Graduate Journal of Sport, Exercise & Physical Education Research, 2019, 10, 26-36 ISSN 2046-9357

EFFECTS OF FITBIT USE ON PHYSICAL ACTIVITY IN CARDIAC REHABILITATION PATIENTS

Erica Suarez[1] & Kim Spaccarotella[2]

[1]The School of Health and Human Performance, Kean University, Union, USA
[2]Department of Biological Sciences, Kean University, Union, USA

ABSTRACT

Previous research has suggested that electronic step counters may help patients increase physical activity, yet little is known about their effectiveness in cardiac rehabilitation. The purpose of this study was to determine if guided Fitbit use can improve physical activity levels in cardiac rehabilitation patients to create a more consistent exercise routine. Thirty one patients, 20 men and 11 women, (mean age 67.4 ± 10.4 years) participated in the study. Sixteen did not own or wear a Fitbit ('non-Fitbit group') and 15 were Fitbit wearers ('Fitbit group'). The mean age was 67.4 ± 10.4 years, and conditions ranged from coronary artery bypass graft, percutaneous coronary artery intervention and myocardial infarction to aortic valve replacement, placement of an automatic defibrillator, angina, coronary artery disease and congestive heart failure. A mixed between-within ANOVA was used to compare Fitbit and non-Fitbit users' average daily metabolic equivalents (METs) at 30, 60 and 90 days of cardiac rehabilitation, 6-minute walk test distances and self-reported quality of life (QOL) on the first and final days of their 6–12-week cardiac rehabilitation programme. Repeated measures ANOVA was used to compare total steps walked for all participants at baseline and completion of the study. Multivariate tests comparing the first and last visit found (p < 0.001 for all) increased METs (2.57 ± 0.650 vs. 3.16 ± 1.00 METs), improved QOL (decreased QOL score of 2.16 ± 0.735 vs. 1.35 ± 0.551), increased walk test (292 ± 107 m vs. 337 ± 117 m), and increased steps per day walked at weeks 1 and 12 (7519 ± 2633 steps vs. 7922 ± 2554 steps) for the group overall, regardless of Fitbit use. There was no significant difference in QOL (p = 0.801) and walk test scores (p = 0.138) when comparing Fitbit users to non-Fitbit users. Thus, Fitbit use alone may not be adequate to improve physical activity in this population. Further research, involving a larger sample, longer follow-up period and behavioural counselling sessions, is needed to determine if other factors are required in combination with Fitbit use to help patients continue daily physical activity after cardiac rehabilitation.

Keywords: Exercise, motivation, pedometer, steps, cardiovascular

Article citation: Suarez, E. & Spaccarotella, K. (2019) Effects of Fitbit use on physical activity in cardiac rehabilitation patients. *Graduate Journal of Sport, Exercise & Physical Education Research*, 10: 26-36.

INTRODUCTION

Cardiovascular disease is the number one cause of death around the world (Kenney et al., 2015; World Health, 2018). The World Health Organization estimates that, on a global scale, approximately 17.9 million people die from heart disease each year, but most cardiovascular diseases can be prevented by adjusting behavioural risk factors, including tobacco control, diet and physical inactivity (2018). One intervention to help patients make lifestyle changes in these areas is cardiac rehabilitation.

Cardiac rehabilitation has been defined as interventions that are required to slow or reverse the progression of cardiovascular disease. These interventions include physical, psychological and social interactions taught by a licensed medical professional to help improve health and well-being in addition to promoting a better overall quality of life (QOL) for people who have cardiovascular diseases (Heran et al., 2011). Cardiac rehabilitation follows guidelines set by the American Heart Association and American Association of Cardiovascular and Pulmonary Rehabilitation, which typically includes up to 36 total exercise sessions over 6–12 weeks of exercise with 1–3 sessions per week, each 45–60 minutes in length, performed initially at a heart rate of 30–50% above resting heart rate (calculated as ([maximum heart rate – resting heart rate] x 0.30–0.50) + resting heart rate), unless the referring cardiologist states otherwise (Price, 2016; Sebastian, 2015). An electrocardiograph-monitored stress test or a 6-minute walk or shuttle test are commonly used to determine functional capacity and measure improvements (Price, 2016).

