had never previously trained for any sport and were not meeting physical activity guidelines. To date, participants have trained regularly for 5 years.¹² A typical training week comprises 3–4×30 min sessions of moderate to vigorous pool and gym-based training. However, we observed that compared with other pool users—non-disabled members of the university community—a relatively large proportion of our participants' training session is spent either preparing to enter the water or drying off and preparing to travel home. Evidence indicates the extra time required for preparation (ie, preparing to participate plus preparing to depart) is associated with reduced participation among people with disabilities.^{13,14} However, we hypothesise that, compared with the general population, the preparation time required by participants with CP&HSN is not simply increased, but increased in the extreme and that extreme increases in preparation time for participants with CP&HSN may help explain their particularly low participation rates and under-representation in the scientific literature. Accordingly, the aim of this pilot study was to conduct a time-motion analysis¹⁵ in order to:

1. Provide an indication of whether there is an extreme difference between the time required for preparatory

Table 1 Characteristics of participants

Characteristic	Non-disabled group (n=20)	Para swimmers group (n=3)
Age, years (±SD)	21.0 (±1.2)	19.7 (±0.5)
Female, n (%)	10 (50)	1 (33)

activities—preparing to commence training and preparing to depart training—for swimmers with and without CP&HSN.

2. Provide a qualitative indication of the preparatory tasks undertaken by swimmers with CP&HSN.

Accepted statistical convention indicates that a value that is more than 3.0 SD different from the mean is considered an outlier,¹⁶ and this was adopted as the criterion for determining whether time differences between swimmers with and without CP&HSN were extreme.

METHODS

Participants

Twenty non-disabled participants were recruited from the School of Human Movement and Nutrition Sciences at The University of Queensland (UQ). Three para swimmers with CP&HSN were recruited from the UQ ParaSTART swimming programme. Participant characteristics are summarised in [table 1](#). The ParaSTART programme uses an athlete-led, consultative model, whereby participants provide regular, ongoing and substantive input to the structure of their training schedule and regime. For this study in particular, participants provided insight into their experiences of time as a barrier to participation in sport.

Data collection

All data collection was carried out at UQ Aquatic Centre. Data collection varied slightly for para swimmers and non-disabled participants.

Data collection for para swimmers used time-motion analysis methods that have been previously described.¹⁵ Specifically, continuous observation by an external assessor accompanied by multimedia recording was carried out, followed by task categorisation and measurement of time costs for particular tasks. Participants were instructed to enter and exit the pool as they normally would if they were completing an individual training session. All participants received assistance from a trained coach/personal assistant (C/PA). An iPhone was used to film each para swimmer entering and exiting the pool on three occasions. All participants arrived and departed in a 'maxi taxi'—a transport van specifically modified to permit secure transport of people with disabilities while they remain in their personal wheelchair. The taxi arrived and departed from a single designated parking spot. Timing of pool entry commenced after payment for the ride had been completed and the participant was ready to exit the taxi. Timing stopped when the participant had

entered the water and was floating independently (either out-of-the-hoist chair or out-of-the-water wheelchair). Timing of pool exit commenced when the participant had finished training, moved to the edge of the pool and was waiting to exit. Timing ceased when the wheelchair had been secured in the carriage area of the taxi and the driver began walking to the driver's seat.

Non-disabled participants were instructed to enter and exit the pool as they normally would if they were completing an individual training session. A stopwatch was used to measure the time taken to enter and exit the pool on three separate occasions. The starting point for the participant was the centre of the designated disabled parking spot. Timing commenced when the participant began walking towards the pool complex and stopped when they had walked down the access ramp into the water and were floating independently. Timing of pool exit began when they first touched the handrail to walk up the access ramp from the pool and stopped when they reached their starting position at the disability parking space.

Both participants with and without disabilities arrived wearing a swimming costume underneath casual sportswear and slip-on footwear. The total distance travelled by all participants for all pool entry and pool exit sequences was 82 m.

