

## Manual wheelchair satisfaction among long-term users and caregivers: A French study

Claire Marchiori,<sup>1-2\*</sup> Djamel Bensmail, MD;<sup>1</sup> Dany Gagnon, PhD;<sup>2</sup> Didier Pradon, PhD<sup>1</sup>

<sup>1</sup>Raymond Poincaré Hospital, Garches, France; <sup>2</sup>Pathokinesiology Laboratory, Centre for Interdisciplinary Research in Rehabilitation of Greater Montreal, Institut de Réadaptation Gingras-Lindsay-de-Montréal, Montreal, Canada

**Abstract**—Wheelchair mobility is a prerequisite to being able to carry out important activities and to participate in social life. Level of satisfaction with the wheelchair and overall quality of life were found to be positively associated. The aim of this study was to determine the level of satisfaction of French manual wheelchair (MW) users and caregivers with MW characteristics. A total of 132 users and 76 caregivers completed a questionnaire about their level of satisfaction with their MW characteristics. Satisfaction scores were independent of age, sex, reason for MW use, and time of use. As a whole, MW users are satisfied. However, a few parameters such as MW weight and difficulties propelling outdoors demonstrate a low level of satisfaction among users. MW weight, brakes, and height of pushing handles are the less satisfying elements among caregivers. In conclusion, the majority of French MW users are satisfied, but some characteristics, such as weight, must be optimized. Considering caregiver needs is paramount when aiming to improve MW parameters such as brakes or pushing handles. Improvement in some MW parameters seems to be important in achieving improved level of satisfaction and increased participation and active lifestyle among MW users and caregivers.

**Key words:** accessories, caregivers, French, French wheelchair, manual wheelchair, parameters, satisfaction, users, wheelchair characteristics, wheelchair satisfaction.

### INTRODUCTION

Mobility is an essential component of activities of daily living and is necessary for participation in social

activities [1]. Impaired body functions leading to limited walking ability may restrict activity and participation [2]. Mobility assistive technology can be a means to improve activity and participation [3]. Among mobility assistive devices currently available, canes are used the most for improving mobility among persons with motor impairments and functional disabilities, whereas wheelchairs rank second; 1 percent of the world population requires a wheelchair, but only 0.3 percent are wheelchair users [4]. In France, 62 persons per 10,000 (i.e., 360,000 people) use a wheelchair [5]. This figure includes 59 persons per 10,000 who use a manual wheelchair (MW), which may be foldable, rigid, sporty, or designed specifically for comfort [5]. These people use an MW for various reasons: neurological disorders, genetic disorders, cognitive deficits, pathology of the lower limb and trunk, or age-related changes. The age-related changes category includes participants more than 60 yr old who have a

**Abbreviations:** GH = geriatric hospital, MW = manual wheelchair, MWU = manual wheelchair user, PAPA = pushrim-activated power-assisted wheelchair, QUEST = Quebec User Evaluation of Satisfaction with Assistive Technology, RH = retirement home, SCI = spinal cord injury, UH = university hospital, UL = upper limb.

\*Address all correspondence to Claire Marchiori, UVSQ, EA 4497, CIC-IT 805, Raymond Poincaré Hospital 92380, Garches, France; +33 1 71 14 49 21.

Email: [marchioriclaire@gmail.com](mailto:marchioriclaire@gmail.com)

<http://dx.doi.org/10.1682/JRRD.2014.04.0092>

reduced level of independence and safety during ambulation due to various age-related changes (e.g., balance problems, muscle weakness) and risk of falls. The majority of MW users (MWUs) live at home (57%), but this trend reverses with age and elderly MWUs mainly live in institutions [5]. With a revenue of €133.8 million (\$141.2 million) in 2007, the wheelchair industry is large and still growing (8% growth between 1996 and 2001) [6].

The provision of an MW aims to improve the mobility of the MWU despite his or her impairments and disabilities. Caregivers, mainly family members and health professionals who play an important role in the person's daily life, also help to improve mobility and promote social integration.

Improved mobility among people with disabilities is a prerequisite for integrating into the community and gaining access to education, employment, and socialization, as well as preventing additional secondary complications (e.g., pressure sores). MW settings are also important in optimizing mobility. Dalyan et al. showed that the use of a poorly configured MW may cause upper-limb (UL) pathologies and actually decrease autonomy [7]. Hence, a well-designed and -adapted MW may allow MWUs to access the same opportunities as other members of their community and improve their level of satisfaction. The choice in the type of MW as well as adjustments must be individualized to enhance satisfaction and usability [8].

MWU satisfaction is an important variable for researchers in the field of mobility [9–11]. Samuelsson and Wressle demonstrated that users used their assistive device (MWs and wheeled walkers) for more years when the level of satisfaction was high [12]. One cause of discontinued use is user dissatisfaction. Moreover, studies have shown that level of satisfaction with the wheelchair and overall quality of life of persons with spinal cord injury (SCI) were positively related in China and the Netherlands [12]. de Groot et al. highlighted key aspects of the wheelchair (i.e., dimensions and simplicity of use) that are important for optimizing an active lifestyle and social participation [10]. The importance of good wheelchair adjustments has been previously described in wheelchair ergonomics literature [13].

