

# Feasibility and Perception of the Impact From Aerobic Exercise in Older Adults With Alzheimer's Disease

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Fang Yu, PhD, GNP-BC, RN<sup>1</sup>, and Ruth M. Swartwood, MA<sup>2</sup>

## Abstract

**Background:** The subjective experience of participating in aerobic exercise is unknown in Alzheimer's disease (AD). **Objective:** The purpose of this study was to understand the subjective perceptions of the feasibility and impact of a 6-month, moderate-intensity aerobic exercise intervention by older adults with AD and their family caregivers. **Methods:** Ten older adults with AD who completed the intervention and their family caregivers participated in four focus group interviews. **Results:** Four converging themes were identified: "There was no perceived positive change in cognitive symptoms," "The 6-month exercise program was socially rewarding," "The 6-month exercise program increased physical strength," and "Participation in aerobic exercise was a positive experience." Family caregivers further identified two additional themes: "The exercise program led to improved attitude in older adults with AD" and "The exercise program reduced caregiver stress." **Discussion:** Aerobic exercise is a feasible and well-perceived intervention for older adults with AD and their family caregivers.

## Keywords

Alzheimer's disease, exercise, cognition, caregiver, psychological function, aerobic exercise

Currently, 5.4 million adults are diagnosed with Alzheimer's disease (AD) in the United States alone.<sup>1</sup> As the population continues to age, this statistic is projected to rise to 14 million by 2050.<sup>1</sup> The AD triad symptoms, cognitive impairment, functional decline, and behavioral and psychological symptoms of dementia (BPSD) precipitate many poor health outcomes and are very burdensome and costly to manage for those affected and their family caregivers.<sup>1,2</sup> However, the prospect for a cure for AD is still bleak: the existing AD drugs have limited short-term efficacy, are not tolerable to some individuals due to side effects, and do not deter AD progress.<sup>3</sup> Medications for BPSD could even increase mortality.<sup>4</sup> Thus, there exists a critical need to evaluate the impact and subjective experience of behavioral interventions such as aerobic exercise in AD.

## Background

Aerobic exercise, defined as "repetitive and rhythmic movement of large muscle groups to improve the efficiency of energy-producing systems that use oxygen,"<sup>5</sup> has demonstrated success in reducing AD neuropathological  $\beta$ -amyloid plaques and improving memory in AD-transgenic mice.<sup>6</sup> At least 5 meta-analyses have been conducted to examine the effect of aerobic exercise on cognition in nondemented older adults, showing that aerobic exercise has a modest to moderate effect sizes at improving cognition.<sup>7-11</sup> A meta-analysis of exercise studies in older adults with cognitive impairment and

dementia suggested that exercise improved cognition.<sup>12</sup> Although a latter meta-analysis did not find physical activity affected cognition in AD, its findings were mainly based on 2 exercise studies where the doses of the physical activities were very low.<sup>13</sup> Although there are only limited numbers of aerobic exercise studies in AD, the emerging findings are encouraging and indicate that aerobic exercise might improve cognition or slow down cognitive decline.<sup>14-18</sup>

Research has further demonstrated that aerobic exercise has the potential to prevent secondary conditions that can arise from cognitive decline such as functional decline in activities of daily living (ADLs) and BPSD.<sup>19</sup> A randomized controlled trial (RCT) reported that a 3-month caregiver-delivered exercise program reduced the number of days that community-dwelling older adults with AD experienced physical restriction.<sup>17</sup> Another RCT showed that a 1-year exercise intervention reduced ADL disability by 6.7% in nursing home residents with AD.<sup>20</sup> Two RCTs have shown that exercise

<sup>1</sup> School of Nursing, Adult and Gerontological Nursing Cooperative, University of Minnesota, Minneapolis, MN, USA

<sup>2</sup> School of Educational Psychology, University of Minnesota, Minneapolis, MN, USA

## Corresponding Author:

Fang Yu, PhD, GNP-BC, RN, School of Nursing, University of Minnesota, 5-160 WDH 1331, 308 Harvard St Se, Minneapolis, MN 55455, USA  
Email: yuxxx244@umn.edu

