Acceptability of Activity Monitor Use During and After Hospitalization in Older Adults with Heart Failure

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Abstract

Background: Many activity monitors have been validated and accepted to track physical activity in adults, however research is limited in clinical populations such as older adults with heart failure. Health tends to decline as people age and makes it more difficult to perform activities of daily living and to get the recommended amount of daily exercise. Getting daily exercise for heart failure patients is essential because it can potentially improve the patient's condition. Activity monitors may help older adults with heart failure track their physical activity levels and support management of their health, but only if they are willing to wear the monitors.

Purpose: The purpose of this study was to determine acceptability of activity monitor wear by older adults with heart failure during and after hospitalization and 30 days after discharge.

Methods: This secondary analysis reviewed data from 27 participants (mean age 78 (SD=9.8)). The participants were given an activity monitor to wear during their hospital stay and continued for 30 days after discharge. The average daily steps in the hospital and at home were calculated and recorded. Average wear time was also calculated for both settings. The participants were also interviewed about their opinions of the activity monitor and wearing it. Activity (steps) and other outcomes were analyzed comparing age groups (60-79 years and ≥80 years).

Results: Those 60-79 years had a longer average length of stay in the hospital (5.8 days (SD=4.7)) than those ≥80 years (4.2 days (SD=2.5)); the 60-79 age group took more daily steps on average in the hospital (1,801 steps (SD=1460)) compared to the ≥80 age group (1,006 steps (SD=465)). Average daily steps for the cohort for the 30 days after discharge was 4,852 (SD=2,254), but the 60-79 age group had a higher average of daily steps (5,083 (SD=2,401)) than the >80 age group (4,412 (SD=2,005)). The percentage of wear time in the hospital was 99% and at home it was 92%. Two themes were identified from participant responses; ease of wearing and monitor interest. The major problem with the monitor post-discharge was remembering to put it back on if taken off. Only four participants were interested to wear and use the monitor long-term.

Conclusion: There was high acceptability of monitor wear both during and after hospitalization during participation in the study. Overall there were no difficulties with the use of the activity monitors. Few participants were interested to use the activity monitors on their own.

Acceptability of Activity Monitor Use During and After Hospitalization in Older Adults with Heart Failure

Background

One modifiable risk factor for cardiovascular disease is a sedentary lifestyle (Centers for Disease Control and Prevention, 2016). The American Heart Association (AHA) (2014) states being physically active is one of the main actions people can take to try and avoid cardiovascular disease. They define physical activity as, "anything that makes you move your body and burn calories" (AHA, 2014). It is recommended that individuals participate in 150 minutes of moderate exercise or 75 minutes of vigorous exercise each week (AHA, 2014). They also indicate that aerobic exercise, such as walking, is the best for the heart. However, only 51% of people in the United States participate in the required amount of exercise each week (American Heart Association and American Stroke Association, 2015). Worse yet, 30% of older adults (65 years and older) report a sedentary lifestyle, and chronically ill older adults – such as those with heart failure – are even more sedentary (AHA, 2015).

This is important because Go, Mozaffarian, Roger, Benjamin, Berry, Borden, Bravata and others (2013) report that 42 million people in the United States with cardiovascular disease are older adults. In 2010, 51% of these older adults received a cardiovascular medical procedure due to an acute or chronic condition. Mobility and physical activity play an important role in recovery and regaining strength to prevent disabilities after hospitalizations (Fisher et al., 2011).

Activity monitors can be used as tools to encourage and support people to be physically active. Diaz et al. (2016) and Takacs et al. (2014) have verified the validity and acceptability of many activity monitors to track physical activity levels in the adult population. However, it is not known if clinical populations, such as patients with heart failure, are interested or accepting of these monitors to track their activity or other health variables.

Therefore, additional studies should be conducted in older adults with chronic illnesses to understand their perspective of using activity monitors to help track their physical activity levels. These monitors could potentially motivate older adults to participate in more physical activity. The monitors could also communicate information about a patient's health to their primary care provider or health supporters that are a part of their treatment team.