In some countries, assistive technology is free of charge, but in other countries, the provision of assistive technology depends on insurance conditions. Furthermore, regulations and assistive technology service systems differ between countries [14]. In the few studies

carried out in China, Denmark, the Netherlands, and Canada, MWUs were found to be satisfied with their MWs [9–12]. However, this question has not been investigated in France. The French healthcare system is different and covers only a few parts of the wheelchair by insurance. The remainder of the cost must be paid by the user. To the best of our knowledge, a few studies have evaluated the level of satisfaction of wheelchair users with specific types of wheelchairs (i.e., power wheelchairs) but not for MWs. Based on a PubMed search using the key words “satisfaction” and “wheelchair,” 224 results were found, but when the key words “French” and “manual” were added, only 2 results were found. One study evaluated satisfaction with a lever-propelled wheelchair prototype but not for MWs with traditional propulsion [15], and the other study evaluated technological equipment in general [16]. When the key word “caregivers” was added, no results were found. Given the important role of caregivers in the mobility of MWUs, it seems important to also evaluate their level of satisfaction with the technical aspects of MWs.

The aim of this study was to determine the satisfaction of French MWUs and caregivers of MWUs with MW characteristics, particularly the wheels, brakes, accessories, and MW dimensions and weight. We believed that increasing our understanding of the satisfaction of MWUs and caregivers would help to improve the design of MWs (dimensions, weight, etc.). MWUs and caregivers each completed a different questionnaire ([Appendix](#), available online only) about their level of satisfaction with the MW parameters. We hypothesized that the level of satisfaction would not vary with age, sex, cause of disability, or MW type and that MWUs would be satisfied on the whole with their MW but that they might not be satisfied with all the specific parameters. Particularly, we hypothesized that they might be dissatisfied with the MW weight. We also hypothesized that full-time MWUs would be less satisfied than occasional MWUs and that the caregivers would be largely less satisfied with the MW parameters than the MWUs.

## METHODS

The study started in December 2011 and finished in June 2012. A convenience sample of MWUs and their caregivers was recruited from various sources, including a geriatric hospital (GH), a retirement home (RH), and a

university hospital (UH). The questionnaire was also posted on the Garches Foundation Web site ([www.handicap.org](http://www.handicap.org)). These different locations were chosen in order to target a wide population. A total of 654 questionnaires was distributed. Individuals over 18 yr old who used a MW were eligible to participate. Participants who were unable to understand and answer the questionnaire were excluded. Caregivers included family members and health professionals of the MWU. They were defined as people who helped a dependent person in activities of daily living [17]. Caregivers over 18 yr old were eligible to participate. The study was approved by a local ethics committee. It was registered as a national multicenter study of MWs. Subjects were not paid for their participation in the study.

### Questionnaire

A questionnaire was developed for the purpose of the study in collaboration with clinicians who prescribe wheelchairs and by a physiotherapist with 20 yr of experience specialized in assisting persons choose and adjust their wheelchairs. The items on the questionnaire included the mechanical characteristics of wheelchairs described by Cooper [18]. **Table 1** describes the questions asked in each category.

#### *Manual Wheelchair Users*

Participants first provided demographic information, including age, sex, height, weight, profession, diagnosis, etiology, and number of years of wheelchair use. They then reported the characteristics of their wheelchair, including type, model, and make. Participants were also asked to report the total number of wheelchairs they had used since their first wheelchair and whether they had a pushrim-activated power-assisted wheelchair (PAPAW). The main part of the questionnaire was related to satisfaction with the MW and its parts, including the brakes, wheels, and accessories (i.e., armrest, head support). A 4-point scale was used to rate global MW satisfaction. The final part of the questionnaire related to participants' needs. Participants were asked to choose their three main criteria when selecting a new MW from a list and an open-ended question was asked about aspects that should be improved.

#### *Caregivers*

The caregiver questionnaire focused on age and sex and the characteristics of the MW, including type, model,

make, and satisfaction related to parts of the MW that the person whom they cared for used. It also asked whether the MWU had a PAPAW. At the end, there was an open-ended question relating to aspects that they felt should be improved.

### Data Analysis

Descriptive statistics (mean  $\pm$  standard deviation for continuous variables and frequencies for categorical variables) were used to describe the study sample, MW characteristics, satisfaction levels, and selection criteria if they needed to buy a new MW. Differences between groups (old/young, male/female, accident/disease, type of MW) regarding global satisfaction score were analyzed with independent Student *t*-tests. These comparisons were carried out to evaluate whether or not the level of satisfaction varied with age, sex, cause of disability, or MW type. The 4-point satisfaction scale was divided into two categories: "quite satisfied and very satisfied" and "not very satisfied and not satisfied at all." A McNemar test was used to analyze global satisfaction and satisfaction with each parameter. A chi-square test was used to analyze satisfaction with each parameter between full-time MWUs and occasional MWUs and to compare satisfaction among caregivers and MWUs. A Bonferroni correction was applied to an adjusted *p*-value of 0.004, which was used for all tests. Data were analyzed with Statistica 10 software (Stat Soft Inc; Tulsa, Oklahoma).

## RESULTS

A total of 132 MWUs and 76 caregivers completed the questionnaire (response rate: MWUs: 35%; caregivers: 27%). Out of the 132 MWUs, 107 (81.1%) were recruited from GHs, RHs, and UHs and 25 were recruited from other sources (Internet).

