Cadernos Brasileiros de Terapia Ocupacional
Brazilian Journal of Occupational Therapy

ISSN 2526-8910

**Review Article**

# Training of the manual wheelchair skill: an integrating literature review

## *Treinamento de habilidades com cadeiras de rodas manuais: uma revisão integrativa da literatura*

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**How to cite:** Caro, C. C., & Cruz, D. M. C. (2020). Training of the manual wheelchair skill: an integrating literature review. *Cadernos Brasileiros de Terapia Ocupacional*, *28*(2), 661-681. https://doi.org/10.4322/2526-8910.ctoAR1863

**Abstract**

Wheelchairs skills training is fundamental in the rehabilitation of disabled people and is considered an essential step in wheelchair prescription/dispensing services. The objective of this study was: (1) to map the interventions for manual wheelchairs skills training available in the literature of the last 10 years (2008-2018); and (2) identify the best levels of scientific evidence on this practice. This was an integrative review of the literature in the Virtual Electronic Library Online (SciELO) and in the Biblioteca Virtual em Saúde (BVS), Literatura Latino-Americana e do Caribe de Ciências da Saúde (LILACS), and PubMed / MEDLINE, with articles in English, Spanish and Portuguese between 2006 and 2018. We found seven randomized controlled trials, all available in the English language and most of Canadian affiliation. The protocol of the *Wheelchair Skills Training Program* - WSTP presented the largest number of studies (n=4) with proven efficacy and confidence in wheelchair skills and attainment of training goals. This protocol has also proved to be effective in individual and group approaches, in contexts of specialized rehabilitation and community services, with a diversified public and a variable training time between two and 24 hours. It is concluded that WSTP has been shown to be a strategy with high levels of evidence on wheelchair skills training, and further research is needed to evaluate the effectiveness of this practice in aspects not yet investigated.

**Keywords:** Motor Skills, Wheelchairs, Rehabilitation, Occupational Therapy.

***Resumo***

O treinamento de habilidades com cadeiras de rodas é um aspecto fundamental na reabilitação de sujeitos com deficiência, sendo considerado um passo imprescindível nos serviços de prescrição/dispensação de cadeiras de rodas. Este estudo teve por objetivos: (1) realizar o mapeamento das intervenções voltadas ao

Received on Dec. 29, 2018; Accepted on: Apr. 4, 2019.

treinamento de habilidades com cadeiras de rodas manuais disponíveis na literatura dos últimos 10 anos (2008-2018); e (2) identificar os melhores níveis de evidências científicas sobre essa prática. Tratou-se de uma revisão integrativa da literatura realizada na biblioteca virtual Scientific Eletronic Library Online (SciELO) e nas bases de dados Literatura Latino-Americana e do Caribe de Ciências da Saúde (LILACS) e PubMed/MEDLINE, com artigos nas línguas inglesa, espanhola e portuguesa, entre os anos de 2008 e 2018. Foram encontrados sete ensaios clínicos controlados randomizados, todos disponíveis na língua inglesa e a maioria de afiliação canadense. O protocolo do *Wheelchair Skills Training Program* – WSTP foi o que apresentou o maior número de estudos (n=5), com eficácia comprovada quanto ao desempenho e confiança em habilidades com cadeiras de rodas e alcance de metas de treinamento. Este protocolo também se mostrou eficaz em abordagens individuais e grupais, em contextos de serviços especializados de reabilitação e na comunidade, com público diversificado e tempo de treinamento variável entre duas e 24 horas. Conclui-se que o WSTP demonstrou ser uma estratégia com altos níveis de evidências sobre o treinamento de habilidades com cadeiras de rodas, sendo necessárias novas investigações para avaliar a eficácia dessa prática em aspectos ainda não investigados.

**Palavras-chave:** Habilidade Motora, Cadeira de Rodas, Reabilitação, Terapia Ocupacional.

## 1 Introduction

Functional mobility, according to the American Occupational Therapy Association (2014), consists of the individual's ability to move or change positions when performing everyday activities, such as moving in the wheelchair and the bed and make transfers, including performance in functional ambulation and the transport of objects. For the World Health Organization (Organização Mundial da Saúde, 2008), mobility is an essential condition for the individuals' participation in various areas of social life.

Several conditions can compromise mobility, including deficiencies, diseases, aging, etc. Evidence points to the impacts of restriction on mobility on the individuals' lives from the point of view of physical limitation and in relation to other aspects of life. A close relationship with feelings of isolation, stress and low self-esteem (Simpson et al., 2008) is also reported. Therefore, reducing participation and decreasing social connection may bring reflections in everyday life by (Finlayson & Van Denend, 2003).

People with disabilities or reduced mobility often require auxiliary equipment for functional mobility. They can also be called assistive technology resources and are defined as "[…] any item, piece of equipment, production system acquired commercially, modified or custom-made, which is used to increase, maintain, or return the functional capacity of individuals with disabilities" (Cook & Polgar, 2002, p. 5). According to the Convention on the Rights of Persons with Disabilities approved by the United Nations General Assembly in 2006, it is the duty of the State to adopt

effective measures to ensure the mobility of persons with disabilities in order to promote the greatest independence (Brasil, 2013).

Among the assistive technology resources are wheelchairs, which, for many individuals, consist of the best way to ensure mobility (Organização Mundial da Saúde, 2008). In addition to mobility contributions, wheelchairs also contribute to maximize the individuals' function through stability, alignment and comfort when sitting (Waugh, 1999; Hoenig et al., 2003; Rousseau-Harrison et al., 2009). Hand wheelchairs are propelled by the user on their own or pushed by another person, and it is the type most commonly used, even in highly developed countries, since they are cheaper than the others (Organização Mundial da Saúde, 2008).

