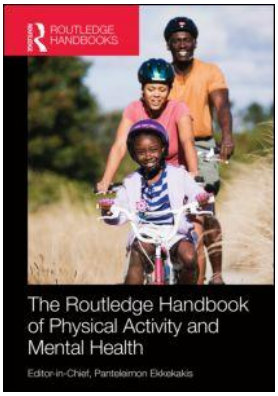

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PHYSICAL ACTIVITY AND QUALITY OF LIFE IN CARDIOVASCULAR AND PULMONARY DISEASES

Charles F. Emery, Risa N. Long, and KayLoni L. Olson

"Physical activity" (PA) and "exercise" are often used interchangeably, but may refer to different concepts. PA typically refers to all types of activities in which body movement and muscle contraction are required, including most activities of daily living (ADLs) such as household chores and PA in the workplace. In contrast, exercise activity generally refers to planned and structured activities undertaken with the purpose of improving components of physical fitness such as muscular strength, flexibility, or physical endurance. The literature on PA and quality of life (QOL) in cardiovascular and pulmonary diseases includes studies of both daily PA as well as intervention studies evaluating the effects of exercise on QOL. Studies of both types of PA were included in this selective review with the goal of identifying the best data available for understanding the relationship between PA and QOL.

QOL is a multi-dimensional construct and various self-report measures have been utilized in the research literature to operationalize the multi-faceted components of QOL (e.g., self-rated health, social functioning, physical functioning, mood, and life satisfaction). The Medical Outcomes Study Short Form-36 (SF-36; Ware & Sherbourne, 1992) is the most commonly used QOL measure in health-related research and is considered a "generic" indicator because it can be used to evaluate QOL across a wide range of health conditions. The SF-36 provides eight subscale scores (physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health) as well as a mental component score and a physical component score. In addition to generic measures of QOL, research and clinical applications typically also assess QOL with illness-specific measures (e.g., Kansas City Cardiomyopathy Questionnaire (KCCQ); Quality of Life after Myocardial Infarction (QLMI) scale; St. George's Respiratory Questionnaire (SGRQ); Cystic Fibrosis Questionnaire – Revised). Most prior studies of QOL among cardiac patients have relied primarily on the SF-36.

Physical activity and quality of life in cardiovascular disease

Cardiovascular disease (CVD) refers broadly to disorders of the heart and vascular system. Thus, a number of distinct clinical disorders are encompassed including coronary heart disease (CHD), stroke, hypertension (HTN), and congestive heart failure (CHF). Although exercise was believed to be dangerous for patients with cardiac disease until the 1970s, during the past three decades it has been well documented that PA is both safe and beneficial for patients with CVD (Smart

Table 35.1 Quality of life outcomes of physical activity among patients with cardiovascular disease

Patient population	*Physical activity and quality of life outcome*	*Caveats*
Coronary heart disease	Exercise-based rehabilitation leads to increased QOL but changes generally do not exceed improvements due to treatment as usual.	– Benefits of exercise-based programs may only emerge during follow-up period. – Combined aerobic and resistance training may be more beneficial than aerobic alone in women. – Evidence of a dose-response relationship. – Age and sex may moderate the relationship between exercise and QOL.
Stroke	Exercise interventions lead to improvements in physical QOL but not necessarily mental QOL.	– Results are not maintained in follow-up (ranging from 12–24 months post-intervention). – Cardiorespiratory fitness may not be the mechanism through which exercise impacts QOL. Gait-speed may be alternative mechanism.
Hypertension	Exercise programs lead to improvements in QOL.	– Aerobic training may be more beneficial than resistance training. – Few studies of young adults.
Congestive heart failure	Lack of change in exercise capacity has been associated with lack of change in QOL.	– Inconsistent results limit reliability of conclusions.

QOL=quality of life

& Marwick, 2005). Table 35.1 provides a summary of QOL outcomes of exercise among patients with CVD.

Coronary heart disease

CHD (also referred to as coronary artery disease (CAD) or ischemic heart disease) is the most common form of heart disease, affecting 7.9% of Americans, and is the leading cause of death in the United States (Lloyd-Jones et al., 2010). CHD is characterized by an inadequate blood supply to the heart tissue resulting from narrowing of the coronary arteries. Reduced blood flow to the heart may result in symptoms of chest pain (angina), and blockage of blood flow may result in a myocardial infarction (MI or heart attack).