Over the last few decades, many scientists have examined the relationship between physical activity, physical fitness and cardiovascular health (Myers, 2003). Previous research has linked regular physical activity to decreased risk of death (Paffenbarger et al., 1993) and coronary heart disease (Kokkinos & Myers, 2010). In addition, expert reviews from the ACSM (American College of Sports Medicine) and the AHA (American Heart Association) recommend physical activity to reduce coronary heart disease events (ACSM, 2007), citing benefits of physical activity that include improvements in cardiovascular function, body weight, insulin sensitivity, blood lipid levels and blood pressure that may reduce the likelihood of developing cardiovascular disease (Fletcher et al., 1996).

Although motivation has been identified as a primary determinant of health behaviour change, interventions such as cardiac rehabilitation that are designed to enhance motivation in behavioural change have shown limited adherence (Fleury & Sedikides, 2007; Perez et al., 2009). One way to instill wellness motivation in this population could be through an external device, i.e., the Fitbit. Low-cost objective measures, such as pedometers and accelerometers, have become standard tools in assessing physical activity levels (Bravata, 2007). Accurate measurement of physical activity is essential in understanding the relationship between physical activity and health outcomes (Bravata, 2007). A pedometer is a portable electronic device that counts each step a person takes by using motion technology. Fitbit has become the lead seller of these portable electronic devices. The Fitbit became available in 2007 with enhanced features and broader commercial market appeal (Mammen et al., 2012).

Several physical activity interventions have shown success in promoting physical activity in patients living with chronic diseases such as heart disease (Bravata et al., 2007; Butler et al., 2009; Houle et al., 2012). Research with outpatient adults found that long-term participation in physical activity following a coronary event significantly improved among those using a pedometer compared with those receiving usual care: 83% of patients with pedometers were still active 12 months after their coronary event compared with 55% of those in the usual care group, $p < 0.05$ (Houle et al, 2012). The authors concluded that wearing a pedometer or accelerometer makes it easier for individuals to self-monitor activity levels (Houle et al., 2012). Further, a randomized control trial comparing physical activity levels among pedometer and non-pedometer users following cardiac rehabilitation reported significant improvements in total physical activity sessions (mean difference of 2.9 ± 6.5 sessions for patients with pedometers vs. -0.9 ± 5.4 sessions for controls, $p = 0.002$), walking minutes (mean difference of 80.7 ± 219.8 minutes for those with pedometers vs. -26.2 ± 199.2 minutes for controls, $p = 0.013$) and walking sessions (mean difference of 2.3 ± 5.5 sessions for those with pedometers vs. -1.7 ± 4.7 sessions for controls, $p < 0.001$) in the intervention group compared with the control group (Butler et al., 2009). Finally, in 2007, a systematic review was performed to evaluate the association of pedometer use with physical activity and health outcomes among outpatient adults (Bravata et al., 2007). The systematic review found that the use of pedometers is associated with significant increases in physical activity of 26.9% and an increase of 2183 steps per day ($p < 0.0001$) compared with baseline, and significant decreases in body mass index (0.38 decrease, $p = 0.03$) and systolic blood pressure (3.8 mmHg decrease, $p < 0.001$) (Bravata et al., 2007). Although pedometers have been used to increase physical activity and improve health (Bravata et al., 2007) by sports and physical fitness enthusiasts, they are becoming more popular as an everyday exercise counter and personal motivator (Mammen et al., 2012). More recently, advances in technology have led to the development of the Fitbit, which includes an accelerometer to measure exercise intensity and better quantify the type of physical activities users perform and can be conveniently worn as a watch (Mammen et al., 2012). Despite the popularity of these devices and research demonstrating the possible benefits of pedometer use in the cardiac rehabilitation population, there is limited research on Fitbit use in cardiac rehabilitation. Thus, the purpose of this study was to evaluate the efficacy of guided Fitbit use to increase physical activity levels in cardiac rehabilitation patients.