**Table 1.** Characteristics of the Study Sample (n = 20)

Mean (SD); range	Older adults with AD, n = 10	Family caregivers, n = 10
Age	78.3 (8.87); 64-91	65.0 (14.1); 49-83
Total years of education	16.6 (3.53); 12-24	18.0 (3.17); 14-23
Baseline MMSE	19.4 (3.75); 13-23	
Baseline CDR: median (range)	1 (1-2)	
N (%)		
Gender		
Male	3 (30.0%)	6 (60.0%)
Female	7 (70.0%)	4 (40.0%)
Ethnicity		
Non-Hispanic white	10 (100%)	10 (100.0%)
Relationship to participants		
Spouse		4 (40.0%)
Daughter		5 (50.0%)
Friend		1 (10.0%)

Abbreviations: SD, standard deviation; AD, Alzheimer's disease; CDR: Clinical Dementia Rating scale with higher score suggesting more severe dementia; MMSE, Mini-Mental State Examination with higher score indicating better cognition.

improved mood and depression in older adults with AD.<sup>21-23</sup> Recent studies have also found that older adults with AD could improve their physical fitness.<sup>24,25</sup>

Despite these findings, there are many gaps in our understanding about the impact of aerobic exercise interventions in older adults with AD. For example, researchers have focused primarily on quantitative AD triad symptoms with little attention to the subjective experiences. Such a focus might prohibit practice adoption of aerobic exercise by health care professionals and lay public because significant effects on AD triad symptoms might not be observed or realized without a substantively large sample. Hence, qualitative methods could potentially enhance our understanding of the subjective experience and provide more rich information about the effect of aerobic exercise than quantitative studies. Understanding subjective experiences will also help propel health care practice changes and ascertain the sustainability of the interventions. Hence, the purpose of the present study was to understand the perceptions of the feasibility and impact of a 6-month, moderate-intensity aerobic exercise intervention by community-dwelling older adults with AD and their family caregivers.

## Methods

### Design

The present study reports on the qualitative arm of a master study that used a single-group, repeated-measures, mixed-method design to provide a 6-month, moderate-intensity aerobic exercise intervention to community-dwelling older adults with mild-to-moderate AD. The cycling intervention was made progressively harder over time until older adults with AD reached their own moderate-intensity cycling for 45 minutes, 3 times a week. The intervention was delivered over 6 months. Moderate intensity was individualized using a combined objective heart rate reserve method (65%-75% heart rate reserve) and subjective perceived exertion rating (12-14 on the Borg Rating of Perceived Exertion Scale). Older adults with AD start

at a lower intensity, for example, 40% heart rate reserve or 9 on the Borg Rating of Perceived Exertion Scale for 10 minutes a session initially. After older adults with AD had completed this dose 3 times in a row, the cycling intensity was increased by 5% heart rate reserve or 1 Borg rating of perceived exertion. After older adults with AD completed this dose 3 times in a row, the cycling duration was increased by 5 minutes per session. This method was used to alternatively increase cycling intensity and duration until older adults reached 45-minute cycling at moderate intensity per session and continued at this dose until the end of 6 months. The cycling intensity, duration, resistance, speed (revolutions per minute), and distance cycled for each session were documented. That information was also documented in the exercise diary we prepared for each older adult with AD, so they could review and share their progress. The exercise diary was a great motivator for the older adults with AD.

The intervention was delivered at either a YMCA gym or a senior community campus, depending on the residence location and preference of older adults with AD. Quantitative outcomes on cognition, physical function, and BPSD were assessed at baseline and at 3 and 6 months. Following the completion of the 6-month intervention, older adults with AD and his or her family caregiver participated in focus group interviews. Focus group interviews were conducted separately for older adults with AD and family caregivers. This study was approved by the university's institutional review board.

### Sample

Ten older adults with AD and 10 family caregivers participated in the focus group interviews. Table 1 depicts the characteristics of the older adults with AD and their family caregivers.

