

Perceptions of anterior tilt seat function among power wheelchair users: A qualitative study

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INTRODUCTION

Power wheelchair (PWC) users report the need for seat functions to manage environmental barriers and navigate public and residential spaces designed for ambulatory individuals. [1, 2]. A lack of fully accessible environments results in wheelchair users relying on care partners for assistance in activities of daily living (ADLs) [3]. The use of seat functions can help to alleviate these burdens by providing an alternative approach for PWC users to accomplish their ADLs independently, as well as better interact with their environment, and avoid secondary conditions associated with prolonged sitting.

The use of anterior tilt (AT) to address some of these needs has become more prevalent in recent years. The AT seat function, similar to posterior tilt-in-space, changes the seat angle orientation in relation to the ground in the sagittal plane. Unlike posterior tilt-in-space, AT angles the seat forward to accommodate a semi-standing posture. A removable knee block and chest strap enhance stability while in the semi-stand position of AT. Limited research on the influence of the AT seat function among PWC users has been performed despite the encouraging literature on the static position [4, 5]. The efficacy of AT seat function requires further examination, both from a clinical perspective as well as from the perspective of the users themselves. The purpose of this study was to gain an in-depth understanding of how PWC users utilize the AT seat function in their own environment and gather perceptions on the usability of the seat function and how it affects functionality and comfort.

METHODS

Design

This qualitative study was a part of a larger mixed-method, repeated measures study. The study protocol was approved by the Institutional Review Board (IRB) at the University of Illinois at Urbana-Champaign (UIUC). PWC users with seat elevation on their wheelchair were recruited between March and November 2018. Participants received a Permobil F3 or M3 enabled with 20° AT seat function for use over a two-week period. Individuals were interviewed during two study visits. The study required approximately six hours of the participants' time in addition to the two week at-home trial period for which they received a total of \$150 in Amazon gift cards.

Participants/Procedure

Participants were recruited through a research registry, posting of flyers, and face-to-face interactions with research staff. Participants were asked to partake if they were: over 18 years of age, use of a PWC with seat elevation, but without AT, for at least 75% of mobility, use of current PWC for at least 6 months, at least one year since the onset of illness or injury that required the use of a PWC, use of a PWC to perform ADLs, and ability to engage in performance of ADLs either independently or with minimal to moderate assistance [6].

After signing an informed consent, participants were asked to complete a demographic survey, paper-based outcome assessments, physical outcome assessments, and semi-structured interviews. This paper is concerned with the qualitative components of the study protocol. Previous publications have provided descriptions of the full study protocol [7]. Each interview lasted approximately 10 minutes. All interviews were audio recorded [9] for later transcription and analysis. Additionally, the interviewer took written notes in order to indicate any gestures which might not have been picked up with audio alone.

Study Visit 1: Researchers met with participants at their homes where physical and paper-based assessments were performed in their own PWC. Upon completion of assessments, a trained interviewer conducted a face-to-face semi-structured interview in order to ascertain the participants' current use of their PWC. Participants were also asked to discuss their expectations for AT.

Study Visit 2: Approximately 2-3 days later, researchers returned to the participants' dwelling with a Permobil PWC enabled with AT. When possible, the drive configuration of the participant's study PWC was matched to the participant's own wheelchair. Participants were fitted in the study wheelchair by a physical therapist with an assistive technology professional certification and approximately 10 years of experience. Participants completed the same physical assessments tested during visit 1 in the study PWC. Participants were instructed to use the

study PWC over the course of the next two weeks. Follow-up calls were made approximately 24-hours and one-week after the second visit to ensure the PWC was fitted and working properly and encourage continued use of AT throughout their trial period.

Study Visit 3: Prior to the completion of the final study visit physical and paper-based assessments, the same trained interviewer conducted a final face-to-face semi-structured interview to ascertain the participants' final impressions of AT function, usefulness, and if they would request the function on their next PWC. After the completion of the final semi-structured interview, the visit 1 study protocol was repeated in the AT enabled PWC.

