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A survey of marginal wheelchair users

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Abstract—Significant numbers of wheelchair users experience difficulties with propulsion due to impaired upper limb function (termed marginal users for this study). A survey of wheelchair users in Tayside, Scotland, was carried out to identify and describe the marginal user population and their propulsion difficulties. Subjects for the survey were identified from the records of National Health Service wheelchair users at Dundee Limb Fitting Centre. Subjects were interviewed at home about their wheelchair-propelling experiences.

Survey results indicated that marginal users represent approximately 15% of the occupant-propelled wheelchair population. The average age of the marginal users surveyed was 48 years and the modal diagnosis was multiple sclerosis. Fifty-nine percent of the marginal users questioned felt that their wheelchairs were not adequate for their requirements.

Key words: *marginal users, multiple sclerosis, propulsion, wheelchair.*

INTRODUCTION

Wheelchair wheel position and other variables, such as castor type and size, handrim type, wheel camber, and backrest angle, can affect the efficiency and effectiveness of wheelchair propulsion for strong, fit users (1–6). However, the effects of such variables on the propulsion of less able users, who are only just capable of self-propulsion, have been neglected. Such wheelchair users are termed marginal users. The effect of optimizing the wheel position on an athlete's wheelchair may be a slightly faster time in a race, but for a less able, marginal wheelchair user it may be the difference between dependent or independent propulsion. The marginal user, therefore, stands to gain more from correct wheelchair adjustment.

The Scottish Office Home and Health Department funded an 18-month research project entitled "The Determination of Optimum Wheel Configurations for Wheelchair Users." The aim of the project was to determine the influence of wheel configuration on manual wheelchair propulsion. These influences were highlighted in clinical trials of marginal wheelchair users. Before the trials could take place, it was necessary to identify and describe the marginal wheelchair user population. A survey of wheelchair users in Tayside was completed for this purpose. This paper describes the survey and its results.

METHOD

Subject Selection

The survey of marginal users began with the identification of potential subjects from the records of over 3,000 wheelchair users (the total wheelchair population of Tayside) at Dundee Limb Fitting Centre. Three selection criteria were applied at this stage:

1. Self-propelling wheelchair users only were considered.
2. A geographical limit was imposed to limit travel. Users were selected only if they lived in the cities of Dundee and Perth or on the coastal strip of Angus (66 percent of the Tayside population).
3. Pre-school users were not considered; at the time of the survey, no children under 5 years old living in Tayside were self-propelling.

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A list of 700 names drawn from the first stage was passed on to the community occupational therapy service and to the staff at specialist educational, residential, and vocational centers for a further phase of sifting. The following exclusion criteria were applied at this stage:

1. Foot/feet only and double rim (one arm) propellers were excluded, as the project dealt specifically with two-wheel propulsion.
2. Users with good upper limb function were excluded. In some cases, impaired upper limb function was the result of problems other than the primary diagnosis (e.g., lower limb amputees with cardiovascular problems).
3. Very frail elderly people were not included due to the demanding nature of testing.
4. Users with poor motivation were excluded due to the lengthy and demanding nature of the trials.
5. Users with poor communication skills were excluded, as the trials made extensive use of subjective user feedback.

One hundred and seventeen users remained from the original list and were contacted by letter inviting them to discuss their propelling experiences. Eighty-three agreed to this request and were interviewed by the project staff.

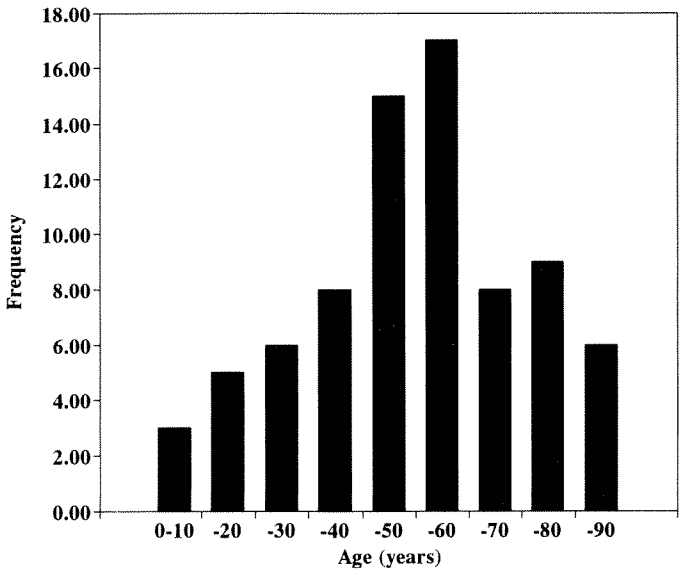

Figure 1.
Age distribution of marginal users.

