

Wheelchair use in everyday life

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Why understand wheelchair use in everyday environments?

- Clinicians and users
 - Relating a clients use (or anticipated use) relative to others may better inform decisions about models and configurations.
- Manufacturers and Suppliers
 - Better information about how products are used can inform design of their products and compare products.
- Payers
 - Any data that relates mobility to health or independence or secondary complications should inform policy. We can and should learn more about use to better distinguish users, and therefore coverage.

Characterizing Manual Wheelchair Use- Study 1

- 6 manual wheelchair users
- Inpatients of rehab facility in UK
- Activity monitor mounted to wheel

Wilson SKM, Haslet PM, Granat MH. Objective assessment of mobility of the spinal cord injured in a free-living environment. *Spinal Cord* (2008) 46, 352-357

7-day total & daily averages

Subj #	Time moving (hr)	Distance (km)	Speed (m/sec)	Daily covariance (%)
2	13.2	34.9	0.73	34
3	4.5	8.4	0.52	55
4	6.2	12.5	0.56	14
5	9.4	17.0	0.50	57
6	10.0	15.6	0.43	20
7	4.1	7.4	0.50	29

Subj #	Avg Time moving/day (hr)	Avg distance/day (km)
2	1.89	4.98
3	0.64	1.2
4	0.88	1.78
5	1.34	2.43
6	1.43	2.23
7	0.58	1.06

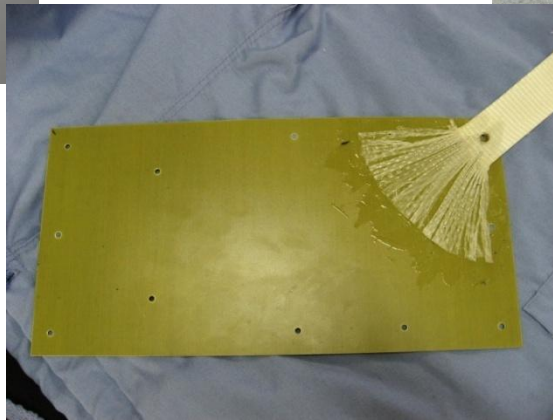
Characterizing Manual Wheelchair Use- Study 2

- 52 Athletes from VA Games
- 2.457 Km (sd= 1.20 km) over 47.9 min (sd=21.4)
- Employed subjects
 - 3.4 km

Tolerico, M, et., al ; Assessing mobility characteristics and activity levels of manual wheelchair users. JRRD 2007

Characterizing Manual Wheelchair Use- Study 3

- 6 full time users living in the community
- Seat occupancy switch
- Accelerometer-based data logger on wheel