### Setting

All focus groups were conducted at the university's Clinical and Translational Science Institute. Transportation was

**Table 2.** Guiding Questions for Focus Group Interviews With Older Adults With AD and Family Caregivers

Questions	Older adults with AD	Family caregivers
Introductory question	Say a little about what being a part of this study (reference to the master study) was like for you?	Please think about your relationship with your loved one prior to this exercise program, then compare that with your relationship with your loved one presently. Describe any changes you've seen or felt, or tell us if things have remained the same.
Question 1	What did you like about the program?	Your loved one has been attending the exercise program for 6 hours per week for the past 6 months. How has this program impacted your life?
Question 2	What did you dislike about the program?	We'd also like to understand how this program has affected you physically and emotionally. Please talk about your overall physical and mental health for the past 6 months.
Question 3	Has your daily life changed since you started the exercise program?	We'd also like to understand how this program has affected you socially?
Question 4	Have you noticed any changes in your memory since you started the exercise program?	We'd like to understand how this study has affected your levels of stress. Please describe your overall level of stress or exhaustion over the course of the past 6 months. Has it changed or stayed about the same?
Question 5	Have you noticed any changes in yourself when you are with other people?	Have you noticed changes in your loved one? These could include behavioral changes, changes in their interests, hobbies, activity or conversation.
Question 6	If you plan to keep exercising after this study, what could be done to help you to do that?	How do you think the provision of this exercise program to other older adults with AD would impact the lives of their caregivers? Please talk about what you liked and didn't like about the program.
Question 7	Will you continue to exercise? Why or why not?	

Abbreviation: AD, Alzheimer's disease.

provided for older adults with AD to attend the focus group interviews. Family caregivers drove themselves to attend their focus group interviews.

### Focus Group Procedure

In the master study, older adults with AD and family caregivers had given informed consent/assent for participating in the focus group interviews. Every effort was made to schedule the focus group interviews as close to the completion of the 6-month intervention as possible. Prior to the beginning of each focus group, informed consent was again discussed with the older adults with AD and family caregivers, and verbal consent was obtained. Included in the consent form was the release to audiotape the focus group sessions. Careful efforts were made to ensure the older adults with AD and their family caregivers understood the consent. They were given ample time and opportunity to ask questions. A standard guide was used to direct the discussions of focus group interviews (Table 2). At the end of the focus group interviews, each older adult with AD and family caregiver received \$25 compensation for participation. All audio-recorded data were transcribed using a university-approved transcription service. Transcribed data were de-identified by the RA before data were analyzed.

Four focus group interviews were conducted for the older adults with AD and family caregivers between November 2010 and November 2011. The format of each focus group interview was designed according to the 10 ingredients for a successful focus group with an emphasis on facilitating a trusting and creating an open environment that fosters honest communication.<sup>26</sup> Two focus groups were conducted with the older adults with AD ( $n = 5$  and  $n = 5$ ). Two focus groups were conducted with the family caregivers ( $n = 5$ ,  $n = 5$ ). The focus group interviews with older adults with AD took 40 to 45 minutes, while the focus group interviews with family caregivers took about an hour and 10 minutes. An undergraduate research assistant (RA) attended each focus group interview and typed notes during the interviews to ensure data quality. A trained counseling psychology doctoral student facilitated each focus group session.

The interview questions were designed to be slightly vague and open ended<sup>27</sup> such that older adults with AD would provide responses that were not unduly biased by the questions asked. The questions for older adults with AD were further simplified in comparison with those for family caregivers to make sure they could understand the questions. Questions focused on the perceived changes due to the intervention. Older adults with AD and family caregivers were reminded before and during the focus group interviews that "change"

referred to positive or negative changes or no change if relevant (Table 2).

### Data Analysis

Data were analyzed using content analysis. The data analysis was based on transcriptions from each focus group, the typed notes taken by the RA, and hand-written notes made by the facilitator during the focus group interviews. Data analysis began with open coding, a process designed to develop initial categories by examining words, phrases, and sentences. During this process, researchers developed code and category labels based on their impressions of the data. Following open coding, codes and categories were organized using axial coding, a process designed to develop structure and relationships within the data. Following axial coding, selective coding, or the integrative process of “selecting the core category, systematically relating it to other categories, validating those relationships (by searching for confirming and disconfirming examples), and filling in categories that need (ed) further refinement and development” was used to develop themes.<sup>28,29</sup>

## Results

### Demographics

Of the 11 enrolled older adults with AD, 10 participated in the focus group interviews, and 1 rescinded consent before any baseline data collection because of busy life schedule to fit the study in. Eight of the 10 older adults with AD completed the 6-month intervention, resulting in an 80% retention rate. The dropouts were due to wrist fracture ( $n = 1$ ) and ankle fracture ( $n = 1$ ). Neither fracture was related to the study. Of the 10 older adults with AD, 7 were women and 3 were men. Their average age and education were 78.3 and 16.6 years, respectively. Their baseline Clinical Dementia Rating score ranged from 1 to 2 and Mini-Mental State Examination scores were 13 to 23, indicating mild-to-moderate stages of AD. They were all non-Hispanic white.