Literature Review

Purpose

The primary purpose of the literature review was to determine if activity monitors have been used in the older adult population with chronic diseases and evaluate if the monitors were accepted by these individuals. A secondary purpose of the literature review was to evaluate physical activity interventions that have been used in older adults with chronic cardiovascular disease and if they were conducted with the use of activity monitors. The literature review was used to discover what environments and populations activity monitors have been used to measure physical activity, and to determine feasibility and acceptability of activity monitor use in older adults.

Search Process

The databases searched were ProQuest and PubMed. The search terms that were used were "older adult", "aging adult", "cardiovascular disease", "physical activity", "exercise", "interventions", "increased mobility", "increased activity level", and "activity monitors". The dates of the articles searched for ranged from 2007 to 2017. The participants in the studies had to be 50 or older. The articles' methods had to include a physical activity intervention for older adult patients with a form of cardiovascular disease.

Major Findings

Physical Activity Interventions. Physical activity can improve the mobility and functioning of older adults with cardiovascular disease. There are many different types of physical activity interventions. Studies show that exercise-training in older adults with heart failure significantly improves participants' quality of life perceptions as measured by Minnesota Living with Heart Failure Questionnaire (p=0.03) (Kitzman, Brubaker, Morgan, Stewart, & Little, 2010) and can improve cardiorespiratory (p=0.01) and psychosocial health (Butler, Furber, Phongsavn, Mark, & Bauman, 2009). Investigators found in their pedometer-monitored intervention that walking sessions significantly improved (p<0.001) at six weeks in older adults. The older adults who wore the pedometers also significantly improved their physical activity minutes (p=0.04) at six months (Butler et al., 2009). It was also discovered that a low-intensity walking regimen in older adults with heart failure, started in the hospital under supervision and then continued at home improved quality of life scores, six-minute walk test, and time up and go test (p<0.05) (Xueyu, Hao, Shunlin, Rongbin, & Yuan, 2017).

Validity of Activity Monitors. There have been multiple studies testing the validity of the FitBit One and the FitBit Flex in adults. Diaz, Krupka, Chang, Shaffer, Yao, Goldsmith and others (2016) conducted a study to validate the FitBit One and the FitBit Flex attached to various areas including, the upper torso, hip, and wrist. The FitBit One attached to the torso was very accurate in measuring step counts (r=0.98) and energy expenditure (r=0.82), as well as the FitBit One attached to the hip (r=0.99, r=0.77). However, the FitBit Flex worn on the wrist was not as accurate in measuring the step counts (r=0.75) nor energy expenditure (r=0.62). Takacs, Pollock, Guenther, Bahar, Napier, and Hunt (2014) also analyzed the validity of the FitBit One and found high correalations between the FitBit One step counts and the gold standard of observer step counts (r=0.97-1.00). Their study agreed with Diaz et al. (2016), that the FitBit One is a reliable and valid physical activity monitor in adults.

Acceptability and Usability of Activity Monitors. There have been a few studies on acceptability and usability of activity monitors in middle-aged and older adults. Farina and Lowry (2017) conducted a study with 25 participants (average age 72.5 years) that focused on the comfort of wearing the Fitbit Charge HR and the Misfit Shine activity monitors. They used a survey to measure satisfaction scores for both devices. The participants were 100% 'quite satisfied' or 'very satisfied' with the weight of the Misfit Shine, however they deemed the Fitbit Charge HR bulky and heavy. Although the participants did not like the weight of the FitBit Charge HR, they did like that it was one piece and easily attachable. At study conclusion the participants were asked if they would wear the devices again, with 52.4% saying that they would wear the Misfit Shine again and 68.2% saying they would wear the FitBit Charge HR again. This acceptability of the FitBit Charge HR over the Misfit Shine could be that it was one piece. Lyons, Swartz, Lewis, Martinez, and Jennings (2017) studied the Jawbone Up and app on a mobile technology device in a sample of 40 participants with an average age of 61.5 years old. Participant acceptability (range 1-5) and overall comfort score was 4.68 (SD 0.58). Twenty-one percent of participants said they would continue to the Jawbone Up, with only one participant stating they would rather use a pedometer. This study showed that it was acceptable for middle-aged adults to use activity monitors.