For WHO, the manual wheelchair is a means for people with disabilities to exercise their human rights and achieve inclusion and equal participation, as well as a resource that contribute to health and quality of life and provides a full and active life in the community (Organização Mundial da Saúde, 2008). Evidence also highlights the relevance of the manual wheelchair in promoting the independence and social participation of the individuals (Hoenig et al., 2003; Rousseau-Harrison et al., 2009).

However, the acquisition of this resource alone does not guarantee independence or satisfactory performance in functional activities (Giesbrecht et al., 2013), since the ineffective use of a wheelchair may compromise independence and even lead the individual to perceive the resource as a barrier to perform activities (Chaves et al., 2004; Barker et al., 2006). The lack of specific training can also generate an aggravation of physical conditions and worsen autonomy and independence (Franchi et al., 2017) or even the resource abandonment (Costa et al., 2015). Therefore, for an effective use of this resource, the user needs to have a variety of skills (Kilkens et al., 2003).

Wheelchairs skills training has great relevance in the rehabilitation process of disabled people, aspects that can be modified to provide greater social participation (Smith et al., 2016). According to the WHO, training aims to allow users the greatest possible benefit with their wheelchairs, thus expecting that the resource dispensation service offers training to users and caregivers on how to maintain it and use it effectively (Organização Mundial da Saúde, 2008). The main training areas of skills are: transferring from the wheelchair; handling the wheelchair; basic notions of wheelchair mobility; preserving health in a wheelchair; taking good care of the chair and cushion; folding and unfolding the wheelchair (Organização Mundial da Saúde, 2008).

This practice is recommended by the WHO, according to Guidelines on the provision of manual wheelchairs in less-resourced settings, which suggests the training of basic skills, such as transfers and propulsion of the chair, and also of other more complex, such as wheel up and down ramps, climb guides and do wheeling (Organização Mundial da Saúde, 2008). WHO also suggests that training is carried out by an instructor who is a health professional or technician or even an experienced user with advanced knowledge on how to train and help other users, under the supervision of a health professional. Those responsible should train the user and their caregivers individually or in groups in the main training areas. It is also suggested to address the necessary skills in order of priority

with the user and delete each item after taught and repeated by the user (Organização Mundial da Saúde, 2008).

Considering the relevance of wheelchairs skills training, investigations are needed on the scientific evidence of protocols aimed at this type of practice, since the level of confidence in clinical decisions should be based, in part, on the strength of the evidence used (Holm, 2000). In this context, we highlight the role of Evidence-Based Practice (EBP), defined as the conscious, explicit and judicious use of the best and most current evidence of research in clinical decision-making on patient care (Bennett & Bennett, 2000). It recommends a clear description of each intervention, including the frequency and duration, giving indications of how they can be implemented to produce similar results in a specific population of individuals (Holm, 2000). It also presents hierarchies and classification systems of studies, in order to assist the selection of the best evidence available to guide decisions about what and how to do with a particular individual or group (Holm, 2000).

This study presents the following research question: what are the studies on manual wheelchairs skills training published in the last 10 years (2008-2018)? And, which of them have higher levels of evidence? The study aimed to perform the mapping of interventions aimed at manual wheelchairs skills training available in the literature in the last 10 years (2008-2018). Another objective was to identify which of these studies have higher levels of scientific evidence.

## 2 Metodology

This study is an integrative review of the literature, which is commonly used in the context of EBP. The method allows synthesizing multiple studies in a systematic and orderly way, enabling general conclusions about the field of study and it is a support for decision-making and improvement of the clinical practice. It also allows the recognition of knowledge gaps to be filled by new studies, making research results more accessible and allowing the reader access to several research in a single study, synthetically (Mendes et al., 2008).

The integrative review allows a broad analysis of the literature based on discussions about methods and results of research and reflections that follows some steps. (1) Selection of the theme, question and guiding hypothesis of the research; (2) Establishments of inclusion and exclusion criteria for studies or search in the literature; (3) Definition of the information to be extracted from the selected studies/categorization of the studies; (4) Evaluation of the studies included in the integrative review; (5) Interpretation of the results; and (6) Presentation of the review/synthesis of knowledge (Mendes et al., 2008).

To carry out the study, we used the descriptors “Motor skills”, “Rehabilitation” and “Wheelchairs” and the Boolean AND/E operators were used in the following databases: Scientific Electronic Library Online (SciELO), *Literatura Latino-Americana e do Caribe de Ciências da Saúde* (LILACS) and PubMed/MEDLINE. The criteria for inclusion of articles in this study were: national and international studies in Portuguese, Spanish and English; studies for the last 10 years (2008-2018); original studies of interventions aimed at training skills with manual wheelchairs; and full-text studies available for reading. We excluded articles with the following characteristics: studies outside the period

determined for the study; literature review studies or meta-analyses; articles that were not fully available for reading; non-intervention studies or intervention studies other than manual wheelchairs skills training; articles with interventions directed to physical conditioning or sports activities; and articles with intervention focused on training a single skill with wheelchairs, for example, transfers only.

In the initial search with the descriptors and Boolean operators mentioned, 172 articles were found in MEDLINE, two in LILACS and zero in SciELO. Afterwards, the inclusion and exclusion criteria proposed for this study were applied. We excluded 165 Articles of PubMed/MEDLINE and two articles of LILACS because they did not meet the inclusion criteria of this study, since they did not relate to training skills with wheelchairs or were outside the period determined for the study or were directed to physical activity training/sports training or training of a single skill. Thus, only seven articles from PubMed/MEDLINE were selected.

