ASSOCIATION OF FRAILTY INDICATORS AND HEALTH CARE RELATED OUTCOMES IN SEVERE CHRONIC OBSTRUCTIVE PULMONARY DISEASE

By

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DEDICATION

This dissertation is dedicated to my family and friends. Thank you for supporting me through all my years of school. I know some of you thought it would never end. I love you all for your support.

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ABSTRACT

Association of Frailty Indicators and Health Care Related Outcomes

In Severe Chronic Obstructive Pulmonary Disease

By

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Chair: Janet L. Larson

Background: COPD is a chronic disease that not only has a high prevalence but is associated with a significant reduced health- related quality of life (HRQoL). Frailty is a prevalent health problem of older people with adverse outcomes. The purpose of this study was to examine demographic characteristics, clinical characteristics, physical frailty indicators, and psychological frailty indicators and their impact on health care outcomes (health related quality of life, death, and utilization of health care resources) in people with severe COPD over time. Methods: The research was a secondary data analysis of 610 severe COPD individuals. HRQol was assessed using the St. George's Respiratory Questionnaire (SGRQ), death was all cause mortality, and health care utilization measured by a self- reported questionnaire.

Results: Age, gender, education, endurance, balance, mobility, coping, and depression were significant (p = <.05) predictors in the models of HRQOL. The total variance explained by the baseline model (demographic, physical, and psychological frailty indicators) was 36%, F (16, 567) = 20.31, p = < .001. The mean survival time for lower frail individuals was 7.4 years compared to 4.7 years for higher frail individuals (p = <.001). Gender, income, education, smoking history, depression, PaO2 (RA), DLCO, TLC, RV, FEV_1, endurance, nutrition, education, and balance were significant (p = <.05) predictors in the models of health care utilization.

Conclusions: Mobility and coping were significant indicators (p = <.001) over time predicting quality of life. These indicators should be included in frailty models. Higher frailty was associated with higher mortality. Those with higher COPD disease severity required increased home visits from health professionals.

CHAPTER ONE: INTRODUCTION

It is predicted that in the United States those age 65 and older will comprise over 20% of the population by the year 2030. By mid-century it is expected that there will be an estimated 88.5 million people age 65 and older. Those who are 65 years and above are the fastest growing population group in United States with expectations to increase by 53.2% by 2020 (U.S. Census Bureau, 2008). As one ages there is an increased risk for developing chronic diseases such as diabetes, cardiovascular disease, arthritis, cancer, and COPD (chronic obstructive pulmonary disease) (Fried et al., 1998; Fried et al., 2001; Mannino & Buist, 2007; Waltson et al., 2006). These diseases can impact the ability to perform activities of daily living, cause physical disabilities, and lead to a loss of independence. Disease burden, disability burden, and health care utilization will likely intensify as life expectancy increases (Fries, 2003). In 2005, over 132 million people in the United States had a chronic condition with one of every four having limitations in performing daily activities (Anderson & Horvath, 2004).

Frailty is a common term used in geriatric literature to define older adults who are at an increased risk for poor clinical outcomes. It is considered a separate entity from the "normal" aging process and known to be changeable over time (Gill, Gahbauer, Allore & Han, 2006; Hubbard, Fallah, Searle, Mitnitski, & Rockwood, 2009; de Vries, Staal, van Ravensberg, Hobbelen, Olde Rikkert, & Nijhuis-van der Sanden, 2011). While frailty is

highly predictive of adverse outcomes such as falls, disabilities, hospitalization, or death (Fried et al., 2001) there is no single clinical test or instrument universally used to define frailty.

Based on U.S. studies it is estimated that frailty will affect 7% of those age 65 years and older, 20% of those age 80 and older, and over 32% in those age 90 and older (Fried et al., 2001; Walston et al., 2002). In one study of older adults (depending on the frailty instrument used) the prevalence range of frailty was reported between 33% and 88%, with the more severe the degree of frailty, the higher the risk of institutionalization and death (Fried, et al., 2001; Rockwood, Mitnitski, Song, Steen, & Skoog, 2006).

There is limited data published on the role of frailty and outcomes in those with COPD. Frailty has been observed in those with COPD especially when shortness of breath is present with this population (Park, Richardson, & Larson 2013). A high prevalence of frailty in COPD was demonstrated in the Women's Health and Aging Studies (Blaum, Xue, Michelon, Semba, & Fried, 2005). In elderly frail adults with COPD a higher mortality was found than in those without COPD (Galizia et al., 2011).

Still little is known about how frailty is characterized in COPD and the impact of frailty on quality of life and health care outcomes in this population. To promote improved health in this population, it is important to identify specific indicators that contribute to the development of frailty and the impact of frailty on quality of life, health care utilization, and death. This could guide future interventional research and ultimately lead to improved outcomes in people with COPD.

An integral conceptual model of frailty by Gobbens (2010) served as the basis for this study. This model was chosen because it incorporates a more holistic approach to

frailty going beyond the physical approach which is the basis for most models of frailty. The model was revised for this study to include quality of life outcomes not previously explored with Gobben's model.

The aims of the study were: 1) to identify demographic characteristics, physical frailty indicators, and psychological frailty indicators and their association with health related quality of life over time in people with severe COPD, 2) to identify physical and psychological frailty indicators and their association with mortality in people with severe COPD and 3) to identify demographic characteristics, clinical characteristics, physical frailty indicators, and psychological frailty indicators and their association with health care utilization over time in people with severe COPD.

The methodology for analyzing the data included descriptive statistics, correlation, regression, and the Kaplan Meier method. The remaining chapters in this dissertation provide the background, significance, theoretical framework, conceptual model, methodology, results, discussion, conclusions, and limitations for this study.

CHAPTER TWO: BACKGROUND AND SIGNIFICANCE

Chronic Obstructive Pulmonary Disease

One of the most significant health problems facing the United States is COPD. Studies targeting COPD are important because of the high and increasing prevalence of the disease, its severity, and the resulting economic burden (Druss, Antonelli Incalzi et al., 2002). Currently, COPD affects 15 million people in the United States and is the third leading cause of death (exceeded only by heart disease, and cancer), accounting for over 143,000 deaths in 2011 (Centers for Disease Control [CDC], 2012). It ranks second in the United States for the number of disability-adjusted life years (DALYs) lost due to the disease. The cost of health care for people with COPD in the U.S. is approximately $50 billion per year which includes both direct and indirect costs (i.e. caretaker expenses and lost productivity) and is expected to increase given the increasing prevalence of the disease (Guarascio, Ray, Finch, & Self, 2013). Worldwide, COPD is the fourth leading cause of death (CDC, 2012).

COPD by definition includes both chronic bronchitis and emphysema (Andreassen, & Vestbo. 2003). It is a preventable and treatable disease characterized by airflow obstruction which is not fully reversible and reflects defects in airway function and/or abnormalities in lung parenchyma. The airflow limitation, usually progressive, is associated with an inflammatory response of the lungs from exposure to noxious particles

or gases. Airflow limitation on spirometry testing and a history of risk factors (with or without symptoms) are primarily used to make the diagnosis of COPD.

COPD is commonly associated with smoking and typically manifests itself in the mid-thirties to mid-forties with changes in lung function but generally clinical symptoms are not apparent until one reaches their mid-fifties (Pauwels, Buist, Calverly, Jenkins, & Hurd, 2001). The clinical symptoms seen in COPD include respiratory symptoms such as wheezing, dyspnea, cough, and sputum (Janssens, Pache, & Nocid, 1999; Qaseem et al., 2007; Stanojevic et al., 2008).

In any disease state comorbidities can occur, but when they occur in COPD they can have a worsening effect on health outcomes. Comorbidities can cause an increase in dyspnea and further decline one's quality of life (Antonelli Incalzi et al., 1997; Barnes & Celli, 2009; Celli, 2010). Comorbidities may include: cardiovascular disease, metabolic syndrome, osteoporosis, anxiety, depression, lung cancer, diabetes mellitus, pulmonary hypertension, obstructive sleep apnea, frailty, skeletal muscle wasting, and skeletal muscle dysfunction (Barnes & Celli 2009; Barr et al., 2009; Chatila, Thomashow, Minai, Criner, & Make, 2008; Di Marco et al., 2006; Fabbri, Luppi, Beghé, & Rabe, 2008; Holguin, Folch, Redd, & Mannino, 2005; Mannino, Thorn, Swensen, & Holguin, 2008). The presence of comorbidities, in particular, diabetes, hypertension, cardiovascular disease, and cancer increase the risk of death in COPD as well as significantly increase health care costs (Foster, Miller, Martin, Caloyeras, Russell, & Menzin, 2006; Galizia et al., 2011; Mannino, Thorn, Swensen, & Holgui, 2008).