### Characteristics of Manual Wheelchair Users

Most participants reported that they spent all day in their wheelchairs (69.7%). The diagnosis and/or disabilities reported included sensorimotor impairments of the lower limbs and trunk (43.2%), neurological diseases (31.8%), genetic diseases (5.3%), and aging (17.4%). The diagnoses were as follows: SCI, amputation, multiple sclerosis, and cerebral palsy. The main cause of MW use among males was trauma (59.7%), while trauma

**Table 1.**

Description of questionnaire.

Information Category	How Obtained
<b>Users</b>	
Demographics	
Sex	Category (men, women).
Age	Number of years.
Height and Weight	Open-ended question.
Profession	Open-ended question.
Years of Use in General	Open-ended question.
Diagnosis	Category (neurological disease, genetic disease, weight problem, sensory deficit, mental deficit, lower-limb deficit, system deficit, old age with motor impairment, other). Several categories can be chosen. Category (birth, accident, disease, old age).
Wheelchair Characteristics	
Number of Wheelchairs Owned	Open-ended question.
Type	Category (foldable, rigid, sport, * comfort, † power). Make and model.
Frequency of Use	Category (sometimes [for particular activities], often, always [for daily life]).
Place of Use	Category (indoors, outdoors, indoors and outdoors).
Difficulty Using	Category (can be realized alone, very difficult, difficult, easy, very easy). About propulsion, transfer, loading of wheelchair into car, folding of wheelchair, crossing obstacles.
Satisfaction with Wheelchair	Category (not at all satisfied, not very satisfied, quite satisfied, very satisfied). About wheelchair (dimensions, weight, ease of indoors and outdoors propulsion, ease of pivot), brakes, wheels, and accessories (armrests, support head).
Improvements	Open-ended question about points to improve on wheelchair.
Criteria	Choose 3 from list of 11 criteria.
<b>Caregivers</b>	
Demographics	
Sex	Category (men, women).
Age	Number of years.
Wheelchair Characteristics: Type	Category (foldable, rigid, sport, * comfort, † power). Make and model.
Satisfaction with Wheelchair	Category (not at all satisfied, not very satisfied, quite satisfied, very satisfied). About wheelchair, brakes, wheels, and accessories.
Improvements	Open-ended question about points to improve on wheelchair.

\*Sport wheelchairs are designed for athletes with disabilities who are competing in sports that require agility and speed such as basketball, tennis, rugby, or racing.  
†Comfort wheelchairs are self-propelled and allow patients to displace themselves and sit for long periods of time, as well as to nap in chair without increasing number of transfers.

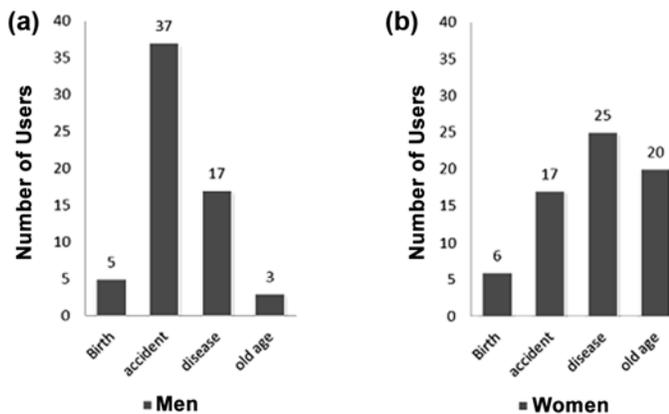
represented only 25 percent of causes for females, with diseases (36.8%) and aging (29.4%) accounting for the largest distribution of causes (**Figure 1**).

In terms of wheelchair skills, most MWUs were able to propel (52.2%) and transfer (45%) easily, i.e., they could perform these tasks independently without difficulty regardless of the surface, slope, or height of the transfer surface. Some reported difficulties in loading their MW into the car (27.2%), folding it (20.4%), and

crossing obstacles (39.4%). Many MWUs were unable to load MW (58.3%), fold MW (48.5%), or cross obstacles independently (43.2%)

#### *Wheelchair Characteristics*

**Table 2** lists the characteristics of the MWs and the MWUs. Of the participants, 100 (75.7%) used a foldable MW, 22 used a rigid MW (16.7%), 8 used a comfort MW (allows for movement, prolonged sitting, and napping



**Figure 1.** Etiology of wheelchair use for (a) men and (b) women.

without an increased number of transfers) (6.1%), and only 2 used a sport MW (1.5%). The average duration of MW use was  $12.5 \pm 13.7$  yr. Each patient had used an average of  $3.1 \pm 3.3$  wheelchairs and had changed their wheelchair every 4.0 yr on average. Only 15 participants (11.4%) owned a PAPA. Most participants used the following MW brands: Invacare (Elyria, Ohio) ( $n = 37$ ; 28.0%) and Kuschall (Witterswil, Switzerland) ( $n = 31$ ; 23.5%).