Of the 10 family caregivers who took part in focus group interviews, 4 were women, 6 were men, and their relationship with the older adults with AD were spouse ( $n = 8$ ), child ( $n = 1$ ), and friend ( $n = 1$ ). Their average age and education were 65.0 and 18.0 years, respectively. They were also all non-Hispanic white.

### Themes Emerged From Focus Group Interviews

Four common themes separately emerged from focus group interviews with older adults with AD and family caregivers, including “There was no perceived positive change in cognitive symptoms,” “The 6-month exercise program was socially rewarding,” “The 6-month exercise program increased physical strength,” and “The assessment of the exercise program was unanimously positive.” Two additional themes appeared from focus group interviews with family caregivers: “The exercise

program led to improved attitude in older adults with AD” and “The exercise program reduced caregiver stress.” They also made recommendations to the exercise.

*Theme 1: There was no perceived positive change in cognitive symptoms.* Older adults with AD reported that they did not perceive any improvements in cognition (eg, improved memory) or a reduction of cognitive symptoms during the intervention. The majority of older adults with AD similarly denied the presence of a decline in cognitive symptoms, although a small number of older adults with AD reported a perception that their cognition had worsened during the 6-month period of the intervention. Older adults with AD, however, were unable to provide examples of changes in cognition that were attributable to the intervention. Some general comments about the impact of the exercise program on their perceived symptoms were made:

I noticed that I still forgot things very much. That's what this horrible disease does; you forget a lot.

When asked about perceived changes, another participant simply said, “I can't think of anything.”

Family caregivers similarly were unable to provide examples of perceptible changes in cognition older adults with AD. Similar to the older adults with AD, a handful of caregivers reported perceptible cognitive decline during the 6-month intervention. After being asked if there were any changes in symptoms related to memory loss, one caregiver said, for example:

He reads the sports page every morning and doesn't have a clue who any of those teams are, what they do, what they play. We went to Gopher basketball and football games for forty years in a row, sat in the same seats and he doesn't even remember. This year he doesn't even know we don't go to the games for the first time, because we watch them on TV. Those are big changes.

Family caregivers noted that it was difficult to determine whether there were any changes because there was no comparison group by which to make an assessment. The caregivers seemed aware that AD is a degenerative disease, so if any positive changes did occur, they might be difficult to identify:

Exercise is certainly good for the heart, and I know an important part of this study is to determine if it's good for the brain. Even if it doesn't show up in really tangible ways, it doesn't mean it hasn't been [good]. The fact is that I have no way of knowing over these 6 months how [loved one's name] would have progressed without it, so I don't have a control versus an experiment. However, she hasn't changed very much if at all.

*Theme 2: The 6-month exercise program was socially rewarding.* All older adults with AD described the 6-month exercise

program as socially rewarding. Older adults with AD specifically noted the presence of other individuals with AD, the presence of the research team who trained them in exercise techniques, and the members of the research team who drove them to and from the exercise facility. Older adults with AD frequently mentioned feeling a sense of camaraderie with other older adults with AD in the program. Particularly, many older adults with AD noted that it was easier to exercise with other adults who were diagnosed with AD.

Sometimes when you have Alzheimer's, you feel kind of alone. [When you exercise with other people] then you don't feel so odd.

Another older adult with AD said, "You felt like a first-class human being, being involved with all these people. Being able to participate in such a gift, it was a blessing."

Another older adult with AD added, "And the camaraderie. It's such a blessing that a person would never realize until they get involved with this."

A handful of family caregivers also stated their loved ones found the program socially rewarding. Many caregivers commented that their loved ones would talk about the relationships made with the research staff and the other older adults with AD. With regard to an older adult with AD who had to drop out of the 6-month program early, a family caregiver stated:

I did notice, though, when she had to drop out it did affect her personally because I think she was really enjoying the program. [She] Loved the sociability. I sense that she felt a loss, loss of the connection.

