

A survey of user perspectives on control devices for electrically powered wheelchairs

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Abstract

A postal survey using a purpose-designed questionnaire was conducted to ascertain adult user perspectives on control devices for electrically powered wheelchairs (EPWs) and their prevalence. Respondent (N = 262) mean age 54.4 years, female 56.8%, mean duration EPW use 10.1 years, mean usage 6.7 days per week and 9.2 hours per day, diagnosis multiple sclerosis 28.3%, cerebral palsy 13.8%, spinal cord injury 11.7%. Control device type 94.6% hand joystick, 2.3% chin joystick, 2.7% switches and 0.4% foot control. 28.0% reported having an accident or mishaps. The majority have control devices that meet their needs, with high levels of user satisfaction. Some users might benefit from adjustments or modifications to their current provision and a few might benefit by changing to a different control device type. High proportions of users reported fatigue or tiredness and pain or discomfort as limiting factors.

Methodology

The questionnaire was piloted by a number of individuals who were not eligible for the survey but who had attended the SMART Centre. The pilot confirmed that the content of the questions and the length of time that it took to complete were appropriate. We posted 471 questionnaires to the study population (individuals ≥ 18 years of age who had an NHS provided EPW in the south east region of Scotland) at the start of September 2014 with a return date of the 30th September. About 1 week before the return date we sent out a reminder. Each completed questionnaire was numbered and the data were entered into a spreadsheet.

Results

A total of 262 (response rate 55.5%) questionnaires were completed and returned. The average age of the participants was 54.4 ± 16.3 years (N = 252; range 18-89 years). The majority of participants were female (56.8% compared with 43.2% male; N = 260). There was no significant difference between the mean ages of male and female participants ($P > .05$, 2-tailed t test) being 53.6 ± 17.0 and 55.1 ± 15.8 years respectively. The mean durations of wheelchair and EPW use were 14.8 ± 11.8 years (N = 229) and 10.1 ± 9.1 years (N = 249) respectively. The mean number of days per week and hours per day of EPW use were 6.7 ± 1.1 days (N = 249) and 9.2 ± 4.3 hours (N = 212) respectively. The vast majority, 89.5% (221), were using their EPW everyday. The largest three diagnostic groups were Multiple Sclerosis (MS) 28.3%, Cerebral Palsy (CP) 13.8% and Spinal Cord Injury (SCI) 11.7%.

The respondents were asked if any of five listed issues limited their use of their EPW. Of the 250 who responded to this question, 42.4% (106) selected 'Fatigue or tiredness', 38.8% (97) 'Pain or discomfort', 26.0% (65) 'Hand or upper limb weakness', 12.4% (31) 'Hand or upper limb range of motion' and 9.2% (23) 'Hand or upper limb tremor'.

Four different types of control device were reported as being used. Of the 261 respondents that specified a control type, 247 (94.6%) were using a hand joystick, 6 (2.3%) were using a chin joystick, 7 (2.7%) were using switches and one (0.4%) was using a foot control. None were using sip and puff.

Participants were asked to rate aspects of their control device on areas related to usability, safety, reliability and overall satisfaction (Table 1). This was on a 5-point Likert scale. For all six aspects, ratings were in the range of agree to strongly agree.

Table 1 Participant ratings for statements on control device usability, safety, reliability and overall satisfaction, where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree and 5 = strongly agree.

Statement	Hand Mean ± SD years (n)	Chin Mean ± SD years (n)	Switches Mean ± SD years (n)	Foot Mean (n)
My control device is easy to set up each time I use it	4.4 ± 0.8 (232)	4.2 ± 1.6 (6)	4.3 ± 0.5 (7)	5.0 (1)
My control device is easy to position where I need it to be	4.1 ± 1.1 (230)	4.3 ± 0.8 (6)	4.4 ± 0.5 (7)	5.0 (1)
My control device is easy to use	4.4 ± 0.8 (242)	4.3 ± 1.2 (6)	4.4 ± 0.5 (7)	5.0 (1)
I feel safe using my control device	4.3 ± 0.9 (244)	4.0 ± 1.3 (6)	4.3 ± 0.5 (7)	5.0 (1)
My control device is reliable	4.3 ± 0.8 (242)	4.2 ± 1.0 (6)	4.4 ± 0.5 (7)	4.0 (1)
Overall, I am satisfied with my control device	4.2 ± 1.0 (239)	3.8 ± 1.5 (6)	4.0 ± 1.0 (7)	4.0 (1)

Participants were asked to list any advantages of their control device (Table 2). There were relevant responses from 135 (51.5%) respondents with a total of 173 advantages listed. The breakdown by control type were 124 (50.2%) users and 158 advantages, 5 (83.3%) and 8, 5 (71.4%) and 6, and 1 (100.0%) and 1 for hand joystick, chin joystick, switches and foot control respectively.