### Satisfaction Ratings

No differences were found between age groups ( $p = 0.09$ ), sex ( $p = 0.93$ ), or cause of MW use ( $p = 0.69$ ) regarding global satisfaction scores and satisfaction with each parameter. Moreover, no differences were found between the types of MW ( $p = 0.39$ ). The majority of MWUs was satisfied (71 MWUs gave a rating of 3 [satisfied] and 26 MWUs gave a rating of 4 [very satisfied]). Only 13 and 22 of 132 MWUs were not satisfied, with ratings of 1 (not satisfied at all) and 2 (not very satisfied), respectively. Only five differences were found between global satisfaction and satisfaction with each parameter (Table 3). MWUs were satisfied with all items (Figure 2) except for two: the MW weight ( $p < 0.001$ , 38%) and outdoor propulsion ( $p < 0.001$ , 39%). As for accessories, few MWUs had a head support (13.6%) or lateral trunk supports (10.6%). MWUs were particularly satisfied with the weight of the wheels ( $p = 0.001$ , 86%), MWU friendliness of the brakes ( $p = 0.002$ , 81%), and indoor propulsion ( $p = 0.001$ , 82%). Concerning the differences among full-time versus occasional MWUs, it appears that there are no differences in mean age ( $p = 0.8$ ) and global satis-

**Table 2.**

Characteristics of study population.

Characteristic	n (%)
<b>Users</b>	132
Mean Age, yr (range)	55.4 (18–97)
Sex	
Male	62 (47)
Female	70 (53)
Mean Time in Use, yr (range)	13.3 (0–52)
<b>Caregivers</b>	76
Mean Age, yr (range)	45.3 (16–81)
Sex	
Male	26 (34)
Female	50 (66)
Relationship	
Family Member	55 (72)
Health Professional	21 (28)
<b>Pathology</b>	
Accident	54 (40.9)
Disease	42 (31.8)
Old Age	23 (17.4)
Birth	11 (8.3)
Other	2 (1.5)
<b>Wheelchair</b>	
Foldable	100 (75.7)
Rigid	22 (16.7)
Comfort	8 (6.1)
Sport	2 (1.6)
<b>Frequency of Use</b>	
Sometimes	22 (16.7)
Often	18 (13.6)
Always	92 (69.7)
<b>Place Used</b>	
Indoors	27 (20.4)
Outdoors	27 (20.4)
Indoors and Outdoors	78 (59.2)

faction ( $p = 0.5$ ). Full-time and occasional MWU satisfaction for MW parameters were similar ( $p > 0.99$ ).

For MWUs, the most important criterion was weight (26.5%), followed by comfort (19%), durability (19%), and maneuverability (16%).

### Characteristics of Caregivers

Caregivers were recruited from GHs, RHs, and UHs (62, 81%) and other sources (Internet) (14, 19%). Out of those, 55 (72%) were family members and 21 (28%) were health professionals. Caregivers were mostly women (50, 65%) with a mean age of  $46.0 \pm 17.5$  yr. Distribution of MW type was the same as that of MWUs with a majority having foldable MWs (64.5%) followed by comfort MWs

**Table 3.**

Comparison of manual wheelchair user parameter satisfaction and global satisfaction ( $n = 132$ ).

Item	Subjects "Quite Satisfied or Very Satisfied" (%)
Dimensions	78
Weight	62*
Propulsion Indoors	82*
Propulsion Outdoors	61*
Ease of Pivot	78
Brake Position	80
Ease of Brakes	81*
Clothes-Guards	65
Pushing Handles	80
Braking Quality	73
Ease of Handrim	73
Wheels Weight	86*
Maintenance of Wheels	75
Armrests	73
Foot Rest	81
Support Head	78
Trunk Support	71
<b>Global Satisfaction</b>	<b>73</b>

\* $p < 0.004$ .

(19.7%) and rigid MWs (14.5%). The task of loading the MW into the car and crossing obstacles was more difficult for caregivers than pushing, folding, and other activities. Indeed, 65.8 and 59.2 percent of caregivers had difficulty in carrying out these activities, respectively.

**Figure 3** depicts MW satisfaction among caregivers. Overall, they were satisfied with the MW (10/12 items satisfied). However, 40 percent were dissatisfied with the push handle, especially its adjustment ( $p = 0.001$ ). **Table 4** shows the comparison of satisfaction with each item between MWUs and caregivers. Caregivers were less satisfied with MW weight ( $p < 0.001$ , 63% dissatisfaction) and brake position ( $p < 0.001$ ). The results of the open-ended question revealed that the most important criterion of an MW for caregivers was that they were lightweight, designed for comfort, and durable (reported 22, 15, and 13 times, respectively). Other aspects also frequently mentioned were compactness (10 times), ease of folding (9 times), and aesthetic qualities (9 times).