Another caregiver shared her perception of the socially rewarding value of the program for her loved one, "He doesn't remember from one day to the other, but he does know that when it's the day to go to this exercise program to be picked up, he's very eager to go. He's very excited to see the people come to pick him up. He's very happy to come back home and tell me it was a good session . . . There were days, when the weather was good, that he would sit on the porch and wait for his ride, but it wasn't a day that they were going to come by. He really valued the people."

**Theme 3: The 6-month exercise program increased physical strength.** Every older adult with AD reported perceptions of increased physical strength and stamina as a result of the exercise program. Many noted a positive impact on their self-perception because of weight loss, a feeling of accomplishment, or being the highest achiever in the group. Because the exercise interventionist documented their achievement in their exercise diaries at the end of each session (eg, achieved resistance level, speed, and distance covered), older adults with AD could see and compare their achievement to their previous sessions and peers. Older adults with AD frequently mentioned feeling more physical safety during the winter

months, while walking on stairs and while traversing uneven terrain (eg, curbs).

One older adult with AD shared, "Physically stronger, yeah. You're more apt to get involved and do more. Summer is no problem. In the winter you're going to push a little bit more because you realize the value of yourself and other people, and if you don't keep involved and pushing ahead you're going to go behind. That's what I learned and it's very true."

Another shared, "I loved the exercising at the Y. I was so fast on the bicycle; no one else could catch me. It was just fun."

While older adults with AD appreciated the impact exercise had on their feelings of self-confidence, appearance, and physical strength, family caregivers also noted those and some other benefits of the exercise program. Primarily, many family caregivers reported feeling more confident in their ability to care for older adults with AD as a result of increased physical strength in older adults with AD. Caregivers frequently noted increased confidence leaving the older adults with AD unsupervised for period of time due to their increased physical strength. Family caregivers discussed this confidence at length, many stating that for the first time in months they felt comfortable leaving the house with their loved one at home. Family caregivers particularly noted an increase in confidence that older adults with AD would not fall or trip in their absence. One caregiver said:

[When I'm gone] I have a better sense of confidence that she'll be okay because her physical ability, I think, has improved.

Another caregiver said, ". . . to see the improvement from five minutes and having to stop, to 55 continuous minutes. I think the notebook information that came every day was very helpful. I would ask Woman F how it went and she would say it was OK, but to see the number of minutes, the number of miles, to see that her blood pressure was just responding perfectly and all those things was really very encouraging. That certainly had a major positive impact on my thinking. And to know she was safer, too, you know?"

**Theme 4: Participation in aerobic exercise was a positive experience.** Older adults with AD unanimously agreed that the exercise program was a positive experience. Older adults with AD cited several reasons for their support of the exercise program including an increase in physical strength, the social nature of the exercise, the opportunity to learn something new, the opportunity to leave the house, and the chance to make progress toward a goal.

If you want to maintain and take care of yourself, and not have your family put you away, you'd better exercise. Anytime I see a program like this, I just thought isn't this a blessing. I just wish they had more.

Most, but not all, of the older adults with AD stated they will continue to exercise. Older adults with AD shared a belief that continued exercise will allow them to live independently as

long as possible. Those who said they would not continue to exercise cited a lack of transportation and the lack of available structured exercise programs as reasons they would not continue. One older adult with AD shared the following:

There's no place to exercise in the place where we live. It's too easy to just think 'Oh, well'.

Multiple family caregivers talked at length about the quality of the program and unanimously praised the program for providing both the older adults with AD and family caregivers with another treatment option for AD. Many family caregivers remarked that, though they were unaware of the extent to which the exercise program affected the cognitive symptoms, they felt confident the program provided benefits that were physical, psychological, and social in nature.

Family caregivers engaged in a discussion regarding their plans for helping the older adults with AD to continue exercising after the program. These discussions focused on the obstacles involved in continuing an exercise program. Family caregivers cited transportation, finances/insurance, one-to-one supervision of their loved one, and the existence of structured exercise programs as obstacles to the ability to continue to exercise in older adults with AD. All family caregivers said they would like to see local gyms, such as the YMCA, provide ongoing exercise programs similar to this one for adults diagnosed with AD.

One caregiver commented on deficits in exiting programs, "I think what in particular my father needed, first of all, the transportation. Even though there's transportation from his building to the Y, it's the activity of when does he quit. xxx(staff) had to tell him when to drink water. People have to tell him when to drink water because he doesn't know when he's thirsty. That's sometimes what happens. Unfortunately, the Y didn't have anything because I would like that to continue, too."