Mercer et al. (2016) conducted research on the usability of four activity monitors (Fitbit Zip, Jawbone Up 24, Misfit Shine, and Withings Pulse) along with a pedometer in adults (50 and older) with chronic illnesses. Ninety-four percent of participants finished using all five devices and completed a technology acceptance questionnaire, based on the Technology Acceptance Model, with a score ranging from one to five (one=strongly disagree and five=strongly agree). On average the group was most satisfied with the Fitbit Zip (3.57) and least satisfied with the pedometer (1.77). The monitor perceived as most beneficial in helping the participants manage

their disease was the FitBit Zip and the least helpful was the pedometer. The average score for ease of use for all of the monitors was 3.12. For this study, 73% of participants said they would purchase an activity monitor for long-term use. The participants also thought that activity monitors have the potential to help with health management and should be recommended for this purpose. However, Rosenberg et al. (2016) found in their research in men with prostate cancer (average age of 70.5 (SD 9.7)) that some participants thought sending Fitbit data to the electronic health record would not be very beneficial because they felt doctors and nurses would not make the time to review their data. The participants felt that it would be more helpful for a physical therapist or personal trainer to get the Fitbit information because these specialists could help them improve on their physical fitness and activity levels. Rosenberg et al. (2016) also asked the participants about the ease of use and wearing of the Fitbit. Overall the participants thought that the Fitbit was easy to use and helpful in keeping track of their physical activity levels and helped the participants see what they needed improvement in. However, a few participants thought that the Fitbit was not helpful because their chronic disease symptoms limited their physical activity levels and the Fitbit did not really capture anything else besides physical activity.

Synthesis and Summary

These research studies prove that physical activity can improve physical activity levels in older adults with cardiovascular disease. All of the studies had a relatively small sample size, so the results might not be generalizable to all older adult patients. The physical activity intervention studies collectively had a total of 241 participants. Sex ratio in the intervention studies was; 59% males and 41% females, which is not adequate to generalize across sexes. Additionally, Kitzman et al. (2010) was the only intervention study to report inclusion of minority participants with 27%, therefore it is not possible to generalize to minority populations.

According Farina and Lowry (2017) and Lyons et al. (2017) most older adults accept the use of activity monitors, reporting most are comfortable to wear and user friendly. A limitation in these studies was lack of reporting on older adults use of cellular devices and computers, so syncing these devices may not be very helpful for the older adult population. Mercer et al. (2016) and Rosenberg et al. (2016) found that older adults think that activity monitor data can be useful for healthcare personnel, but the participants in each study had conflicting views of which healthcare staff should get the information. There was only a total of 123 participants in these four studies. Only Lyons et al. (2017) reported minority population (35%) in their research. All of the studies on activity monitor use involved the participants using the monitors at home.

Gaps in Literature. The literature review shows a lack of studies on acceptability of activity monitors in older adults with heart failure. There also needs to be more research that includes minority older adults with cardiovascular disease and the impact of physical activity and activity monitors on their conditions and if minority groups are willing to use activity monitors. Research is also limited about whether or not activity monitors can communicate relevant physical activity data to medical personnel. Lastly, no study examined acceptability of monitor use in hospitalized patients. This supports the need for conducting a study to include older adults (60 years or older) diagnosed with heart failure.

Nurses can implement these findings by educating cardiovascular patients on the importance of the effects physical activity can have on cardiovascular disease. The nurses can suggest an exercise plan for the older adult cardiovascular patient or provide the patient with pamphlets with different exercise plan options. They can suggest reasonably priced activity monitors to measure the amount of physical activity the patient participates in or to measure other health variables. Further research in this area should be on activity monitors in older adults with chronic diseases.

Research Aims

The primary aim of this research study was to determine acceptability of activity monitor wear by older adults with heart failure during and immediately after hospitalization. Under this primary research aim, total wear time of monitors was obtained for both hospital and home setting and participants were interviewed with three questions about the acceptability of activity monitors. Their responses were reviewed in a secondary analysis and sorted into themes.