Cross-sectional studies generally reflect positive associations of PA with enhanced QOL across a wide range of patients with CVD, including older women (age ≥ 60 years; Janz et al., 2001). Among 262 cardiac patients entering a rehabilitation program, $\dot{V}O_2$max was associated with higher ratings on several SF-36 QOL dimensions (Jette & Downing, 1996). Conversely, in a large sample (n=1024) of patients diagnosed with CAD, low exercise capacity was associated with worse QOL and poorer overall health (Ruo et al., 2003).

In contrast to positive data from cross-sectional studies, longitudinal studies and exercise intervention studies indicate that PA may not be essential for improved QOL among patients with CVD. Emery and colleagues (2004) found that physical and mental QOL improved for

men and women with CVD over a 12-month period following hospital admission, regardless of physical activity level. Likewise, improvements in QOL associated with exercise interventions often do not exceed improvements observed in control groups, as reflected in a review of randomized controlled trials (RCTs) by Taylor and colleagues (2004). However, several studies suggest that exercise treatment is associated with improvement in QOL at longer-term follow-ups of 6 months, 8 months, and 12 months (Belardinelli et al., 2001; Dugmore et al., 1999; Elley, Kerse, Arroll, & Robinson, 2003). In these studies, improved QOL is associated with increased functional capacity, as reflected by increases in peak $\dot{V}O_2$ and 6-minute walk distance, although not all studies included indicators of mental health. In addition, more intensive training has been associated with greater gains in QOL. Aerobic training combined with strength training resulted in more substantial improvements in QOL than aerobic exercise alone among women with CHD (Arthur et al., 2007; Hung et al., 2004). Similarly, Nieuwland and colleagues (2000) found that 6 weeks of high-intensity exercise led to significantly greater improvements in mental QOL (SF-36) than did low-intensity exercise.

Studies suggest possible age-related effects of exercise among patients with CVD. Marchionni and colleagues (2003) found that exercise was associated with improved physical QOL among post-MI participants over age 75, but individuals under age 75 reported improvements in physical QOL regardless of exercise status. Also, Seki and colleagues (2003) found improved mental QOL among older men (mean age = 70 years) with CHD following exercise training in the absence of increased functional capacity.

Stroke

Stroke occurs when there is disturbance of blood flow to one or more regions of the brain resulting from a clot in the bloodstream or a burst blood vessel. Consequences range from minimal damage to death, but many stroke survivors experience long-term impairment of functioning, including difficulty with ADLs and with cognitive tasks. Stroke is the fourth leading cause of death in the United States, and the leading cause of long-term disability. Additionally, one in eight stroke survivors experiences a subsequent stroke.

Cross-sectional data from 118 individuals 1 year after stroke indicate that degree of disability is associated with reductions in both PA and QOL (Carod-Artal, Egido, Gonzalez, & de Seijas, 2000). Among stroke survivors (2.4% of total sample of 51,193), self-report of regular exercise was associated with less impairment in health-related QOL (HRQOL) during the previous 30 days (Greenlund et al., 2002). However, recent data suggest that exercise may be associated with only select aspects of QOL. In a group of 40 stroke survivors, Rand and colleagues (Rand, Eng, Tang, Hung, & Jeng, 2010) found that PA measured both via accelerometer and via self-report was associated with physical QOL but not mental QOL (SF-36).

De Weerd and colleagues (De Weerd, Rutgers, Groenier, & van der Meer, 2011) conducted at-home longitudinal interviews of stroke patients (n = 57) immediately after hospital discharge and at 1-year follow-up. Patients who maintained or increased PA during the 1-year interval reported enhanced QOL, specifically better physical functioning and reduced physical role limitations.

Conflicting evidence emerged from a Cochrane review of exercise effects on QOL among stroke survivors (Saunders, Greig, Mead, & Young, 2009), but a recent review of RCTs reported positive effects of exercise on QOL (Chen & Rimmer, 2011). Across studies, exercise is associated with improved mental and physical QOL post intervention with a small to medium effect, but improvements in QOL are reduced at follow-up (ranging from 12–24 months post-intervention). Langhammer, Stanghelle, and Lindmark (2008) found that non-cardiorespiratory factors

associated with self-initiated exercise may account for enhanced QOL outcomes, possibly reflecting increased self-efficacy or sense of responsibility among self-initiators.