Finally, all family caregivers endorsed the exercise program and stated that it is something they wish could continue. Many caregivers expressed concerns about the future of the older adults with AD, given that the program would be ending. All family caregivers engaged in a spontaneous brainstorming session about plans for getting together in the future for social and exercise activities. Many caregivers also noted a sense of loss as a result of the program ending.

One caregiver said, "As far as an exercise program, I think it was just a real, real plus. I can't find any fault with that at all. Coming to be picked up at the home and taken over there and having a personal trainer and so forth."

Another added, "I hope that it does continue. The results, well, though you may not be able to measure them quantitatively, are good. They're positive, at least in my opinion, and I would recommend it to other people."

Another caregiver said, "I wish every person with Alzheimer's could have something like this. It's just too bad it's coming to an end."

**Theme 5. The exercise program led to improved attitude in older adults with AD.** While older adults with AD and caregivers

denied improvements in AD symptoms, family caregivers noticed an improvement in the general attitudes in older adults with AD. Every family caregiver affirmed an improvement in mood, attitude, or outlook. Many family caregivers stated that the attitude change in older adults with AD was particularly noticeable immediately following the exercise program. One caregiver speculated that the improved attitude was the result of increased self-efficacy:

I think it's from [inaudible.] She thought she had achieved something and it made her more positive.

Another caregiver said, "But her actual symptoms, as far as memory and all that, no, I don't see any improvement there, but the overall attitude and just her overall outlook I think is better. She seems more interested in doing things and being active, which is nice."

One older adult with AD shared her perception of having an improved attitude, "It just makes you feel good to be involved, especially when you live alone. You're meeting different people and their ideas and what they think. You pick up on each person that you've been involved with. That's, again, a plus for yourself. You just feel very good."

Another older adult with AD added, "I loved it. It was something to talk about and hear about and smile about. It was wonderful. Other people . . . I don't know if you're going to do it again, but, boy, I would say to anyone, go for it."

**Theme 6: The exercise program reduced caregiver stress.** Caregivers responded enthusiastically to the focus group question that asked them to comment on the impact this program has had on their personal levels of stress. Several caregivers stated the improved physical health of their loved ones reduced their stress by providing them with peace of mind, confidence in their loved ones' abilities, and regular respite allowing them more time to focus on other things. One caregiver said:

I kind of felt it was a relief that he was somewhere he enjoyed, and he was with other people. I took advantage to maybe do some shopping without worrying about him or taking him with [me]. I think the exercise has given him a boost, and I think it's less stress you feel.

In addition to stress reduction, caregivers frequently shared that the increase in their loved one's physical strength positively impacted their attitudes and outlook on the disease. Several caregivers shared that watching their loved one make progress toward a goal was encouraging and inspired hope. One caregiver said:

As far as this affecting me, I think one thing was it made me feel good that something was being done that was positive because I get tired of going to the doctor and having him say, "Well, there's not much we can do for Alzheimer's".

## Discussions

Findings from this study support that aerobic exercise program is in great need and might provide an alternative or accessory therapeutic intervention for community-dwelling older adults with mild-to-moderate AD and their family caregivers. Four themes emerged separately from focus group interviews with older adults with AD and their family caregivers and converged that the 6-month cycling program resulted in no perceived positive change in cognitive symptoms, was socially rewarding, increased physical strength, and was assessed unanimously positively. Family caregivers further reported that the exercise program led to improved attitude in older adults with AD and reduced caregiver stress.

The cognitive trajectory of AD is a continuing, irreversible decline over time.<sup>30</sup> Several family caregivers noted a continuing decline in cognitive symptoms as well; however, they reported that the lack of comparison made it difficult to determine whether cognitive decline could have been more or less without our cycling intervention. Furthermore, 2 of the older adults with AD whose family caregivers reported cognitive decline experienced a physical injury during (but not as the result of) the exercise program, which further suggests that quantitative studies could provide more reliable and accurate estimates of the effects of aerobic exercise interventions on cognitive changes.