Analysis

Descriptive statistics were used to identify the sample. Demographic characteristics were examined for potential influence on participants' ability to use AT successfully. Means and standard deviations of continuous variables were used to categorize the sample using SPSS version 24.0.

Recordings of interviews were transcribed verbatim for thematic analysis [8]. Two authors, R.Y. and S. M., read all of the interviews several times over, individually coding for common themes. After individual coding, the researchers met to compare and discuss key themes related to the original research question. Once a consensus was reached, a codebook was created to aid analysis. All final coded transcriptions were reviewed by author L.R., who did not take part in the initial coding. Data analysis was performed on an ongoing basis. Demonstrative responses for use in the final publication were identified once the codebook had been created.

RESULTS

Ten fulltime PWC users (7 female), age 27 ± 12 years living with Multiple Sclerosis, Cerebral Palsy and Spinal Muscular Atrophy participated in the study. Participants had used a PWC on average 13 ± 7 years and received an average of 23 ± 12 hours of ADL assistance per week. One participant discontinued involvement citing a lack of time and failed to complete the final study visit, however data from study visit 1 was included in the analysis. No meaningful differences were found between the responses given by the participant who withdrew from the study and those who completed all assessments.

All participants reported regular participation in activities outside of their home and all but one participant reported an openness to using new technologies and ADL methods. Participants indicated that they spent most or all of their waking hours in their PWC and that they used most or all of the seat functions available to them on their PWC. Participants reported several barriers to participation including: (1) a need for assistance, (2) wheelchair issues, and (3) poor accessibility of public space.

Prior to the use of AT, participants reported that they anticipated AT would help them (1) reach objects, (2) require less assistance, and (3) get closer to people and objects.

"I think that it can be helpful for reaching for things on shelves in the store and also getting underneath the sink and reaching for things on the sink counter and I have some shelves and a copy machine at work that I think might be good for it." (Participant 2)

Immediately after using AT for the first time, participants described both positive and negative impressions of the seat function, as well as multiple locations they anticipated using the function in their community. These initial impressions remained mostly the same after the completion of the 14 day trial period. After using the study wheelchair for 14 days, participants reported that AT helped them to (1) reach a little further, (2) have additional positioning options, (3) improve their functional ability, and (4) increase their use of their seat functions.

"For people who want [to be] doing one more thing by themselves, [it] could mean that much more in empowerment. Being able to do one more thing just a little bit better could be really helpful." (Participant 4)

Participants also reported some limitations of AT after use in their environment. Some reported using AT was not sufficiently more helpful than a seat elevator alone. Also, participants who did not use a chest strap typically expressed concern that the safety equipment was restricting.

"The knee block and the seat belts held me back so much...it was just overall more restrictive because of the way the safety features were set up." (Participant 2)

Additionally, it was noted by participants that in order to use the AT seat function adequately in their environment, more training on how to use the function was required:

"It is hard to figure out how to position the chair itself to be able to use it successfully." (Participant 1)

While most participants reported that AT did not have an impact on their chair comfort, some participants noted discomfort associated with the knee blocks.

"I think the padding on the knee thing could be better, softer. And the device a little lighter and easier to pull on and off" (Participant 8)

Participants reported multiple specific environments and tasks in which they found AT to be beneficial, including: (1) in the community, (2) at work/school, and (3) in their home.

"Using the elevator, [AT] actually helped by leaning me forward to press the button." (Participant 10)

When asked if they would request AT on their future devices, four participants indicated that they would, four reported that they would not, one was unsure, and one did not report. Regarding recommendations for future AT designs, participants largely focused on the desire to see improvements to the usability of the safety equipment by making them less restrictive, more comfortable, and more compact.

"I would suggest for whoever designed the [knee blocks] to take into account rubbing on people's skin and stuff." (Participant 2)

Additionally, participants reported a desire for the chair to be able to change positions faster and provide additional arm support to better facilitate forward reaching. Two participants indicated that having a feature that enabled them to tuck their feet more under their seat, so that the footplates were out of the way in a forward approach, would make AT more effective.