METHOD

Participants

Thirty one patients, 20 men and 11 women (mean age 67.4 ± 10.4 years), participated. Of these, 16 did not own or wear a Fitbit ('non-Fitbit group') and 15 were Fitbit wearers ('Fitbit group'). Participants were recruited from an outpatient cardiac rehabilitation facility in New Jersey, United States, and were enrolled in cardiac rehabilitation. Participants were required to complete an informed consent form, a medical history questionnaire and a Physical Activity and Readiness Questionnaire (NASM) to determine their capability to participate in the study. Furthermore, participants completed a release of liability and received medical clearance from a physician if necessary, determined by their PAR-Q response. As listed in Table 1, the majority of participants were married. The majority of men reported good health and were employed, whereas the majority of women reported fair/poor health and were not employed.

Protocol

Participants who owned a Fitbit were placed into the Fitbit group, and those who did not own a Fitbit were placed into the non-Fitbit group. All participants continued their prescribed rehabilitation as well as normal daily activities. Each rehabilitation session included a 5-minute warm-up on a SCIFIT recumbent bike, PhysioStep recumbent elliptical, SCIFIT arm ergometer or Landice treadmill, an exercise session in which each patient worked on each piece of equipment at his or her prescribed heart rate for 5–10 minutes, and a 5-minute cool-down walking around the room. Following current guidelines, the prescribed heart rate was calculated as 20–60% above resting heart rate unless the referring cardiologist stated otherwise (Sebastian, 2015). Under the supervision of cardiac rehabilitation staff, patients self-monitored their own heart rate. In addition, subjects in the Fitbit group met with the primary investigator weekly for 5 minutes after one of their exercise sessions to review Fitbit data, including steps walked, and discuss any issues they had with their Fitbit or connection to their Fitbit app. This meeting was called 'guided' Fitbit use. Each patient completed 18–36 sessions of their already scheduled cardiac rehabilitation at 45–60 minutes each. The cardiac rehabilitation programme ran for 6–12 weeks, and patients completed 2–3 sessions each week. The initial evaluation period for cardiac rehabilitation was 90 minutes. During the initial evaluation the participants met with the cardiac rehab nurse for a one on one interview which is normal cardiac rehab protocol. During this time, the participants' gender, age, marital status, occupation, diagnosis, self-reported health status, level of physical activity before and after a cardiac event was recorded to provide more information regarding each patient. A medical history questionnaire, a Dartmouth Quality of Life questionnaire (Dartmouth College, 2009) and a patient health (PHQ-9) questionnaire (Spitzer et al., 1981) were taken on the first visit. The QOL questionnaire asked respondents to rate their health, physical activity level, difficulty performing daily activities, level of social activity, pain, level of social support and overall perception of life over the past 4 weeks. A score of 0 on the QOL questionnaire represents a good perception of QOL as the score increases, perception of QOL is increasingly negative, with a score of 5 being the worst. The PHQ-9 questionnaire asked respondents about feelings of depression, sleeping issues, energy level, appetite, negative feelings, poor concentration, changes in attention or lack of interest and suicidal thoughts over the past 2 weeks. A score of 0 indicates no issues, and a score of 3 indicates poor health.

Statistical analysis

A mixed between-within ANOVA was used to compare MET levels, 6-minute walk test distances and QOL from pre-cardiac rehabilitation to post-cardiac rehabilitation among patients in the Fitbit and non-Fitbit groups. A repeated measures ANOVA was used to compare steps for all participants at the beginning and end of cardiac rehabilitation. A significance level of $p < 0.05$ was used to determine significance, and the data were processed using SPSS version 22.0.

RESULTS

There were no significant differences between participants in the Fitbit and non-Fitbit groups.