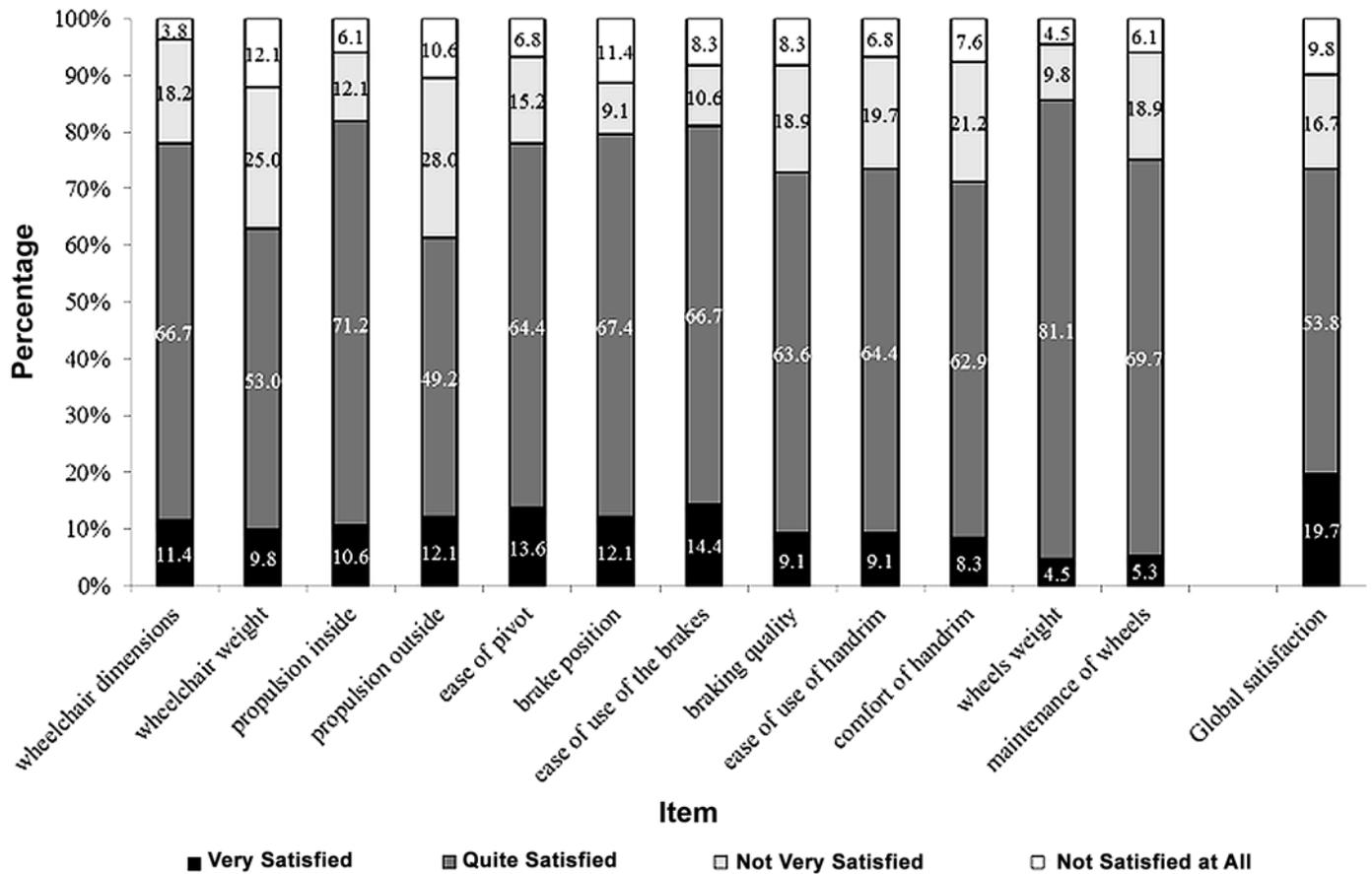
## DISCUSSION

The aim of this study was to evaluate the satisfaction of French MWUs and caregivers with MW characteris-

tics. To our knowledge, this has hardly been evaluated around the world and no studies have specifically been conducted in France on MWUs and caregivers. We believe that measuring satisfaction with an MW is an important aspect of assessing the quality of an MW. The major findings of this study are that French MWUs are generally satisfied with their MW and its technical characteristics, although some improvements do seem necessary. The results of this study showed that weight and outside propulsion were the main reasons of dissatisfaction among MWUs. Caregivers were unsatisfied with MW dimensions and the brakes and were most unsatisfied with MW weight.

de Groot et al. showed a relationship between participation and simplicity of use and between an active lifestyle and MW dimensions [10]. They showed that some aspects of the MW should be optimized because they are related to an active lifestyle and participation. MWUs considered the wheelchair to have a positive influence on their opportunity to work and have an active leisure life [12]. Other studies have also shown that participants who were more satisfied with MW dimensions or who were satisfied overall had a more active lifestyle [9–11]. The results of our study showed that MWUs are satisfied with their MWs (73.5% satisfied, mean score of 2.8/4). The global satisfaction scores and level of satisfaction for each item did not depend on age, sex, or etiology. These results are similar to those reported by de Groot et al., who did not find any differences between age or sex groups [10]. Satisfaction with MW dimensions and simplicity of use indoors was above 80 percent, similar to the previous study. The most important aspects perceived by the MWUs were that the MW was lightweight, designed for comfort, durable, and easy to maneuver. The same items were found to be important in a study by Samuelsson and Wressle [12].

As we hypothesized, despite the fact that the persons were globally satisfied, they had many criticisms. MW weight and outdoor propulsion were the aspects with the most mixed responses for MWUs. Unlike MWUs, the most mixed responses among caregivers concerned the MW's weight, dimensions, position, and ease of use of the brakes and push handles. In the previously mentioned studies, the authors reported lower levels of satisfaction with MW weight [10–12]. The results of the study by Samuelsson and Wressle showed that MW weight and the type of surface have an effect on propulsion [12]. Cowan et al. indeed showed that surface type substantially