Distance, time moving & bouts of mobility

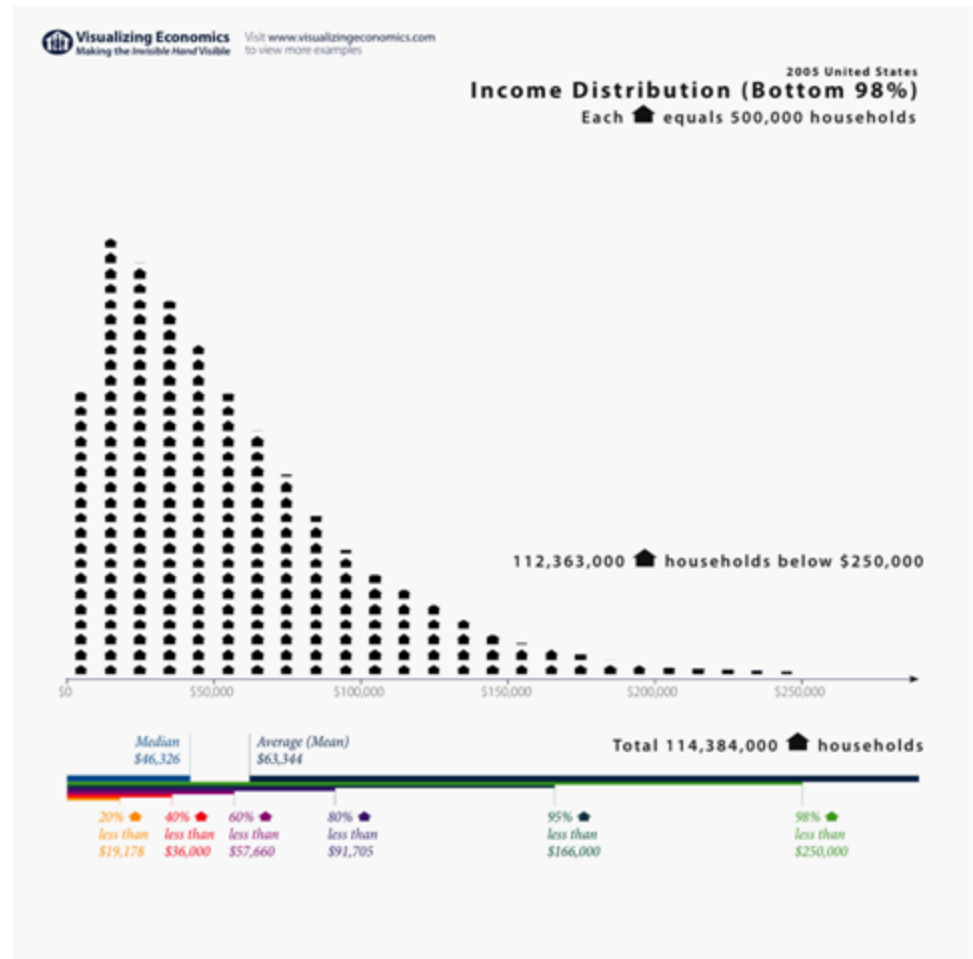
- Three constructs, 2 are commonly described
- Bouts of movement
 - Represent transitions between activities
 - Technical definition
 - Movement that is < 5 ft in < 5 sec
- Distance and time are very highly correlated
- Bouts are least correlated to the others in MWC and PWC data
- Data varies widely within and across subjects

Mean vs median

- Why look at median versus mean?
- Example: Income in the US
 - Normal or skewed?
 - What is the mean? median?

Median= 46,300
Mean= 63,300

20% < \$29,200
40% < \$36,000
60% < \$57,700
80% < \$91,700
95% < \$166,000
98% < \$250,000



Median and ranges of movement

Subject	Distance (m)		Time (min)		Number Bouts	
A	2295	(1710 - 3062)	95	(80 - 133)	113	(88 - 151)
B	1153	(523 - 2605)	61	(42 - 75)	81	(63 - 93)
C	1167	(875 - 1233)	87	(84 - 88)	119	(118 - 133)
D	676	(103 - 1150)	35	(7 - 46)	46	(14 - 60)
E	1375	(700 - 1731)	71	(39 - 91)	92	(58 - 112)
F	3596	(1577 - 4694)	134	(82 - 153)	136	(114 - 178)

* Subjects A, E & F are employed

Characterization of Power Wheelchair Use in the Home and Community

- 25 full-time power users
- Monitored for 2 weeks
 - Seat occupancy
 - Wheel movement
 - GPS
- Prompted recall used to add context & detail

Sonenblum SE, Sprigle S, Harris FH, Maurer CL, "Characterization of Power Wheelchair Use in the Home and Community," Archives of Physical Medicine and Rehabilitation **89(3)**, 486-91, 2008.