Subsequently, these articles were read in full for data collection. This procedure sought to identify: (1) general data from the articles: name of the study, authors, journal, year of publication, languages in which the study is available; (2) structure of the articles: type of study, participants, places where the study was carried out, interventions for wheelchair skills training and for the control group; (3) content of the articles: objective of the study, main inclusion criteria of participants, procedures for selection and allocation in groups, protocol of wheelchairs skills training, main measure of results and limitations of the study.

Finally, we sought to identify the level of evidence of each study, according to the hierarchies proposed by EBP: level I - systematic review of multiple randomized controlled clinical trials; Level II - randomized controlled clinical trial; Level III - clinical trials without randomization, cohort study, time series, control case studies; Level IV – non-experimental studies of more than one study center or group; and Level V – opinions of respected authorities based on clinical evidence, descriptive studies or expert committee reports (Holm, 2000).

After data collection, the results were organized in the database and, later, the analysis of the results found was performed.

## 3 Results

Seven studies of interventions aimed at training skills with manual wheelchairs, carried out in the last 10 years, were identified. All of them were published in scientific journals in the area of rehabilitation, especially the Archives of Physical Medicine and Rehabilitation (n=4). All studies available are from the current decade, with the highest number in 2016 (n=2). The language of all the studies was English (n=7), with a prevalence of those coming from North American countries (n=5) (Canada and the United States) (Table 1).

**Table 1.** General data of articles.

| STUDY | TITLE | AUTHORS/YEAR | JOURNAL | LANGUAGE | AFILLIATION |
|---|---|---|---|---|---|
| 1 | Wheelchair Skills Training for Functional Activity in Adults with Cervical Spinal Cord Injury | Yeo & Kwon (2018) | International Journal of Sports Medicine | English | South Korea |
| 2 | Pilot Study of a Peer-Led Wheelchair Training Program to Improve Self-Efficacy Using a Manual Wheelchair: A Randomized Controlled Trial | Best et al. (2016) | Archives of Physical Medicine and Rehabilitation | English | United States |
| 3 | Effectiveness of Group Wheelchair Skills Training for People With Spinal Cord Injury: A Randomized Controlled Trial | Worobey et al. (2016) | Archives of Physical Medicine and Rehabilitation | English | Canada |
| 4 | Immediate video feedback on ramp, wheelie, and curb wheelchair skill training for persons with spinal cord injury | Wang et al. (2015) | Journal of Rehabilitation Research & Development | English | United States |
| 5 | Wheelchair skills training to improve confidence with using a manual wheelchair among older adults: a pilot study | Sakakibara et al. (2013) | Archives of Physical Medicine and Rehabilitation | English | Canada |
| 6 | Efficacy and retention of the French-Canadian version of the wheelchair skills training program for manual wheelchair users: a randomized controlled trial | Routhier et al. (2012) | Archives of Physical Medicine and Rehabilitation | English | Canada |
| 7 | Effectiveness of a wheelchair skills training programme for community-living users of manual wheelchairs in Turkey: a randomized controlled trial | Oztürk & Ucsular (2011) | Clinical Rehabilitation | English | Turkey |

It was observed that all studies were controlled and randomized clinical trials (n=7), so the classification of the studies' evidence was exclusively level II. The places of the studies were, in the majority, rehabilitation centers or hospitals (n=6). Most studies presented samples composed of manual wheelchair users (n=6); three (n=3) composed exclusively of subjects with spinal cord lesions. The intervention focused on training skills with wheelchairs most used was the Wheelchair Skills Training Program (WSTP) (n=5); while most control groups did not receive any training (n=4) (Table 2).

**Table 2.** Structuring of articles – 2008 to 2018.

| STUDY | TYPE OF STUDY | LEVEL OF EVIDENCE | PLACE | PARTICIPANTS | MAIN INTERVENTION | CONTROL INTERVENTIONS |
|---|---|---|---|---|---|---|
| 1 | Randomized controlled clinical trial | Level II | Rehabilitation center | Manual wheelchair users with spinal cord injury | Wheelchair Skills Training Program | Conventional exercise session |
| 2 | Randomized controlled pilot clinical trial | Level II | Rehabilitation center and community | Manual wheelchair users living in the community | WheelSee in Peer-Led format | None |
| 3 | Double blind randomized controlled clinical trial | Level II | Model centers for individuals with spinal cord injury | Manual wheelchair users with spinal cord injury | Wheelchair Skills Training Program | None |
| 4 | Randomized controlled clinical trial | Level II | Rehabilitation center | Manual wheelchair users with recent spinal cord injury | Immediate video feedback | Conventional training |
| 5 | Simple-blind randomized controlled clinical pilot trial | Level II | Research laboratory in a rehabilitation hospital | Community seniors with no experience in the use of manual wheelchairs | Wheelchair Skills Training Program | None |
| 6 | Simple-blind multicenter randomized controlled clinical trial | Level II | Rehabilitation center | Manual wheelchair users | Wheelchair Skills Training Program | Conventional treatment |
| 7 | Randomized controlled clinical trial | Level II | Community | Users of manual wheelchairs in daily life | Wheelchair Skills Training Program | None |