Due to the nature of physical deficits associated with stroke, gait-specific exercise is often a focus of rehabilitation programs. Schmid and colleagues (2007) found that gait-speed increases during exercise rehabilitation were associated with improvements in physical QOL, but a recent review found no evidence that improvement in gait-speed affects QOL (Van de Port, Wood-Dauphinee, Lindeman, & Kwakkel, 2007). Combs and colleagues (2010) found improved QOL and physical fitness following treadmill-based exercise among 19 stroke patients, but changes in physical fitness were not correlated with changes in physical QOL at program completion or at 6-month follow-up, suggesting that cardiorespiratory fitness may not be the mechanism by which exercise influences physical QOL among post-stroke patients.

Hypertension

Essential, or primary, HTN is a condition marked by high blood pressure that is not secondary to another identifiable medical condition. HTN can lead to vascular weakness, scarring, increased risk of blood clots, and accumulation of plaque in the arteries. In turn, HTN places increased burden on the circulatory system and contributes to greater risk of future cardiac events as well as other medical conditions. HTN is one of the most common chronic health problems in the United States, affecting one out of three individuals.

In a cross-sectional study of 361 hypertensive patients, Fernandez and colleagues (Fernandez, Garcia, Alvarez, Giron, & Aguirre-Jaime, 2007) found that self-reported PA was positively associated with select domains of QOL in men and in those under age 65, but PA was more broadly associated with QOL among women and older participants (over age 65). Short-term, 24-hour PA measured with the actigraph among hypertensive patients has been positively associated with specific components of QOL such as emotional role functioning and physical functioning (SF-36; Okano et al., 2004).

Among hypertensive individuals, exercise programs typically lead to improvements in functional capacity and most aspects of QOL, including mental QOL, for middle-aged adults (Tsai et al., 2004) and older adults (Park et al., 2010), as well as women (Povoa et al., 2010). The latter study found that aerobic training was associated with greater QOL improvements than resistance training.

Congestive heart failure

CHF occurs when the heart cannot sufficiently pump blood throughout the body. It is a progressive disorder in which the heart continues to function but at a suboptimal level, leading to complications. Most often, individuals with CHF experience symptoms of fatigue, fluid accumulation in the lungs, and exercise intolerance.

Among CHF patients, the cross-sectional relationship between exercise capacity and QOL varies depending on the measure of activity. Better performance on the 6-minute walk test is associated with higher self-reported QOL (Santos & Brofman, 2008), while $\dot{V}O_2$max has been associated with some domains of QOL (physical function, role-physical, general health, vitality, mental health) but not other domains (bodily pain, social function, role-emotional; Juenger et al., 2002). In a recent study of 36 patients with CHF, PA measured via accelerometer was not associated with physical or mental QOL (van den Berg-Emmons, Bussmann, Balk, & Stam, 2005).

Results of intervention studies among individuals with CHF are equivocal (e.g., Pihl, Cider, Stromberg, Fridlund, & Martensson, 2011). Following a systematic review of the literature,

Lloyd-Williams and colleagues (Lloyd-Williams, Mair, & Leitner, 2002) found that methodological concerns regarding the types of measures and the timing of assessments precluded firm conclusions. However, exercise programs of varying lengths (3 to 12 months) have been associated with improvements in QOL and increased functional capacity (Patwala et al., 2009; Bocalini, dos Santos, & Serra, 2008; Flynn et al., 2009), and failure to achieve increased $\dot{V}O_2$max or 6-minute walk distance has been associated with failure to experience changes in QOL (Brubaker, Moore, Stewart, Wesley, & Kitzman, 2009). However, studies do not consistently evaluate mental QOL. Data suggest that older individuals (<70 years) and very old individuals (≥70 years) with CHF experience exercise-associated increases in QOL (Miche et al., 2009), as do women with CHF (Gary et al., 2004).

Although some studies indicate that improvements in aerobic capacity may be the mechanism by which PA influences QOL (e.g., Mandic et al., 2008), other studies suggest that PA may not lead to improved QOL among patients with CHF (Van Tol, Huijsmans, Kroon, Schothorst, & Kwakkel, 2006). Additionally, a recent review of RCTs failed to find enhanced QOL among patients with CHF despite significant improvements in functional capacity (Chien, Lee, Wu, Chen, & Wu, 2006).

Methodological problems/concerns in this line of research

There is promising evidence of positive effects of exercise on QOL among patients with CVD, but there are a number of problems with this line of research, including methodological variability across studies in measures of QOL and PA/exercise capacity, type and length of exercise training programs, and absence of randomized controlled studies. Inconsistent findings may result from variability in measures of similar domains (e.g., 6-minute walk, $\dot{V}O_2$max, and actigraph are not consistently associated with QOL).