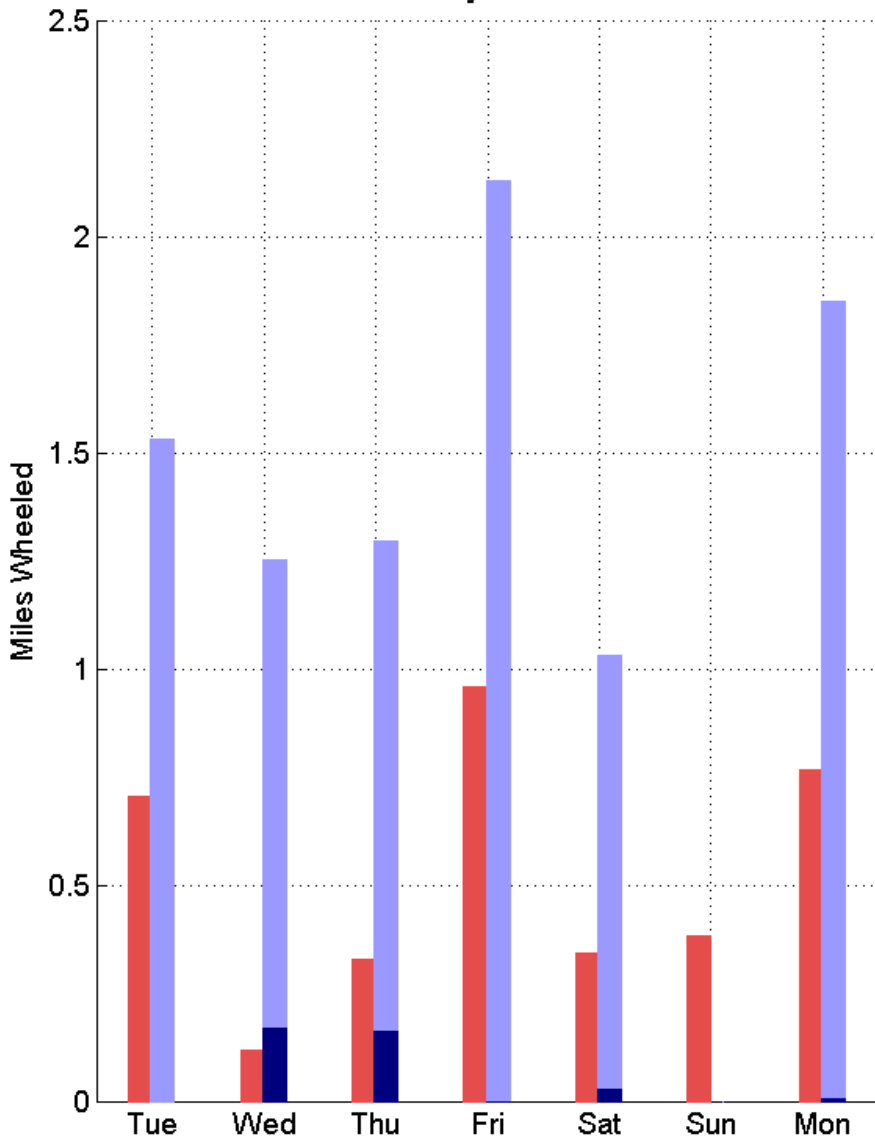
Environment	Variable	Median	Mean	SD
Home	% Distance	59	57	30
	% # Bouts	75	71	23
	% Time	64	63	27
Not Home Indoors	% Distance	13	22	18
	% # Bouts	13	19	17
	% Time	11	20	17
Not Home Outdoors	% Distance	2	19	29
	% # Bouts	2	8	12
	% Time	2	15	22

Median bout characteristics differ based on environment.