Data analysis

Quantitative data were analysed using Microsoft Excel. The mean, SD and range of pool entry and exit times for the para swimmers and non-disabled group were calculated. An independent samples t-test (alpha level set at $p < 0.05$) showed no significant difference between non-disabled males and females in mean times for pool entry ($p = 0.47$, Effect size = 0.347) or pool exit ($p = 0.17$, Effect size = 0.678), therefore males and females were treated as a single group for comparison. Effect size estimates (Cohen's d) were used to compare each para swimmer's pool entry and exit times against the non-disabled group. Effect sizes were interpreted as follows: small, 0.20–0.50; moderate, 0.50–0.80; and large, greater than 0.80. An effect size of > 3.0 was considered extreme.¹⁶

Video footage of the para swimmers' pool entry and exit sequences was obtained and analysed using Windows Media Player. A qualitative description of the tasks

completed by each para swimmer during pool entry and exit was recorded.

Patient and public involvement

Young people with CP were involved in the design of this study, and provided insight into their experiences of time as a barrier to participation in sport.

RESULTS

Table 2 presents a summary of the functional classifications of each para swimmer in each of five key domains—gross motor function, manual ability, communication function, visual function and eating and drinking.

Figure 1 presents mean pool entry times in minutes and seconds for both the non-disabled participants and para swimmers 1, 2 and 3. The average total time for the non-disabled group was 1:14 ($\pm 0:14$). The average total time taken for the pool entry sequence for para swimmers 1, 2 and 3 was 16:00 ($\pm 02:23$), 10:08 ($\pm 02:18$) and 13:20 ($\pm 04:11$), respectively.

Figure 2 presents mean pool exit times in minutes and seconds for both groups. The average total time for the non-disabled group was 1:37 ($\pm 0:20$). For para swimmers 1, 2 and 3 the average total time taken for the pool exit sequence was 15:48 ($\pm 02:06$), 13:38 ($\pm 01:45$) and 10:39 ($\pm 01:48$), respectively.

Table 3 presents effect size estimates for each para swimmer's pool entry and exit times compared with the non-disabled group mean. All effect sizes for each of the para swimmers in pool entry and pool exit sequences met the criteria for extreme (≥ 3 SD).

Table 4 presents the results of the qualitative analysis of pool entry and exit. Activities are presented in chronological order. Pool entry comprised four activities: transport arrival and exit; pool complex entry; water preparation; and water entry. The tasks which comprise each of those activities are presented in the third column. The total number of tasks was 39 (pool entry tasks=14; pool exit tasks=25), and 35 (90%) required either wheeled mobility or assistance (partial or full) from the taxi driver or C/PA. Four tasks—marked (*)—were done independently by participants without the use of wheeled mobility.

Figure 3 presents the relative contributions of the four pool entry activities. *Water preparation* took the most time for all para swimmers (range: 4:35–7:03). The quickest

Table 2 Characteristics and sport classes of para swimmers

Participant	Age	Motor type/distribution	GMFCS	MACS	CFCS	VFCS	EDACS	Swimming class
1	20	Choreoathetoid	IV	II	III	I	I	S2/SB2/SM2
2	19	Spastic quadriplegia	IV	II	II	I	I	S3/SB2/SM3
3	20	Spastic quadriplegia	IV	II	I	I	II	S2/SB2/SM2

CFCS, Communication Function Classification System; EDACS, Eating and Drinking Ability Classification System; GMFCS, Gross Motor Function Classification System; MACS, Manual Ability Classification System; VFCS, Visual Function Classification System.

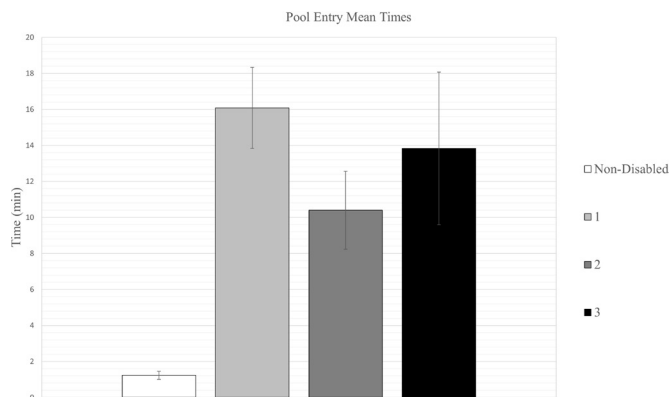


Figure 1 Mean total time required for pool entry in the non-disabled group and para swimmers.

activity for para swimmers 1 and 2 was *Transport arrival and exit* and the quickest for para swimming 3 was *Pool complex entry*.