Although a generic QOL measure such as the SF-36 allows for comparison across patient groups and studies, generic measures may not be sensitive to illness-specific changes in QOL. In addition, prior studies have routinely addressed physical QOL but have not consistently assessed mental QOL.

Physical activity and quality of life in pulmonary disease

Pulmonary disease refers to disorders of the lungs and respiratory system. Thus, pulmonary disease incorporates a number of distinct conditions including chronic obstructive pulmonary disease (COPD), asthma, interstitial lung disease (ILD), cystic fibrosis (CF), and pulmonary hypertension, all of which have been associated with reduced QOL. Table 35.2 provides a summary of QOL outcomes of exercise among patients with pulmonary disease.

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death in the United States and a major cause of disability. It is estimated that 12 million Americans have been diagnosed with COPD and another 12 million are living with COPD, but have not yet been diagnosed. COPD encompasses both emphysema and chronic bronchitis. Common symptoms include shortness of breath, cough with sputum production, fatigue, and insomnia. Risk factors include a history of smoking, genetics, and exposure to environmental toxins. Historically, COPD has affected more men than women, but the prevalence among women has increased in recent decades, primarily due to increased smoking rates among women (Mannino & Buist, 2007).

Table 35.2 Quality of life outcomes of physical activity among patients with pulmonary disease

Patient population	*Physical activity and quality of life outcome*	*Caveats*
Chronic obstructive pulmonary disease	Exercise-based rehabilitation leads to improvement in QOL immediately following intervention.	– Gains in QOL following exercise-based programs diminish during follow-up (12–24 months). – Maintenance programs plagued by poor compliance.
Asthma	– Greater physical activity associated with better QOL in children. – Exercise training improves QOL in adults.	– More randomized studies of QOL outcomes are needed, especially among children.
Interstitial lung disease – Pulmonary fibrosis – Sarcoidosis	Evidence for exercise-related increases in QOL.	– Randomized studies are needed to further explicate mechanisms of change.
Cystic fibrosis	Aerobic and anaerobic training may lead to improvements in physical domains of QOL among children and adolescents.	– Unclear whether supervised training is more effective than unsupervised training. – More studies examining QOL as a primary outcome are needed.
Pulmonary hypertension	Exercise-based rehabilitation may lead to improvements in QOL.	– Duration and intensity of exercise-based programs vary based on disease severity.

QOL=quality of life

Cross-sectional studies of patients with COPD generally indicate that lower PA is associated with poorer QOL (e.g., Belza et al., 2001). Greater PA, as measured by the 6-minute walk test, has been positively associated with physical QOL (Katsura, Yamada, Wakabayashi, & Kida, 2005).

Observational studies (e.g., Verril, Barton, Beasley, & Lippard, 2005) and randomized studies (e.g., Emery, Schein, Hauck, & MacIntyre, 1998) among patients with COPD indicate that exercise interventions (10–12 weeks) are associated with significant increases in HRQOL. Longitudinal studies of exercise training and maintenance indicate improvements in physical and mental QOL immediately following treatment, but improvements diminish during the year following treatment (Ringbaek, Brøndum, Martinez, Thøgersen, & Lange, 2010; Ries, Kaplan, Myers, & Prewitt, 2003). A recent meta-analysis of 31 RCTs of exercise rehabilitation found a positive effect of exercise on HRQOL, with effect sizes for physical and mental QOL exceeding a minimally important clinical difference (Lacasse, Goldstein, Lasserson, & Martin, 2006).

Asthma

Asthma is a common respiratory disease among all ages, but the disease originates primarily during childhood. Approximately 25 million people in the United States have asthma, and most cases are diagnosed among individuals aged 5–17 years. Asthma is characterized by airway inflammation, reversible airflow obstruction, and recurring symptoms including wheezing, dyspnea (i.e.,

shortness of breath), chest tightness, and coughing. The etiology is unknown, but asthma tends to be hereditary and is associated with repeated respiratory infections in childhood or exposure to specific allergens. More women than men are affected by asthma, but more boys than girls are diagnosed with asthma. Asthma is incurable, but can be managed with a variety of pharmacological treatments.

Cross-sectional data generally reveal a positive association between PA and QOL. In a population-based study of patients (n = 12,111) with asthma, lower PA was associated with poorer physical QOL (Ford, Mannino, Redd, Moriarty, & Mokdad, 2004). In a survey of PA among children with asthma, Cheng and colleagues (2010) found that individuals with higher levels of PA reported better physical and mental QOL than those with lower PA.