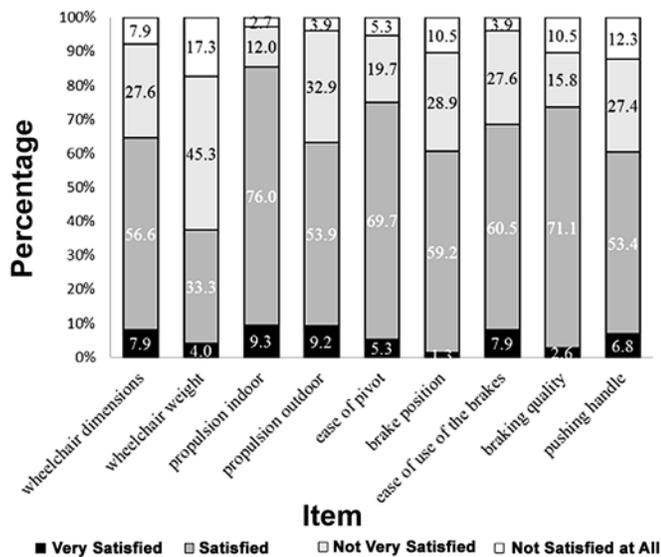
**Figure 2.** Percentage of answers given by manual wheelchair users to item of satisfaction questionnaire.

affects self-selected velocity, peak resultant force, and peak tangential force and that the addition of 9 kg reduces self-selected velocity and increases peak forces on each surface [19]. Cowan et al. concluded that the greatest reductions in the resultant peak force would be obtained with the lightest possible wheelchair [19]. To our knowledge, no studies have been carried out on satisfaction with wheelchair accessories. Caregivers are less satisfied than MWUs in terms of push handles and brakes.

It is interesting to note that despite the fact that MWUs and caregivers were dissatisfied with several aspects of the MWs, they expressed overall satisfaction. It therefore appears that they are resigned to the fact that they have to live with this reality. This is known as accommodation. Accommodation is an effect of the environment on the MWU that alters his or her way of seeing, doing, and thinking. It reflects the action of the environ-

ment on the cognitive activity of the subject, reorganizing knowledge, and changing his or her way of seeing things. Thus, to accommodate to the MW, the person must accept its faults and qualities. In other words, the person learns to put up with it whatever happens [20].

The caregivers in this study were family members and health professionals with a majority of women (65%) aged 46 yr on average. This is similar to a previous study in which the caregivers were found to be generally women (68%) with a mean age of 47 yr [21]. The main sources of dissatisfaction among caregivers were MW weight, dimensions, brakes, and push handles. This is likely related to the fact that these elements can cause discomfort or pain (such as low back pain) and limit the caregiver's actions. If the MW is too heavy, it is difficult to move, especially for tasks such as loading it into a car. Similarly, if the push handles are improperly adjusted or not adjustable, this can cause back pain. A study by van



**Figure 3.** Percentage of answers given by caregivers to item of satisfaction questionnaire.

der Woude et al. showed that the biomechanical load when pushing a wheelchair is partly influenced by push handle height [22]. In general, higher push handles appear to offer some advantages. Low push handles create greater net moments of force, compression forces, and shear forces on lumbar 5 to sacral 1 and greater lifting forces in comparison with higher push handles. van der Woude et al. determined that the push handles should be positioned at 86.5 percent of shoulder height and should therefore be adjustable. Moreover, caregivers have a high-risk of developing low back pain [23]. This can interfere with the caregiver's own life as well as with

the mobility of the MWU. The brakes are also a problem because of their low position on the MW.

The elements of satisfaction and dissatisfaction highlighted here and in other studies must be taken into account in the design and modification of MWs since a well-designed, well-adjusted MW can enhance the mobility and community participation of individuals with reduced mobility [4]. Moreover, a poorly adjusted or adapted MW may cause secondary UL pathologies and decreased independence [7]. The importance of a well-adjusted wheelchair has been previously described in the literature. For example, seat height has an effect on physical strain; a low, backward position of the seat allows greater efficiency of propulsion, but if the seat is too low and the wheels too far back, this increases joint angles and could increase the risk of UL injuries [24].

One major problem is that MWUs often have difficulty in obtaining improved MW models, such as lighter, more compact MWs, because of the cost. In France, the level of reimbursement from the state depends on the type of wheelchair, e.g., €558 (\$589) for a rigid and foldable wheelchair and €948 (\$1,001) for a comfort wheelchair. These sums do not correspond with the price of sophisticated wheelchairs, which can be over €4,000 (\$4,224). If users do not have a complementary health insurance plan to help them pay for their wheelchair, they are often unable to access the one best suited to their MW needs. In this study, MWUs and caregivers were unanimous in their belief that the price of wheelchairs is too high. A study of the France Paralyzed Association on wheelchair funding showed that reimbursement is insufficient compared with the price and that it does not allow persons with disabilities to acquire a wheelchair that reflects their needs [25]. MWUs hesitate to choose a more

**Table 4.** Comparison of parameter satisfaction of manual wheelchair users and caregivers.

Item	Subjects "Quite Satisfied or Very Satisfied" (%)	
	Manual Wheelchair Users (n = 132)	Caregivers (n = 76)
Dimensions	78	64
Weight	62*	37*
Propulsion Indoors	82	85
Propulsion Outdoors	61	63
Ease of Pivot	78	75
Brake Position	80*	61*
Ease of Brakes	81	68
Clothes-Guards	65	74
Pushing Handles	80*	60*

\* $p < 0.004$ .

expensive MW based on the amount of reimbursement since most of them cannot cover the difference. Decreasing the cost, changing insurance regulations, or improving global insurance coverage should be a priority in order to allow access for all. Mobility should not be a luxury, and rehabilitation professionals should lobby for this alongside MWUs and caregivers.