Table 1: Descriptive data of all participants

	n	Mean age (years)	Marital status	Occupation	Self-reported health status
Men	20	66 ± 11.2	90% married 5% widowed 5% never married	65% employed 30% retired 5% disabled	65% good 30% fair/poor 5% excellent/very good
Women	11	69.9 ± 8.3	64% married 27% widowed 9% divorced	36% employed 64% retired 0% disabled	27% good 73% fair/poor 0% excellent/very good
Group	31	67.4 ± 10.4	81% married 13% widowed 3% never married 3% divorced	55% employed 42% retired 3% disabled	52% good 45% fair/poor 3% excellent/very good

Table 2 shows the mean and standard deviation for METs, steps walked, QOL, and 6-minute walk test scores between participants in the Fitbit and non-Fitbit groups. Regardless of Fitbit use, QOL improved for all participants (mean score 2.16 ± 0.735 at baseline vs. 1.35 ± post-rehabilitation, $p < 0.001$). There was a statistically significant increase in distance walked during the 6-minute walk test ($p = 0.000$) for all participants, regardless of Fitbit use, at the end of rehabilitation compared with baseline. It was also found that all participants walked significantly more steps at week 12 than week 1 ($p = 0.001$).

Table 2: Descriptive statistics for METs, steps walked, QOL and 6-minute walk test (ft)

	n	Mean	Standard deviation
METs at 30 days			
No Fitbit	13	2.4	0.60
Fitbit	12	2.8	0.68
Total	25	2.6	0.65
METs at 60 days			
No Fitbit	13	2.7	0.48
Fitbit	12	3.3	0.93
Total	25	3.0	0.80
METs at 90 days			
No Fitbit	13	2.9	0.65
Fitbit	12	3.4	1.4
Total	25	3.2	1.1
Quality of life at start			
No Fitbit	16	2.1	0.89
Fitbit	15	2.2	0.56
Total	31	2.2	0.74
Quality of life at end			
No Fitbit	16	1.4	0.51
Fitbit	15	1.3	0.59
Total	31	1.4	0.55
6-minute walk test at start			
No Fitbit	16	877.9	408.9
Fitbit	15	1043.7	264.7
Total	31	958.1	351.3
6-minute walk test at end			
No Fitbit	16	100	423
Fitbit	15	1218	316
Total	31	1107	385
Steps walked at week 1			
Total	15	7519	2633
Steps walked at week 12			
Total	15	7922	2554

DISCUSSION

The purpose of this study was to determine if guided Fitbit use can change physical activity levels and QOL in cardiac rehabilitation patients. The findings suggest no differences in physical activity levels and QOL based on Fitbit use, as improvements in METs, QOL, walk test scores and steps were observed for all participants, regardless of Fitbit use, from baseline to the end of cardiac rehabilitation.

The data show an improvement in QOL during cardiac rehabilitation. Similar findings were reported in a recent meta-analysis of 5 studies that assessed changes in QOL among patients attending cardiac rehabilitation compared with controls (mean improvement in QOL score of 4.00, 95% confidence interval of 0.26 to 7.74, $p = 0.04$) (Smart et al., 2018). One of the goals for cardiac rehabilitation intervention is to help improve health and well-being as well as promote a better overall QOL for people who have cardiovascular diseases (Heran et al., 2011), so lower scores are expected.

The data show an increase of 148.6 ± 33.8 ft in 6-minute walk test scores from beginning to completion of cardiac rehabilitation. There were no significant differences for the 6-minute walk test scores when comparing Fitbit and non-Fitbit users. It has been reported that the 6-minute walk test can be used to obtain reliable and valid measures of physical endurance in older adults (Rikli & Jones, 1998). It has also been reported that the 6-minute walk test moderately reflects overall physical function and performance (Rikli & Jones, 1998). Since cardiac rehabilitation was created to improve physical functioning in adults with cardiovascular disease, we could expect 6-minute walk test scores to improve throughout the completion of cardiac rehabilitation.