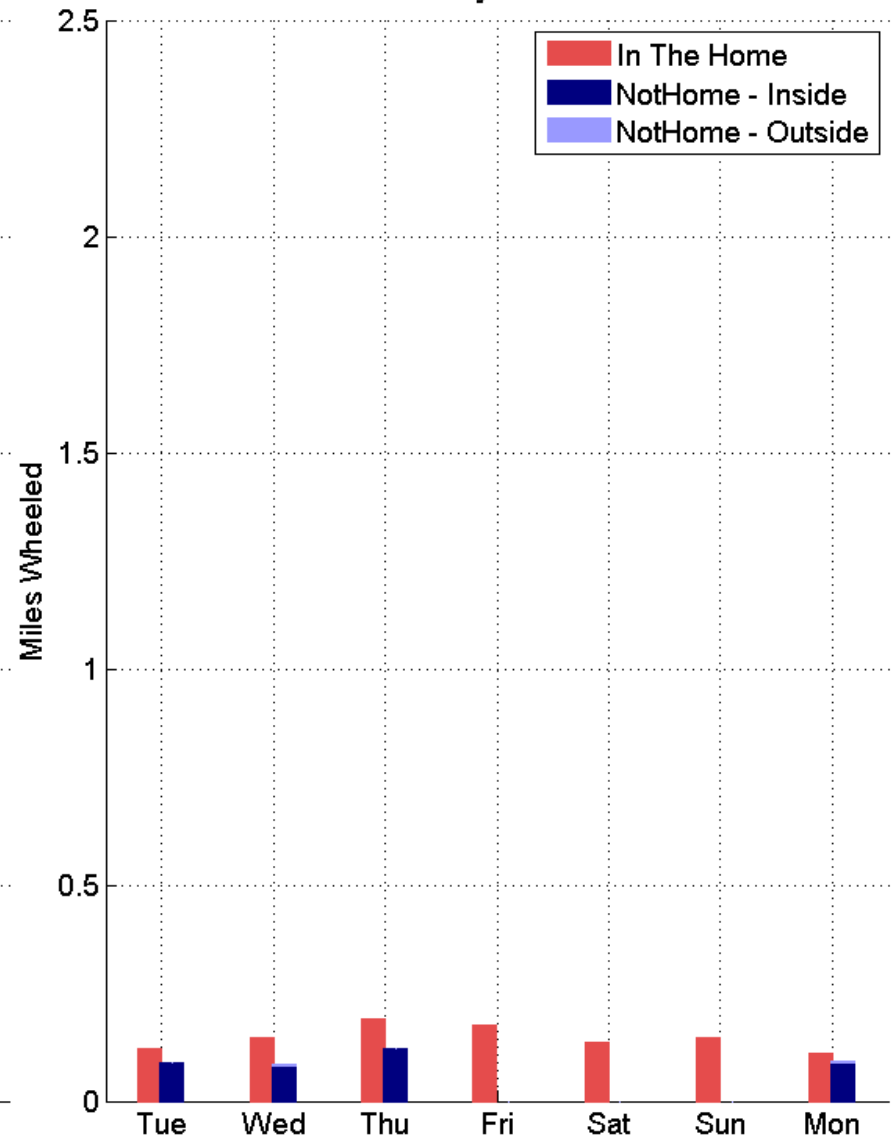
	Distance (m)	Duration (sec)	Speed (km/hr)
Home	3.7	18	0.8
Not Home Indoors	4.2	18	1.0
Not Home Outdoors	11.3	34	1.6

Comparing two users

Subject A



Subject B



10 vs 14" wheels

Can and should we try to discuss this?



Comparing usage

- PWC study- the median user
 - spent 10.6 hours in his/her wheelchair daily
 - wheeled 1.085 km over 58 minutes
 - 110 bouts
- MWC study- the *median* inpatient
 - Wheeled 2.0 km over 67 minutes
- MWC study- *mean* of Veterans Games participants
 - 2.457 Km over 47.9 min
- MWC study- the *median* community user
 - 1.33 km over 77 min
 - 101 bouts

How far do people walk?