## LIMITATIONS

This study excluded MWUs who were unable to understand and answer the questionnaire. Vignier et al. showed that half of this population has cognitive impairments and two-thirds have some communication difficulties and memory disorders [5]. The population studied was an average age of  $55.4 \pm 19.8$  yr, with 70 women and 62 men. In comparison with the study by Vignier et al. [5], our population is younger. This is likely related to the recruitment method. The majority of MWUs who participated were recruited from Raymond Poincaré Hospital and lived at home, whereas in the study by Vignier et al., the majority lived in institutions [5]. Vignier et al. determined five types of MWUs [5], but in our study only three were represented: elderly with physical impairments, dependant elderly living in institutions, and active MWUs with motor impairments. As for the type of wheelchairs, most MWs were foldable and a few were comfort wheelchairs. Since they are often used both inside and outside, the MW is an essential tool for mobility. Nevertheless, it appears that a large number of MWUs stay in their room or their residence. This is particularly true for those who live in institutions and are above the age of 60 [5]. This is confirmed by the results of our study, since all the MWUs who lived in institutions used their MWs inside only. The younger subjects in our sample used the MW both inside and outside. These results cannot therefore be generalized to the entire population of MWUs. Also, we did not use the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST) 2.0 questionnaire, which is a standardized evaluation tool especially developed to measure user satisfaction with assistive devices [26]. QUEST 2.0 has been used in several studies and is used in several countries. Using this index could be interesting to compare satisfaction with MWs in France and other countries based on the same items.

## CONCLUSIONS

The results of this study show that the majority of French MWUs express a good level of satisfaction with their MWs. They also show that the global satisfaction scores and satisfaction with MW-specific items do not depend on age, sex, or etiology or the type of MW. The results showed that some aspects of the MW (lightweight design, comfort, durability, and maneuverability) and MW parameters (dimensions and push handles) should be optimized because they are related to an active lifestyle and participation. It is also important to consider caregivers by improving parameters such as the push handles, brakes, and MW weight. Improving these aspects of the MW should decrease the risk of musculoskeletal injuries for both MWUs and caregivers, thus possibly improving mobility and satisfaction.

## ACKNOWLEDGMENTS

### Author Contributions:

*Study concept and design:* C. Marchiori, D. Pradon.

*Acquisition of data:* C. Marchiori.

*Analysis and interpretation of data:* C. Marchiori.

*Drafting of manuscript:* C. Marchiori, D. Bensmail.

*Critical revision of manuscript for important intellectual content:* D. Pradon, D. Gagnon.

*Final approval:* D. Pradon.

**Financial Disclosures:** The authors have declared that no competing interests exist.

**Funding/Support:** This material was based on work supported by the Safran Foundation and the Garches Foundation.

**Additional Contributions:** We would like to thank Carolyn Bastable Laidman for revising this article.

**Institutional Review:** All participants were informed of the objectives and nature of the study, which was approved by the Researcher Ethics Committee of the Raymond Poincaré Hospital.

**Participant Follow-Up:** The authors do not plan to inform participants of the publication of this study because contact information is unavailable.

## REFERENCES

1. Lilja M, Borell L. Elderly people's daily activities and need for mobility support. *Scand J Caring Sci.* 1997;11(2):73–80. [PMID:9256808] <http://dx.doi.org/10.1111/j.1471-6712.1997.tb00436.x>
2. World Health Organization. International classification of functioning, disability and health: ICF. Geneva (Switzerland): World Health Organization; 2001.