Comparisons between Fitbit users' and non-Fitbit users' step counts were made at week 1 and week 12. Although no differences in steps walked based on Fitbit use were found, all of the participants walked significantly more steps at week 12 compared with week 1. A study conducted in Australia gave pedometers to patients who were currently enrolled in cardiac rehabilitation (Butler et al., 2009). The intervention was 6 weeks long and included self-monitored activity using the pedometer, a step calendar which included step goals for each day and actual steps walked, behavioural counselling and a goal-setting session. The data were collected at baseline, 6 weeks into the study and 6 months into the study. The patients that had the pedometer showed a greater increase in total physical activity minutes (mean increase of 86.77 ± 277.5 min for pedometer users vs. mean increase of 4.8 ± 244.2 minutes for controls, $p = 0.044$) and an increase in cardiorespiratory fitness (mean increase of 0.37 ± 0.8 METs for pedometer users vs. 0.24 ± 1.2 METs for controls, $p = 0.01$) (Butler et al., 2009). This suggests that steps walked may increase during the progression of cardiac rehabilitation. Moreover, a study conducted at Brown University followed 130 patients after completing cardiac rehabilitation. Patients were randomly chosen to receive phone interventions with exercise counselling or to receive only telephone support that did not focus on exercise. The study reported that the patients who received phone calls with exercise counselling were exercising about 80 minutes more per week at the end of 12 months compared with those who did not receive exercise counselling (95% CI: 22, 137) (Pinto, 2011). Thus, the addition of theory-based behaviour counselling with pedometer use may explain the greater improvement in long-term physical activity reported in several studies (Houle, 2012; Pinto, 2011). Indeed, a study of 731 patients in cardiac rehabilitation reported that those who received pedometer-based, in-person counselling that incorporated behaviour change techniques, such as goal setting, barrier identification, feedback and relapse prevention, showed an increase of 500 steps per day compared with those who received cardiac rehabilitation alone (ter Hoeve, 2015). A systematic review of 14 interventions to promote physical activity among patients in cardiac rehabilitation concluded that programmes utilizing combinations of behavioural interventions, such as self-monitoring, goal setting, feedback and prompting were most successful (Chase, 2011). Although Fitbit users in the current study met with the primary investigator weekly to review Fitbit data and receive guidance about Fitbit use, more extensive counselling sessions, with greater emphasis on behavioural intervention strategies, may be needed to improve the effectiveness of Fitbit use in truly motivating cardiac rehabilitation patients.

Other studies suggest that pedometer equipment has a positive effect on physical activity in this population over time. The previously mentioned study by Butler in Australia, showed an increase in total physical activity minutes and cardiorespiratory fitness after 6 months and an increase in psychosocial health at both 6 weeks and 6 months (Butler et al., 2009). The present study showed that with or without the use of the Fitbit, participants increased MET levels, QOL, step count and 6-minute walk test scores. It is expected that participants in cardiac rehabilitation will show improvements in these areas, but the use of the Fitbit may help participants continue to show improvement after the completion of cardiac rehabilitation. Indeed, research by Pinto and colleagues reported significant group differences in exercise participation but only after 12 months, suggesting a possible long-term effect (2011). It would be beneficial to carry out further research tracking patients after completion of cardiac rehabilitation to see if they continue to use the Fitbit and determine long-term effects on their lifestyle.

CONCLUSION

In the present study, participants' MET levels, QOL, step count and 6-minute walk test scores improved from the beginning to the end of cardiac rehabilitation with no significant difference between Fitbit vs. non-Fitbit users.