Persons with COPD are at risk for a decreased health-related quality of life (HRQoL) (Almagro & Castro, 2013; Shavro, Ezhilarasu, Augustine, Bechtel, &

Christopher, 2012). HRQoL should be measured in this population to have an increased understanding of the disease burden. When a person has more than one comorbidity a further decline in HRQoL may occur especially in older people (Parekh, Goodman, Gordon, & Koh, 2011). The relationship between COPD, comorbidities and HRQoL is likely to be complex but certainly decreasing comorbidities could assist in improving HRQoL (Blinderman, Homel, Billings, Tennstedt, & Portenoy, 2009).

Health care utilization is increased in people with COPD as it is associated with a higher risk of hospitalization and use of an emergency department (Fan, Ramsey, Make, & Martinez, 2007; Holguin, Folch, Redd, & Mannino, 2005). Despite the significant morbidity and mortality associated with the disease it should be noted that prevalence, morbidity, and mortality remain vastly underestimated worldwide. The reasons for this include: lack of data from underdeveloped countries, the diagnosis being made when the disease is in an advanced state, not making the correct diagnosis, and the failure of COPD to be listed as the underlying cause of death on a death certificate. When COPD is considered a contributing cause of death on a death certificate instead of the actual cause of death, the mortality rates are underestimated.

Frailty

Frailty affects over six million people in the United States (Balducci & Stanta, 2000). It is recognized as a major public health problem associated with adverse health outcomes, disabilities, institutionalization, dependency, and mortality but there is no agreement on the definition or measurement methodology (Bandeen-Roche et al., 2006; Bauer & Seiber, 2008; Bergman et al., 2007; Fried et al., 2001; Fried, Ferrucci, Darer,

Williamson, & Anderson, 2004; Lee, Buth, Martin, Yip, & Hirsch, 2010; Rockwood, Mitnitski, Song, Steen, & Skoog, 2006).

Frailty in the elderly is intuitively recognized by most geriatricians though it lacks a clear operational definition. It is commonly identified relative to physical loss. The American and Italian Geriatricians define physical frailty as impairments in domains that include mobility, balance, motor processing, cognition, nutrition (weight change), muscle strength, endurance (reflective of exhaustion and fatigue feelings), and physical activity (Walston et al., 2006). Others define frailty when a person has increased vulnerabilities to stressors and a diminished physiologic reserve capacity, or when a disability puts a person at a greater risk of having an adverse outcome (Fried et al., 2001; Morley, Kim, Haren, Kevorkian, & Banks, 2005; Morley, Perry, & Miller, 2002; Rockwood, Fox, Stolee, Robertson, & Beattie, 1994; Rockwood, 2005; Walston et al., 2006). Each frailty definition has its own individual set of components. Commonly, physical indicators serve as the basis for each definition (Fried, et al., 2001; Strawbridge, Sherma, Balfour, Higby, & Kaplan, 1998; Studenski, et al., 2004; Winograd, Gerety, Chung, Goldstein, Dominquez, & Vallone, 1991).

Frailty can occur in the absence of a chronic illness. Data from the Cardiovascular Health Study demonstrates that one-quarter of older patients without comorbidities exhibit symptoms of frailty but it is also well documented that some chronic illnesses can contribute to frailty (Blaum, Xue, Michelon, Semba, & Fried, 2005; Buchner, Beresford, Larson, LaCroix, & Wagner, 1992; Fried at al., 2001; Klein, Klein, Knudston, & Lee, 2005; Morley, Haren, Rolland, & Kim, 2006; Newman, et al., 2001; Reid, Williams, & Gill, 2005). Peripheral vascular disease, congestive heart failure, and

diabetes mellitus have been associated with frailty (Klein, Klein, Knudston, & Lee, 2005; Morley, Haren, Rolland, & Kim, 2006; Newman, et al., 2001; Reid, Williams, & Gill, 2005). Persons with chronic obstructive lung disease, depression, anemia, osteoarthritis, chronic kidney disease, obesity, low body mass index, and a history of myocardial infarction have a higher risk of frailty (Barzilay et al., 2007; Blaum, Xue, Michelon, Semba, & Fried, 2005; Buchner, Beresford, Larson, LaCroix, & Wagner, 1992; Fried at al., 2001; Wilhelm-Leen, Hall, Tamura, & Chertow, 2009).

Several studies suggest lower education levels, lower incomes, African-American race, and females have an increased risk of frailty and that frailty increases as age increases (Blaum, Xue, Michelson, Semba, & Fried, 2005; Boyd, Xue, Simpson, Guralnik, & Fried, 2005; Cigolle, Ofstedal, Tian, & Blaum, 2009; Cohen, Harris, & Pieper, 2003; Fried et al., 2001; Gobbens, van Assesn Luijkx, Wijnen-Sponselle, & Schols, 2010; Kiely, Cupples, & Lipsitz, 2009; Mitnitski, Mogilner, MacKnight, & Rockwood, 2002; Newman et al., 2001; Ostir, Ottenbacher, & Markides, 2004, Puts, Lips, & Deeg., 2005; Rockwood et al., 2004; Romero-Ortuno, Walsh, Lawlor, & Kenny, 2010; Walston et al., 2002). In contrast, one group did not find a higher prevalence of frailty in older women compared to older men (Strawbridge, Shema, Balfour, Higby, & Kaplan, 1998). There are two possible reasons for this finding. First, the group included cognitive function as an indicator of frailty. Since this was a highly predominant finding of older men (within their study) it may have increased the number of males considered frail. Second, more of the males were married than females therefore the males had the potential for daily support or assistance. Subjectively, the males could have responded as

not needing support when in fact they were actually receiving it though they did not view it this manner.

Finally, though numerous studies have examined indicators that characterize frailty there are few published studies available that examine frailty and its association with COPD. Additionally, there is a gap in the literature regarding health related outcomes as a consequence of frailty in COPD (Blaum, Xue, Michelon, Semba, & Fried, 2005; Galizia et al., 2011).

Frailty Outcomes.

In older people, independent of health status or disease state, those identified as frail had a higher rate of disability than those who were not frail (Ensrud et al, 2008; Fried et al, 2001). Disabilities such as increased falls and impairments in activities of daily living are seen more commonly in older people with frailty (Fried et al., 2001; Kiely, Cupples, & Lipsitz, 2009). Theoretically if frailty were prevented or decreased then falls and impairments may also be decreased (De Lepeleire, Iliffe, Mann, & Degryse, 2009, Fried et al., 2001). Frailty has been highly predictive of death in previous studies (Fried et al., 2001; Graham, Snih, Berges, Ray, Markides & Ottenbacher 2009). Findings suggest that the frailty process may be slowed down by treating the underlying issue that causes frailty such as the loss of muscle mass. The loss of muscle mass is a major cause of frailty and disability in older frail people (Roubenoff, 2000). Exercise and interventions to improve physical functioning may reverse frailty (Faber, Bosscher, Chin, & van Weiringen, 2006). This is an important observation since the health care utilization of elderly is growing and prevention or reduction of frailty in this population can potentially have major health benefits and decreased health care costs.

Of further significance is the belief that frailty is a dynamic state which allows for changes in the level of frailty over time (Gill, Gahbauer, Allore & Han, 2006; Hubbard, Fallah, Searle, Mitnitski, & Rockwood, 2009; Rockwood, Fox, Stolee, Robertson, & Beattie, 1994; Rockwood, Stolee, & McDowell, 1996). The extent to which this occurs, how this occurs, and what interventions may alter frailty levels remain unclear. Future research may provide a better understanding of how to alter the frailty process in the hopes of improving quality of life and decreasing adverse events in older people.