Figure 4 presents the relative contributions of the four pool exit activities. Departure preparation took most time for para swimmers 1 and 2, while water exit took most time for para swimmer 3. Pool complex exit took least time for para swimmers 1 and 2 while transport departure took least time for para swimmer 3. The time taken for transport departure during pool exit was similar to the time taken for transport arrival and exit during pool entry.

DISCUSSION

This comparative time-motion analysis of non-disabled swimmers and para swimmers with CP&HSN indicates that CP&HSN is associated with high time costs for activities required to prepare for swimming training and to depart from swimming training. Pool entry and pool exit time costs for para swimmers with CP&HSN were well above the threshold for extreme (≥ 3 SD). The defining characteristics of people with CP&HSN are that they use wheeled mobility and require personal assistance with fundamental tasks of daily living. The qualitative analysis indicated that 90% of the tasks undertaken by para

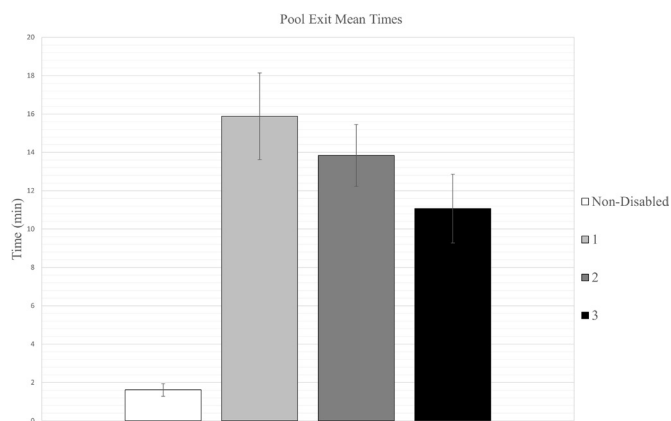


Figure 2 Mean total time required for pool exit in the non-disabled group and para swimmers.

Table 3 Effect size estimates for each para swimmer's pool entry and exit times compared with the non-disabled group mean

Sequence	Effect size (d)		
	Para swimmer 1	Para swimmer 2	Para swimmer 3
Pool entry	8.7	5.5	4.1
Pool exit	9.4	9.5	7.0

swimmers with CP&HSN required personal assistance or the use of wheeled mobility, indicating that these characteristics of our participants played an important role in the elevated time costs and suggesting that, in physical activity contexts, it may be valid to consider people with CP&HSN separately from others who have CP.

It is plausible that people with CP&HSN also incur extreme time costs when preparing to train or preparing to depart from physical activities other than swimming. Although this remains to be tested, if it is true it would help to explain three other phenomena relevant to physical activity and people with CP&HSN: their low rates of participation in all forms of physical activity; their low rates of participation in competitive sport; and their low representation in scientific studies evaluating physical activity interventions.

In relation to general physical activity, lack of time is one of the most commonly reported barriers to participation in physical activity for people with CP.¹⁷ Logic would suggest that as the time cost of preparatory activities increases, the attractiveness of participating in those activities would decrease and, when time costs are extreme, they would constitute a significant barrier to participation. Currently, the use of wheeled mobility and the requirement for personal support are not identified as barriers to participation. However, the findings of this study suggest that these factors, and their relation to time cost and other known barriers (eg, facility accessibility, availability of transport, facility staff skills and disability experience), should be considered in the future.

