Spinal Cord Series and Cases (2020)6:8
https://doi.org/10.1038/s41394-020-0257-x

ARTICLE

Quality of life, concern of falling and satisfaction of the sit-ski aid in sit-skiers with spinal cord injury: observational study

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Received: 13 August 2019 / Revised: 17 January 2020 / Accepted: 20 January 2020

Abstract

Study design Observational study.

Objective To describe (1) user satisfaction, (2) the Quality of Life (QoL) and (3) fear of falling in individuals with tetraplegia or paraplegia who used a mono-ski for sit-skiing.

Setting Spinal units and Sport associations.

Methods An observational study of people with spinal cord injury (SCI) who used a sit-ski. Participants were recruited in various SCI rehabilitation centers and sport associations. Participants completed three assessment tools: the Quebec User Evaluation of Satisfaction with assistive Technology (QUEST 2.0); the World Health Organization Quality of Life (WHOQoL-BREF); the Spinal Cord Injury Fall Concern Scale (SCI-FCS). Results were evaluated with chi-squared test and Kolmogorov–Smirnov's test and the significance was set for p values < 0.05.

Results Fifteen participants were included. Results showed positive and statistically significant values for all the items of the SCI-FCS related to fear of falling, and for most of the items of the WHOQoL-BREF related to QoL and the QUEST 2.0 related to satisfaction with the device.

Conclusions This study highlights that sit skiing is correlated with high levels of satisfaction with the mono-ski, increases in QoL, and low levels of fear of falling. In adding these findings to the existent literature, it can be stated with more certainty that sit-skiing is a sport that can be recommended in rehabilitation and sports therapy programs.

Introduction

In people with a spinal cord injury (SCI), sedentary behavior can cause adverse effects on health, functioning, and quality of life (QoL). There is strong, consistent evidence that exercise can improve cardiorespiratory fitness and muscular strength in people with SCI [1]. Some authors have suggested that for people with tetraplegia, a rating of perceived exertion may provide a more valid indication of exercise intensity than heart rate [1]. Emerging evidence has also shown a range of exercise benefits, including reductions in depression, shoulder pain, and the risk of cardiometabolic diseases, with improved respiratory function. Moreover, there have also been reports showing several positive effects on QoL, life satisfaction, participation, and functional independence [2–6], and one report that suggests that participation in organized sports was positively associated with employment in adults with chronic SCI [7]. Thus, sports therapy is a functional technique that helps with physical, psychological, and social problems encountered by individuals with SCI [8].

Sit-skiing is a Paralympic sport that makes skiing possible for people with disabilities. People who practice this sport use a special aid called a sit-ski, which is made of a personalized molded seat attached to a single ski. Evidence has shown how snow sports can positively influence self-esteem, physical potential awareness, balance, and general performance in people with disabilities [4]. Laskowski et al. addressed the topic of skiing and disabilities as early as 1991, pointing out how the sport could be adapted for a

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Published online: 07 February 2020

wide range of pathologies, such as cerebral palsy, multiple sclerosis, SCI, hemiplegia, amputation, blindness, spina bifida, and muscular dystrophy [9]. However, there is a lack of evidence regarding the outcomes of snow sports for people with disabilities, thereby making it difficult for these sports to be recommended by therapists and healthcare professionals. Sit-skiing has become a Paralympic sport; [10–19] however, related literature has focused on the physical aspects of the individuals and the benefits it provides [13–17]. Although aspects such as kinematics [13, 15], fitness [14, 16], biomechanics [17, 18], and positioning [19] in sit-skiing have been addressed, studies including QoL or the level of satisfaction with the sit-ski is limited. We consider it important to identify if there are other benefits from sit-skiing; therefore, our study was performed to explore other aspects of sit-skiing such as satisfaction with the device, QoL, and fear of falling in tetraplegic or paraplegic individuals who used the mono-ski for sit-skiing.

Materials and methods

This observational study aimed to evaluate the QoL, the fear of falling, and the satisfaction of individuals with SCI who used a mono-ski. Any individual with SCI who had used a mono-ski were considered eligible for the study. No limits were set regarding the level of the spinal lesion, sex, or age. No additional exclusion criteria were set. All individuals who volunteered to participate in the survey were informed of procedures and aims of the study and those who agreed were included. All participants had to provide informed consent before they could complete the questionnaires [20, 21]. Personal information was first collected to detect demographics. Then, the measures were self- administered to participants in the form of questionnaires through a single file in a digital form, which was converted with Google. docs. Once the questionnaires were completed, the three analyzed aspects were evaluated through IBM-SPSS version 23.00 with a test for individual samples, with a p value < 0.05 considered as being significant.