- The role of free-living daily walking in human weight-gain and obesity. Levine, JA, et. al; Diabetes. 2008
 - **“walking comprises many short-duration, low-velocity walking bouts”**
 - **On average, a participant took 47 (range 46-62) walks per day: 85% were <15 min in duration, and 88% occurred at <2 mph;**
 - **On average, people walked about 11.25 km/day (7 miles)**
- Measurement of daily walking distance-questionnaire versus pedometer , Bassett D, Cureton A, Ainsworth B; Med & Sci in Sports & Exercise, 2000.
 - **Average: 4.17 +/- 1.61 km**
- How Many Steps/Day Are Enough?: Preliminary Pedometer Indices for Public Health. Tudor-Locke C, Bassett Jr D - Sports Medicine, 2004
 - **<5000 steps: sedentary (2.25 to 3 km)**
 - **5000-7500: typical (3.4-4.5 km)**

Why we should care

- Daily use varies widely within a person
- Use varies widely across people
- Movement is characterized by short bouts of movement
 - For PWC, this indicates need for maneuverability more than top speed
 - For MWC, this indicates that starts, stops and turns dominate propulsion
- Even if one considers only ITH, disparity of use can inform prescription (10” wheel vs 14”)
- Repair and replacement frequency is impacted by wheelchair usage

Why we should care- MWCs

- Research has not defined a dose-response relationship between time of MWC use and UE overuse injury
 - The disparity in propulsion might have masked this relationship
 - Documenting bouts of mobility and time moving might be a better measure

Why we should care- MWCs

- Can comparing average speed data to our clients' speeds inform prescription?
 - A client unable to reach the average speed necessary for 'everyday mobility' may form basis for different MWC or need for PWC
- Should research into propulsion reflect speeds used in everyday mobility?
- Endurance – total time propelling leads to 2 considerations
 - Enough 'umph' at end of the day
 - Able to get to point B from Point A (longest trek)

