Gender Differences in the Effects of Physical Activity on Mental Health in Older Adults

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Abstract

Older adults make up the fastest growing portion of the United States population and they are likely to not engage in physical activity. Physical activity has multiple benefits, including better mental health and the prevention of cognitive decline. Research shows that women are more likely to live a sedentary lifestyle and to suffer from mental health issues. Due to the link between improvement of mental health and exercise and the fact that women are more likely to experience mental health problems, it was predicted that the positive effects of exercise would be more profound in older women than in men. In this study, older adults went through a 16-week long exercise program and completed measures of their mental health (the Beck Depression Inventory, Beck Anxiety Inventory, and the Emotion Regulation Questionnaire). These were assessed before and after the exercise intervention and ANOVA tests were run to determine whether the effects of exercise on mental health differed for women versus men. The results did not support the hypothesis, in that no gender differences were found. However, there were some overall improvements. The sample being nonclinical and its relatively small size could account for the lack of gender difference findings.

Gender Differences in the Effects of Physical Activity on Mental Health in Older Adults

Older adults are the fastest growing segment of the population, not only in the United States, but worldwide (Erickson, Gildengers, & Butters, 2013). Older adults have a number of health challenges. Less than 5% of adults meet the recommended amount of physical exercise, and this is even less in older adults (Evenson, Wen, Metzinger, & Herring, 2015). A study using a body worn accelerometer, an objective measure, reported that 67% of the older population were sedentary for more than 8.5 hours per day (Harvey, Chastin & Skelton, 2013). Past research has demonstrated that sedentary behavior is especially harmful in older age because individuals who are sedentary age less successfully and have a lower quality of life (Harvey et al., 2013). Although some aspects of mental health get better with age, some get worse. Physical activity has been known to improve quality of life in a variety of ways, including improving mental health (Ratey & Hagerman, 2008). So, increasing physical activity may be an important method for improving mental health and quality of life in older adults.

There are a number of reasons that physical activity is linked with better mental health outcomes. One reason may be the biological effects of exercise on the brain. With advancing age, parts of the brain begin to shrink which results in cognitive decline (Erickson et al., 2013). However, the brain has an ongoing capability of plasticity, so it has been suggested that cognitive decline in older adults can be reduced with physical activity (Erickson et al., 2013). Enhanced blood flow, improvements in neurotransmitter systems, and increased brain volume have been effects found from physical activity, all of which play a main role in memory and cognitive functions (Chodzko-Zajko, Proctor, Singh, Mnson, Nigg, Salem, & Skinner, 2009).

In addition, exercise is known to counteract a large number of age-related diseases, such as Alzheimer's and Parkinson's (Erickson et al., 2013). This can be explained by the benefits on

cognitive speed, motor function, and visual and auditory attention caused by physical activity (Angevren, Aufdemkampe, Harald, Verhaar, Aleman, & Vanhees, 2008). Knowing this, it is perhaps unsurprising that past research has demonstrated that those with an active lifestyle perform better in memory and executive function tasks (Etnier, Nowell, Landers, & Sibley, 2006). A study done by Colcombe and Kramer (2003) revealed that increasing physical activity for 3 to 6 months was effective in improving cognitive performance in older adults.

The other mechanism that could be responsible for the link between physical activity and better mental health is the psychological effects of exercise. Multiple studies demonstrate that physical activity improves mood and reduces symptoms of anxiety and depression (Penedo & Dahn, 2005). Although studies have suggested that anxiety can be reduced with exercise, it is difficult to study because of the diversity of anxiety disorders (Strohle 2009). In contrast, there is more literature when it comes to depression. Eight randomized controlled trials with people over the age of 60 who suffered from depression found that exercise has a significant effect on the disorder when comparing it with a control group (Schuch, Vancampfort, Rosenbaum, Richards, Ward, Veronese, & Stubbs, 2016). One randomized trial of older adults done by Mather and colleagues (2002) compared an exercise group to a non-exercise group with continued antidepressant therapy. Results demonstrated that 55% of the exercise group had positive responses, while only 33% of the non-exercise group did (Mather, Rodriguez, Guthrie, McHarg, Reid, & McMurdo, 2002).