Table 2 Categorised advantages of control devices.
For hand control, only advantages with 8 or more cases are listed.

Type	Advantages	Example responses	Number
Hand	Easy and simple to use	'Extremely easy to set up and use. I find the joystick system very intuitive.' 'Simple enough to work out the different jobs it does.'	43
	Facilitates independence	'It means I can be very independent. I can move about freely without relaying on someone else if I was in my manual chair all the time.' 'Gets me about in house can use toilet on my own'	40
	Good position	'I have short arms. Control placement in right position for hand placement.'	10

	Easy/comfortable to hold/grip	'Centrally placed helps me balance easier' 'Since golf ball grip fitted easier to grip.' 'It doesn't require a strong grip.'	9
	Good manoeuvrability	'Good at manoeuvring in a tight space.' 'Excellent for fine manoeuvring.'	8
Chin	Facilitates independence	'I can travel about my accommodation area.' 'Does give me some freedom in some small way.'	5
	Easy and simple to use	'Easy to use.'	2
	Easy/comfortable to hold/grip	'The ball chin piece is ideal.'	1
Switches	Facilitates independence	'It makes me mobile and allows me a degree of independence.' 'Give me more freedom.'	3
	Easy and simple to use	'I find it easy to control.'	1
	Matches requirements	'Helps me as I cannot use a joy stick.'	1
	Connectivity	'It gives me access to environmental controls.'	1
Foot	Matches requirements	'Its unique a one off device.'	1

Participants were asked to list any disadvantages of their control device (Table 3). There were relevant responses from 91 (34.7%) respondents with a total of 110 disadvantages listed. The breakdown by control type were 88 (35.6%) users and 106 advantages, 2 (33.3%) and 2, and 1 (14.3%) and 2 for hand joystick, chin joystick and switch control respectively.

Table 3 Categorised disadvantages of control devices.
For hand control, only disadvantages with 8 or more cases are listed.

Type	Disadvantages	Example responses	Number
Hand	Knob detaches and/or loose	'Golf ball control/knob keeps coming off.' 'Control top keeps coming off.'	17
	Accidental activation (off/on, joystick, speed setting)	'Too easily turned on. Sometimes it comes on when my wife/carer bumps against it.' 'When I'm moving my sleeve can turn the speed control' 'Passers by can accidentally nudge it!'	10
	Difficulties due to fatigue, tremor, discomfort, numbness or weakness	'My hand gets sore using the one hand to control my wheelchair.' 'Because I have a tremor I sometimes lose my grip.' 'Hand/arm just too weak to control it sometimes.'	8
	Poor position	'The control device is wrongly positioned' 'Hard to reach with being down low.' 'Too far away to reach the joystick.'	8
	Restricts access to tables, etc	'Position prevents me moving close to table or desk.' 'Cannot get under table / close to table.'	8
Chin	Difficulties due to fatigue	'Cannot go outside on her own without someone being with her as sometimes finds controlling her wheelchair tiring.'	1
	Design limitations	'Can't clean chin control ball.'	1
Switches	Design limitations	'The scrolling menu takes time and can be difficult in busy places.'	1
	Seating support	'If headrest slips I lose control if I am on my own.'	1

Participants were asked to state anything that they would like to change about their control device (Table 4). There were relevant responses from 103 (39.3%) respondents with a total of 122 changes. The breakdown by control type were 99 (40.1%) users and 118 changes, 2 (33.3%) and 2, and 2 (28.6%) and 2 for hand joystick, chin joystick and switch control respectively.

Table 4 Categorized desired changes to control devices.
For hand controls, only changes with 8 or more cases are listed.