Sit-ski

The device is referred to as a mono-ski, if it has a single ski (Fig. 1), or a bi-ski if it has two skis attached [5]. The former is the most utilized by athletes. In this study, all participants used a mono-ski.

Rating scales

The Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST 2.0) [22–24], the World Health Organization Quality of Life (WHOQoL-BREF) [25, 26], and the Spinal Cord Injury Falls Concern Scale (SCI-FCS) [27, 28] were utilized.

Fig. 1 Mono-ski aid.

QUEST 2.0 [22, 23] evaluates the level of satisfaction of the individual with an aid, which can help with posture, mobility, environment, visual and hearing impairment, or the execution of activities of daily living (ADL). QUEST 2.0 is composed of two sections, the first is concerned with the aid, including eight items assessing dimensions, weight, adjustment, safety, durability, ease of use, comfort, and effectiveness. The second section assesses the service through four items. Each item is completed using a five-point satisfaction scale, with 1 indicating "not satisfied at all" and 5 being "very satisfied". Results are divided into three sections: aid, service, and total, enabling comparisons between the subscale and scale. The reliability of the instrument for the Italian population has been reported with a Cronbach's alpha value of 0.740 and an intraclass correlation coefficient (ICC) for test-retest reliability of 0.853 and >0.994 for each domain [23].

The World Health Organization Quality of Life (WHO-QoL-BREF) is a self-administered scale that has 26 items. It measures QoL and enables healthcare professionals to assess pathology through its impact on social relationships, job activities, and economic conditions, as perceived by the

patient. The WHOQoL-BREF [25, 26] maintains one item from each of the 24 sections of the longer WHOQoL-100, while also adding two general items. The scale presents four domains: physical (PHYS), psychological (PSYCH), social relations (SR), and environment (ENV). Every item is completed on a five-point Likert scale that expresses the subject's perception of the 46 aspects of life. Reliability of the instrument for the Italian population has been reported with a Cronbach's alpha value ranging from 0.65 for the SR domain to 0.80 for the PHYS domain. Furthermore, the ICC for the test-retest reliability ranges from 0.76 for the ENV domain to 0.93 for the PSYCH domain [26].

The SCI-FCS [27, 28] is a valid instrument used to evaluate the concern of falling in individuals with SCI. It has 16 items rated from 1 (no concern) to 4 (high concern) on the basis of how concerned each individual is regarding falls in different circumstances. The respondent can also select the heading "incapable of completing the process", which corresponds to a score of 0. All scores are totaled to obtain a single score from 16 to 64, which is directly proportional to the individual's level of concern. The reliability of the instrument for the Italian population has been reported as a Cronbach's alpha of 0.827, an ICC for inter-rater reliability of 0.972, and an intra-rater reliability of 0.973 [28].

Data analysis

Statistical analyses of results obtained through the QUEST 2.0 and WHOQoL-BREF were performed using chi-square tests for individual samples (for each item) and Kolmogorov–Smirnov tests for individual samples (for total scores). All items inherent to the SCI-FCS scale were also examined with Kolmogorov–Smirnov tests for individual samples.

Results

Subjects were recruited between April and September 2018 through two spinal units and two sport associations. Fifteen individuals were accepted to participate in the study and the three questionnaires were completed online. Demographic characteristics of participants are reported in Table 1; before being included in the study, all 15 participants had previously been trained on the device by an occupational therapist or physiotherapist.

Results obtained through the QUEST 2.0 are reported in Table 2. Statistically significant results were found regarding only a few items such as weight ($p = 0.042$), stability and safety ($p = 0.016$), comfort ($p = 0.023$), and professional service ($p = 0.026$). Results obtained from the administration of the WHOQoL-BREF are reported in Table 3. Significant results were found in the physical ($p = 0.000$) and psychological ($p = 0.001$) areas; however, in the areas of social relations and environment the results were not significant ($p = 0.117$ and $p = 0.200$, respectively). Finally, all items inherent to the SCI-FCS scale were examined through Kolmogorov–Smirnov tests for individual samples and were found to be significant, therefore rejecting the hypothesis regarding the concern of falling, as shown in Table 4.

Table 1 Demographic characteristics of mono-ski users.