Surrogate measures of health and well-being such a HRQoL are readily used in research as outcomes measures. The relationship between frailty and HRQoL is unique as both frailty and HRQoL are widely used concepts without consensus definitions. In a small study of community-dwelling older adults those with frailty had a decreased HRQoL (Puts, Shekary, Widdershoven, Heldens, Lips, & Deeg, 2007). In older Mexican Americans with frailty there was a significant association ($p < 0.001$) with lower HRQoL scores (Masel, Graham, Reistetter, Markides, & Ottenbacher, 2009). Others have noted that some components of the physical indicators of frailty have been associated with a decreased HRQoL (Sayer, Syddall, Martin, Dennison, Roberts, & Cooper, 2006). Limited data exist in those with both COPD and frailty but one can hypothesize that a decreased HRQoL would be observed in this group.

It is recognized that frailty is associated with a higher risk of hospitalization and long –term care (Fried et al., 2004). It is estimated that the majority of the 1.6 million elderly people living in nursing home are frail (Gabrel, 2000). A higher rate of emergency room visits has also been documented in frail elderly people (Hunt, Walsh,

Voegeli, & Roberts 2013; Walsh, Roberts, Nicholls, & Lattimerl, 2008). Overall, older frail individuals are at significant risk for increased uses of health care utilization.

Theoretical Framework

The Federal Council on Aging in 1978 described a specific group of older individuals as "frail elderly". This frail elderly group needed support from individuals or agencies to assist with activities of daily living due to a variety of problems (Hogan, MacKnight, & Bergman, 2003). Over the years the term frailty has evolved from a dependence on others to a somewhat more refined concept. Numerous definitions, models, and indicators for frailty have been noted in the literature. Aging, malnutrition, decreased strength, loss of muscle mass, chronic illnesses, and inflammation are indicators that are associated with frailty in various frailty models (Ahmed, Mandel, & Fain, 2007; Bortz, 2002; Gobbens, Luijkx, Wijnen-Sponselee, & Schols, 2010; Rockwood, Fox, Stolee, Robertson, & Beattie, 1994; Strandberg, & Pitkala, 2007). While it is recognized that a comprehensive geriatric assessment should include a frailty assessment a universal accepted method for measuring frailty is not available (Fried et al., 2001; Mitnitski, Graham, Mogilner, & Rockwood, 2002; Strawbridge, Shema, Balfour, Higby, & Kaplan, 1998; Wells, Seabrook, Stolee, Boree, & Knoefel, 2003).

One of the most widely used approaches to define frailty is the "frailty phenotype" published by Fried and colleagues (2001). The frailty phenotype defines frailty as "a biologic syndrome of decreased reserve and resistance to stressors, resulting from cumulative declines across multiple physiologic systems". Using five criteria they developed a "frailty phenotype" (Appendix A). The criteria include: weight loss, exhaustion, weakness, slowness, and low energy expenditure. The absence of any criteria

indicates a non-frail individual. An individual with one or two criteria present is considered pre-frail. An individual with more than two criteria present is considered frail. Despite being limited to only physical criteria this phenotype has shown high predictive value. In the Cardiovascular Health Study this phenotype independently predicted a three-year incidence or progression of disability in mobility, activities of daily living (ADL), hospitalization, and death with unadjusted hazard ratios ranging from 1.82-4.46 (Fried et al., 2001). When adjusting for the number of health, disease, and social characteristics the hazard ratios ranged from 1.29-2.24 in predicting five-year mortality (Fried et al., 2001). Using Fried's frailty phenotype, the Women's Health and Aging Studies found that frailty strongly predicted disability and mortality independent of a disease state (Bandeen-Roche et al., 2006).

Conceptual Model

This study was guided by the Integral Conceptual Model of Frailty (Gobbens, 2010) [Figure 1]. The conceptual model defines frailty using indicators from three domains: physical, psychological, and social. It was chosen to provide additional criteria that may be part of frailty outside of Fried's frailty phenotype of physical criteria only. A modified model (Figure 2) that utilizes a more holistic approach was used in this study.

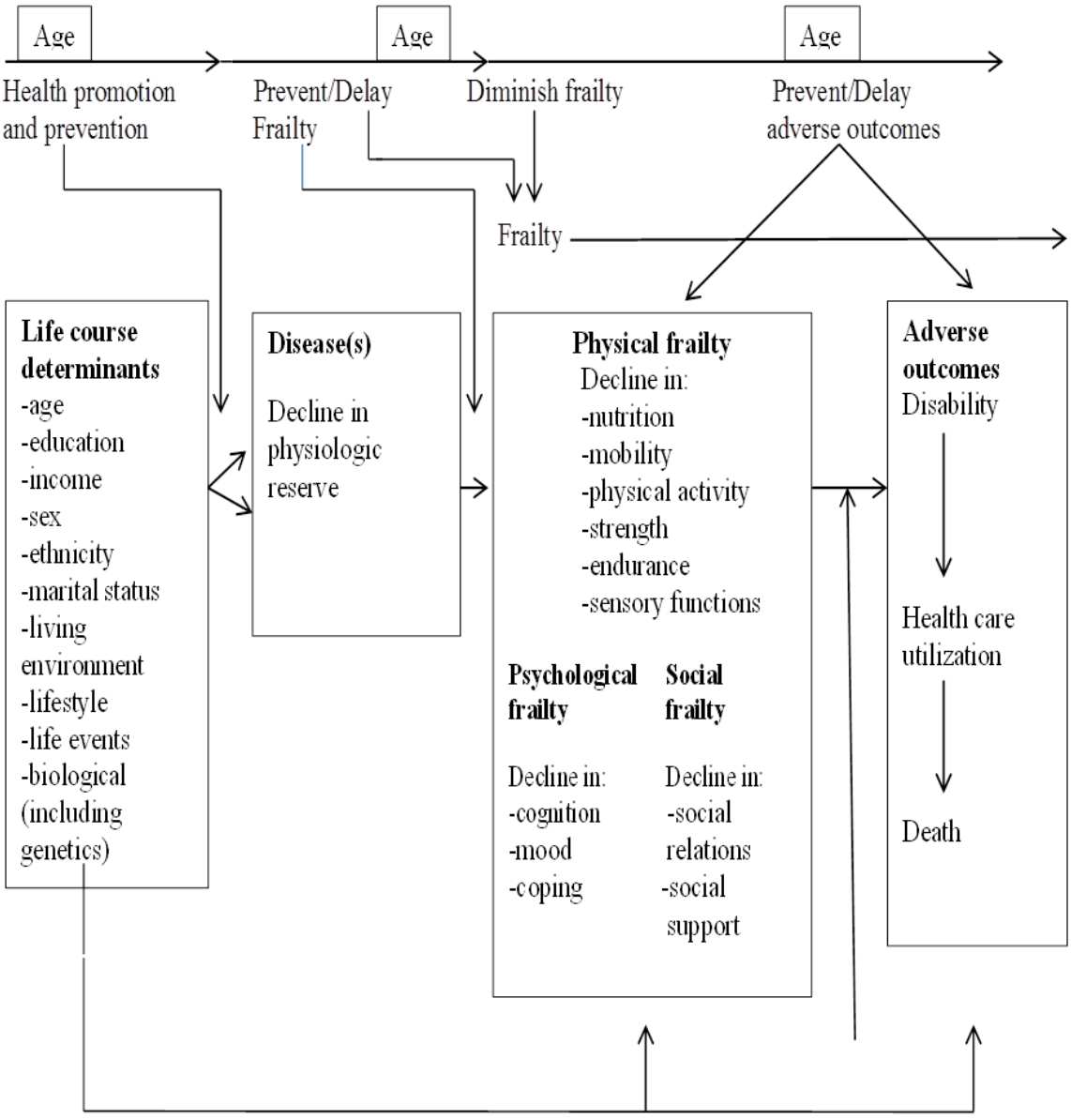


Figure 1. An integral conceptual model of frailty (Gobbens et al. 2010). Used with permission of author.

Life Course Determinants.

This section of the model views demographic indicators such as age, education, income, sex, ethnicity, and marital status as determinants which lead to frailty and subsequent adverse events. It also incorporates living environment, lifestyle, life events, and biologics (including genetics) in the domain. Age, gender, education, income, marital

status, ethnicity, lifestyle, and living environment have all been found to be associated with an increased prevalence of frailty (Blaum, Xue, Michelson, Semba, & Fried, 2005; Curcio, Henao, & Gomez 2014, Gobbens, van Assesn Luijkx, Wijnen-Sponselle, & Schols, 2010; Woo, Chan, Leung, & Wong, 2010).