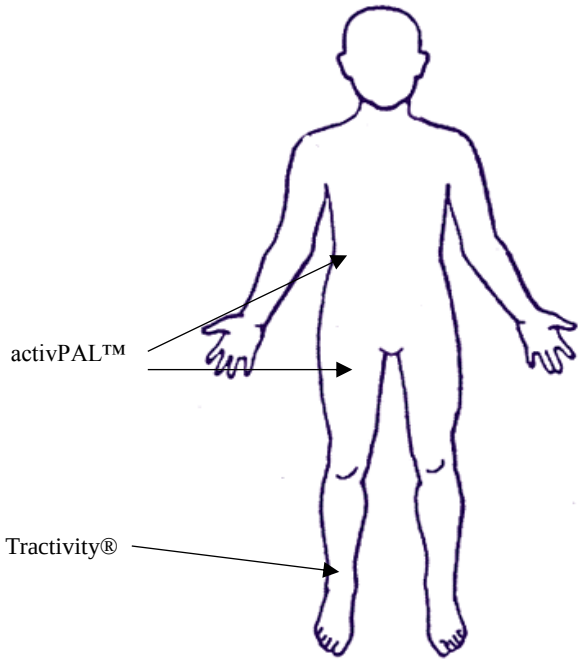
A secondary aim of this research study was to look at usability of the activity monitors for assessing physical activity. Under this secondary research aim postural and ambulatory data were obtained and a secondary analysis was performed.

Methods

This study was a secondary analysis of data from a pilot study investigating mobility in hospitalized older adults with heart failure (Floegel et al., 2017). Inclusion criteria for this study were: 60 years or older admitted to hospital with a heart failure diagnosis, living at home prior to hospital admission, English speaking. Exclusion criteria were: no cognitive disability, medical contraindication to wearing activity monitors, nor discharged to a skilled nursing facility.

The original study was performed with 27 participants. After consent, activity monitors were placed on the participant and worn continuously during their hospital stay: an activPAL™ monitor on the upper right abdomen and on the thigh attached with medical grade tape, and a Tractivity® monitor on the ankle in an ankle strap (See Figure). The activPAL™ monitors measured postural data and the Tractivity® monitored measured the step count. The participants continued to wear the Tractivity® ankle monitor for 30 days post-discharge. Postural data obtained were: total wear time, average daily hospital steps, hospital percentage time lying, sitting, standing, and ambulating. Post-discharge data collected were: total wear time and

average daily steps. Descriptive statistics (mean, standard deviation, and median) were calculated for the total group and stratified into age groups (60-79 and ≥80).



At study conclusion participants were interviewed regarding acceptability of the activity monitors with three questions:

1. What was your experience wearing the monitors in the hospital? Did you have any concerns/issues/non-wear time?
2. How was wearing Tractivity® at home for the month? Did you have any concerns/issues/non-wear time?
3. Would you like to continue using Tractivity® for personal use with your smartphone or computer application? I can set it up for you.

The interview data were recorded and later transcribed, and similar statements were grouped and then sorted into themes. The themes were developed by analyzing every participant's response to each question and determining if there were any similarities between them.

Results

Participants were age 78.0 ± 9.8 years. Fourteen (52%) of the participants were females and they were distributed evenly among the two age groups. The 60-79 age group had a significantly lower ejection fraction (35.3 ± 14.3) – an indication of more severe heart failure condition. The median length of stay was 3.9 days. Those 60-79 years had a longer median length of stay in the hospital (4.2 days) than those ≥80 years (3.5 days) (See Table 1). The 60-79 age group took more daily steps on average in the hospital (1,801 ± 1460) compared to the ≥80 age group (1,005 ± 465). Average daily step count for the cohort during the 30-day post-discharge period was 4,851 ± 2,253, but the 60-79 age group had a higher average count (5,083 ± 2,401) than the ≥80 age group (4,412 ± 2,005). The percentage of activity monitor wear time for all participants was 99% for hospital stay and 92% during the 30 days after discharge.