	Mean ± Standard Deviation	Median
Age	36 ± 13.38	35
Years from injury	13 ± 8.55	11.5
	Frequency	Percentage
Males	11	73
Females	4	27
Lesion level		
C5	1	6.6
C6	3	20
C7	1	6.6
T3	1	6.6
T4	1	6.6
T6	3	20
T10	1	6.6
T12	2	13.3
L1	1	6.6
L3	1	6.6

Discussion

This study had the objectives of studying, for the first time, satisfaction with the sit-ski, the QoL, and the fear of falling in a population of sit-skiers. The QUEST 2.0 results showed that the users seemed to be satisfied with the weight, stability, safety, comfort, and the professional services regarding the aid. These results could be explained by considering the fact that the participant, before being included in the study had previously been trained on the device by an occupational therapist or physiotherapist. This was mainly conducted by occupational therapists or, in their absence, by other rehabilitation professionals. Specific activities, such as transfers in and out of the sit-ski and balance control while progressively decreasing support, could help increase the safety and knowledge regarding the aid. Moreover, the sit-ski is adapted to the user's anthropometric measures and his/her preserved functions, which determine whether the aid will be set in an active or passive mode. Ultimately, skiing is an activity that requires a great deal of effort on the part of the trunk and upper limbs.

Table 2 Kolmogorov–Smirnov test for single samples; QUEST 2.0.

Null hynpothesis	Mean (Standard Deviation)	*p* value
Satisfaction with the weight of assistive device	3.4 (0.9)	0.042
Satisfaction with easiness in adjusting the parts of assistive device	3.7 (1)	0.053
Satisfaction with safety and security of assistive device	3.9 (0.8)	0.016
Satisfaction with durability (endurance. resistance to wear) of assistive device	3.9 (1)	0.053
Satisfaction with easiness in use assistive device	3.9 (0.8)	0.068
Satisfaction with comfortability of assistive device	3.7 (1.2)	0.023
Satisfaction with the quality of the professional services received for using assistive device	4.3 (0.9)	0.026

Table 3 Chi-squared test for single samples; WHOQoL-BREF.

Null hypothesis	Mean (Standard Deviation)	*p* value
How would you rate your quality of life?	3.9 (1)	0.002
How satisfied are you with your health?	3.9 (0.9)	0.000
To what extent do you feel your life to be meaningful?	3.9 (0.7)	0.003
How well are you able to concentrate?	3.7 (0.8)	0.053
How safe do you feel in your daily life?	3.5 (0.9)	0.000
How healthy is your physical environment?	3.9 (1)	0.053
Have you enough money to meet your needs?	3.3 (1)	0.016
How well are you able to get around?	3.8 (1.2)	0.022
How satisfied are you with your sleep?	4.0 (0.8)	0.002
How satisfied are you with your ability to perform your daily living activities?	3.5 (1.1)	0.003
How satisfied are you with your capacity for work?	3.7 (1)	0.000
How satisfied are you with yourself?	3.9 (0.7)	0.000
How satisfied are you with your personal relationships?	4.2 (0.4)	0.035
How satisfied are you with the conditions of your living place?	4.1 (0.8)	0.026
How satisfied are you with your transport?	3.9 (0.5)	0.004
How often do you have negative feelings such as blue mood. despair. anxiety. depression?	2.1 (0.6)	0.022
Physical health domain	107.5 (22.3)	0.000
Psychological domain	86.7 (8.6)	0.001

Indeed, continuous movements to maintain balance through the outriggers and the necessary pushes to complete transfers require a training program that involves many upper limb muscles.

The average QUEST scale result in our study (46 ± 8.27) was compared to other QUEST results in the literature related to other devices and was found to be higher. For example, in a study carried out in Canada by Vincent et al. [29], a convenience sample of 24 long-term manual wheelchair users with SCI resulted in an average score of 39.76. In a Korean study by Hwang et al., a sample of 70 people with traumatic SCI scored an average of 35 [30]. Our results compared to these studies would indicate that the mono-ski users we interviewed had greater satisfaction with the device compared to the users interviewed in other studies. However, in interpreting this result, it should be considered that our population followed specific training.