Disease.

Disease is defined as a decline in physiologic reserve that can lead to frailty. Diseases can put one at an increased vulnerability to stressors thereby increasing the risk of frailty. Osteoarthritis, congestive heart failure, obesity, chronic kidney disease, and a low body mass index have been associated with frailty (Blaum, Xue, Michelon, Semba, & Fried, 2005, Fried et al., 2001; Klein, Klein, Knudston, & Lee, 2005; Morley, Haren, Rolland, & Kim, 2006; Reid, Williams, & Gill, 2005).

Physical Domain.

The physical domain includes a decline in the following indicators: nutrition, mobility, physical activity, strength, and sensory functions (vision and hearing). These measurement indicators have been included in other existing operational definitions of frailty (Buchman, Wilson, Bienias & Bennett, 2009; Ferruci, Guralnik, Studenski, Fried, Cutler, & Watson, 2004; Fried et al., 2001; Puts, Lips, & Deeg, 2005; Rockwood et al., 2005; Strawbridge, Shema, Balfour, Higby, & Kaplan, 1998; Winograd, Gerety, Chung, Goldstein, Dominquez, & Vallone, 1991).

Psychological Domain.

The psychological domain includes the following indicators: cognition, mood (depression and anxiety), and coping. Mood and coping are seen less frequently in other models but there is support for their inclusion in the model. Cognitive symptoms (such as

Alzheimer's and other forms of dementia) are part of the Canadian Study of Health and Aging (CHSA) Frailty Index and mild cognitive impairments have been observed within older frail individuals (Boyle, Buchman, Wilson, Leurgans, & Bennett, 2010; Stuck, Walthert, Nikolaus, Büla, Hohmann, & Beck, 1999). Depression and anxiety have been demonstrated to play a role in frailty and are considered mood criteria in this model within the psychological domain (Puts, Lips, & Deeg, 2005; Rockwood et al., 2005; Schuurmans, Steverink, Linderberg, Frieswijk, & Slaets, 2004; Winograd, Gerety, Chung, Goldstein, Dominquez, & Vallone, 1991). The last component of the psychological domain is coping. Coping (or a sense of mastery), meaning the extent to which a person has the feeling of being in control of their life, has been examined in one prior publication as part of a frailty model (Puts, Lips, & Deeg, 2005). Coping was not found to be a significant independent predictor in the above publication.

Social Domain.

The social domain includes the following measurement indicators: social relations and social support. Currently no other conceptual model of frailty includes social relations and social support but Stuck and colleagues (1999) identified limited social contacts as a predictor of functional decline during aging and others acknowledge the need for a social component of frailty (Bergman, Be´land, Karunananthan, Hummel, Hogan, & Wolfson, 1997; Markle-Reid & Browne, 2003).

Adverse outcomes.

Disability, health care utilization, and death are included in this domain and this has been supported by previous research. Fried's frailty phenotype has been demonstrated to be a predictor for the development of disability, increased hospital admission and death

(Fried et al., 2001). Frailty has shown prognostic value in predicting mortality and morbidity in those undergoing cardiac surgery (Afilalo et al., 2014). In geriatric trauma patients frailty is a significant predictor of an unfavorable hospital discharge (Joseph et al., 2014).

Model Revision for Study

We have revised the Integral Model of Frailty (Figure 2) to include health related quality of life outcomes (HRQoL) and add clinical characteristics for this population. HRQoL is a multi-faceted component encompassing several dimensions such as: functional and symptom status, perception of health, biological/physical factors, and overall well-being (Wilson & Cleary, 1995). HRQoL is frequently used to evaluate the impact of health care interventions (Bennett et al., 2003; Browning, Hou, Chui, Deer, & Murray, 2003). How one perceives HRQoL can impact health care outcomes (Schmier, Chan, & Kline-Leidy, 1998). Previous studies have reported changes in quality of life in those with COPD (Mahler, Tomilson, Olmstead, Tosteson, & O'Connor 1995; McSweeney, Grant, Heaton, Adams, & Timms, 1982). It was added to this model as there is limited information on HRQoL as an outcome in COPD people with frailty.

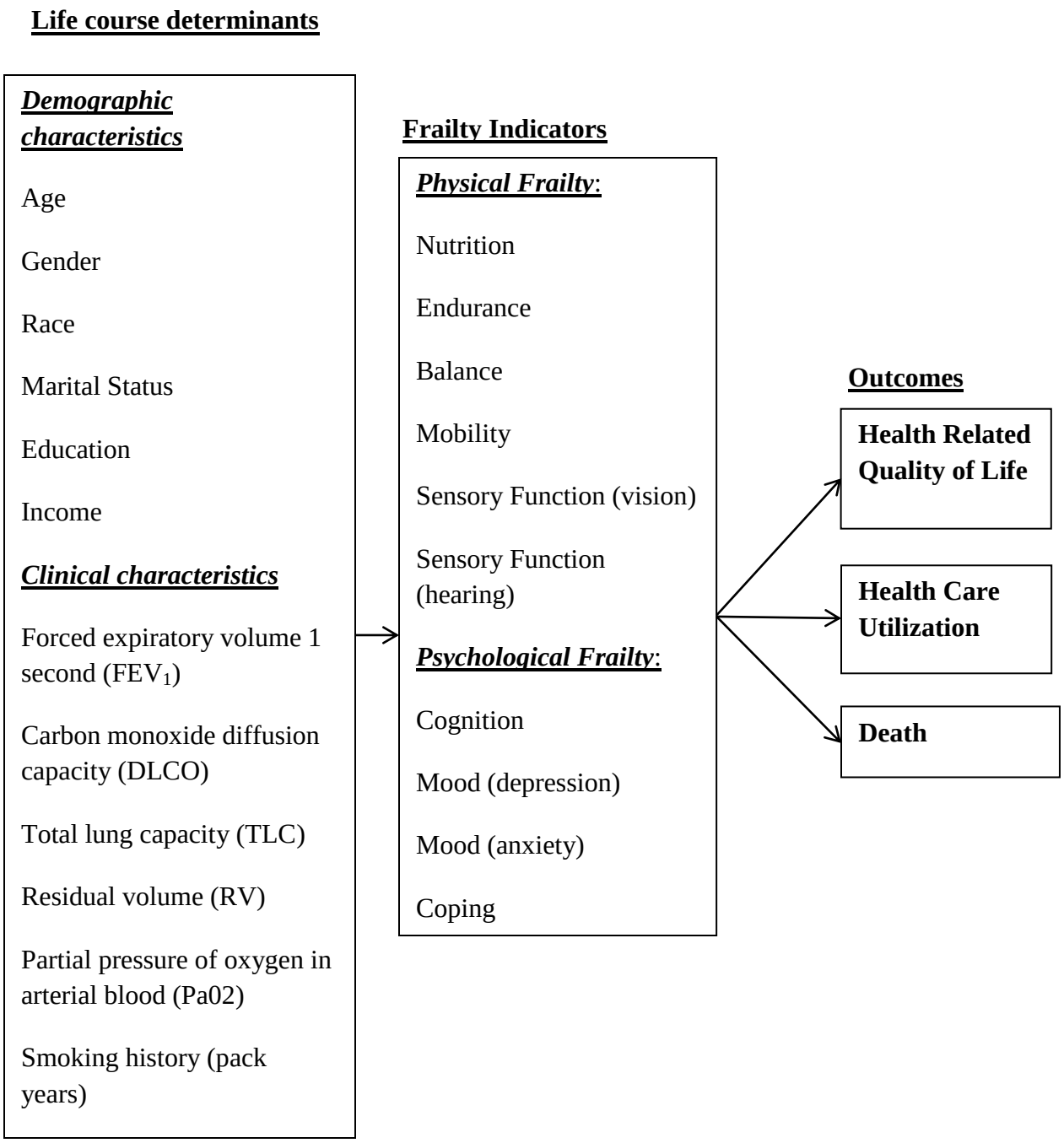


Figure 2. Revised Integral Conceptual Model of Frailty for this study

The model used for this study contains the three domains: life course determinants, frailty indicators, and outcomes. The demographic characteristics, the physical frailty indicators and the psychological frailty indicators used were the indicators from the

original conceptual model of frailty. Clinical characteristics used in this study were chosen for theoretical reasons.

Life course determinants.