"Maybe having some way to prop your arms up, for people who do not have a lot of upper body strength to...still be able to utilize that feature, to be able to reach further." (Participant 3)

DISCUSSION

The current study examines PWC user's perceptions of the AT seat function after two weeks of use of a study wheelchair enabled with the seat function. This study provided insight into the performance and function of AT seat function from the perspective of PWC users outside of a laboratory setting. This is unique compared to the previous literature that primarily focused on static anteriorly tilted seat positioning in laboratory settings [4, 5].

Findings of this study revealed that the AT seat function provides participants with extra reach and additional body positioning options that make it easier to conduct a range of daily tasks in a variety of environments. The effect of AT may have vast impacts on a PWC user's ability to perform tasks independently. Interestingly, all of the environment specific benefits discussed by participants in this study closely align with the community environments and vocational/recreational examples given by RESNA in their position paper on standing devices for PWCs [10]. AT appears to have similar perceived benefits to standing devices for users in their social and vocational environments. Future research will need to explore the long term physical impact of regular use of AT and how this compares to standing function.

Generally, participants with limited upper extremity function did not find AT to be much more beneficial than the seat elevator function alone. These users indicated AT would be more beneficial for someone with better use of their upper extremities. This may be a factor for consideration by practitioners when deciding if the AT seat function would be beneficial for their client.

Some participants discussed the benefits of using AT as an alternative form of pressure relief and stretching. This suggest that AT may have clinical benefits towards users' physical well-being. Future studies will need to look at the specific pressure redistribution that results from the use of AT. However, some participants reported increased pressure on their shins as a result of the use of the knee block while using AT. As a result, clinicians must ensure proper adjustment of the knee block and frequently follow up with their clients to ensure proper alignment.

Based on the qualitative data, AT may be a beneficial alternative to standing function for individuals who lack standing tolerance. Previous research [8] has indicated that AT positioning appears to partially shift pressure off of the user's sitting surface and into their lower extremities. Further research is needed to assess the use of AT as an alternative to standing function in populations who have been determined as not likely to be able to tolerate the use of a standing wheelchair.

All participants discussed the influence of the safety equipment associated with AT. The chest strap was primarily described as limiting forward leaning. The knee block was primarily criticized for its bulk and weight, making it hard to manipulate independently and getting in the way of reaching downward. These concerns provide valuable insight into where the AT function on PWCs can be improved in order for manufacturers to better accommodate

the needs of potential users of these technologies. Additionally, careful consideration and use of customized safety equipment is critical to maximize functionality of each client.

The present study had several limitations as it was exploratory in nature, involving only 10 participants with a limited range of mobility impairments and occupations. The inclusion of a larger number of participants with a greater variety of backgrounds would improve the generalizability of the results. Given the short length of the study, participants were not likely to see physical health improvements that AT may provide over time. A longer trial period would improve the likelihood of participants reporting effects related to their health and well-being. Since the study wheelchair did not have the same exact dimensions as the participants' own wheelchair, several participants reported issues they did not usually face unrelated to AT use when interacting with their environment. The study made use of trial wheelchairs that even with expert fitting, a high level of customization was not possible, which may have influenced overall perceptions of the seat function. Future studies would benefit from investigating individuals who are receiving AT on their own wheelchairs upon receiving the new device. This would eliminate confounding variables and allow for a longer period of use. Despite the limitations, this study serves as an important pilot to help inform future, larger studies.

CONCLUSIONS

Participants felt that AT provided additional functionality by allowing them to reach further than they could without AT. Benefits of using AT were discussed in a variety of environments. Additionally, some participants felt AT provides a greater range of positioning options that may have potential benefits for pressure relief and overall comfort. Consideration is still needed to address design concerns of the safety equipment necessary to utilize AT, which may limit users' natural functionality. The findings of this study will inform future iterations of the seat function and its associated safety equipment design. These findings also add to the existing literature on the AT seat function, which help clinicians in identifying the appropriateness of this seat function for their clients.

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