The statistical analysis regarding the WHOQoL-BREF resulted in significant values in the PHYS and PSYCH domains, but not in the SR or ENV domains. These results may be explained by the importance sports has for people with SCI, given it has been found to increase physical qualities, strengthen preserved functions, and provide feelings of security and self-esteem. The non-significant values for the SR domain may be explained by the fact that the subjects were not generally satisfied with their sex lives, which is one of the three items that make up the SR domain. Since architectural barriers would still represent problems in the subjects' lives, this could explain the results regarding the ENV domain. The average results from the WHOQoL-BREF in each domain (PHYS: 107.47 ± 22.3; PSYCH:

Table 4 Kolmogorov–Smirnov test for single samples; SCI-FCS.

Null hypothesis	Mean (Standard Deviation)	*p* value
Getting dressed or undressed	0.9 (0.5)	0.000
Moving around the bed	1.0 (0.4)	0.000
Inserting enema or toileting	0.9 (0.6)	0.000
Washing or showering self	1.1 (0.5)	0.000
Transferring on/off a commode or toilet	0.9 (0.4)	0.000
Transferring in/out of bed	1.1 (0.6)	0.000
Transferring in/out of a car	0.9 (0.5)	0.000
Reaching for high objects	1.1 (0.5)	0.000
Picking objects up from the floor	0.9 (0.3)	0.000
Cooking or food preparation	1.1 (0.7)	0.000
Pushing wheelchair on flat ground	1.0 (0.4)	0.000
Pushing wheelchair on an uneven surface	1.5 (0.9)	0.001
Pushing wheelchair up/down gutters or curbs	1.9 (1.2)	0.017
Pushing wheelchair up/down a slope	1.6 (1.1)	0.000
Shopping	1.1 (0.5)	0.000
Lifting heavy objects across body	1.1 (0.59)	0.000
Total	18.2 (6.1)	0.001

86.7 ± 8.6; SR: 46.4 ± 6.2; ENV: 116.27 ± 13.5) were compared to values in the literature, including studies by Burke [31], who examined neuropathic pain in people with SCI and De la Barrere [32], who examined 54 people in Spain with SCI (64.35; 71.10; 69.11; 69.76, respectively). After correlating the averages, it can be stated that all values are higher in this study except for the SR domain. It is possible that this finding may be related to a positive impact that the sit-ski has on the physical and psychological sphere of QoL in people with SCI.

Finally, results obtained through the SCI-FCS show that falling did not seem to be a concern of our participants. This could be explained by the fact that the participants were already highly independent when they started sit-skiing, a sport that requires a high level and range of physical capabilities [14]. Also, in this case, the average result (25.53 ± 16.7) was compared to another study that used the SCI-FCS. The correlation showed higher results obtained by the current population compared to the average results in larger samples that included people with acute SCI in England (23.0) [33], Norway (22.0) [34], Italy (18.7) [28, 33], and Sweden (21.0). We postulate the high levels of satisfaction with the aid and low levels regarding the concern of falling are because the included individuals had undergone measurement and training prior to the use of the device and study participation. Prior to use a mono-ski, to find the perfect aid and fit, it is necessary to gather some of the athlete's measurements and data. These figures include the pelvis width, the height from the seat to the shoulders, the length from the backrest to the popliteal fossa, the length from the foot sole to the popliteal fossa, the length from the elbow to the wrist, the weight and height, the lesion type and the functional level, and other pathology-related problems [5, 35]. Training for the use of the aid was based on a daily repetition of exercises, a gradually increasing difficulty level, and following specific personalized programs. The choice and personalization of the aid as well as a specific training program are therefore vital in the personalization of the aid to the user's characteristics and features, resulting in improved safety and independence in transfers and movements with the sit-ski.

This study was an observational study with the aim of describing the psychosocial conditions of people with SCI who use sit-skis. In comparing this study with others in the literature, it must be considered that the populations of the various studies were not comparable, neither for the number of people included nor for the characteristics of the sample. Therefore, the results must be interpreted as pilot data that identifies sit-skiing as a possible variable that affects a better QoL, satisfaction of help, and less fear of falling.

Limits of the study

Some limits of this study include the choice of a convenience sample of volunteers and the small sample size. This may be the result of the fact that skiing, and sit-skiing in particular, is a very expensive sport due to the cost of the aid, access to the slopes, and accommodations. Moreover, snow sports require specific weather conditions, making the sport restricted to a few locations that support skiing. Furthermore, this study did not have a control group; there was no pre post testing and finally, since the participants attended the training independently before being included in this study; and detailed information were not gathered, losing important variables about how much training was done and what the frequency was, as well as information about different trainers. Another limit was in the digital administration—even though its advantages consist of better directness and faster feedback, it can cause misunderstandings of some items, possibly leading to answers that do not fully reflect the subject's situation. Thus, it would be advisable to increase the number of participants and provide supervision during the administration of the questionnaires to provide assistance and verify the accuracy of the answers.