The most recent study using WSTP was that of Yeo & Kwon (2018), which aimed to verify the effectiveness of wheelchair skill training in the performance of these skills and in the performance of superior limb skills in adults with cervical spinal cord lesions. The participants (n=24) were randomized and allocated into two groups: training (n=13), which received training sessions of wheelchair skills; and control (n=11), which received conventional exercise sessions for the upper limbs. Both groups training lasted 8 weeks with a frequency of three times a week and 1 hour per session, including heating, training program for each of the groups and deheating, all supervised by physiotherapists. The participants were evaluated with the Wheelchair Skills Test (WST) and the Van Lieshout Test (VLT), and the tests were performed in the pre and post-training (after 4 and 8 weeks). The results reveal that the group that received training showed significantly higher scores in the performance of wheelchair skills in the 4- and 8-week post-training; unlike the control group, which did not present significantly different scores after the training sessions. No significant differences were observed on the scores of upper limb skills between the groups, although in both groups,

the performance of upper limb skills was increased between the beginning and the eighth week of training. However, the scores were not significant between the beginning and the fourth week, as well as between the fourth and eighth week. Thus, the study concluded that training skills with wheelchairs is more beneficial than conventional exercises in individuals with spinal cord injury. The authors point out several limitations of the study, such as the restricted sample size and the fact that it is not representative of the entire population with spinal cord injury. Another observation is the fact that the study did not include subjects with complete lesions, since for subjects with this type of injury it can be difficult to perform the training program. They also pointed out factors that were not controlled in the current study, such as residual functional motor control of the hand, blood pressure, heartbeat and previous experience with the wheelchair, which could affect individual skills with the wheelchair. Finally, another limitation could be the fact that the study used standardized chairs, so it was not possible for participants to perform training with their own wheelchair (Yeo & Kwon, 2018).

The second study that used WSTP was of Worobey et al. (2016) that aimed to evaluate the effectiveness of training in a group approach in the manual wheelchair skills of participants with spinal cord injury. The study was conducted in four model centers for individuals with spinal cord injury, and two training rounds were performed in each place, with 12 to 20 participants each. The participants were randomized into two groups: WSTP training and control, with six to 10 participants in each. The training group was submitted to six 90-minute group classes each; while the control group received two one-hour control sessions. The following documents were used: the Wheelchair Skills Test – Questionnaire Version 4.2 (WST-Q) for capacity and performance and the Goal Attainment Scale (GAS) for the design of the individual skills that participants wanted to improve. The results showed that the training group with WSTP showed improvements in the performance of advanced skills with wheel chairs, as well as facilitated the achievement of individually established goals in 65.6%. In addition, the results revealed that participants with the worst scores in the instruments at the beginning of the study and those with higher training frequency had higher gains after WSTP. The study presented as limitations the fact that 30% of the sample did not complete the follow-up, thus, the authors consider that this reality may have introduced bias to the study. It was also possible to observe limitations related to variability in the number of sessions in which the participants were present and the short follow-up period of the study. There was also variability of time between the first evaluation and the beginning of the intervention, which may have an impact on the retention of skills. Another limitation was the fact that the psychometric properties of the WST-Q subscores were not established, as well as the need to adapt the intervention due to mixed groups and the different individual goals of the participants (Worobey et al., 2016).

The third study with WSTP was that of Sakakibara et al. (2013), whose objective was to investigate the effects of wheelchairs skills training on inexperienced elderly people confidence in the use of these resources. The study was conducted in a research laboratory of a rehabilitation hospital and featured 20 elderly participants living in the community, with no experience with the use of a manual wheelchair, simulating a new user. The subjects were randomized and allocated in the intervention group (n=10) or in the control group (n=10). The first group received two one-hour sessions each, using

the WSTP protocol according to the Wheelchair Skills Test (WST) sequence, that is, from the easiest skills for the most difficult. As soon as participants were able to complete a skill successfully and safely, or when there was no sign of frustration, subsequent skill training began, and so on until the end of the session. The control group received a single phone contact to remind participants about the study and its purpose, to schedule a post-intervention interview for data collection, as well as to verify their interest to attend a WSTP training session after the study completion. The main result measure used was the Wheelchair Use Confidence Scale-Manual (WheelCon-M) to assess confidence in the use of the manual wheelchair. The results showed that two 1-hour WSTP training sessions can be effective in improving confidence in the use of a manual wheelchair among inexperienced elderly people in the use of this resource. Major effects were observed in areas related to maneuvers around the physical environment, knowledge and problem solving, support and management of emotions related to the performance of activities and behavior in social situations. There was an improvement of 14.4% in wheelchair skills in the group that received the intervention. On the other hand, one study's limitation was the fact that the participants do not use wheelchairs, since the effects of training on confidence in the case these resources are really need, can be underestimated. Another limitation observed was the use of two different types of wheelchairs, which can result in training experiences different to a control group participant. Another limiting factor was the different number of individuals with postsecondary education, which may have influenced the differences in confidence between the groups. Finally, the time proposed for WSTP was at the lower limit than recommended to observe skills improvements, and may not reflect the overall improvement in participants' confidence due to lack of time for complete mastery of some skills (Sakakibara et al., 2013).

The fourth study that used WSTP was that of Routhier et al. (2012), which aimed to test the hypothesis that compared to a control group that received standard treatment, manual wheelchair users submitted to the French-Canadian version of WSTP would have a significant increase in their ability with wheelchairs, and that these improvements would be retained in three months. The study was carried out in three rehabilitation centers, and the convenience sample consisted of 39 adult participants who used a manual wheelchair daily and who were in therapy at the recruitment sites. The participants were randomized and allocated in the WSTP group or control group, both receiving a standardized treatment. Participants in the WSTP group also received about 5.9 training sessions, with a total average duration of five hours and 36 minutes. The sample was submitted to the Canadian French version of WST Version 3.2, administered for baseline evaluation, post-training – on average 47 days after the initial evaluation, and in a third period – on average 101 days after the second evaluation. The results showed that wheelchair skills had a relative increase of 18% in the group that received WSTP intervention, especially in community-level skills. In relation to the results retention, no statistically significant differences were observed between the groups (<0.5%) after 3 months. The study presents as limitation the fact that the sample is small and the dropout rate was high, especially in the control group, compromising definitive conclusions on the retention of long-term gains. Other limitations were the impossibility of blinding the participants of the WSTP group in relation to the training they received, with possible influence on the scores of the control group; variations

between recruitment sites in relation to participant characteristics and standard therapy received; and the absence of placebo intervention, which may justify the improvement of the group that received WSTP treatment because it received 5 to 6 extra hours of training compared to the control group (Routhier et al., 2012).