Both physical activity and mental health in older adults show differences based on gender. For example, lack of physical activity increases with age, but it is more common in women than in men (Edwards & Sackett, 2016). Research has shown that a variety of psychological factors are associated with participation in physical activity; these factors include

self-efficacy and self-esteem (Edwards & Sackett, 2016). It may be that older women have lower exercise self-efficacy and less confidence in themselves as exercisers due to traditional gender roles, and this may explain their lack of exercise. Other variables related to gender, such as education, income, and employment may also play a role in physical activity participation (Zhang & Yen 2015).

Additionally, women are more likely to suffer from mental health issues than men. Worldwide, depression is two to three times more common in women (Vafaei, Ahmed, Freire, Zunzunegui, & Guerra, 2016). Women also have higher prevalence rates than men for all anxiety disorders (McLean, Asnaani, Litz, & Hofmann, 2011). This is likely due to the fact that women are more exposed to more stressful events and risk factors for mental disorders than their counterparts (Vafaei et al., 2016). After the age of 65, depression rates decline in both men and women, but the prevalence is still greater in the latter, and depression is the leading cause of disease burden in women (Albert 2015).

Based on research that shows physical activity is linked to improved mental health, and research that shows older women are particularly susceptible to both mental health issues as well as a sedentary lifestyle, I believe the positive effects of exercise on mental health will be more profound in older women than in older men. This hypothesis will be tested in the context of an ongoing study of the effects of physical activity on cognitive, emotional, and social functioning among older adults (The FORCE Study; 1R01AG043452, PI; A. Bryan). In the larger study, inactive older adults aged 60 and over are randomly assigned to 16 weeks of supervised exercise that is either low intensity continuous training (LICT) or moderate intensity continuous training+ interval training (MICT+IT). I predict that while all participants will show improvements in

anxiety and depression as a result of exercise, and that there will be no difference by condition, these improvements will be greater for women.

Method

Participants

To be eligible for the FORCE study, participants had to be 60 or older, sedentary, able to make fewer than 3 errors on the Pfeiffer Mental Status exam, willing to accept random assignment to condition, physically capable of engaging in moderate exercise activity, able to successfully complete a maximal oxygen capacity (VO_2 max) test, and had to stay in the area for the next 6 months. Participants were recruited through mailed flyers, online resources such as craigslist, clinicaltrials.gov, publications, or research match, and online national health volunteer registry. Monetary compensation was given to participants. The sample for this analysis was made up of participants who had already finished the larger study and had answered all the measures required.

A total of 81 Participants completed the Emotion Regulation Questionnaire, 78 participants completed the Beck Depression Inventory, and 68 completed the Beck Anxiety Inventory at baseline and follow up from a pool of 124 participants. There were 77 women that participated in the study, 40 were in the MICT+IT group and 37 were in the LICT group. The mean age was 69.58 (SD=4.96). There were 47 men in the sample, 24 were in the MICT+IT group and 23 were in the LICT group. The mean age was 69.68 (SD=6.80). The majority of participants were married or divorced, had an education of at least a bachelor's degree, had an income larger than $60,000 per year, and were retired. The majority of the sample consisted of people who identified as White, with 6 Asians and 4 Hispanics. Because some participants

didn't complete either the exercise or measures at follow up, they were not included in the data analysis.

Design

A mixed design ANOVA was used to examine gender differences in the change in mental health from baseline to after the exercise intervention in the Beck Depression Inventory, Beck Anxiety Inventory, and Emotion Regulation Questionnaire. The between groups factors were condition assignment (LICT vs MICT+IT) and gender (men vs women) and the within groups factor was time (pre-exercise training vs post-exercise training).