Conclusions

Various studies have demonstrated how sit-skiing has certain effects on kinematics, biomechanics, comfort, and sitting position. This study highlighted that sit-skiing may be

correlated with high levels of satisfaction with the monoski, QoL, and low levels of fear of falling. It is important to raise public awareness by stressing the importance of sports therapy. It must also be noted that the quantity of evidence in the field of sit-skiing, especially regarding the QoL aspect, is very limited, which makes further studies necessary in the near future. In adding these findings to the existent literature, it can be stated with more certainty that sit-skiing is a sport that can be recommended in rehabilitation and sports therapy programs.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Compliance with ethical standards

Ethical approval We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during the course of this research. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent Informed consent was obtained from all participants for being included in the study.

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References

1. Tweedy SM, Beckman EM, Geraghty TJ, Theisen D, Perret C, Harvey LA. Exercise and sports science Australia (ESSA) position statement on exercise and spinal cord injury. J Sci Med Sport. 2017;20:108–15.
2. Tasiemski T, Kennedy P, Gardner BP, Taylor N. The association of sports and physical recreation with life satisfaction in a community sample of people with spinal cord injuries. NeuroRehabilitation 2005;20:253–65.
3. Sale P, Mazzarella F, Pagliacci MC, Aito S, Agosti M, Franceschini M. Sport, free time and hobbies in people with spinal cord injury. Spinal Cord. 2012;50:452–6.
4. Anneken V, Hanssen-Doose A, Hirschfeld S, Scheuer T, Thietje R. Influence of physical exercise on quality of life in individuals with spinal cord injury. Spinal Cord. 2010;48:393–9.
5. McVeigh SA, Hitzig SL, Craven BC. Influence of sport participation on community integration and quality of life: a comparison between sport participants and non-sport participants with spinal cord injury. J Spinal Cord Med. 2009;32:115–24.
6. Petrofsky J, Meyer J, Magsino R, Zook S, Kao JK, Magsino R, et al. Biomechanics in physically disabled monoskiers versus conventional downhill skiers and snowboarders. J Appl Res. 2003;3:124–36.
7. Blauwet C, Sudhakar S, Doherty AL, Garshick E, Zafonte R, Morse LR. Participation in organized sports is positively associated with employment in adults with spinal cord injury. Am J Phys Med Rehabil. 2013;92:393–401.
8. Scivoletto G, Di Lucente L, Fuoco U, Di Donna V, Laurenza L, Macellari V. Riabilitazione e valutazione dei pazienti mielolesi: l'esperienza della Fondazione S. Lucia di Roma. Rapporti ISTISAN 08/39 Istituto Superiore di Sanità. 2008:2:61–5.
9. Laskowski ER. Snow skiing for the physically disabled. Mayo Clin Proc. 1991;66:160–72.
10. Nasuti G, Temple VA. The risks and benefits of snow sports for people with disabilities: a review of the literature. Int J Rehabil Res. 2010;33:193–8.
11. Burkett B. Paralympic sports medicine-current evidence in winter sport: considerations in the development of equipment standards for paralympic athletes. Clin J Sport Med. 2012;22:46–50.
12. Gastaldi L, Pastorelli S, Frassinelli S. A biomechanical approach to paralympic cross-country sit-ski racing. Clin J Sport Med. 2012;22:58–64.
13. Bhambhani Y, Forbes S, Forbes J, Craven B, Matsuura C, Rodgers C. Physiologic responses of competitive canadian cross-country skiers with disabilities. Clin J Sport Med. 2012;22:31–8.
14. Thompson WR. The paralympic winter athlete. Clin J Sport Med. 2012;22:1–2.
15. Cavacece M, Smarrini F, Valentini PP, Vita L. Kinematic and dynamic analysis of a sit-ski to improve vibrational comfort. Sport Eng. 2005;8:13–25.
16. Bernardi M, Carucci S, Faiola F, Egidi F, Marini C, Castellano V, et al. Physical fitness evaluation of paralympic winter sports sitting athletes. Clin J Sport Med. 2012;22:26–30.
17. Rosso V, Gastaldi L, Rapp W, Lindinger S, Vanlandewijck Y, Linnamo V. Biomechanics of simulated versus natural cross-country sit skiing. J Electromyogr Kinesiol. 2017;22:31–8.
18. Morriën F, Taylor MJD, Hettinga FJ. Biomechanics in paralympics: implications for performance. Int J Sports Physiol Perform. 2017;12:578–89.
19. Lund Ohlsson M, Laaksonen MS. Sitting position affects performance in cross-country sit-skiing. Eur J Appl Physiol. 2017;117:2123–4.
20. Galeoto G, De Santis R, Marcolini A, Cinelli A, Cecchi R. The informed consent in occupational therapy: proposal of forms. G Ital Med Lav Erg. 2016;38:107–15.
21. Galeoto G, Mollica R, Astorino O, Cecchi R. Il consenso informato in fisioterapia: proposta di una modulistica. G Ital Med Lav Erg. 2015;37:245–54.
22. Demers L, Monette M, Lapierre Y, Arnold DL, Wolfson C. Reliability, validity, and applicability of the Quebec user evaluation of satisfaction with assistive technology (QUEST 2.0) for adults with multiple sclerosis. Disabil Rehabil. 2002;24:21–30.
23. Galeoto G, Colucci M, Guarino D, Esposito G, Cosma E, De Santis R, et al. Exploring validity, reliability, and factor analysis of the Quebec user evaluation of satisfaction with assistive technology in an Italian population: a cross-sectional study. Occup Ther Health Care. 2018;32:380–92.
24. Colucci M, Tofani M, Trioschi D, Guarino D, Berardi A, Galeoto G. Reliability and validity of the Italian version of Quebec user evaluation of satisfaction with assistive technology 2.0 (QUEST-IT 2.0) with users of mobility assistive device. Disabil Rehabil Assist Technol. 2019;25:1–4. https://doi.org/10.1080/17483107.2019.1668975
25. Harper A, Power M, Orley J, Herrman H, Schofield H, Murphy B, et al. Development of the World Health Organization WHOQOL-BREF Quality of Life Assessment. Psychol Med. 1998;28:551–8.