The fifth study that used WSTP was that of Oztürk & Ucsular (2011). This study aimed to test the hypothesis that compared to the control group, wheelchair users living in the community in Turkey who completed WSTP had a better overall score on WST performance and safety. This study was conducted in the community, with 24 participants who use the wheelchair in daily life. The participants were randomized into two groups, training group (n=14) and control group (n=10), the first submitted to three training sessions per week, with 45 minutes each, for four weeks; while the second did not receive any intervention. In each training session, the participants spent 5-10 minutes practicing the skills that had learned previously, the following 30-35 minutes they practiced new skills and in the final 10 minutes, they performed deheating activities. The data collection instrument used was WST (version 4.1) to assess performance and safety in wheelchair skills. The results revealed that the total average percentage score of performance in wheelchair skills increased significantly in both groups, but more expressively in the training group (19%). There was a significant increase in the total average percentage score of safety in the training group (23.4%), while no significant change was observed in the control group. The study presented as limitations the reduced number of the sample and the high dropout rate of the participants due to transport difficulties. Other limiting factors were the fact that the same physiotherapist performed the training and evaluations; and the participants used wheelchairs other than those they were used to (Oztürk & Ucsular, 2011).

The study that used WheelSee in Peer-Led format to train wheelchair skills was that of Best et al. (2016). This study aimed to evaluate the effect of training on the self-efficacy of manual wheelchair users living in the community, as well as exploring the influences of this intervention on manual wheelchair skills, on the mobility in the living space and participation satisfaction. The study was conducted in a rehabilitation center and in the community with a sample of 28 participants who were randomized into 2 groups: one who received training; and a control group that did not receive any kind of intervention. The intervention was co-administered by a coach with 15 years of experience as a manual wheelchair user and a support coach with more than 10 years of experience in training skills with such a resource. The goal setting was made based on the WSTP guide. The experimental group (n=16) received five sessions of one and a half hour each, of the WheelSee Program to increase self-efficacy. Wheelchair Use Confidence Scale Version 3.0 (WheelCon) was used as measures to assess self-efficacy; WST-Q Version 4.1 for skills capacity and performance; the Life Space Assessment (LSA) for mobility in the living space; and Wheelchair Outcome Measure (WOM) for participation satisfaction, all of which were applied in the pre and post-intervention. The results showed that the WheelSee program of wheelchair skills training in Peer-Led format promoted a significant increase in manual wheelchair users' self-efficacy, as well as significant improvements in the capacity and performance of these skills. On the other hand, the results did not reveal statistically significant differences between the

groups in mobility in the living space and satisfaction. Limitations are observed in terms of generalization of the results, since they apply only to the city of Vancouver, which is more accessible and has greater variations in weather when compared to other Canadian cities. Even so, the authors consider that the convenience sample and sampling methods may not represent all users of manual wheelchairs. The limitation of the study also pointed out that the sample is restricted, so it did not allow the analysis of potentially important variables subgroups, such as age and previous experience with wheelchairs. Finally, as another limitation of the study, the authors pointed out the comparisons between an experimental group and a control group that did not receive any contact (Best et al., 2016).

The study that used immediate video feedback (IVF) in training skills with wheelchairs was that of Wang et al. (2015). This study aimed to test the hypothesis that the effects of IVF on training skills with ramp chairs, guide and doing wheeling could be equivalent or better than a conventional training for the same purpose. The study was directed at manual wheelchair users with recent spinal cord injury (T1-L1) and without any previous training for the skills of wheeling, ramp and guide. Manual wheelchair users were paired (nine pairs) according to motor function level, age and gender and were randomized into two groups: a control, which received conventional training, and an experimental, using IVF training. For this training, a video model was developed with 17 experienced wheelchair users performing the appropriate technique for each skill. The training sessions lasted approximately 30 minutes each, held twice a week until the participant mastered the skills. In both groups training, the instruction was first given, then the participants practiced the ability, and finally the feedback was repeated until they acquired the ability. Participants in the control group received additional verbal feedback on the correct performance and errors, based on the observation of the participant's practice. Those in the experimental group watched three videos of skill examples with a model with similar level of injury, gender and age. Then, the participant practiced the skill, and the practical performance was recorded by video cameras. The feedback lasted approximately five to seven minutes for both groups. Then, the participants were submitted to the test of competence of skills with wheelchair, retention and transfer, all of which were paired to check the differences in training time, need for safety intervention and the rate of success in the performance of the two groups. The results showed that there were no differences between the groups in training time or in the three wheelchair skills, revealing that the use of IVF for training skills with manual wheelchairs can produce effects similar to those results of conventional training. Therefore, the authors point out that training with IVF can be an alternative training method for wheelchair skills. On the other hand, limitations of the study were also observed due to the very small sample, not representing all subjects with spinal cord injuries. Another limiting aspect of the study was the fact that the authors did not separate the phases of going up and down the ramp and guide skills, the latter being performed with a lower height (12.6 cm) than the standard (15 cm). Finally, the authors also question the absence of verbal or graphic tips that presented the main components needed for the performance of wheelchair skills (Wang et al., 2015).