Interview and Questionnaire

Subjects were interviewed in their most familiar wheelchair environment. This was usually at home, although some children were seen in their school. This gave the interviewer the opportunity to see wheelchair propulsion under normal conditions. The interview, which took the form of a questionnaire, was designed to highlight factors limiting successful wheelchair propulsion and daily use. Particular reference was made to wheel configuration. Propulsion difficulties were divided into categories of technical, functional, and environmental. Information was requested on the following topics:

- User background detail, including information on support services
- User medical background and diagnosis
- Wheelchair and seating information, including propulsion technique and ability
- Wheelchair environments
- Daily wheelchair activities, including transfer technique.

Of those interviewed, 3 were not considered to be sufficiently impaired. This left a group of 80 marginal users (44 male, 36 female).

RESULTS AND DISCUSSION

Estimation of the Marginal User Population Size

The number of marginal users identified in the survey was scaled to account for the subjects excluded in the sampling process (geographical exclusions, frail elderly, and users with poor motivation and communication) and to provide a minimum estimate for the population size of marginal wheelchair users. This gave an estimated total of 145 marginal users in Tayside, representing approximately 15 percent of the occupant-propelled wheelchair population.

The populations of Tayside, Scotland and the UK are approximately 400,000, 5 million, and 55 million respectively. Tayside has a sufficiently large population to be considered representative, in general, of the UK population. Approximate estimates, therefore, of Scotland and the UK's marginal user population sizes are 1,800 and 20,000.

Description of Marginal User Population

Twenty-four percent (19) of the marginal wheelchair users studied came from the 0–30-year age group (**Figure 1**). Typical diagnoses for these young users were spina bifida, cerebral palsy, and muscular dystrophy.

Fifty percent (40) of the users studied were between 30 and 60 years of age (**Figure 1**). This was reflected by many of the diagnoses being associated with deterioration in middle age: multiple sclerosis 26 percent (21), rheumatoid arthritis, 9 percent (7), amputations, 6 percent (5), and cerebral vascular accident (CVA), 6 percent (5) (**Figure 2**).

Twenty-six percent (21) of the sample were in the 60–90 age group, many of whom had been reasonably active wheelchair users in the past, but had become marginal through the combined effects of ageing and their diagnoses.

Figure 2 shows users by category. The largest diagnostic categories of marginal users in Tayside are multiple sclerosis, 26 percent (21), spina bifida, 10 percent (8), rheumatoid arthritis, 9 percent (7), and cerebral palsy, 8 percent (6).

As shown in **Figure 3**, 75 percent (60) of the subject group were using standard Ministry model 8 wheelchairs,

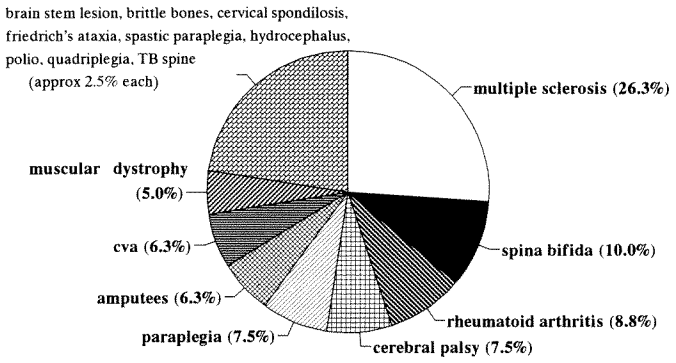

Figure 2.
Diagnoses of marginal users.

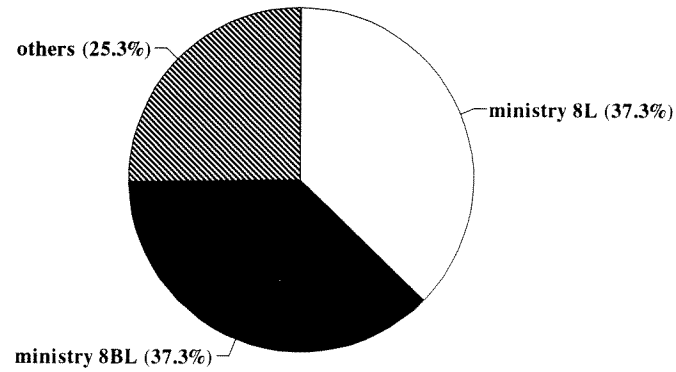

Figure 3.
Wheelchair types employed by marginal users.