26. De Girolamo G, Rucci P, Scocco P, Becchi A, Coppa F, D'Addario A. et al. Quality of life assessment: validation of the Italian version of the WHOQOL-Brief. Epidemiol Psichiatr Soc. 2000;9:45–55.
27. Boswell-Ruys CL, Harvey LA, Delbaere K, Lord SR. A Falls Concern Scale for people with spinal cord injury (SCI-FCS). Spinal Cord. 2010;48:704–9.
28. Marquez MA, De Santis R, Ammendola V, Antonacci M, Santilli V, Berardi A, et al. Cross-cultural adaptation and validation of the "spinal Cord Injury-Falls Concern Scale" in the Italian population. Spinal Cord. 2018;56:712–8.
29. Vincent C, Gagnon DH, Dumont F. Pain, fatigue, function and participation among long-term manual wheelchair users partnered with a mobility service dog. Disabil Rehabil Assist Technol. 2017;14:99–108.
30. Hwang WJ, Hwang S, Chung Y. Test-retest reliability of the Quebec user evaluation of satisfaction with assistive technology 2.0-Korean version for individuals with spinal cord injury. J Phys Ther Sci. 2015;27:1291–3.
31. Burke D, Fullen BM, Stokes D, Lennon O. Neuropathic pain prevalence following spinal cord injury: a systematic review and meta-analysis. Eur J Pain. 2017;21:29–44.
32. Salvador-De La Barrera S, Mora-Boga R, Ferreiro-Velasco ME, Seoane-Pillado T, Montoto-Marqués A, Rodríguez-Sotillo A, et al. A validity study of the Spanish—World Health Organization Quality of Life short version instrument in persons with traumatic spinal cord injury. Spinal Cord. 2018;56:971–9.
33. Butler Forslund E, Roaldsen KS, Hultling C, Wahman K, Franzén E. Concerns about falling in wheelchair users with spinal cord injury-validation of the Swedish version of the spinal cord injury falls concern scale. Spinal Cord. 2016;54:115–9.
34. Roaldsen KS, Måøy ÅB, Jørgensen V, Stanghelle JK. Test-retest reliability at the item level and total score level of the Norwegian version of the Spinal Cord Injury Falls Concern Scale (SCI-FCS). J Spinal Cord Med. 2016;39:317–26.
35. Langelier E, Martel S, Millot A, Lessard JL, Smeesters C, Rancourt D. A sit-ski design aimed at controlling centre of mass and inertia. J Sports Sci. 2013;3:1064–73.