Given that other studies mentioned in the literature suggest that pedometer equipment has a positive effect on physical activity in this population, especially when paired with exercise counselling and when used over a longer time, it would be beneficial to carry out further research tracking patients after completion of cardiac rehabilitation. This would give additional insight into whether participants continued Fitbit use, how it would affect their lifestyle and what effect the addition of exercise counselling may have. Although many cardiac rehabilitation patients own Fitbits, the results of this study suggest simply wearing one is insufficient to affect physical activity. To maximize Fitbit effectiveness in cardiac rehabilitation, health professionals may need to incorporate Fitbits into behavioural counselling sessions or long-term follow-up programmes that provide more structured guidance and support.

FIRST AUTHOR'S BIOGRAPHY

Erica Suarez completed her Masters of Exercise Science programme, concentrating on exercise physiology, from Kean University's Nathan Weiss Graduate College. She began the graduate programme in January 2015. Her research began in May 2017 and data collection concluded in December 2017.

ACKNOWLEDGEMENTS

The authors would like to thank all of the participants for their time, effort, dedication and patience in helping complete this study; without them this study would not have been possible.

REFERENCES

American College of Sports Medicine and American Heart Association. (2007) Exercise and acute cardiovascular events: placing the risks in perspective. *Medicine and Science in Sports and Exercise* 39(5): 886-897.

American Heart Association (2014) What is cardiovascular disease? Available at: http://www.heart.org/HEARTORG/Conditions/What-is-Cardiovascular-Disease_UCM_301852_Article.jsp#.Wt97_Mvrthc. [Accessed: 31 March 2018].

Bravata, D. M., Smith-Spangler, C., Sundaram, V., Gienger, A. L., Lin, N., Lewis, R. & Sirard, J. R. (2007) Using pedometers to increase physical activity and improve health: a systematic review. *Journal of the American Medical Assocation* 298(19): 2296-2304.

Buss, M., Van Deursen, R. W. & Wiles, C. M. (2009) Real-life step and activity measurement: reliablility and validity. *Journal of Medical Engineering and Technology* 33: 33-41.

Butler, L., Furber, S., Phongsavan, P., Mark, A. & Bauman, A. (2009) Effects of a pedometer-based intervention on physical activity levels after cardiac rehabilitation: a randomized controlled trial. *Journal of Cardiopulmonary Rehabilitation and Prevention* 29(2): 105-114.

Chase, J. (2011) Systematic review of physical activity intervention studies after cardiac rehabilitation. *The Journal of Cardiovascular Nursing* 26(5): 351-358.

Chiauzzi, E., Rodarte, C. & DasMahapatra, P. (2015) Patient-centered activity monitoring in the self-management of chronic health conditions. *BMC Medicine* 13(1): 77.

Fletcher, G. F., Balady, G., Blair, S.N., Blumenthal, J., Caspersen, C., Epstein, S., Froelicher, E. S., Pina, V. F. & Pollock, M. L. (1996) A statement for health professionals by the committee on exercise and cardiac rehabilitation of the council on clinical cardiology, American Heart Association. *Circulation* 94(4): 857-862.

Fleury, J. & Sedikides, C. (2007) Wellness motivation in cardiac rehabilitation: the role of self-knowledge in cardiovascular risk modification. *Research in Nursing & Health* 30(4): 373-384.

Heran, B. S., Chen, J. M., Ebrahim, S., Moxham, T., Oldridge, N., Rees, K. & Taylor, R. S. (2011) Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane Database of Systematic Reviews* (7), CD001800-1.

Houle, J., Doyon, O., Vadeboncoeur, N., Turbide, G., Diaz, A. & Poirier, P. (2012) Effectiveness of a pedometer-based program using a socio-cognitive intervention on physical activity and quality of life in a setting of cardiac rehabilitation. *Canadian Journal of Cardiology* 28(1): 27-32.

Kenney, E.L., Wilmore, J.H., & Costill, D.L. (2015). Physiology of Sport and Exercise, 6th ed. Champaign: *Human Kinetics*.

Kokkinos, P. & Myers, J. (2010) Exercise and physical activity: clinical outcomes and applications. *Circulation* 122(16): 1637-1648.