In para sport, participation rates are lowest among athletes with HSN,^{7,8} and although increasing participation is a strategic priority of the International Paralympic Committee,⁹ events for athletes with HSN continue to be removed from the Paralympic programme because of low participation rates.⁸ If the extreme time costs incurred by people with CP&HSN in our study can be generalised to other sports, they carry a potential increase in the financial cost for training (extra time for facility hire, extra coaching time, the cost of personal support workers) and for travel to competition (the travel cost required for personal support workers and baggage allowance for extra wheelchairs, particularly power chairs). The inconvenience and extra expense associated with training and travelling with athletes with HSN may adversely affect their prospects of being selected to compete at national and international competitions. A research effort is

Table 4 Pool entry and exit activities for para swimmers, divided into component tasks and presented in chronological order

Sequence	Activities	Tasks required
Pool entry (total distance travelled=82 m; n=4 activities comprising 14 tasks)	Transport arrival and exit (n=5 tasks)	Driver exits taxi and opens back door, partially lowers the elevator, steps up and enters taxi. Driver detaches wheelchair safety straps, exits the taxi and raises elevator fully. Participant wheels onto the elevator. Driver lowers elevator fully. Participant wheels off the elevator.
	Pool complex entry (n=1 task)	Participant wheels to the pool complex to meet C/PA.
	Water preparation (n=3 tasks)	C/PA removes participant's jacket and/or shirt and pants. C/PA puts on participant's cap and/or goggles. C/PA takes and stores participant's accessories.
	Water entry (n=5 tasks)	Participant wheels to the pool edge. C/PA transfers participant onto pool hoist or pool wheelchair. Participant clips on safety belt.* C/PA lowers participant into the pool or pushes pool wheelchair down ramp. Participant disengages from hoist/pool wheelchair and floats independently.*
Pool exit (total distance travelled=82 m; n=4 activities comprising 25 tasks)	Water exit (n=10 tasks)	Participant finishes session and moves to hold on to pool edge.* C/PA retrieves day chair from storage and brings to poolside. C/PA lowers the pool hoist into the pool or pushes pool wheelchair down ramp. Participant releases his grasp of the pool edge and, with C/PA's help, positions to permit hoist or wheelchair exit. Participant clips on safety belt.* C/PA raises the pool hoist or pushes pool wheelchair out. C/PA removes participant's cap and/or goggles. C/PA dries participant and places towels on day chair. C/PA unclips safety belt. C/PA transfers participant onto wheelchair.
	Departure preparation (n=2 tasks)	C/PA folds and stores participant's towels. C/PA helps participant don jacket and/or shirt and pants.
	Pool complex exit (n=3 tasks)	C/PA hands back or packs participant's accessories. C/PA gives participant transport payment cards. Participant wheels to the designated waiting place for the taxi.
	Transport departure (n=9 tasks)	Driver opens back and side door to taxi. Driver lowers the elevator fully. Participant and driver move onto the elevator. Driver raises the elevator. Participant and driver enter the taxi. Driver attaches wheelchair safety straps. Driver folds the elevator into a secure position for transit. Driver exits taxi and closes back and side door. Driver enters taxi and taxi departs.

*Tasks entailed wheeled mobility but did not require partial or complete assistance from taxi driver or coach/personal assistant (C/PA).

required to establish to what extent this problem materialises in practice. Funding schemes and incentives may be required to ensure that people with CP&HSN are not excluded.

Although people with CP&HSN comprise approximately 35% of the CP population,⁴ their exclusion from scientific studies evaluating physical activity interventions is well documented. Of the 1359 people with CP who have participated in randomised controlled trials evaluating leisure time physical activity interventions in people with CP, only 140 (~10%) were CP&HSN.⁵ The extreme time associated with participation for people

with CP&HSN will potentially lead to increases in research cost due to the extra time required for intervention delivery and physical assessment of participants. Therefore, researchers with limited resources may be disinclined to recruit people with CP&HSN for studies evaluating physical activity interventions.