3. Smith RO. Measuring the outcomes of assistive technology: Challenge and innovation. *Assist Technol.* 1996;8(2):71–81. [PMID:10163931] <http://dx.doi.org/10.1080/10400435.1996.10132277>
4. World Health Organization. Guidelines on the provision of manual wheelchairs in less resourced settings. Geneva (Switzerland): World Health Organization; 2008.
5. Vignier N, Ravaut JF, Winance M, Lepoutre FX, Ville I. Demographics of wheelchair users in France: Results of national community-based handicaps-incapacités-dépendance surveys. *J Rehabil Med.* 2008;40(3):231–39. [PMID:18292927] <http://dx.doi.org/10.2340/16501977-0159>
6. Extraits de l'enquête INEUM (réalisée en 2006–2007 pour la CNSA) sur le marché français des fauteuils roulants. France: Ineum Consulting; 2006. French.
7. Dalyan M, Cardenas DD, Gerard B. Upper extremity pain after spinal cord injury. *Spinal Cord.* 1999;37(3):191–95. [PMID:10213328] <http://dx.doi.org/10.1038/sj.sc.3100802>
8. Cooper RA. Wheelchair research and development for people with spinal cord injury. *J Rehabil Res Dev.* 1998;35(1):xi. [PMID:9505246]
9. Chan SC, Chan AP. User satisfaction, community participation and quality of life among Chinese wheelchair users with spinal cord injury: A preliminary study. *Occup Ther Int.* 2007;14(3):123–43. [PMID:17624872] <http://dx.doi.org/10.1002/oti.228>
10. de Groot S, Post MW, Bongers-Janssen HM, Bloemen-Vrencken JH, van der Woude LH. Is manual wheelchair satisfaction related to active lifestyle and participation in people with a spinal cord injury? *Spinal Cord.* 2011;49(4):560–65.
11. Giesbrecht EM, Ripat JD, Quanbury AO, Cooper JE. Participation in community-based activities of daily living: Comparison of a pushrim-activated, power-assisted wheelchair and a power wheelchair. *Disabil Rehabil Assist Technol.* 2009;4(3):198–207. [PMID:19241234] <http://dx.doi.org/10.1080/17483100802543205>
12. Samuelsson K, Wressle E. User satisfaction with mobility assistive devices: An important element in the rehabilitation process. *Disabil Rehabil.* 2008;30(7):551–58. [PMID:17852301] <http://dx.doi.org/10.1080/09638280701355777>
13. van der Woude LH, Bouw A, van Wegen J, van As H, Veeger D, de Groot S. Seat height: Effects on submaximal hand rim wheelchair performance during spinal cord injury rehabilitation. *J Rehabil Med.* 2009;41(3):143–49. [PMID:19229446] <http://dx.doi.org/10.2340/16501977-0296>
14. Brandt A, Iwarsson S, Ståhle A. Older people's use of powered wheelchairs for activity and participation. *J Rehabil Med.* 2004;36(2):70–77. [PMID:15180221] <http://dx.doi.org/10.1080/16501970310017432>
15. Rifai Sarraj A, Massarelli R, Rigal F, Moussa E, Jacob C, Fazah A, Kabbara M. Evaluation of a wheelchair prototype with non-conventional, manual propulsion. *Ann Phys Rehabil Med.* 2010;53(2):105–17.
16. Brochard S, Pedelucq JP, Cormerais A, Thiebaut M, Rémy-Néris O. Enquête de satisfaction sur l'équipement technologique des personnes tétraplégiques par blessure médullaire. [Satisfaction with technological equipment in individuals with tetraplegia following spinal cord injury]. *Ann Readapt Med Phys.* 2007;50(2):78–84. French. [PMID:17137672] <http://dx.doi.org/10.1016/j.annrmp.2006.09.004>
17. Confederation of Family Organisations in the European Union. Charter for family carers [Internet]. Brussels (Belgium): COFACE; 2015 [updated 2012 Mar 19]. Available from: [http://coface-eu.org/en/upload/07\\_Publications/COFACE-DisabilityCharterEN.pdf](http://coface-eu.org/en/upload/07_Publications/COFACE-DisabilityCharterEN.pdf)
18. Cooper RA. Wheelchair selection and configuration. New York (NY): Demos; 1998.
19. Cowan RE, Nash MS, Collinger JL, Koontz AM, Boninger ML. Impact of surface type, wheelchair weight, and axle position on wheelchair propulsion by novice older adults. *Arch Phys Med Rehabil.* 2009;90(7):1076–83. [PMID:19577019] <http://dx.doi.org/10.1016/j.apmr.2008.10.034>
20. Winance M. Mobilités en fauteuil roulant: Processus d'ajustement corporel et d'arrangements pratiques avec l'espace, physique et social. *Politix.* 2010;90(2):115–37. French.
21. Dutheil N. Aide et aidants des adultes, en ménage ordinaire, ayant une reconnaissance administrative de leur handicap [Internet]. Ministère de l'emploi et de la solidarité. French. Available from: <http://ifrhandicap.ined.fr/hid/hiddif/HTML/ETUDE09-2.PDF>
22. van Der Woude LH, Van Koningsbruggen CM, Kroes AL, Kingma I. Effect of push handle height on net moments and forces on the musculoskeletal system during standardized wheelchair pushing tasks. *Prosthet Orthot Int.* 1995;19(3):188–201. [PMID:8927531]
23. Hoogendoorn WE, van Poppel MN, Bongers PM, Koes BW, Bouter LM. Physical load during work and leisure time as risk factors for back pain. *Scand J Work Environ Health.* 1999;25(5):387–403. [PMID:10569458] <http://dx.doi.org/10.5271/sjweh.451>
24. Gorce P, Louis N. Wheelchair propulsion kinematics in beginners and expert users: Influence of wheelchair settings. *Clin Biomech (Bristol, Avon).* 2012;27(1):7–15. [PMID:21840091] <http://dx.doi.org/10.1016/j.clinbiomech.2011.07.011>

25. Roulants DE, Bornuat A, Choanière MP, Logeart C. Etude sur le financement des fauteuils roulants. Association des Paralysés de France; 2008. French.
26. Demers L, Weiss-Lambrou R, Ska B. Development of the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST). *Assist Technol.* 1996;8(1):3–13.  
[\[PMID:10159726\]](#)  
<http://dx.doi.org/10.1080/10400435.1996.10132268>

Submitted for publication April 2, 2014. Accepted in revised form January 23, 2015.

This article and any supplementary material should be cited as follows:

Marchiori C, Bensmail D, Gagnon D, Pradon D. Manual wheelchair satisfaction among long-term users and caregivers: A French study. *J Rehabil Res Dev.* 2015;52(2): 181–92.

<http://dx.doi.org/10.1682/JRRD.2014.04.0092>

ORCID: Claire Marchiori: 0000-0002-4906-1387; Dany Gagnon, PhD: 0000-0003-3464-4667