Figure 4a.
Wheelchair Model 8L.

such as models 8L, 8BL, 8LC, and 8LJ. **Figures 4a** and **4b** illustrate examples of the most-used models (8L and 8BL). The remaining 25 percent (20) were using alternative models: Carter's Activ (4), Carter's Imperial (1), Chevron (1), Everest & Jennings (1), Newton (4), Poirier Roller (1), Quickie (2), Quickie Breezy (1), Remploy Roller (1), Swede Champ (2), Swede Elite (1), Vessa Variant (1). Of these alternative models, 15 percent (3) were supplied

Table 1.
Comments and different types of wheelchairs.

Comment	Model 8 (60)		Others (20)		Both (80)	
Wheelchair inadequate	67%	(40)	35%	(7)	59%	(47)
Technical problems	33%	(20)	10%	(2)	28%	(22)
General discomfort	42%	(25)			31%	(25)
Castors too small	23%	(14)			18%	(14)
Poor drive wheel position	15%	(9)			11%	(9)
Heavy to propel	18%	(11)	10%	(2)	16%	(13)
High rolling resistance	15%	(9)	5%	(1)	13%	(10)
Obtrusive armrests	13%	(8)	5%	(1)	11%	(9)
Obtrusive footplates	7%	(4)	15%	(3)	9%	(7)
Poor backrest angle	8%	(5)	5%	(1)	8%	(6)
Handrim grip too narrow	8%	(5)			6%	(5)
Uncomfortable seating	5%	(3)	5%	(1)	5%	(4)

Figure 4b.
Wheelchair Model 8BL.

through the National Health Service (NHS) and 85 percent (17) were purchased privately as the users felt that the NHS prescriptions were inadequate. (**Figure 3** and **Table 1**).

Only 39 percent (31) of the marginal users questioned propelled with the rims only, 54 percent (43) gripped the tire and rim together and 7 percent (6) the tire only. This

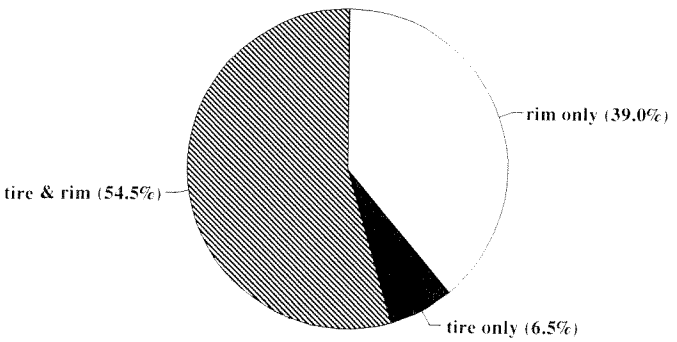

Figure 5.
Wheel grip methods of marginal users.

suggests that for 60 percent of those questioned, the handrims did not fulfill the purpose for which they were designed (**Figure 5**).

Fifty-five percent (44) of users transferred by standing and pivoting on their feet, reflecting the fact that marginal users often have some limited lower limb function. Only 23 percent (18) employed the sideways transfer technique, as most did not have sufficient upper limb strength for lifting themselves over the wheel (**Figure 6**).

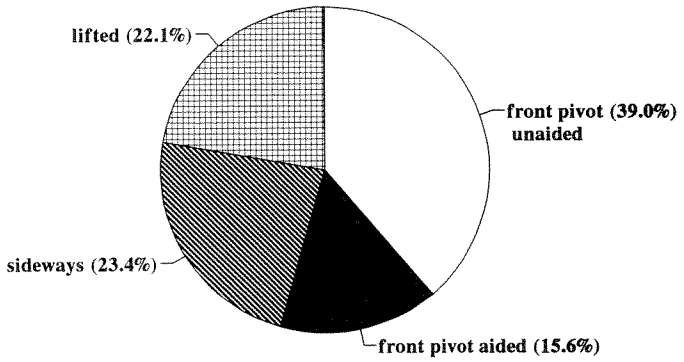

Figure 6.
Transfer techniques of marginal users.