Type	Change	Example responses	Number
Hand	Change in position and/or easier, more flexible position adjustment	'Nearer to me so it is easier to use.' 'A better design for extending\shortening arm which holds the device.' 'Right to left movement of joystick box as well as front and back.'	16
	Higher speed	'Too slow when outside, I feel it's dangerous to slow crossing the road.' 'Too slow.'	10
	Different size and/or shape and/or texture of knob	'A ball would be easier to use.' 'Joystick to be non slide as I use the back of my hand.'	9
	Swing/fold away mount or set back to allow easier access to tables/desks.	'Easier to move out off the way when sitting at a table.' 'Fold back position to allow getting close to table.'	8
Chin	Different size and/or shape and/or texture of knob	'Not to have ball control but something a little flatter.'	1
	Different, more compact mount	'Space taken up by 'poles' need for chin control especially when it is moved to the side to allow top/jumper to be put on/off, or reposition in chair.'	1
Switches	Quicker interface	'To change direction and general manoeuvring without having to stop + start, waiting for menus to scroll round.'	1
	Higher speed	'Faster speed setting.'	1

Discussion & Conclusions

People with MS and CP were found to be the largest diagnostic categories. Frank and De Souza (2013) reported the same finding, although the proportions differed possibly due to variations in methodology as well as their study being restricted to users of powerchairs for both indoor and outdoor use. Similarly, both studies found those with SCI and MD to be in the top five largest diagnostic categories.

The vast majority of participants, 94.6%, were found to be using a hand joystick. This was a greater proportion than the 84 to 92% (weighted and simple average respectively) reported by Henderson et al. (2013). For the less prevalent control devices, the proportions in this study are correspondingly less than those summarised by the latter study. The numbers of users are relatively small for the less prevalent devices, but given the more representative population including in this study the authors advocate that it provides a truer reflection of the population of EPW users as a whole than the four studies analysed by Henderson et al. (2013).

A number of disadvantages and desired changes were reported by users. Some might be addressed with minimum intervention (securing/replacing a loose knob, changing knob shape and/or size, joystick position, adjusting speed and acceleration settings). Others may be intractable or indicative of the requirement for a change of control device (e.g. to one without a control dial for speed) or a change of type, for example, when hand fatigue, tremor or discomfort becomes unmanageable. These findings indicated that there is a need to proactively follow up users and conduct planned reviews. This will be particularly important for those with deteriorating progressive conditions, such as MS, as has been recommended for wheelchair and seating users (Dolan 2013; Dolan & Henderson 2014).

This study is the first on control devices on a large, general population of EPWs users. The respondents were, on the whole, experienced and regular users of EPWs with a wide range of diagnoses and provision that reflects the heterogeneous nature of EPW users. The vast majority appeared to have control devices that meet their needs, though some might benefit from adjustments or modifications to their current provision and others might benefit by changing to a different type of control device. A high number reported fatigue or tiredness and pain or discomfort to limit their use of their EPW and prescribers need to be mindful of these issues when determining the most suitable type of control device and where it should be positioned.

The vast majority of EPW users have a hand joystick as a control device. Hand joysticks were reported to be easy and simple to use and facilitate independence with a high level of user satisfaction. Hand joystick users reported problems with the knob detaching, accidental activation, poor positioning and restricted access to tables and other issues that manufacturers may wish to address when designing new control devices. Alternative control devices (such as chin joysticks and switches) were far less prevalent, but can be a vital means of independent control, and therefore mobility, for those unable to use a hand joystick. Due to the small number of users of alternative controls in this study, only limited information about them was acquired. To find out more about the non-hand joystick control devices a further study with more in depth analysis of these control devices would be required.

References

Frank AO, De Souza LH. Recipients of electric-powered indoor/outdoor wheelchairs provided by a national health service: a cross-sectional study. *Arch Phys Med Rehabil* 2013;94:2403-9.

Henderson GI, Dolan MJ, Geggie CJ. A review and appraisal of clinically prevalent control devices for electrically powered wheelchairs. *Technology and Disability* 2013;25:221-32.

Dolan MJ. Clinical standards for National Health Service wheelchair and seating services in Scotland. *Disability and Rehabilitation: Assistive Technology* 2013; 8 (5): 363-372.

Dolan MJ, Henderson GI. Patient and equipment profile for wheelchair seating clinic provision. *Disability and Rehabilitation: Assistive Technology* 2014;9:136-43.