Table 1. Sample Characteristics

Characteristic	Total N=27	Age Group 60-79 n=15	Age Group 80+ n=12
Age, Mean (SD)	78.0 (9.8)	70.6 (5.6)	87.3 (4.2)
BMI, Mean (SD)	26.4 (5.2)	27.0 (6.5)	25.6 (3.3)
Female, N (%)	14 (52%)	7 (47%)	7 (58%)
White, N (%)	25 (93%)	13 (87%)	12 (100%)
Hispanic, N (%)	2 (7%)	2 (13%)	0 (0%)
EF, Mean (SD)	42.2 (15.3)	35.3 (14.3)	50.8 (12.2)
Length of Hospital Stay Mean (SD)	5.1 (3.9)	5.8 (4.7)	4.2 (2.5)

Table 2. Hospital and Post-Discharge Posture and Ambulation Results

Monitor Measurement	Total N=27	Age Group 60-79 n=15	Age Group 80+ n=12
Hospital Steps/24hrs, Mean (SD)	1447 (1184)	1801 (1460)	1005 (465)
% Hospital Stay Lying, Mean (SD)	64%	57%	71%
% Hospital Stay Sitting, Mean (SD)	30%	35%	25%
% Hospital Stay Standing, Mean (SD)	5%	6%	4%
% Hospital Stay Ambulating, Mean (SD)	2%	3%	0%
Avg. Steps 30 Days Post Discharge, Mean (SD)	4851 (2253)	5083 (2401)	4412 (2005)

Across all participants in the hospital, there were 20.5 hours of missing activePAL™ data, due to lost devices. This was less than 1% of total wear time for the cohort. The lost devices occurred due to patient diaphoresis and toileting care. For Tractivity® there were 12 hours of data lost on one participant, during the discharge process at the hospital, but it was found and placed in the patient's bag.

During the post-discharge period, lost data-hours from the Tractivity® monitor resulted from removing the device for personal care (e.g. bathing) and forgetting to put the monitor back on, a desire to remove it for personal reasons, or incorrect placement of the monitor on the ankle. This led to about 8% of lost data days across participants for the 30-day period.

The main themes identified were ease of wearing and monitor interest. The monitors were perceived as acceptable by most participants, during their hospital stay. Most stated they did not notice the activity monitors in the hospital nor did they interfere with care. One patient stated, "Not even a problem when I had my catheterization (cardiac)" (Participant 117, Male,

60.3 years). While another patient said, “They were not in the way, even for my procedures” (Participant 128, Male, 84.5 years).

Many participants stated that the activity monitors were easy to wear. One participant said, “It was around my sock and I didn’t remember it was there most of the time” (Participant 109, Male, 89.7 years). Another participant stated, “It was very easy to keep on in the ankle strap and comfortable” (Participant 123, Male, 75.1 years). While one participant said. “It was a bother sometimes but I remembered you need the information for your study” (Participant 119, Male, 71.7 years).

Only four participants (15%) were interested in wearing the monitor for personal use after study conclusion. One participant stated, “I’m interested in wearing it still. I downloaded the app and am ready to have you set it up for me” (Participant 108, Male, 73.6 years). The lack of interest in continuing use of the monitors was supported by one participant saying, “I'm just wearing this to help you out, you can take it back. I know how much I need to walk” (Participant 100, Male, 88.2 years). Another person said, “No it does not show anything on the thing (device), so I don’t care to wear it. I don’t have the phone and don’t use a computer much” (Participant 101, Female, 75.5 years). The ages of the participants that said they would be willing to use the monitor long-term were 60.3 years, 66.9 years, 73.6 years, and 75.1 years.

Discussion

There was high monitor wear time in this sample of older adults with heart failure. There were very few problems identified with wearing the activity monitors in the hospital and 30 days post-discharge. All of the participants accepted wearing the monitors in the hospital as they did not interfere with their care. The main participant issue regarding at-home Tractivity® wear was taking it off for personal care and forgetting to put it back on. The activity monitors were worn for a majority of the hospital stay and the discharge period.