## 4 Discussion

### 4.1 Overview of studies on training skills with wheelchairs

One of the objectives of this study was to identify interventions aimed at training skills with manual wheelchairs, published in the last decade. Seven articles were found in the databases considered for this study, all published in English, most with American affiliation and coming from countries considered developed, such as Canada and the United States. These findings show there is more concern with this theme in those countries, which may bring more advanced levels of investments and incentives for conducting research in the area of health and rehabilitation, as well as greater development in the area of health and rehabilitation of people with disabilities.

The studies identified were all carried out in the last 8 years, with the highest number in 2016, which shows an increased concern about this type of clinical practice in recent years. Nevertheless, scientific production on the theme was restricted, giving indications that training skills with wheelchairs is still a little explored subject in the databases surveyed for this study. Possible justifications can be the barriers to evidence-based practice, both at the systemic and individual level, including the lack of administrative support, access to research evidence, the ability to find and interpret evidence and the professionals' time availability (Law & Baum, 1998). Another possible factor is that training skills with wheelchairs has not yet been adopted in a generalized way in clinical practice, not even in countries considered developed (Giesbrecht et al., 2013).

Although most of the studies found are Canadian and American, evidence from these countries points to rates below 20% of wheelchair skill training among young people who underwent rehabilitation during hospitalization, with training restricted to specific skills such as wheelchair transfers to bed, toilet or bathroom (Karmarkar et al., 2010; Smith & Kirby, 2011). This shows that many individuals did not receive optimal training for resource use or that the training provided did not cover all the skills necessary for performance and confidence in using the resource. These conditions go against the propositions WHO, which advocates various wheelchair skills training in the rehabilitation process (Kilkens et al., 2003; Organização Mundial da Saúde, 2008).

The lack of adequate training of wheelchair users is a broad issue, which involves a number of factors. Authors point out the influence of aspects related to the professional training of workers involved in the rehabilitation process, such as lack of knowledge and ability to demonstrate maneuvers (Coolen et al., 2004). Problems related to the rehabilitation process were also identified, such as prioritizing other demands rather than training skills during the hospitalization period and lack of support for training skills in contexts of rehabilitation (Giesbrecht et al., 2013). Therefore, we point out the need for investigations on possible causes and solutions for this problem among rehabilitation professionals.

The absence of Latin American publications in the databases surveyed gives us indications that this type of clinical practice is still non-existent or poorly adopted and disseminated in these countries. This contradicts UN determinations, once several of these countries are States Parties to the Convention on the Rights of Persons with Disabilities, they should therefore take measures to ensure the mobility of people with disabilities, which includes training for the proper use of wheelchairs (Organização

Mundial da Saúde, 2008). Brazil is one of the signatories of this international treaty, ratifying it with constitutional amendment status in 2008 (Brasil, 2013). In addition, since 1993, Ordinance 116 of the Ministry of Health provides not only for the granting of wheelchairs, but also the training of the patient for the resource use (Brasil, 1993). Even though, training skills with wheelchairs was not evidenced in any Brazilian study in the databases surveyed.

A possible justification for the lack of training of wheelchair skills in developing countries may be the lack of rehabilitation services or poor access to them, since evidence attests that, in the world, 80% of people with disability live in low-income countries, the vast majority being deprived of basic rehabilitation services (World Health Organization, 2006). A 2006 United Nations report shows that about 62 countries did not have national rehabilitation services for people with disabilities (Organização das Nações Unidas, 2006). In Brazil, for example, there are about 2651 million people with physical disabilities, but only 489,000 of them attend rehabilitation services, which corresponds to 18.4% (Franchi et al., 2017). The Northeast region has the lowest rates of access to rehabilitation services (15.9%); while the Southern region has the highest rates (23%). Therefore, it is assumed that access to wheelchairs can be scarce, as well as interventions aimed at training skills with the resource.

These realities are worrying, as underdeveloped countries have a large number of physical barriers to mobility and are precarious in terms of accessibility, which requires users to have many wheelchairs mobility skills (Organização Mundial da Saúde, 2008). In addition, the lack of training can compromise occupational performance, both in terms of independence and social participation (Rousseau-Harrison et al., 2009). Therefore, in addition to spending on specialized health services, even higher social and social security costs may also occur in the long term, since wheelchair users will be less likely to re-enter in the society, requiring care by professionals or family members.

In Brazil, training skills with wheelchairs is an eminent demand, considering that in 2015 there was an expansion in the list of wheelchairs dispensed by the Unified Health System, which further expanded access to this resource. Concomitantly with this, there has been an expansion of the theme of assistive technology, which has become present in different agendas and national sectors, with increasing interest in the area in recent years (Galvão Filho, 2013). Thus, we highlight the need for investigations on the effectiveness and costs of interventions aimed at training wheelchair skills in the country, in order to support the implementation of these practices in the context of wheelchair skills rehabilitation and dispensation of orthotics, prostheses and auxiliary means for mobility.

### 4.2 Evidence on manual wheelchairs training skills

The second objective of this study was to identify studies that presented higher levels of scientific evidence. The findings showed that all selected studies dealt with level II evidence, according to the McMaster University (Holm, 2000) classification, so all of them can be considered the highest level of evidence in terms of clinical trials, with high methodological rigor, second only to the systematic reviews of the literature, which bring together several clinical trials.

The most common places of study were rehabilitation centers or hospitals (n=5) (Yeo & Kwon, 2018; Best et al., 2016; Worobey et al., 2016; Wang et al., 2015; Sakakibara et al., 2013; Routhier et al., 2012), which indicates that this type of practice was performed as part of the rehabilitation process. It is important training skills with wheelchairs since the beginning of the resource use, since in this period, the routines and patterns for the use of the wheelchair are still in developement, and users are more able to adapt their mobility techniques (Coolen et al., 2004). Therefore, WHO recommends that the wheelchair dispensing service should offer training to the user in order to promote the greatest possible benefit from its use (Organização Mundial da Saúde, 2008).