The life course determinants of the frailty include age, gender, race, marital status, education and income. The clinical characteristics added to this model include: forced expiratory volume 1 second (FEV1), carbon monoxide diffusion capacity (DLCO), total lung capacity (TLC), residual volume (RV), partial pressure of oxygen in arterial blood (PaO2), and smoking history. These were chosen to provide a measure of COPD disease severity.

Frailty Indicators.

In this study, frailty indicators were used from two domains (physical and psychological). The social domain was not included because data were not available in this data set.

Physical frailty indicators.

The physical frailty indicators used include: nutrition, endurance, balance, mobility, and sensory function (vision and hearing). These measurement indicators have been noted in other existing operational definitions of frailty (Buchman, Wilson, Bienias & Bennett, 2009; Ferruci, Guralnik, Studenski, Fried, Cutler, & Watson, 2004; Fried et al., 2001; Puts, Lips, & Deeg, 2005; Rockwood et al., 2005; Strawbridge, Shema, Balfour, Higby, & Kaplan, 1998; Winograd, Gerety, Chung, Goldstein, Dominquez, & Vallone, 1991).

Psychological frailty indicators.

The psychological frailty indicators used include: cognition, depression, anxiety, and coping. Cognition, depression, and anxiety have all been previous used in other definitions of frailty (Puts, Lips, & Deeg, 2005; Rockwood et al., 2005; Schuurmans, Steverink, Linderberg, Frieswijk, & Slaets, 2004; Winograd, Gerety, Chung, Goldstein, Dominquez, & Vallone, 1991). Though coping was not found to be a significant independent predictor in a previous publication, for the purpose of this study, it was retained in the model because people with frailty are at risk of adverse outcomes and psychological resources may influence how people cope with their physical problems.

Outcomes.

The outcomes include HRQoL, death, and health care utilization. The evidence to support these outcomes was presented earlier.

Study Purpose

The purpose of this study was two-fold. First, guided by a revision of Gobben's Integral Conceptual Model of Frailty the intent was to identify the association of physical and psychological indicators of frailty and their impact on HRQoL and death in those with severe COPD. Second: to identify the association of demographic characteristics, clinical characteristics, physical frailty indicators, and psychological frailty indicators with frequency of health care utilization in people with severe COPD over time. Frailty is considered a dynamic concept and the revised model allows for changes over time in this population (Fried et al., 2001; Gill, Gahbauer, Han, & Allore, 2006; Hubbard, Lang, Llewellyn, & Rockwood, 2010; Rockwood, Fox, Stolee, Robertson, & Beattie, 1994; Rockwood, Stolee, & McDowell, 1996).

Specific Aims and Hypotheses

The specific aims for this study were:

Specific Aim 1: To identify demographic characteristics, physical frailty indicators, and psychological frailty indicators and their association with HRQoL over time in people with severe COPD using the revised model of Gobben's Integral Conceptual Model of Frailty.

Hypothesis 1.1: The presence of physical and psychological indicators of frailty in people with severe COPD will be associated with a decreased HRQoL.

Specific Aim 2: To identify physical and psychological frailty indicators and their association with mortality in people with severe COPD using the revised model of Gobben's Integral Conceptual Model of Frailty.

Hypothesis 2.1: The presence of physical and psychological indicators of frailty in people with severe COPD will be associated with increased mortality.

Specific Aim 3: To identify demographic characteristics, clinical characteristics, physical frailty indicators, and psychological frailty indicators and their association with health care utilization over time in people with severe COPD using the revised model of Gobben's Integral Conceptual Model of Frailty.

Hypothesis 3.1: The presence of certain demographic and clinical characteristics in people with severe COPD will be associated with increased health care utilization.

Hypothesis 3.2: The presence of physical and psychological indicators of frailty in people with severe COPD will be associated with increased health care utilization.

CHAPTER THREE: METHODS

Research Design

The sample for this secondary data analysis came from the National Emphysema Treatment Trial (NETT). The NETT was a national study evaluating medical management versus lung volume reduction surgery in combination with medical management in severe COPD patients. This study was funded by the National Heart, Lung, and Blood Institute and the Health Care Financing Administration. This multicenter center trial utilized 17 centers across the United States. The study was an unmasked, randomized trial with prospective accrual of patients with an equal allocation for randomization to either medical management or medical management with lung volume reduction surgery. The primary outcome measures were survival and maximum exercise capacity. Secondary measures collected included: quality of life, pulmonary function and gas exchange, radiologic studies (chest radiographs, high resolution chest CT scans, and nuclear perfusion scans), oxygen requirements, 6 minute hall walk test, cardiovascular measures (electrocardiogram, echocardiogram, and heart catheterization [if indicated], attention and psychomotor function, and cost effectiveness. An important goal of the trail was to identify selection criteria for lung volume reduction surgery. Study screening began in 1997 with the first randomization in 1998. Study duration was 4.5 years with a 6-month close-out period. The recruitment goal was 2,500 patients, 6%

expected to be of a minority background and 30% expected to be women. All patients completed 6 – 10 weeks of pulmonary rehabilitation prior to randomization. Data collection occurred at baseline, randomization, 6 months post randomization, 12 months post randomization, 24 months post randomization, 36 months post randomization, 48 months post randomization, and 60 months post randomization (Fishman et al., 2003). The study flow chart for the number of patients assigned to each treatment can be seen in Figure 3.

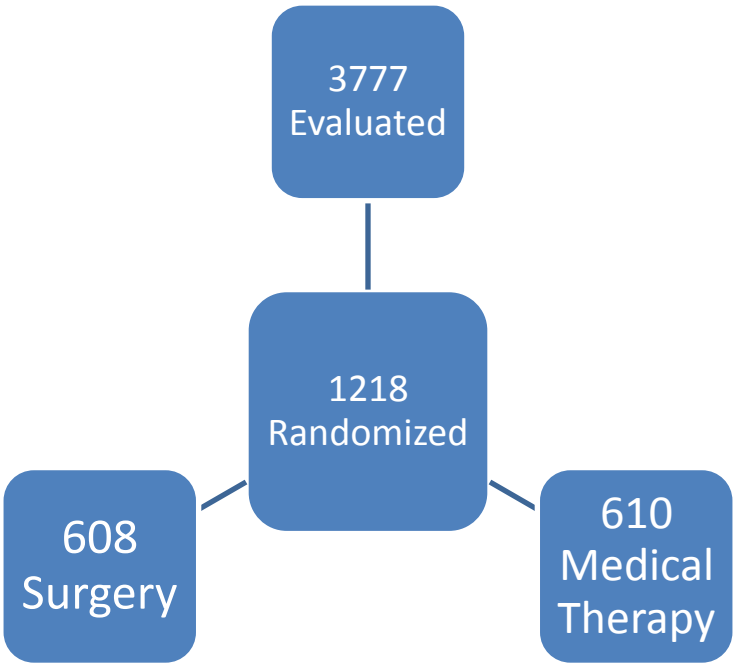


Figure 3. Study Flow Chart

The final sample for this study was the 610 subjects assigned to medical therapy. The surgical arm (*n*=608) was not included in this study as undergoing a surgical procedure has risks and varied outcomes complicating the interpretation of outcomes of this study.

As noted earlier there is no universally accepted method to measure frailty. To assess frailty in this study, indicators were chosen from the original data that closely

match those in the Integral Conceptual Model of Frailty. All life course determinants (ex: living environment, lifestyle, and life events) from the original model were not available in this data set. The physical and psychological frailty indicators in the revised model closely correspond to indicators in the original conceptual model. We did not calculate a frailty score but evaluated physical frailty indicators and psychosocial frailty indicators and their impact on outcomes in those with severe COPD. The time points for outcomes include a baseline measurement, 6 months post randomization, 12 months post randomization, 24 months post randomization, and 36 months post randomization. Table 1 provides an overview of the physical frailty indicators, the psychological frailty indicators, and the time points each were measured.

Table 1.