Measures

The measures used were the Emotion Regulation Questionnaire (Roger & Najarian, 1989), the Beck Depression Inventory (Beck, Steer, Ball & Ranieri, 1996), and the Beck Anxiety Inventory (Beck & Steer, 1990). The Emotion Regulation Questionnaire has 10 items (α=.742) that measure one's tendency to regulate emotions, either with cognitive reappraisal or expressive suppression. The scale ranges from 1 to 7, with 7 being strongly agree, and a sample item is "When I want to feel more positive emotion (such as joy or amusement), I change what I'm thinking about". The Beck Depression Inventory is a self-report measure that consists of 21 items (α=.849) assessing the severity of symptoms related to depression. Participants are asked to rate on a scale of 0 to 3 the severity and frequency of symptoms of depression, including sadness (e.g. 0= "I do not feel sad", 1= "I feel sad much of the time", 2= "I am sad all the time", 3= "I am so sad or unhappy that I can't stand it"). The sum of the scores results in a number ranging from 0 to 63, the higher the number the more severe the depression is. The Beck Anxiety Inventory, similar to the Beck Depression Inventory, contains 21 items (α=.805) and measures the severity of anxiety symptoms, a sample item is "feeling hot" (e.g. 0= "Not at all", 1= "Mildly but it didn't

bother me much", 2= "Moderately-it wasn't pleasant at times", 3= "Severely, it bothered me a lot").

Procedure

After being pre-screened for eligibility and having an informed consent meeting, participants answered the three measures at baseline. Then, participants were randomly assigned into one of the two groups, LICT or MICT+IT for the 16-week long exercise intervention. In each condition participants went to the CU Change Exercise Lab for supervised exercise sessions 3 times per week, totaling 48 sessions. All exercise sessions were tailored to each participant's level of cardiorespiratory fitness obtained at baseline. The LICT exercise consisted of a comfortable pace that was no more than 50% the participant's maximum heart rate. The MICT+IT group had a different exercise intervention, it included 3-minute long intervals which aimed to reach 85-95% of the participant's maximum heart rate. The change to intervals was gradual; the first 3 weeks consisted of reaching 60% of the participant's maximum heart rate, weeks 4-6 the participant gradually built an intensity of 75-85% of their maximum heart rate where one session per week had a set of intervals, weeks 7-9 participants had two sessions with intervals, and weeks 10-16 participants had intervals every session. All exercise sessions consisted of 30 minutes, the moderate intensity group had an additional 2-minute warm up at the beginning. Participants were free to take their time to cool down after completion of the 30 minutes. At the beginning of every exercise session, participants had to put a heart rate monitor on and the supervisor wrote down the participant's heart rate and rate of perceived exertion every 5 minutes during the session. After the completion of the 48 sessions, participants completed the three mental health measures again.

Results

Statistical analysis was performed using SPSS. Multiple mixed design ANOVAs were run to determine the main effects of gender, time, and condition, as well as all possible 2- and 20way interactions (gender x time, gender x condition, time x condition, and gender x time x condition) on the three measures of mental health.

Results for the analysis on the Emotion Regulation Questionnaire appear in Table 1. As can be seen in the table, the only notable finding was a marginal effect of time $F(1, 77) = 2.462$, $p=.12$. Over time, on average, there were increases in emotion regulation pre-exercise to post-exercise (see Figure 1). All other main effects and interactions were not significant.

Results for the analysis for the Beck Depression Inventory resulted in a significant effect on time $F(1, 74) = 6.59$, $p= .01$ and a significant effect on condition $F(1, 74) = 4.77$, $p=.03$. As can be seen in Figure 2, the main effect of time indicated that on average depression scores decreased significantly from pre-exercise training to post-exercise training. Also, depression scores were significantly higher, on average, in the LICT condition, collapsing across time points. There were no other significant main effects or interactions. The mean score for this measure was 7.6 (SD=6.1) and when scoring for it this falls under the range of what is normal. When scores range from 14-19 there is a mild depression, 20-28 there is moderate depression, and 29-63 there is severe depression.

Finally, the analysis for the Beck Anxiety Inventory resulted in no significant main effects or interactions (see Table 3). Though the direction of the means (see Figure 6) suggests that anxiety decreased in men in the LICT condition and did not change for any other group, this effect was not significant. The mean score for this measure was 4.71 (SD=4.2), which falls in the range of scores that means minimal anxiety. Standardized cutoffs for this measure are 0-9 normal

to minimal anxiety, 10-18 mild to moderate anxiety, 19-29 moderate to severe anxiety, and 30-63 severe anxiety.