Results from this study strongly suggest there are benefits to community-dwelling older adults with mild-to-moderate AD. Exercise may be an appropriate activity for this population when it supports social interaction because this outcome seemed to be important to participants. Several participants indicated that exercising with other older adults with AD normalized their disease and made them feel less ostracized from society. Older adults with AD also made a variety of vague, but positive statements about the value of exercise such as, "It just feels good to do it" and "It gives me something good to do." Also, the older adults with AD indicated that, in some cases, increased physical strength and stamina led to a more positive mood or outlook. Combined, these results indicate that aerobic exercise programs provided improved the overall quality of life for individuals with AD and their family caregivers, whether aerobic exercise produces tangible cognitive effect or not.

The impact of the 6-month exercise program on family caregivers is positive. Multiple caregivers discussed the pleasure that both the older adult with AD and their family caregivers took in making progress toward a goal. Family caregivers reported that making physical progress gave both the older adults with AD and family caregivers hope. In addition, family caregivers stated that increased physical strength has reduced caregiving demands, increased their confidence in the safety in older adults with AD, created more free time for family caregivers, reduced caregiving stress, and worry about the older adults with AD, making older adults with AD less likely to injure themselves and allowing them more freedom to engage in routine activities. Such changes provided family caregivers a sense of optimism and normalcy in the midst of a declining disease process.

Many family caregivers also noted the exercise program felt, as one caregiver described it, "bittersweet." Family caregivers affirmed several positive effects of the exercise program on themselves; however, they noted a feeling of dread at the thought of the program ending. Many noted that they had the option to place their loved one in an adult day program following the exercise study, but every caregiver said they would not do so. They cited the lack of physical activity, few opportunities to develop a sense of accomplishment, and high risk of depressed mood as reasons they would not place their loved ones in an adult day program. The caregivers expressed frustration because ongoing exercise programs do not exist. These results clearly highlight a deficiency in the extant care programs available to older adults diagnosed with AD.

## Study Limitations

This study has a small sample size that calls into question whether or not data saturation did occur (see Krueger and Casey<sup>27</sup>). It is possible that additional themes would have arisen had the sample sizes been larger. This study is further limited by the fact that the study participants were highly educated and ethnically homogeneous, suggesting that the findings might be generalizable to educated, white older adults with mild-to-moderate AD, but not other populations. We did not track some variables that might be important to consider, for example, how social engagements have changed during the aerobic exercise intervention, which may have affected the results of our study. Additionally, we conducted focus group interviews after the participants completed the 6-month intervention. It is possible that their ability to recall the exercise experiences and their retrospective reports were influenced by their cognitive impairment and situational factors on the day of assessment rather than reflecting their experiences.

## Implications for Future Research

Future qualitative studies with larger sample sizes, diverse education, and ethnic backgrounds are needed to corroborate our findings. With suitable resources, a longitudinal approach, for example, focus groups biweekly or monthly, might help capture the participant's experiences in real time. Using a sample representative of the general older adult population with AD will increase the generalizability of future studies. Further, our study was to determine if and how aerobic exercise intervention was meaningful in AD, a control group was not needed. However, future studies that examine the effects of aerobic exercise on outcomes should use a control group.

## Clinical Implications

This study has several implications for health care professionals working with older adults with AD in a variety of settings. Primarily, the results indicate that aerobic exercise is feasible to do with older adults with AD, despite of their impaired cognition and judgment. Our findings show that exercising with

others with AD was an enjoyable, fulfilling, and socially rewarding activity. These results are important because they suggest that this sample of older adults with AD and their family caregivers endorse this form of treatment and are willing to comply with this form of treatment. Strategies for successfully engaging older adults with AD include peer support, rapport, goal-setting, and encouragements. To ensure exercise safety, older adults with AD should be screened to rule out exercise contraindications.

Our findings also highlight the degree of loneliness that older adults with AD suffer. This study has demonstrated that exercise has the potential to also promote psychological well-being for older adults with AD, which is consistent with other findings.<sup>22,23</sup> Hence, exercise could serve as a form of supportive treatment though more research is necessary to determine the complete psychological effects of exercise on the mental health of adults with AD.

## Conclusion

Participation in aerobic exercise has many likely benefits for older adults with AD; however, there is a lack of well-developed aerobic exercise intervention for older adults with AD. Regardless of potential effects, aerobic exercise interventions must be feasible and enjoyable, so older adults with AD will participate. Our study has shown that aerobic exercise is feasible and enjoyable from participant's perspectives.

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