Unlike the research studies in the literature review, this study had the participants wear the activity monitors in the clinical setting and at home. The investigators visited the participants in the hospital setting, which could have led to the high wear time of the activity monitors. The literature review studies provided activity monitors that the participants could interact with because they had a display screen, while the participants in this study could not and had to have the data shared with them by the investigators. All of the literature review research used a FitBit monitor, which is usually worn on the wrist, whereas this study had the participants wear the Tractivity® on their ankle. Activity monitor placement was chosen on the ankle because measuring steps in older adults with varied ambulatory is more accurate in this location (Floegel, Florez-Pregonero, Hekler, & Buman, 2017).

Limitations of this study were the small sample size and minority population was not represented, just like the literature review, therefore the results could not be generalizable to a larger population of heart failure patients. The activity monitors were worn without interaction, which may limit conclusions on acceptability of use. This factor was important to one participant that stated, "No, it doesn't show anything on the thing (device), so I don't care to wear it. I don't have the phone and don't use a computer much" (Participant 101, Female, 75.5 years).

This study showed that activity monitor wear was acceptable in a sample of older adults with heart failure. However, there was not a high acceptability rate (15%) of older adults willing to use the activity monitor long-term.

Future research should be conducted with a larger sample size to determine if the results would be generalizable. Research should determine if older adults have preferences or a particular activity monitor that they are willing to use. There needs to be research to investigate interventions to promote long-term use of activity monitors in older adults. Also, future studies

should test feasibility of activity monitors communicating data with primary health care providers to.

References

American Heart Association. (2014). American Heart Association Recommendations for Physical Activity in Adults. Retrieved from http://www.heart.org/HEARTORG/HealthyLiving/PhysicalActivity/FitnessBasics/American-Heart-Association-Recommendations-for-Physical-Activity-in-Adults_UCM_307976_Article.jsp#.WWPV2ITyvIV

American Heart Association. (2015). Physical Activity in Older Americans. Retrieved from http://www.heart.org/HEARTORG/HealthyLiving/PhysicalActivity/FitnessBasics/Physical-Activity-in-Older-Americans_UCM_308039_Article.jsp#.WWPW1YTyvIU

American Heart Association & American Stroke Association. (2015). North Carolina Fact Sheet [Fact Sheet]. Retrieved from http://www.heart.org/idc/groups/heart-public/@wcm/@adv/documents/downloadable/ucm_492900.pdf

Butler, L., Furber, S., Phongsavan, P., Mark, A., & Bauman, A. (2009). Effects of a pedometer-based intervention on physical activity levels after cardiac rehabilitation. *Journal of Cardiopulmonary Rehabilitation and Prevention, 29,* 105-114. Retrieved from http://ovidsp.uk.ovid.com.jproxy.lib.ecu.edu/sp-3.25.0a/ovidweb.cgi?Link+Set+Ref=00005082-201109000-00003|01273116_2009_29_105_butler_rehabilitation_%7c00005082-201109000-00003%23xpointer%28id%28R19-3%29%29%7c10%7c%7covftdb%7c01273116-200903000-00006&P=58&S=GHFIPDJFGOHFDMDCFNGKCABGPPMGAA00&WebLinkReturn=Full+Text%3dL%7cS.sh.37.38%7c0%7c00005082-201109000-00003

Centers for Disease Control and Prevention. (2016). Heart Disease Fact Sheet [Fact Sheet]. Retrieved from https://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_heart_disease.htm

Centers for Disease Control and Prevention. (2017). Stats of the State of North Carolina. Retrieved from https://www.cdc.gov/nchs/pressroom/states/northcarolina/northcarolina.htm

Diaz, K. M., Krupka, D. J., Chang, M. J., Shaffer, J. A., Yao, M., Goldsmith, J., . . . Davidson, K. W. (2016). Validation of the fitbit one® for physical activity measurement at an upper torso attachment site. *BMC Research Notes, 9.* doi:http://dx.doi.org.jproxy.lib.ecu.edu/10.1186/s13104-016-2020-8

Farina, N. & Lowry, R.G. (2017). Older adults' satisfaction of wearing consumer-level activity monitors. *Journal of Rehabilitation and Assistive Technologies Engineering, 4,* 1-6.