Kroenke, K., Spitzer, R. & William, W. (2001) The PHQ-9: validity of a brief depression severity measure. *Journal of General and Internal Medicin*e 16: 606-616.

Mammen, G., Gardiner, S., Senthinathan, A., McClemont, L., Stone, M. & Faulkner, G. (2012) Is this bit fit? Measuring the quality of the FitBit step-counter. *Health and Fitness Journal of Canada* 5(4): 30-9.

Mampuya, W. M. (2012) Cardiac rehabilitation past, present and future: an overview. *Cardiovascular Diagnosis and Therapy* 2(1): 38.

Myers, J. (2003). Exercise and cardiovascular health. *Circulation* 107(1): e2-e5.

Nelson, M. E., Rejeski, W. J., Blair, S. N., Duncan, P. W., Judge, J. O., King, A. C. & Castaneda-Sceppa, C. (2007) Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation* 116(9): 1094.

Omenn, G. S., Beresford, S. A. & Motulsky, A. G. (1998) Preventing coronary heart disease: B vitamins and homocysteine. *Circulation* 97: 421-424.

Perez, A. & Fleury, J. (2009) Wellness motivation theory in practice. *Geriatric Nursing* 30(2): 15-20.

Pinto, B. M., Goldstein, M. G., Papandonatos, G. D., Farrell, N., Tilkemeier, P., Marcus, B. H. & Todaro, J. F. (2011) Maintenance of exercise after Phase II Cardiac Rehabilitation: a randomized controlled trial. *American Journal of Preventive Medicine* 41(3): 274–283.

Price, K. J., Gordon, B. A., Bird, S. R. & Benson, A. C. (2016) A review of guidelines for cardiac rehabilitation exercise programmes: is there an international consensus? *European Journal of Preventive Cardiology* 23(16): 1715-1733.

Rikli, R. E. & Jones, C. J. (1998) The reliability and validity of a 6-minute walk test as a measure of physical endurance in older adults. *Journal of Aging and Physical Activity* 6(4): 363-375.

Sebastian, L., Reeder, S. & Williams, M. (2015) Determining target heart rate for exercising in a cardiac rehabilitation program: a retrospective study. *The Journal of Cardiovascular Nursing* 20(2): 161-171.

Smart, N. A., King, N., Lambert, J. D., Pearson, M. J., Campbell, J. L, Risom, S.S. & Taylor, R.S. (2018) Exercise-based cardiac rehabilitation improves exercise capacity and health-related quality of life in people with atrial fibrillation: a systematic review and meta-analysis of randomized and non-randomised trials. *Open Heart* 5.

Sebastian, L. A., Reeder, S. & Williams, M. (2015) Determining target heart rate for exercising in a cardiac rehabilitation program: a retrospective study. *The Journal of Cardiovascular Nursing* 30(2): 164-171.

Spitzer, W.O., Dobson, A.J., Hall, J., Chesterman, E., Levi, J., Shepherd, R., Battista, RN & Catchlove, BR (1981). Measuring QOL in cancer patients: a concise QL index for use by physicians. *Journal of Chronic Disease* 34:588-597.

ter Hoeve, N., Sunamura. M., Stam, H. J., Boersma, E., Geleijnse, M. L., van Domburg, R. T. & van den Berg-Emons, R. J. G. (2018) Effects of two behavioral cardiac rehabilitation interventions on physical activity: a randomized trial*. International Journal of Cardiology* 255: 221-228.

Turk-Adawi, K. I., Oldridge, N. B., Tarima, S. S., Stason, W. B. & Shepard, D. S. (2013) Cardiac rehabilitation patient and organizational factors: what keeps patients in programs? *Journal of the American Heart Association* 2(5): e000418.

World Health Organization. (2015) Cardiovascular diseases. Available at: http://www.who.int/cardiovascular_diseases/en/ [Accessed: 31 March 2018].

World Health Organization. (2018) The top ten causes of death. Available at: http://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death. [Accessed: 20 November 2018].