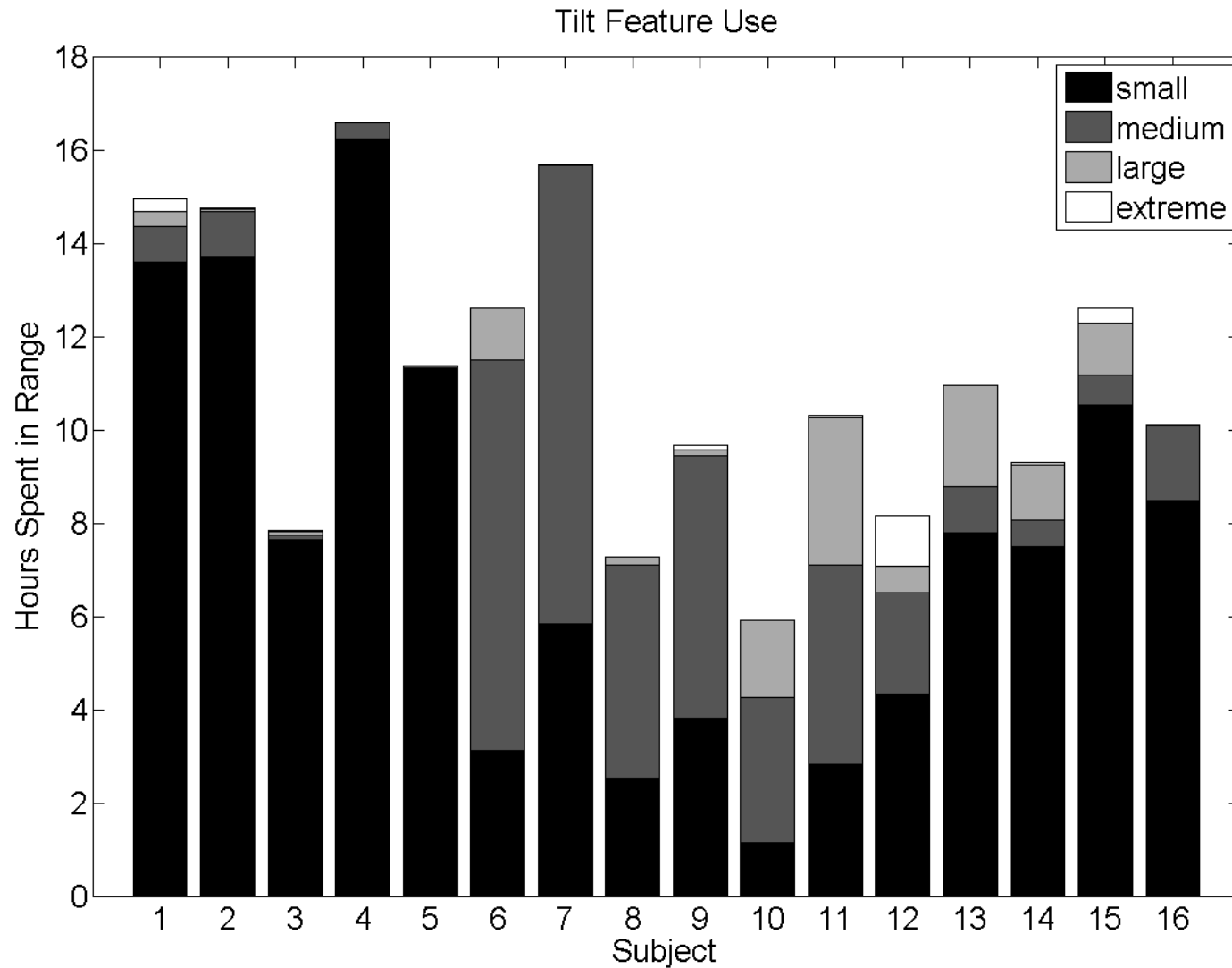
Comparing wheelchair use to walking

- Studies of both produce disparate results
- However, wheelchair movement is quite low, comparatively
- Can we infer walking data reflects typical ADL needs?
- Can we use this comparison to
 - judge ‘mobility limitation’?
 - make an argument that mobility devices should facilitate equal movement ?

Use of tilt-in-space

- Obtaining of specialized wheelchair features can be problematic
- Understanding use of TIS
 - Better document indications
 - Inform ways to optimize usage
 - Better match devices to users
- Recent publications: very consistent results
 - Ding D, et. Al; Usage of tilt-in-space, recline, and elevation seating functions in natural environment of wheelchair users, JRRD, 2008
 - Sonenblum S, et. Al, Use of power tilt systems in everyday life. Disability and rehabilitation. Assistive technology, 2009