Outcomes of supervised exercise interventions among older patients with asthma have revealed improvements in asthma-related QOL (Mendes et al., 2010; Turner, Eastwood, Cook, & Jenkins, 2011), and self-administered exercise has been associated with maintaining gains in physical QOL during a 12-week follow-up (Dogra, Kuk, Baker, & Jamnik, 2011). Basaran and colleagues (2006) found that an 8-week basketball training program in children with asthma led to a significantly larger increase in physical and mental QOL than in a control group. Fanelli and colleagues (Fanelli, Cabral, Neder, Martins, & Carvalho, 2007) also found increases in physical and mental QOL following 16 weeks of aerobic training versus no training among children with moderate to severe asthma. Most exercise intervention studies in children with asthma have not included measures of QOL, limiting the ability to draw conclusions about the effects of PA on QOL.

Interstitial lung disease

Interstitial lung disease (ILD) refers to a large group of disorders classified by scarring of the lung tissue (interstitium). There are many causes of ILD, including autoimmune diseases, medication side effects, and occupational exposure. The most common type of ILD is idiopathic pulmonary fibrosis (IPF).

Idiopathic pulmonary fibrosis

Pulmonary fibrosis is a condition characterized by thickening and scarring (fibrosis) of the lung tissue over time. Symptoms of IPF include dyspnea, clubbing (rounding and/or widening of the finger tips and toes), chronic dry cough, fatigue, and unintentional weight loss. The etiology of IPF is unknown in most cases, but risk factors include history of tobacco use, viral infections, and medication use (e.g., cancer medications, antibiotics, and propanolol). It is estimated that 128,000 Americans have IPF, but this may be an underestimate due to the lack of standardized diagnostic criteria (Raghu, Weycker, Edelsburg, Bradford, & Oster, 2006).

Poorer exercise performance (measured by 6-minute walk distance) has been associated with lower QOL among patients with IPF in Japan (Tomioka, Imanaka, Hashimoto, & Iwaski, 2007). Nishiyama et al. (2008) found marked improvements in exercise capacity and physical QOL in patients with IPF following 10 weeks of exercise training compared to controls.

Sarcoidosis

Pulmonary sarcoidosis is another form of ILD characterized by inflammation and formation of tiny lumps of cells (granulomas) in the lungs. Symptoms of sarcoidosis include shortness of breath, coughing, and wheezing. During non-active phases of illness, inflammation decreases and granulomas may lessen in size, but symptoms can still occur. Sarcoidosis is known to affect African Americans more often than Caucasian Americans, but the cause of the disease remains unknown.

Poor exercise performance, as indexed by the 6-minute walk test, has been associated with decreased physical and mental QOL among patients with sarcoidosis (Baughman, Sparkman, & Lower, 2007; Bourbonnais & Samavati, 2010). Additionally, skeletal muscle weakness, as measured by quadriceps peak torque, was associated with poorer physical and mental QOL among 25 patients with sarcoidosis complaining of fatigue (Spruit et al., 2005).

Due to the broad categorization of ILDs, studies often comprise various diagnoses. Observational studies including mixed samples of patients with ILD (IPF and sarcoidosis) report positive associations of exercise capacity with physical and mental QOL (Chang, Curtis, Patrick, & Raghu, 1999), and increased general and disease-specific QOL following 6 weeks of exercise (Jastrzębski, Gumola, Gawlik, & Kozielski, 2006). Additionally, improvements in disease-specific QOL have been observed in a randomized study of 57 patients with ILD (34 IPF, 4 sarcoidosis) following 8 weeks of supervised exercise compared to controls (Holland, Hill, Conron, Munro, & McDonald, 2008), but there was a significant decrease in these gains 6 months following completion of the program.

Cystic fibrosis

Cystic fibrosis (CF) is a genetic disease characterized by excessive mucus buildup affecting the respiratory, endocrine, and digestive systems. The most prominent symptoms appear in the lungs, with mucus buildup contributing to shortness of breath and increased production of bacteria leading to infection and lung damage. There are approximately 30,000 Americans with CF, primarily individuals of northern European ancestry. The average lifespan for individuals with CF is currently 30 years, but advancements in treatment have contributed to a steady rise in the estimated life expectancy during the past 50 years.

Cross-sectional data indicate a positive relationship between activity level and QOL among children with CF. Children with the highest level of activity report better QOL than children with lower activity levels (Selvadurai, Blimkie, Cooper, Mellis, & Van Asperen, 2004).