Physical Frailty Indicators, Psychological Frailty Indicators, and Time Points Measured

Indicator	Baseline	6 months post randomization	12 months post randomization	24 months post randomization	36 months post randomization
Nutrition	X	X	X	X	X
Endurance	X	X	X	X	X
Balance	X	X	X	X	X
Mobility	X	X	X	X	X
Vision	X	X	X	X	X
Hearing	X	X	X	X	X
Cognition A	X	*	X	X	X
Cognition B	X	X	X	X	X
Depression	X	**	**	**	**
Anxiety	X	**	**	**	**
Coping	X	X	X	X	X

*Not completed at this time point

** Completed only at baseline, scores inputted (from baseline) for all other time points.

Demographic Characteristics

Table 2 lists the demographic characteristics that were used to measure the life course determinants from the original model. The demographic characteristics chosen for this study are the same characteristics from the life determinant section of the conceptual model. Demographics are widely used in research as they provide essential information about the population being studied. The table below provides information on how the demographic characteristics were measured in the original study and how they were coded for this study.

Table 2.

Demographic Characteristics Table

Clinical Characteristics	Original Measure	Coding
Age	• Actual age in years at time of enrollment	• Number
Sex	• Male • Female	• Male • Female
Race	• White (not Hispanic) • African American (not Hispanic) • Hispanic • Asian or Pacific Islander • American Indian or Alaskan Native • Other	• White (Caucasian) • Non-white (includes all other categories)
Marital status	• Single, never married • Separated • Divorced or annulled • Widowed • Married	• Married • Not married (includes all other categories)
Education	• Did not complete high school • Completed high school • Some college or post high school education or training • Bachelor's degree or higher	• Did not complete high school • Completed high school • Some college or post high school education or training/Bachelor's degree or higher
Annual Income	• Less than $15,000 • $15,000-$29,999 • $30,000-$49,999 • $50,000 or more	• Less than $15,000 • $15,000-$29,999 • $30,000-$49,999 • $50,000 or more

Demographic characteristics

Age: In the original data set age ranged from 0-99. People under age 52 were coded as 0 and those over 79 were coded as 99. We recoded age so those previously coded as 0 were coded as 50. Those previously coded 99 were recoded to 81. This was done since

there are no people in the study at age 0 and it is unlikely that a person 99 would be in the original study.

Sex: Gender was coded as male or female.

Race: Race was coded for this study as White (Caucasian) or Non-white (includes all other categories).

Marital status: Marital status was coded as married or not married (all other categories).

Education*:* Education was coded into three categories; 1) did not complete high school, 2) completed high school, or 3)some college or post high school education or training/Bachelor's degree or higher.

Income*:* Income was coded into four categories; 1) less than $15,000, 2) $15,000-$29,999, 3) $30,000-$49,999, and 4) $50,000 or more.

Clinical Characteristics

Pulmonary function tests, arterial blood gases, and smoking history were used to reflect disease specific clinical characteristics, the second half of the life course determinants. A description of the clinical characteristics and how they were measured in the original study is found in Table 3. The clinical characteristics were not part of the original conceptual model of frailty though they do theoretically relate to the disease section of the model and can provide information on disease severity with this population for this study. Pulmonary function testing (FEV_1,) is used to measure lung function thereby providing a stage of disease severity. TLC and RV are characteristically increased in COPD and as such they provide information about the degree of hyperinflation of the lungs. DLCO provides information on how adequate the oxygen moves from the lungs to the blood and is frequently decreased in people with COPD.

This again provides us with information regarding disease severity. PaO_2 is a measurement of the oxygen in arterial blood. This is frequently decreased in people with COPD providing information on disease severity. Smoking history was used as a clinical characteristic as it provides information on years of smoking relative to the disease severity. Most people with COPD have smoked in excess of 20 pack years.

Table 3.

Clinical Characteristics Table

Clinical Characteristics	**Original Measure**
Forced expiratory volume 1 second (FEV_1), % predicted	• Spirometry (liters)
Diffusion capacity (DLCO), % predicted	• Single breath diffusion test (ml/min/mmHg)
Total lung capacity (TLC), % predicted	• Plethysmography (liters)
Residual Volume (RV), % predicted	• Plethysmography (liters)
Partial pressure of oxygen in arterial blood (PaO2)	• Measured from arterial blood
Smoking history (pack years)	• Self-report of cigarette pack per day * years smoked (pack years)

Clinical characteristics

In the original data set predicted values for the pulmonary function testing were calculated using the predicted equations of Crapo and Morris (Crapo & Morris, 1981; Crapo, Morris, & Gardner 1981: Crapo, Morris, Clayton, & Nixon, 1982). Testing performed met American Thoracic Society (ATS) criteria.

Forced expiratory volume 1 second (FEV_1): FEV_1 was obtained by spirometry testing with the individual in a sitting position. The actual percentage of predicted was determined by post-bronchodilator FEV_1 /the individual's predicted FEV_1. The post-

bronchodilator percent predicted was used as a continuous indicator and reflects the degree of airflow obstruction.

Diffusion capacity (DLCO): DLCO was obtained with the individual in a sitting position by using the actual measured post-bronchodilator DLCO (ml/min/mmHg)/the individual's predicted DLCO (ml/min/mmHg). The post-bronchodilator percent predicted was used as a continuous indicator and reflects the extent to which oxygen passes from the lungs to the blood.

Total lung capacity (TLC): The TLC was obtained by body plethysmography with the individual in a sitting position. The actual percentage of predicted was determined by the post-bronchodilator TLC (liters)/ the individual's predicted TLC (liters). The post-bronchodilator percent predicted was used as a continuous indicator and it reflects the amount of air in the lung contained in the lung at the end of a maximal inhalation.

Residual Volume (RV): The RV was obtained by body plethysmography with the individual in a sitting position. The actual percentage of predicted was determined by the post-bronchodilator RV (calculated by subtracting slow vital capacity [SVC in liters] from the TCL [liters]/ the individual's predicted RV. The post-bronchodilator percent predicted was used as a continuous indicator and it reflects the volume of air remaining in the lung after a maximal exhalation.

Partial pressure of oxygen in arterial blood (PaO2): PaO_2 was measured with the individual rested and in a sitting position on room air. A radial arterial blood gas was drawn and analyzed. PaO_2 was measured in mmHg. The actual measured value in mmHg was used as a continuous indicator and it reflects the partial pressure of arterial blood.

Smoking history: Smoking history was calculated by the number of cigarette packs smoked per day times the number of years smoked. The calculated value was used as a continuous indicator.

Frailty Indicators

Table 4 lists the physical frailty indicators which were used to measure physical frailty as part of the original physical frailty domain in the conceptual model. A description of the physical frailty indicators, how they were measured in the original study, and how they were coded for this study is provided. The physical frailty indicators listed below with the exception of balance were all part of the initial integral conceptual model of frailty. Balance was added to the model as it has been supported by others as a predictor of frailty (Dayhoff, Suhrheinrich, Wigglesworth, Topp, & Moore, 1998; Gill, Gahbauer, Allore, & Han, 2006).

Table 4.

Physical Frailty Indicators

Physical Frailty Indicators	**Original Measure**	**Available responses in original data set**	**Coded**
Nutrition	Body mass index (BMI)	• Number (continuous indicator)	• Number
Endurance	Cardiopulmonary exercise test (peak watts)	• Number (continuous indicator)	• Number
Balance	Over the last 3 days did you have: Difficulty with your balance, standing, or walking?	• No days • Yesterday • 2 days ago • 3 days ago	A response of "no days" was considered as having no difficulties with balance. All other responses were considered as having difficulties with balance.
Mobility	Over the last 3 days did you : Avoid walking, have trouble walking, or walk more slowly than other people your age?	• No days • Yesterday • 2 days ago • 3 days ago	A response of "no days" was considered as having no difficulties with mobility. All other responses were considered as having difficulties with mobility.
Sensory function (vision)	Do you have blindness or severely impaired vision in both eyes? Do you have blindness or severely vision in one eye?	• Yes • No • Yes • No	A response of "yes" to any one of these questions was considered as having difficulties with vision.
Sensory function (hearing)	Do you have any hearing loss or deafness?	• Yes • No	A response of "yes" this question was considered as having difficulties with hearing.

Physical frailty

Nutrition. Weight and height were measured. BMI was calculated by kg/m^2; weight/ $[(ht/100)^2]$. The calculated value was used as a continuous indicator. BMI is easily measured and has been used to predict outcomes in COPD (Celli, 2010).