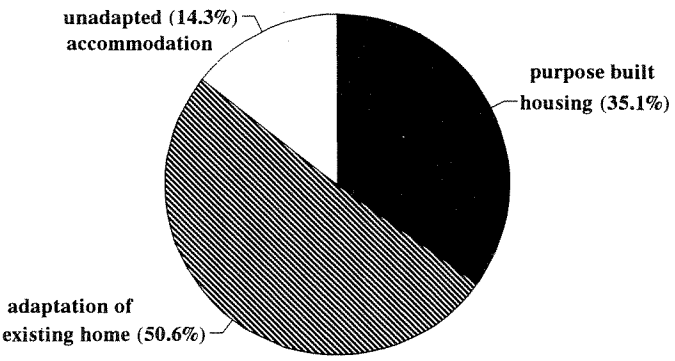

Figure 7.
Home environments of marginal users.

Nearly two thirds, 65 percent (52), of those interviewed did not live in purpose-built wheelchair housing (**Figure 7**). This lead to further propulsion difficulties caused by environmental factors. Standard width doorways caused access problems, particularly when turning through them in wheelchairs with footrests attached. Ramps created problems with rearward tipping instability. Door sills were reported to be difficult to negotiate and caused rearward tipping instability on impact with the front castor wheels. Inappropriate floor covering caused high rolling resistance.

Each user was asked to comment on the perceived adequacy of his/her wheelchair; 59 percent (47) felt that their chairs were inadequate with only 41 percent (33) feeling that their chairs were adequate. Those people who found their wheelchairs adequate often qualified this by saying that they had tried no other models.

Twenty-eight percent (22) of the wheelchair users interviewed thought that technical features of their wheelchairs inhibited successful propulsion and activities of daily living (e.g., poor wheel reach). Twenty-five other users (31 percent) were aware only of general discomfort and difficulties in using their chairs but were unable to describe the source of the problems.

Users were invited to give a subjective account of their own propelling experiences, identifying aspects of the wheelchair that they felt influenced propulsion performance. These comments were divided into the following categories:

Propulsion: Eighteen percent (14) commented that small casters compromised propulsion by creating rearward tipping instability when negotiating small obstacles such as door sills. Poor drive wheel position was noticed by 11 percent (9).

Rolling Resistance: Sixteen percent (13) felt that their wheelchairs were heavy to propel; 13 percent (10) thought that their castor type, together with floor surfaces, created high rolling resistance.

Wheelchair Frame: Eleven percent (9) commented that their armrests were obtrusive and inhibited wheel reach; 9 percent (7) said that their footplates were obtrusive and inhibited access through narrow spaces; and 8 percent (6) thought that their backrest angle compromised wheel reach and propulsion.

Handrims: Six percent (5) remarked that their handrims were too narrow to grip.

Seating: Five percent (4) found their wheelchairs to be uncomfortable.

Other Comments: Some users commented on more individual problems. These included:

- Large wheel diameters compromise sideways transfers
- Forward-positioned wheels compromise sideways transfers
- The plastic coating of the rims and the rubber of the tires caused allergic reactions
- Providing space for winter clothing widens the seat and inhibits wheel reach
- Cushion height inhibits wheel reach, particularly for someone with short arms
- Cushion height influences rearward tipping stability
- Punctures are difficult to cope with, particularly when living alone.

Table 1 compares comments about Ministry model 8 and other types of wheelchairs.

CONCLUSION

The survey results indicate that 15 percent (145) of the self-propelling wheelchair population in Tayside are experiencing difficulty in propelling their wheelchairs and may be termed marginal users. They exhibited the following characteristics:

1. Functional deterioration in middle age due to conditions such as multiple sclerosis, rheumatoid arthritis, amputation, and cerebrovascular accident (CVA); 50 percent are in the 30–60 age group.
2. Frailty due to old age creates propulsion problems for established wheelchair users; 26 percent are in the 60–90 age group.
3. Young marginal users (24 percent—under 30 years old) typically have conditions such as spina bifida, cerebral palsy, and muscular dystrophy.
4. Sixty-five percent of those questioned faced indoor and outdoor access problems as they lived in non-purpose-built accommodation.
5. The majority (59 percent) of users questioned said that their wheelchairs were inadequate for their requirements. Typical wheelchair problems included inadequate wheel positions (11 percent), castor wheels that were too small (18 percent), high rolling resistance (16 percent), obtrusive footplates (11 percent), and unsatisfactory handrims (6 percent).

The survey results provided valuable information about marginal wheelchair users. In addition, it was a valuable source of subjects for the subsequent investigation into propulsion by marginal users.

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