Only one study was conducted entirely in the community (Oztürk & Ucsular, 2011), while another was carried out in both the rehabilitation center and the community (Best et al., 2016). Authors reinforce it is relevant health professionals involvement in care at the territorial and community level in the rehabilitation process (Aoki et al., 2011). These practices dialogue with the propositions of Community-Based Rehabilitation (CBR), which aims to expand and enable coverage of attention to people with disabilities, starting from the needs identified by the community and using simplified technology, existing or encouraged within Community resources (Maior, 1996). This is relevant because it brings the interventions to the subject's living space, in order to favor learning, ensuring access to services and promoting social inclusion, in addition to lower costs in terms of physical spaces availability.

Most studies used WST or WST-Q instruments to assess wheelchair skills (Yeo & Kwon, 2018; Worobey et al., 2016; Sakakibara et al., 2013; Routhier et al., 2012; Oztürk & Ucsular, 2011; Best et al., 2016). These instruments are intended to evaluate 34 wheelchair skills, ranging from the most basic to the most complex ones, such as climbing a guide or doing wheeling (Wheelchair Skills Program, 2018). Both have good psychometric properties (Kilkens et al., 2003; Fliess-Douer et al., 2010). The first is a practical evaluation in which the patient should perform the skills and they should be recorded by the evaluator; while the second consists of a self-administered questionnaire or applied by a professional through a script (Wheelchair Skills Program, 2018). Although most studies have used WST, WST-Q has the advantage of not requiring specific equipment or environments, and can be applied in various contexts and in a shorter time, allowing to evaluate not only the skill, but also confidence, performance frequency and training goals from the subject's perspective (Wheelchair Skills Program, 2018). Therefore, it can be an effective instrument to be applied in the community or in contexts with little physical space available.

All interventions aimed at training skills with wheelchairs used were effective in increasing the performance of these skills, demonstrating that they can bring improvements in mobility with the use of the resource (Yeo & Kwon, 2018; Worobey et al., 2016; Sakakibara et al., 2013; Routhier et al., 2012; Oztürk & Ucsular, 2011; Best et al., 2016; Wang et al., 2015). The gains observed reinforce the idea that wheelchair skills are aspects possible of being acquired in clinical practice (Smith et al., 2016). This is of great importance especially in developing countries, which still present many challenges in terms of public policies and government actions for the implementation of accessible spaces, so it can be considered an action that expands the mobility of the users of this resource in different spaces.

Most studies used WSTP (Yeo & Kwon, 2018; Worobey et al., 2016; Sakakibara et al., 2013; Routhier et al., 2012; Oztürk & Ucsular, 2011). This is part of the Wheelchair Skills Program (WSP), a program composed of standardized assessments (WST and WST-Q) and wheelchair skills training protocols aimed at the user and their caregiver (WSTP). It was developed at Dalhousie University and the Nova Scotia Health Authority in Canada in the mid-1980s through studies on the theme of wheelchairs (Wheelchair Skills Program, 2018). WSTP supports the Guidelines on the provision of manual wheelchairs in less-resourced settings of the WHO, 2008, since it allows both the evaluation and training of skills for wheelchair users. A recent systematic review found that WSTP is safe and effective in training wheelchair skills (Tu et al., 2017). Authors also point out that WSTP is safe as well as practical for training these skills (Coolen et al., 2004).

Studies with WSTP have shown increased performance for wheelchair skills in the context of specialized rehabilitation services (Yeo & Kwon, 2018; Worobey et al., 2016; Sakakibara et al., 2013; Routhier et al., 2012) and the community (Oztürk & Ucsular, 2011). The most expressive gains showed an increase between 18% and 19% (Routhier et al., 2012; Oztürk & Ucsular, 2011). Older clinical trials on WSTP also identified significant improvements in skill performance in both contexts (Best et al., 2005; MacPhee et al., 2004). Therefore, it was observed that WSTP is versatile and easy to administer because it does not require the use of large technologies or high costs. On the other hand, IVF required audiovisual resources and video productions for the intervention and did not show better results than conventional training of wheelchair skills (Wang et al., 2015). Therefore, we can point out the excellent cost-benefit of WSTP, especially for contexts with lower resources.

WSTP training also promoted improvement in the performance of wheelchairs skills in advanced and community-level among individuals without disabilities (Worobey et al., 2016; Sakakibara et al., 2013) and among users already experienced in the use of the resource, with an increase of up to 34% of the skills (Routhier et al., 2012). It is believed that wheelchair skills can have positive reflexes in other areas, as observed in one of the studies that also pointed out the improvement in knowledge and problem solving, support and management of emotions related to the performance of activities and behavior in social situations (Sakakibara et al., 2013). This can be explained by the fact that complex skills are fundamental in the process of independence, also favoring participation and social experiences.

It was observed the effectiveness of WSTP in wheelchair skills confidence among elderly people who had never used this resource (Sakakibara et al., 2013) and among users already experienced in using it (Oztürk & Ucsular, 2011). Although the absence of disability among the participants and the training time below the lower limit than recommended were pointed out as possible influences on confidence in the study by Sakakibara et al. (2013), it was observed that an intervention with similar time and participants with disabilities also increased confidence in up to 23.4% in the study by Oztürk & Ucsular (2011). This gain is relevant since the lack of confidence can contribute to the inadequate use of the wheelchair, for barriers in the performance of activities (Chaves et al., 2004; Barker et al., 2006) and even lead to abandon the resource (Costa et al., 2015). Therefore, it is believed that WSTP can favor the effective

use of the wheelchair, preventing risks of falls and injuries and increasing safety during the performance of daily activities.