Endurance. Endurance was measured as the peak watts performed on a cardio-pulmonary exercise test. Peak watts have been used as a valid measurement for outcomes in several studies with COPD people (Arnardottir, Boman, Larsson, Hedenstrom, & Emtner, 2007: Fishman, et al., 2003; Martinez, et al., 2006). Cardio-pulmonary exercise testing was used to evaluate exercise capacity. Improvements in endurance time during cycling have been noted in people with severe airflow limitation after a weightlifting training program (Simpson, Killian, McCartney, Stubbing, & Jones, 1992). Endurance time has also been closely associated with ventilatory stress (i.e., dyspnea) in COPD (Neder, Jones, Nery, & Whipp, 2000). Supplemental oxygen (FiO_2= 0.3) was used during the exercise test. A 5 minute resting phase was completed while on the cycle and patients were breathing through the circuit. Following the resting phase 3 minutes of unloaded pedaling at a cadence between 40 – 70 rpm was completed. Ramp rate (5 watts/minutes or 10 watts/minute) for the exercise portion was determined by post bronchodilator maximum voluntary ventilation (BDMVV). If BDMVV $\leq$ 40.0, ramp rate =5 watts/minute; if BDMVV > 40.0, ramp rate =10 watts/minute. Patients began the exercise portion, pedaling to achieve 40 rpm or higher. The test ended when cadence dropped below 40 rpm and did not return, when the patient requested to end, or when a staff member terminated the test for safety. If the patient completed the 5 minute rest phase and the 3 minutes of unloaded pedaling, but could not do any loaded pedaling,

maximum work was considered to be 0 watts. The actual peak watts achieved on the exercise test was used as a continuous indicator and reflects exercise capacity.

Balance. Balance was measured by self-report from one question from the Quality of Well-being Scale (QWB). There is no available published data to support the use of this single question measure as an indicator for balance although overall the QWB was initially designed as a general outcome measurement tool and has high correlation (r = 0.54, $p < 0.001$) with FEV_1 when studied in COPD patients (Kaplan, Atkins, & Timms, 1984). It is unlikely the balance response would be much different over time (such as if the question reflected a longer period of time) without an abrupt change in one's medical condition (Kaplan, Atkins, & Timms, 1984). The question was "Over the last 3 days did you have: difficulty with your balance, standing, or walking?" The response choices were: no days, yesterday, 2 days ago, or 3 days ago. If the answer was yesterday, 2 days ago, or 3 days ago it was considered as having difficulties with balance.

Mobility. Mobility was measured by self-report with one question from the QWB: "Over the last 3 days did you avoid walking, have trouble walking, or walk more slowly than people your age?" The response choices were: no days, yesterday, 2 days ago, or 3 days ago. If the answer was yesterday, 2 days ago, or 3 days ago it was considered as having difficulties with mobility. There is no available published data to support the use of this single question measure as an indicator for mobility though problems with mobility are commonly seen in the elderly, especially in the frail and elderly population (van Iersela, Munnekeb, Esselink, Benraad, & Olde-Rikkert, 2008).

Sensory function (vision). Vision was measured by self-report with two questions from the QWB: 1) "Do you have blindness or severely impaired vision in both eyes?" and 2)

"Do you have blindness or severely impaired vision in one eye?' A "yes" answer to either of the two questions was considered as having difficulties with vision. There is no available published data to support the use of this single question measure as an indicator for vision. It is a self-reported indicator lacking reliability or validity data.

Sensory function (hearing). Hearing was measured with one question from the QWB: "Do you have any hearing loss or deafness?" A "yes" answer to this question was considered as having difficulties with hearing. There is no available published data to support the use of this single question measure as an indicator for hearing. It is a self-reported indicator lacking reliability or validity data.

Table 5 lists the psychological frailty indicators which were used to measure psychological frailty as part of the original psychological frailty domain in the conceptual model A description of the indicators used to determine psychological frailty, how they were measured in the original study and how they were coded for this study is provided.

Table 5.

Psychological Frailty Indicators

Psychological Frailty Indicators	**Original Measure**	**Available responses in original data set**	**Coded**
Cognition	Trail Making Part A	• Number (continuous indicator) • Scored according to standard protocol	• Raw score
Mood (Depression)	Beck Depression Inventory	• Number (continuous indicator) • Scored according to standard protocol	• Raw score
Mood (Anxiety)	State Trait Anxiety Inventory	• Number (continuous indicator) • Scored according to standard protocol	• Raw score
Coping	Which days (if any) over the past 3, not including today, you have had: "Feelings that you had little or no control over events in your life?"	• No days • Yesterday • 2 days ago • 3 days ago	A response of "no days" was considered as having no difficulties with coping. All other responses were considered as having difficulties with coping.

Psychological frailty

Cognition. Cognition was measured using Trail Making Part A and B (Appendix B) (Reitan, 1958). This neuropsychological assessment tool is designed to measure divided

attention, concentration and psychomotor functioning (Reitan, 1958). The Trail Making Test is a standard component of most neuropsychological screening examinations and one of the most widely used tests administered for neuropsychological screening. Validity of this test for assessing cognition has been demonstrated in other studies (Arbuthnott & Frank 2000; Reitan 1958) Part A requires perceptual motor speed. Part B is more challenging requiring perceptual motor speed and the ability to shift back and forth between numbers and letters thus the ability for cognitive flexibility is assessed (Arbuthnott & Frank, 2000; Lezak, 1983). Part B was also measured and considered for inclusion in the analysis though due to the presence of multicollinearity only Part A was used. The score is obtained as the number of seconds needed to complete each part. The raw score was used as a continuous indicator and reflects cognitive function.

Mood. Mood was measured for depressive symptoms and anxiety using two self-report instruments: the Beck Depression Inventory (BDI) (Appendix C) (Beck, Steer & Brown, 1996) and the State Trait Anxiety Inventory (STAI) (Appendix D) (Spielberger, 1970).

Mood (Depression)

The BDI is widely used to detect possible depression in normal populations. It assesses twenty one symptoms and attitudes including: mood, pessimism, sense of failure, lack of satisfaction, guilt feelings, sense of punishment, self-dislike, self-accusation, suicidal wishes, crying, irritability, social withdrawal, indecisiveness, distortion of body image, work inhibition, sleep disturbance, fatigability, loss of appetite, weight loss, somatic preoccupation, and loss of libido (Beck Brown, Steer, Eidelson, & Riskind, (1987). A meta-analysis showed the internal consistency estimate for psychiatric patient yielded a mean coefficient alpha of 0.86 (Beck, Steer, & Carbin, 1988). The internal consistency

estimate for non-psychiatric people is acceptable; Cronbach's alpha is 0.81. The BDI has been demonstrated to be a valid brief screening measure of depression (Reynolds & Gould, 1981; Storch, Roberti, & Roth, 2004). The BDI scores were calculated by standard procedures and used as a continuous indicator.

Mood (Anxiety)

Anxiety was measured using the State Trait Anxiety Inventory (STAI). The STAI is a forty item questionnaire that yields two scores: a score associated with the first 20 items and a second score associated with the last 20 items. Respondents are asked to rate themselves on each item on the basis of a 4-point Likert scale, ranging from "almost never" to "almost always" for trait anxiety The scores are weighted with each section having a possible score from 20-80. It was developed as a tool for assessing anxiety in normal (non-psychiatric) adults, but has been used in assessing anxiety in medical and surgical patients. The inventory assesses both state and trait anxiety. State anxiety can be defined as a temporary emotional state that results from situational stress. An individual demonstrates feelings of apprehension and tension during this transitory period. Trait anxiety represents a predisposition to react with anxiety in stressful situations in individuals who are generally relatively stable. The last twenty questions of the STAI reflect "trait anxiety" which indicate how an individual describes themselves (i.e., how they generally feel). To better assess their overall susceptibility to anxiety and not an isolated feeling at the moment only the trait anxiety score was included.. The STAI has been used in over 3000 studies and has demonstrated internal consistency with a Cronbach's alpha of 0.89 (Barnes, Harp, & Jung, 2002). The STAI has demonstrated

validity in previous studies (Marteau & Bekker 1992; The trait anxiety score was used as a continuous indicator.

Coping. Coping was measured by self-report with one question regarding feelings, thoughts, and behaviors from the QWB questionnaire. As the model supports the notion of an individual's ability to have control over events in their lives the following question was used: "Which days (if any) over the past 3, not including today, you have had": "Feelings that you had little or no control over events in your life?" The response choices were no days, yesterday, 2 days ago, or 3 days ago. If the answer was yesterday, 2 days ago, or 3 days ago it was considered as having difficulties with coping. There is no available published data to support the use of this single question measure as an indicator for coping although coping styles and coping resources have been associated with HRQoL outcomes in people with COPD (Hesselink et al., 2004).