Discussion

The purpose of this study was to determine whether the effect of exercise on indicators of mental health differed by gender. The hypothesis was that the positive effects of exercise on mental health would be more profound in women. It was predicted that women would have more significant changes than their male counterparts.

There is existing evidence that physical activity improves mental health, and there was some support for this assertion in the results for this study. There were marginal or significant effects of exercise on both the Emotion Regulation Questionnaire and the Beck Depression Inventory. There were no changes in the Beck Anxiety Inventory.

However, for depression, the means did decrease for both men and women. This is consistent with existing literature that supports the idea that behavioral changes people make are more important in the treatment of depression than the cognitive changes (Dimidjian, Hollon, Dobson, Schmaling, Kohlenber, Addis & Atkins, 2006). In this case, the exercise intervention was the behavioral change. Still, these changes were not statistically significant, so the results for the study were not what was predicted.

Limitations and Future Directions

There are a couple of methodological reasons that could account for these results. The sample size was not large enough; as the sample size increases, the margin of error on estimates decreases and the statistical power increases. Also, a larger sample size can deliver a more representative sample of the population. Floor effects could be another factor, because this was not a sample recruited for high levels of depression or anxiety. This nonclinical sample's levels

of depression and anxiety might have been too low to detect an effect causes the phenomenon. Future studies could recruit a clinical sample of subjects who meet criteria for an anxiety or major depressive disorder which may allow for an effect to be detected.

Other reasons why the results were not what was predicted may include the participants themselves. Although the results were not statistically significant, average scores were higher for women at follow up than at baseline (see Figure 6). Participants had to live a sedentary lifestyle, meaning they were not used to physical activity. Physical activity causes changes in the body that mimic those of anxiety, which could account for the increase of scores in the Beck Anxiety Inventory (e.g. “Feeling hot”, “heart pounding/racing”, “hot, cold sweats”). Participants could have had associated the effects of exercise with these symptoms.

The Emotion Regulation Questionnaire results could be insignificant because cognitive skills were not targeted in this study and participants were not taught any. However, the results are consistent with existing literature that supports the idea that cognitive behavioral therapy does not have significant results when treating depression in comparison to either of its components (Jacobson, Dobson, Truax, Addis, Koerner, Gollan & Prince, 2000).

Furthermore, older women and men have fewer differences as they get older. An example of this is stress response; younger men have a more exaggerated response than younger women (Kudielka, Buske-Kirschbaum, Hellhammer, & Kirschbaum, 2004). Stress response is linked to mental health because too much stress may lead to depression. Similarities in the age group responsivity would suggest that one would not expect to find large differences in this age cohort since depression and anxiety are conceptualized as an exaggerated stress response. This could be one reason why the gender differences were not what was expected, because the differences decrease.

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Table 1. ***Effects of Gender, Condition, and Time on Emotion Regulation Questionnaire Scores***

Effect	df	F	p-value
Gender	(1, 77)	.728	.85
Time	(1, 77)	2.462	.12
Condition	(1, 77)	.036	.85
Gender x Time	(1, 77)	.162	.69
Gender x Condition	(1, 77)	.736	.39
Time x Condition	(1, 77)	1.226	.27
Gender x Time x Condition	(1, 77)	.377	.54

Table 2. ***Effects of Gender, Condition, and Time on Beck Depression Inventory Scores***

Effect	df	F	p-value
Gender	(1, 74)	.350	.56
Time	(1, 74)	6.59	.01
Condition	(1, 74)	4.77	.03
Gender x Time	.(1, 74)	.003	.96
Gender x Condition	(1, 74)	.003	.956
Time x Condition	(1, 74)	.151	.699
Gender x Time x Condition	(1, 74)	1.367	.246

Table 3. ***Effects of Gender, Condition, and Time on Beck Anxiety Inventory Scores***