WSTP also showed efficacy in a group approach (Worobey et al., 2016). Although the study has limitations, such as the composition of the sample with different levels of spinal cord injury, diversity in the individual training goals and absence of some participants in some intervention sessions, it was possible to observe improvements in the performance of advanced skills with wheelchairs and achieving individual goals set by users in up to 65.6% (Worobey et al., 2016). Thus, WSTP can be a viable option to be used in groups, which in theory, reduces costs with professionals and facilitates the availability of service schedules by professionals and staff, favoring the application of wheelchair skills training in outpatient and hospital contexts.

WSTP was effective with an average of just two hours of training among elderly individuals who had never used wheelchair (Sakakibara et al., 2013) and among community-resident wheelchair users (Oztürk & Ucsular, 2011). Similar training times were observed in older studies that used WSTP with subjects with musculoskeletal and neurological impairments at the beginning of rehabilitation and undergraduate students in occupational therapy, being evident gains in the performance of wheelchair skills in both (MacPhee et al., 2004; Coolen et al., 2004). Even with a shorter training time than suggested by the WSP guidelines, which suggests 4 hours of training to improve skill capacity (Kirby et al., 2015), positive results were observed. Therefore, the program can be effective with a few hours of training, both for subjects who have no experience with the resource and with more experienced users.

Other studies presented a higher amount of training time with WSTP. Subjects with incomplete cervical spinal cord injury showed improvement with an average of 24 hours of training (Yeo & Kwon, 2018), while subjects with spinal cord injuries equal to or below level C8 received about 9 hours of training (Worobey et al., 2016). Wheelchair users in general and subjects with musculoskeletal and neurological impairments showed improvement in abilities with the resource after an average of 4 hours and 30 minutes and 5 hours and 30 minutes of training, respectively (Routhier et al., 2012; Best et al., 2005). These differences in the amount of hours required for the effectiveness of training can be explained by the various physical impairments presented by wheelchairs users of the studies, as is the case of people with tetraplegia, who probably required a longer training time due to motor and sensory impairments in the upper limbs. It is believed that the group approach also requires longer intervention time, in view of the different training goals among the participants (Worobey et al., 2016). Therefore, it is possible to say that WSTP seems to be effective and easily adaptable to various levels of motor impairment and conditions.

The groups that received WSTP presented higher results than the groups that received other interventions. Individuals with cervical spinal cord injury who received WSTP training, compared to subjects who received conventional exercise sessions for the upper limbs, besides presenting better performance rates of skills with wheelchairs, also showed a functional increase in upper limb skills (Yeo & Kwon, 2018). Adult wheelchair users who received WSTP, compared to a group that received standard treatment, although they did not have statistically significant differences in the retention of results at the end of 3 months, showed an increase in wheelchair skills by 18% (Routhier et al., 2012). On the other hand, the results showed that there were no

significant differences between IVF and conventional training of wheelchair skills, so the last was not advantageous in terms of the costs needed for its implementation (Wang et al., 2015).

Although training with WheelSee and IVF proved to be effective in performing wheelchair skills, they showed results limited to a single study each, without evidence with diverse audiences (Wang et al., 2015; Best et al., 2016). WSTP, in turn, presented efficacy both among subjects with different disabilities who already used wheelchairs and among subjects who had never used the resource before. This can be explained by the versatility of the program, which brings together about 39 skills with wheelchairs in the WSP guidelines (Wheelchair Skills Program, 2018). Thus, it is considered that this program is complete and responds to recommendations on the need to acquire a series of skills for an effective use of the resource (Organização Mundial da Saúde, 2008; Kilkens et al., 2003).

## 5 Final Considerations

The scientific production on wheelchairs skills training was restricted, demonstrating that the theme is still little explored. On the other hand, the findings showed that in recent years there was a slight increase in the production of scientific evidence on training skills with wheelchairs in countries considered developed, such as Canada and the United States.

Studies with high levels of evidence on training skills with manual wheelchairs were identified, especially WSTP, which was the most present among the findings of this review. This protocol showed effectiveness in relation to performance and confidence in wheelchair skills, achievement of training goals established by the participants and facilitating the acquisition of skills with the upper limbs. WSTP was applied in individual and group approaches and in diverse contexts, such as hospitals, rehabilitation centers and the community. It was also versatile in relation to the public, since it was applied with subjects with disabilities or without disabilities; among new or experienced users of wheelchairs; and between young and old adults. It was possible to observe efficacy with just over two hours of training, depending on the conditions of the participants. Therefore, compared to the other identified protocols, it gathers a greater number of scientific evidence on the subject.

Wheelchair skills training with WSTP was aligned with who recommendations, since interventions were performed by specialized professionals and covered a large number of wheelchair skills, from the most basic to the most complex ones. Therefore, compared to the other protocols, it was the one that most responded to WHO recommendations on the areas to be addressed in the wheelchair skills training process.

This study presents limitations regarding the criteria adopted for searching studies, such as the year of publication of the articles, the databases researched and the languages considered, since broader searches could bring greater evidence about training skills with wheelchairs that were not taken into consideration in this review.

It is expected that this study will contribute to the implementation of wheelchair skill training in rehabilitation services aimed at the users of this resource, as well as to the development of new evidence on the subject. New studies that specifically evaluated the efficacy of WSTP in functional independence, occupational performance and social participation are suggested, since we did not identify studies that specifically evaluated the effectiveness of the program in relation to these variables.

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