Finally, physical activity studies in people with CP have primarily evaluated effectiveness, but either do not measure or fail to report intervention feasibility or the processes required to facilitate participation. More detailed reporting of the environment in which physical activity interventions are delivered, and any

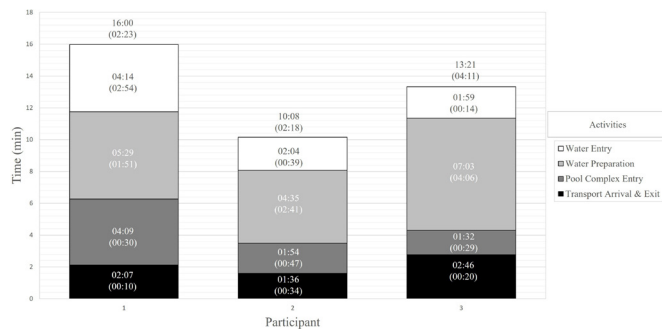


Figure 3 The total time taken for the pool entry sequence for each para swimmer, together with relative contributions of each of the four groups of activities: transport arrival and exit; pool complex entry; water preparation; and water entry. Activity order is chronological from bottom to top. Time presented in mean minute:second (SD).

individualised supports or adjustments made for participants, would be beneficial. Perhaps most importantly, clinicians and researchers should simply be aware of the extreme time costs incurred by tasks requiring personal support. Further studies are also required to evaluate whether—and to what extent—factors which reduce time costs for people with CP&HSN may increase participation in physical activity.

Strengths and limitations

The validity of this time-motion analysis of pool entry and exit procedures in swimmers with CP&HSN depended on having study participants who trained and competed regularly. Unless participants had preparation and departure procedures that were well practised and were assisted by well-trained personal support workers familiar with their needs, poor execution and lack of familiarity would have confounded results. The pool of people in Australia meeting these selection criteria is very small. Of the 2716 competitive para swimmers in Australia, only 39 have HSN and not all of these have CP. So although

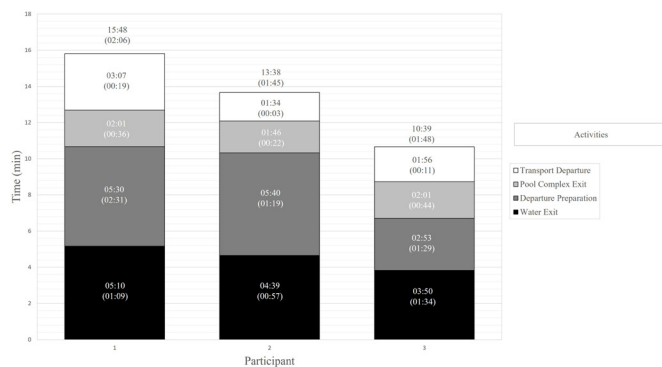


Figure 4 The total time taken for the pool exit sequence for each para swimmer, together with relative contributions of four groups of activities: water exit; departure preparation; pool complex exit; and transport departure. Activity order is chronological from bottom to top. Time presented in minutes—mean (+SD).

the absolute number of participants was small ($n=3$), they constitute $\sim 8\%$ of the total eligible population in Australia (with or without CP) and so is a relatively good sample. The large effect sizes obtained further mitigate the small sample size—the smallest is 4.2 SD. These striking and consistent results reduce the likelihood that they occurred by chance. Nonetheless, because $n=3$, the findings are not generalisable and should be interpreted cautiously.

An important study limitation is that the total time cost of the para swimmers' training methods, including preparatory procedures beginning at home, was not measured. For example, participants arrived dressed in their swimming costumes and it is likely that this dressing activity incurred significantly greater time costs than those of the non-disabled swimmers.

CONCLUSION

This pilot study suggests that, compared with non-disabled swimmers, time costs for preparation to commence or depart training are extremely high for para swimmers with CP&HSN. We used the term people with CP&HSN to differentiate people with CP who wheeled mobility and require personal assistance with fundamental tasks of daily living from people with CP who do not. Our qualitative analysis indicated that 90% of the tasks undertaken by the para swimmers required reliance on wheeled mobility or personal assistance, indicating that this collective term has utility in a physical activity context. Further research is required to evaluate the veracity of these findings.

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Contributors ID: project design, collected and analysed the data, refined the manuscript. DC, AD: collected and analysed the data, drafted the manuscript. EB: project design, refined the manuscript. SMT: project design, analysed the data, refined the manuscript. SMT is author acting as guarantor.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants and was approved by The University of Queensland (UQ) Human Research Ethics Committee (application number: 2015000831). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

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