Observational data evaluating effects of a 6-month home-cycling program among children with CF indicated improvements in QOL, as reflected by increases in perceived physical appearance and general self-worth (Gulmans et al., 1999). In addition, the short-term effects of anaerobic training have been associated with increased physical QOL among children with CF and this effect was sustained at 12-week follow-up (Klijn et al., 2004).

A randomized study of home-based, individualized exercise training among patients with CF led to improved health perception at follow-ups of 6, 18, and 24 months (Hebestreit et al., 2010). Inpatient aerobic training (but not strength training) contributed to improvements in physical QOL 1 month following discharge from the hospital among adolescents with CF (Selvadurai et al., 2002).

Pulmonary hypertension

Pulmonary hypertension (PH) is characterized by a progressive increase in blood pressure in the pulmonary arteries. The increase in pulmonary resistance results from narrowing of the blood vessels within the lungs, causing the right side of the heart to work harder to pump blood through the lungs. Over time the increased workload results in the enlargement of the right side of the heart, leading to right ventricular failure. PH can also develop secondary to primary pulmonary diseases such as COPD or ILD. Among patients with COPD, mild comorbid PH is common. Symptoms of PH include shortness of breath upon exertion, dizziness, chest pain, swelling of the legs and ankles, and fatigue.

Poorer exercise performance (measured by 6-minute walk distance) has been associated with lower QOL among patients with PH (Taichman et al., 2005), but increases in physical and mental QOL were observed among patients with PH who participated in 15 weeks of home-based exercise training following a 3-week in-hospital program (Mereles et al., 2006).

Methodological problems/concerns in this line of research

Limitations of the extant research include reliance on self-report measures of QOL, some of which have limited data on validity and reliability. Studies examining PA and QOL among patients with various pulmonary diseases generally use QOL measures that were validated for use in patients with COPD (e.g., SGRQ and SF-36), thereby limiting the validity of QOL assessment in some studies. Disease-specific measures of QOL have been developed for CF and asthma, but are not used regularly.

In addition, most studies rely on convenience samples of patients from clinical or hospital settings, thereby reducing the generalizability of results to community settings. Further limitations include small sample sizes, variability in measures of exercise capacity, and few longitudinal studies investigating change in HRQOL over time. Although mental QOL generally appears to be positively associated with PA, studies have not consistently assessed mental QOL.

Directions for future research

The gaps in the current literature suggest directions for further research. There remain relatively few studies addressing PA and QOL among patients with pulmonary disease, especially less common pulmonary diseases such as CF and IPF. Overall, there are relatively few RCTs evaluating the effects of exercise on QOL, although there are well-controlled studies among patients with CHD and COPD. Instead, most studies provide observational evidence of the relationship between PA and QOL. However, observational studies provide only preliminary evidence of the influence of PA levels on QOL. In the future, additional experimental studies would help to further explicate the relationship between PA and QOL, as well as help identify mechanisms by which PA may influence QOL in different patient groups.

Measurement problems also plague studies of PA and QOL. The gold standard for assessing PA is exercise stress testing. However, stress testing is impractical and cost-prohibitive in larger, community-based studies of PA. Therefore, studies in the field have typically used self-report measures of PA, but these measures are subject to responder bias. Studies also make use of PA measurement devices such as pedometers and accelerometers, but these devices also may introduce bias due to variability in adherence to measurement procedures, especially among patients with chronic cardiovascular and pulmonary illnesses.

QOL measurement is routinely conducted via self-report because the construct of QOL is typically reliant on participant perception. However, as with any self-report measure, responses may be biased due to desire for positive self-presentation. Utilization of both generic and illness-specific measures may help mitigate these biases. In addition, inclusion of objective QOL indicators and attention to components of QOL is critical to clarify effects in both physical and mental domains of functioning.

Conclusions

The preponderance of evidence from studies of both cardiovascular and pulmonary disease supports a positive relationship between PA and QOL (both physical and mental), although past

studies have focused more on physical QOL than mental QOL. Differences across diagnostic groups have been observed. For example, PA may not be critical for short-term improvements in QOL among patients with CHD, but appears to be related to longer-term increases in QOL. In contrast, among stroke patients, PA is associated with short-term improvement in QOL, but not with longer-term QOL outcomes. Among patients with CHD and CHF, increased exercise capacity appears to be a mechanism of improved QOL, but not necessarily among stroke patients. Studies of patients with pulmonary disease do not reflect a consistent association between increased functional capacity and increased QOL. In general, the research literature in QOL outcomes of exercise among patients with pulmonary disease is less developed than the literature among patients with cardiovascular disease.

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