Effect	df	F	p-value
Gender	(1, 64)	.000	.99
Time	(1, 64)	.007	.94
Condition	(1, 64)	.077	.78
Gender x Time	(1, 64)	.964	.33
Gender x Condition	(1, 64)	.727	.397
Time x Condition	(1, 64)	.223	.64
Gender x Time x Condition	(1, 64)	.181	.67

Figure 1. ***Emotion Regulation Questionnaire: Marginal Effect of Time***

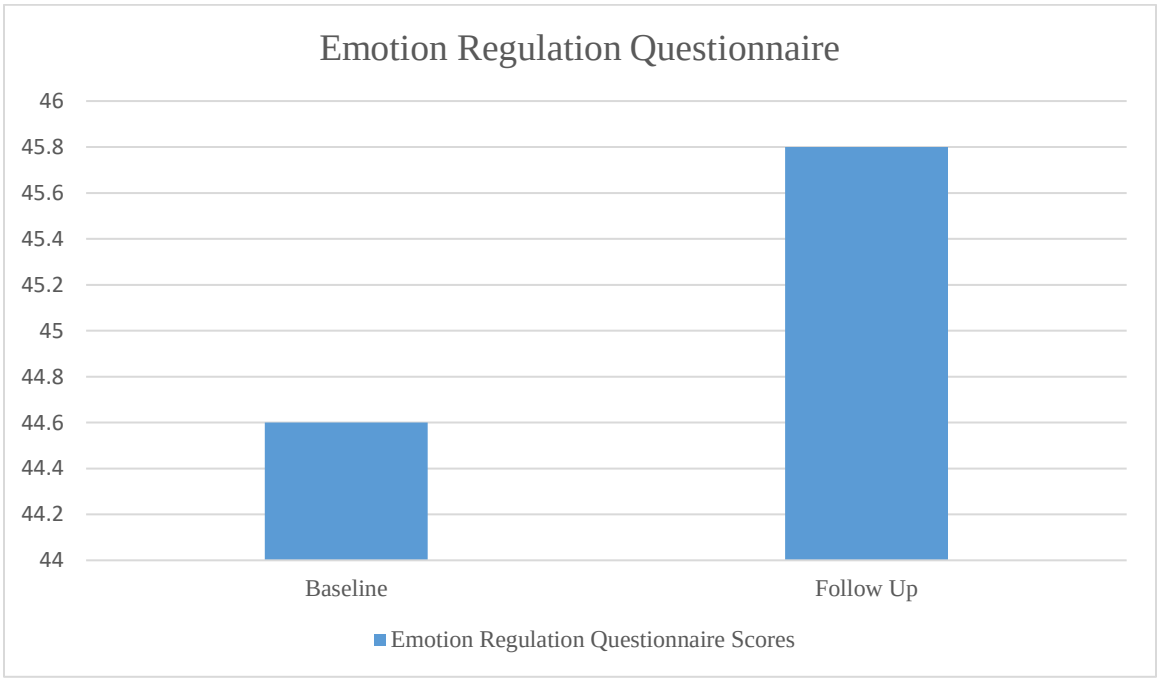

Figure 2. ***Beck Depression Inventory: Effect of Time***

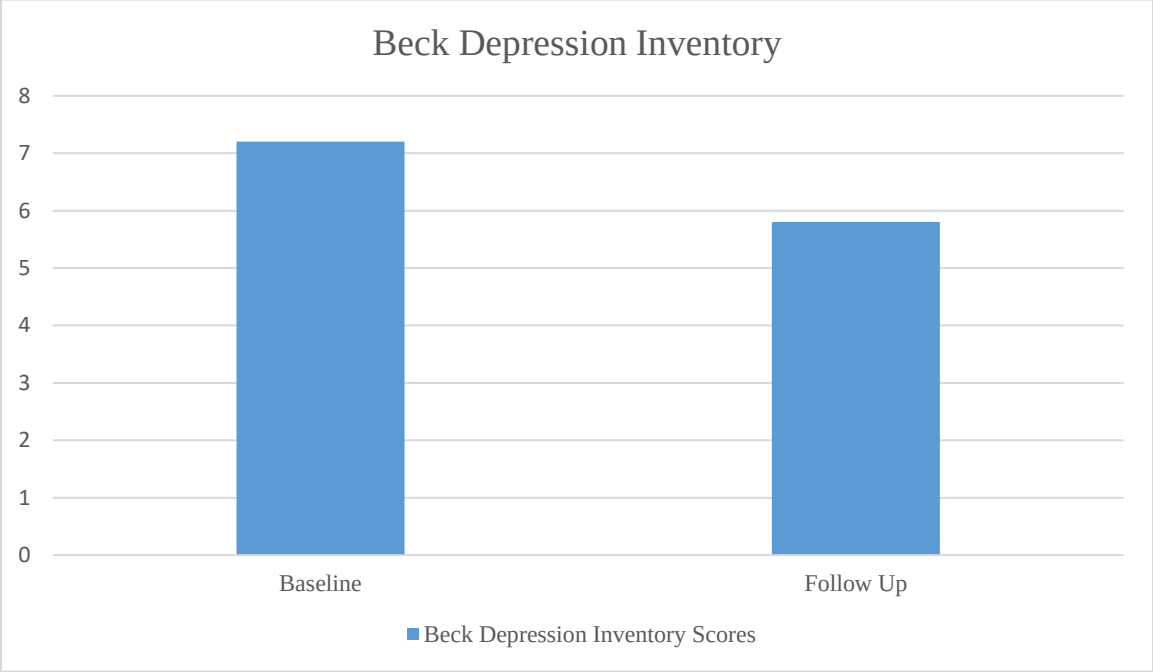

Figure 3. ***Beck Depression Inventory: Effect of Condition***

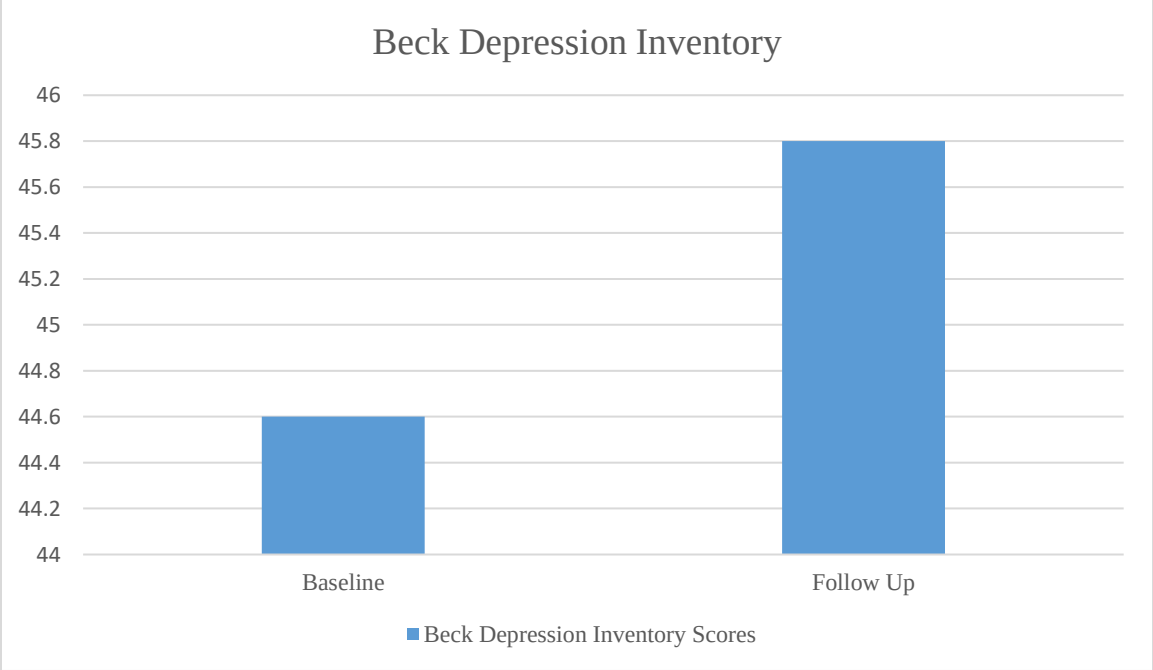