Fisher, S.R., Goodwin, J.S., Protas, E.J., Kuo, K., Graham, J.E., Ottenbacher, K.J., & Ostir, G.V. (2011). Ambulatory activity of older adults with acute medical illness. *The American Geriatrics Society,* 59, 91-95. doi:10.1111/j.1532-5415.2010.03202.x

Floegel, T.A., Dickinson, J.M., Derananian, C., McCarthy, M., Hooker, S.P., & Buman, M.P. (2017). Association of posture and ambulation with function 30 days after hospital discharge in older adults with heart failure. *Journal of Cardiac Failure, 24*(2), 126-130.

Floegel, T.A., Florez-Pregonero, A., Hekler, E.B., & Buman, M.P. (2017). Validation of consumer-based hip and wrist activity monitors in older adults with varied ambulatory abilities. *The Journals of Gerontology Series A: Biological and Medical Sciences, 72*(2), 229-236.

Go A.S., Mozaffarian D., Roger V.L., Benjamin E.J., Berry J.D., Borden W.B., Bravata D.M… (2013). Heart disease and stroke statistics—2013 update: A report from the American

Heart Association. Retrieved from https://www.heart.org/idc/groups/heart-public/@wcm/@sop/@smd/documents/downloadable/ucm_319574.pdf

Kitzman, D. W., Brubaker, P. H., Morgan, T. M., Stewart, K. P., & Little, W. C. (2010). Exercise training in older patients with heart failure and preserved ejection fraction: a randomized, controlled, single-blind trial. *Circulation. Heart Failure*, *3*(6), 659–667. http://doi.org.jproxy.lib.ecu.edu/10.1161/CIRCHEARTFAILURE.110.958785

Lyons, E.J., Swartz, M.C., Lewis, Z.H., Martinez, E., & Jennings, K. (2017). Feasibility and Acceptability of a wearable technology physical activity intervention with telephone counseling for mid-aged and older adults: A Randomized Control Pilot Trial. *JMIR MHEALTH AND UHEALTH, 5*(3).

Mercer, K., Giangregorio, L., Schneider, E., Chilana, P., Li, M., & Grindrod, K. (2016). Acceptance of commercially available wearable activity trackers among adults aged over 50 and with chronic illness: a mixed-methods evaluation. *JMIR MHEALTH AND UHEALTH*, *4*(1).

Rosenberg, D., Kadokura, E.A., Bouldin, E.D., Miyawaki, C.E., Higano, C.S., & Hartzler, A.L. (2016). Acceptability of Fitbit for physical activity tracking within clinical care among men with prostate cancer. *AMIA Annual Symposium Proceedings Archive,* 1050-1058.

Takacs, J., Pollock, C. L., Guenther, J. R., Bahar, M., Napier, C., & Hunt, M. A. (2014). Validation of the Fitbit one activity monitor device during treadmill walking. *Journal of Science and Medicine in Sport, 17*(5), 496-500. Retrieved from http://search.proquest.com.jproxy.lib.ecu.edu/docview/1611830541?accountid=10639

Venturelli, M., Cè, E., Limonta, E., Schena, F., Caimi, B., Carugo, S., … Esposito, F. (2015). Effects of endurance, circuit, and relaxing training on cardiovascular risk factors in

hypertensive elderly patients. *Age, 37*(5), 101. http://doi.org.jproxy.lib.ecu.edu/10.1007/s11357-015-9835-4

Xueyu, L., Hao, Y., Shunlin, X., Rongbin, L., & Yuan, G. (2017). Effects of low-intensity exercise in older adults with chronic heart failure during the transitional period from hospital to home in china: A randomized controlled trial. *Research in Gerontological Nursing, 10*(3), 121-128. doi:http://dx.doi.org.jproxy.lib.ecu.edu/10.3928/19404921-20170411-02