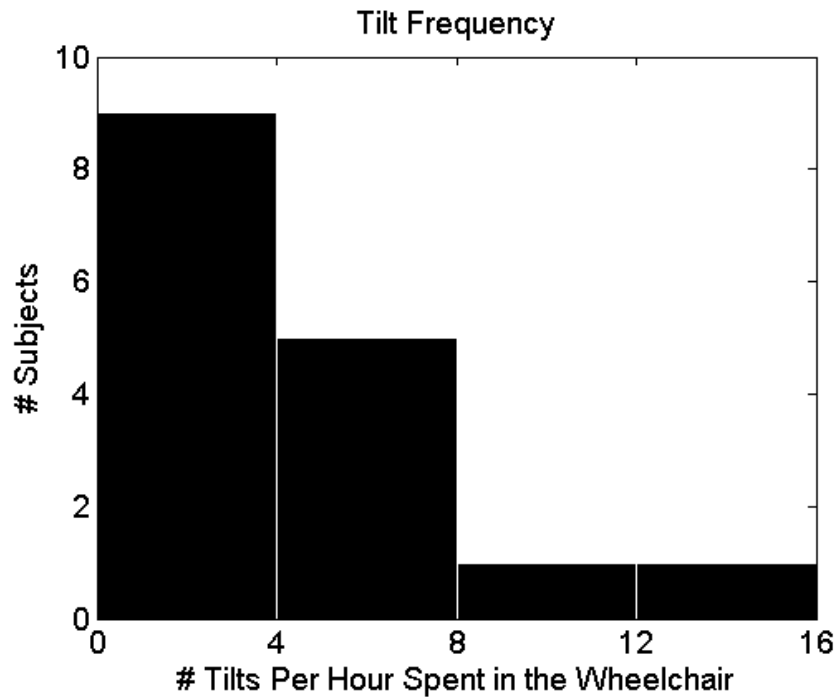
Tilt feature use



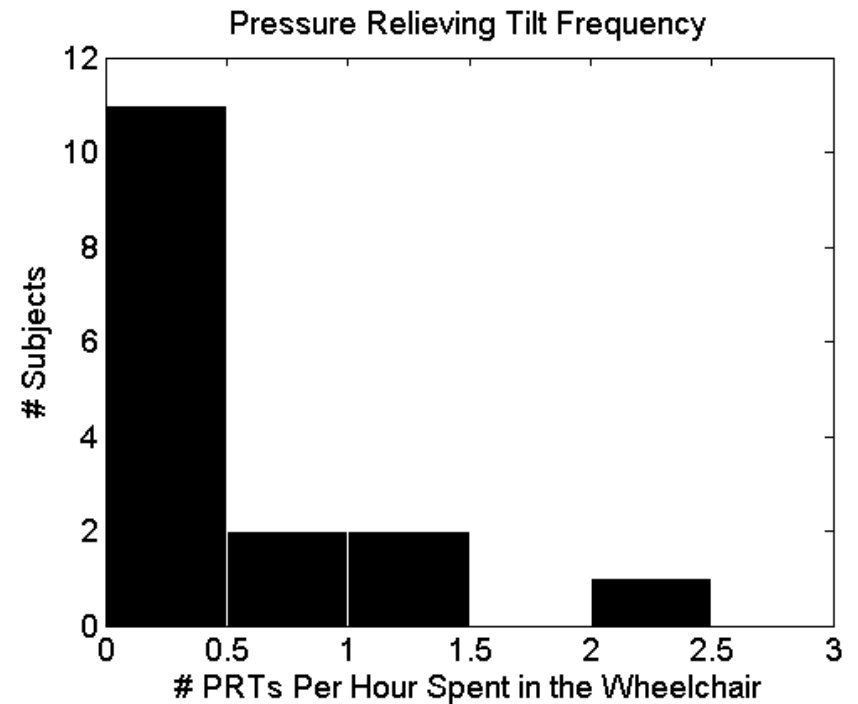
Subject	Typical Position	% Time < 15	% Time 15 -29	% Time 30 -44	% Time ≥ 45
1	7	91%	5%	2%	2%
2	9	93%	6%	<1%	<1%
3	6	98%	1%	<1%	<1%
4	9	98%	2%	0%	0%
5	1	100%	0%	0%	0%
6	27	25%	67%	8%	0%
7	16	36%	63%	<1%	0%
8	19	37%	61%	3%	0%
9	15	39%	58%	2%	<1%
10	25	19%	52%	29%	0%
11	25	28%	42%	30%	<1%
12	3	54%	26%	6%	14%
13	9	70%	9%	21%	0%
14	2	80%	6%	13%	<1%
15	5	84%	5%	9%	3%
16	7	84%	16%	<1%	0%
Median	9	75%	13%	2%	0%
Mean	11	65%	26%	8%	1%
S.D.	8	30%	26%	10%	3%

Use of tilting per hour

Use of tilt feature



Tilting >30°



Why should we care?

- People use their TIS feature frequently
 - May indicate that small changes in position increase comfort , stability and/or function
 - Regardless of the reason, use of feature should be encouraged during set-up and training
- Many people sit in some tilt for extended periods
 - May indicate gravity-assisted positioning is sought
 - Perhaps we can investigate this during evaluation for and training of TIS systems

Can we increase tilt magnitudes?

- Few people use full ranges of TIS feature
 - We have no reason to obsess over small differences in maximum tilt magnitudes
 - Our obsession should be in increasing utilization
- Better training and education may be indicated
 - During delivery, all users should be brought through full tilt range
 - Reports of confidence issues
 - Lack or awareness of reason TIS was prescribed
 - Perhaps IPM can be used as a training tool

Done