Figure 4. ***Emotion Regulation Questionnaire: Marginal Means***

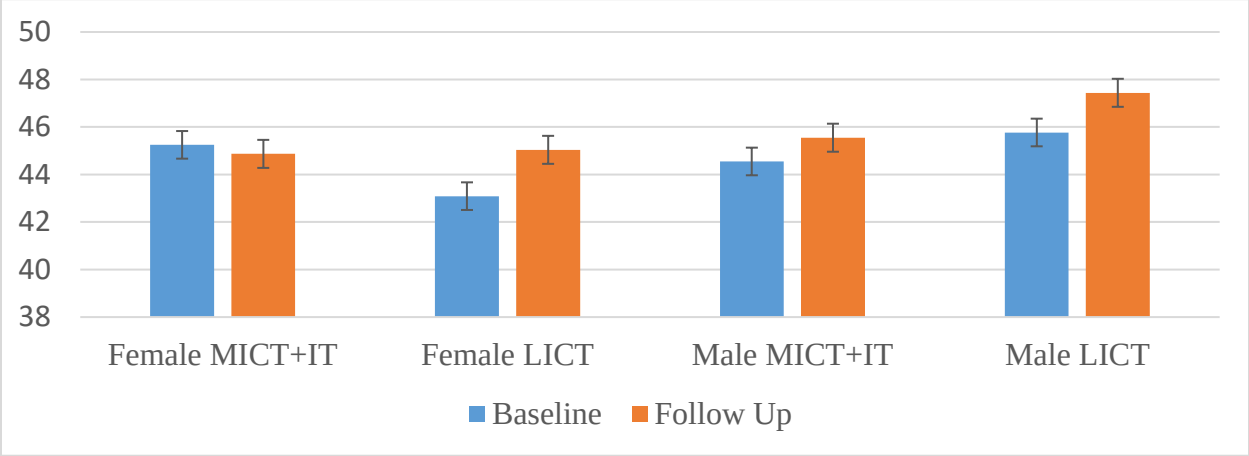

Figure 5. ***Beck Depression Inventory: Marginal Means***

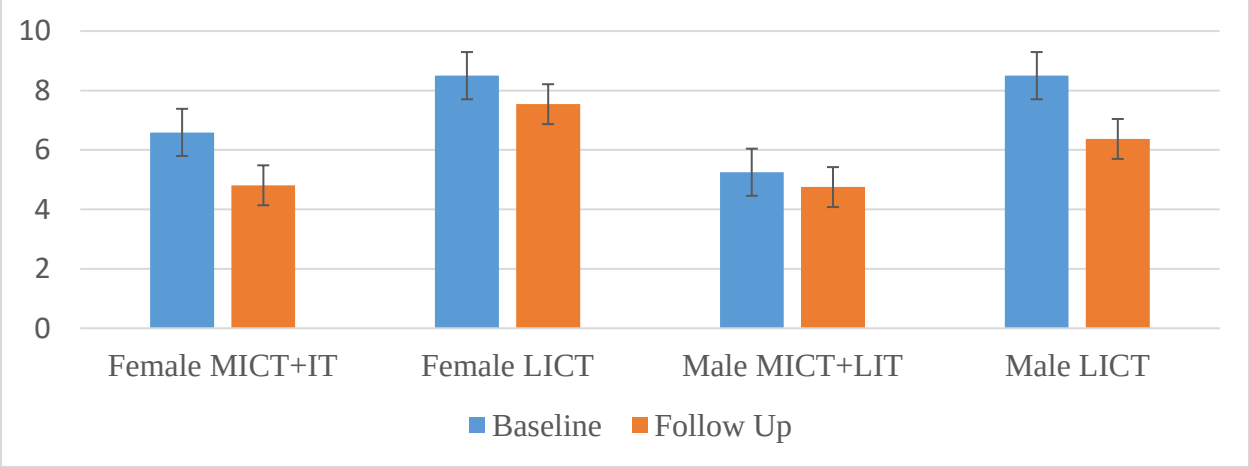

Figure 6: ***Beck Anxiety Inventory: Marginal Means***