Outcomes

Table 6 lists the study outcomes for this study. The outcome variables with the exception of HRQoL were part of the original conceptual model of frailty outcome section. HRQoL was added to this model since research has consistently demonstrated COPD impairs HRQoL (McSweeney, Grant, Heaton, Adams, & Timms 1982; Stahl, Lindberg, Jansson, Ronmark, Svensson, Anderson…Lundback, 2005). A description of the outcomes and how they were measured in the original study is provided.

Outcomes

The outcomes for the model included HRQOL, health care utilization, and death.

Health related quality of life. HRQoL was measured by self-report with the St. George's Respiratory Questionnaire (SGRQ) (Appendix E.). The disease specific self-

administered questionnaire provides an overall score which has been validated in numerous studies to measure impact on overall health, daily life, and perceived well-being in people with obstructive airway disease. The original SGRQ demonstrated a Cronbach's alpha of 0.91 for reliability. When translated to American English the internal reliability (Cronbach's α) was 0.71 (Barr, Schumacher, Freeman, LeMoine, Bakst, & Jones, 2000). The intraclass correlations for test-retest reproducibility for the SGRQ range from 0.795 to 0.900 (Jones, Quirk, Baveystock, & Littlejohns, 1992). The SGRQ has demonstrated validity in previous studies in COPD (Jones, Quirk, Baveystock, & Littlejohns, 1992; Rutten-van Molken, Roos, & Van Noord, 1999).

There are 2 parts in this questionnaire which include: symptoms (frequency and severity) and activities. Part 1 (symptoms) asks about the frequency of symptoms with a 1, 3, or 12 month recall. There are several scales for the symptom section with response choices from four to five possibilities. Part 2 (activities) asks about activities that are limited by breathlessness, social functioning, and psychological disturbances at the current time. The scales for the activity section are all dichotomous (true/false) with the exception of the last question which is a 4-point Likert scale. A score is calculated for each section as well as an overall score. Each item within the questionnaire has an empirical overall derived weight with final scores ranging from zero to one hundred where zero indicates best health and one hundred indicates worst health. In males and females (ages 60-69) with no lung disease the average mean score is 11.6 (Ferrer et al., 1997). In moderate to severe COPD the average scores ranged from 48.3 to 50.5 (Rutten van Molken, Roos, & van Noord, 1999). The continuous score of the SGRQ was used as an outcome in the analyses.

Health care utilization. Health care utilization was measured by self-report with multiple questions relating to the type of health care utilized. The information about the timing of when health care utilized was prefaced by: "Health care utilization since the last regularly scheduled visit or in the past 3 months, whichever interval is shorter". The following questions were used:

> "How many nights since that date have you stayed overnight in a hospital or other acute care facility?"
>
> "How many nights since that date have you stayed overnight in a rehabilitation hospital, nursing home, or other non-acute care facility?"
>
> "How many times since that date have you been seen at any emergency room (department), triage area, or urgent care facility?"
>
> "How many times since that date have you visited a physician, physician's assistant, or a nurse in their office or have you visited an outpatient clinic for any reason?"
>
> "How many times since that date has a health care professional/provider (e.g. home health agency nurse, physical therapist, occupational therapist) visited your residence?"
>
> "How many times since that date has a health care service worker (aide/attendant) or a health equipment technician come to your residence for health reasons or to adjust, service, or care for some item of health equipment used by you?"

The health care utilization questions ask about overnight stays, visits to health care providers and visits to homes. For ease of interpretation of the results we recoded these outcomes into three groups. Group 1: The questions that involved an overnight stay

to a facility ("How many nights since that date have you stayed overnight in a hospital or other acute care facility?" and "How many nights since that date have you stayed overnight in a rehabilitation hospital, nursing home, or other non-acute care facility?") were recoded as hospital/non-hospital overnight stays. Group 2: The questions that involved a visit to a health care provider ("How many times since that date have you been seen at any emergency room [department], triage area, or urgent care facility?" and "How many times since that date have you visited a physician, physician's assistant, or a nurse in their office or have you visited an outpatient clinic for any reason?") were recoded to provider visits. Group 3: The questions that involved health care providers going to the home ("How many times since that date has a health care professional/provider [e.g. Home health agency nurse, physical therapist, occupational therapist] visited your residence?" and "How many times since that date has a health care service worker [aide/attendant] or a health equipment technician come to your residence for health reasons or to adjust, service, or care for some item of health equipment used by you?") were recoded to home care visits.

The responses were used as a continuous indicator.

Death. All-cause mortality was included in this study for each individual. Death was ascertained as of December 2008, by reports from the participating clinical centers and review of the Social Security Administration's Master Death File. Death was coded as "yes" or no".

Table 6.

Outcomes

Outcomes	Original Measure
Health Related Quality of Life	• St. George's Respiratory Questionnaire Multiple questions with a total score available 0-100.
Health care utilization	*Health care utilization since the last regularly scheduled visit or in the past 3 months, whichever interval is shorter.* • How many nights since that date have you stayed overnight in a hospital or other acute care facility? • How many nights since that date have you stayed overnight in a rehabilitation hospital, nursing home, or other non-acute care facility? • How many times since that date have you been seen at any emergency room (department), triage area, or urgent care facility? • How many times since that date have you visited a physician, physician's assistant, or a nurse in their office or have you visited an outpatient clinic for any reason? • How many times since that date has a health care professional/provider (e.g. Home health agency nurse, physical therapist, occupational therapist) visited your residence? • How many times since that date has a health care service worker (aide/attendant) or a health equipment technician come to your residence for health reasons or to adjust, service, or care for some item of health equipment used by you?
Death	• All-cause mortality

Procedures

Protection of Human Subjects

This was a secondary data analysis. All data were de-identified. Data were obtained from the NHLBI BioLINCC (Biologic Specimen and Data Repository Information Coordinating Center) after Institutional Review Board (IRB) approval was granted from the University of Michigan. Data were stored on a password protected computer accessible only to research team members.

Analysis

Statistical tests were conducted using SPSS (Version 20.0, SPSS Inc. Chicago, IL). Prior to analysis all of the indicators were reviewed for missing values, outliers and fit between distributions and the assumptions of multivariate analysis such as: 1) presence of a linear relationship between the indicators, 2) homoscedasticity, 3) normal distribution of the data, and 4) multicollinearity and singularity (Tabachnick & Fidell, 2007). For the demographic characteristics, income was not available on one case. For the clinical characteristics smoking history was not available on 3 cases. In regression missing values by default are eliminated. This was also the case for this study. The missing values were eliminated in the regression models. The final sample size is provided in the tables at each time point for the analysis.

Linearity and homoscedasticity were evaluated by examination of bivariate scatterplots and residual plots. Bivariate scatterplots suggested a linear relationship was evident and the rectangular patterns in the residual plots indicated homoscedasticity of the data meaning these assumptions were met.

Having normally distributed variables (indicators) is an underlying assumption of many statistical tests (Tabachnick & Fidell, 2007). To assess the normality of the distributions of the continuous indicators, normal probability plots and boxplots were utilized. Normal distribution of all continuous indicators was found.

Multicollinearity is present when the variables (indicators) are highly correlated, whereas singularity exists when the variables are too similar (or redundant) as when two or more of the variables are actually measuring the same thing (Tabachnick & Fidell, 2007). Multicollinearity was examined using Pearson product moment correlation coefficients. A review of the correlation matrix revealed that there was a strong positive correlation (r = .62, n= 608, $p < 0.01$) between Trail Making Part A and Trail Making Part B therefore as noted earlier, only Trail Making Part A was used in the analysis. The two mood indicators, depression (BDI) and anxiety (STAI) were also highly correlated at each time point (r = .68, n= 610, $p < 0.01$). Despite the finding of a high correlation between these two indicators, both were retained for analysis since prevalence rates for anxiety, depression, or both in COPD vary widely and have been reported to range from 10% up to as high as 79% with depression seen more frequently in females than males (Barnes 2010; Barnes & Celli, 2009; DiMarco et al., 2006). No other physical frailty indicators or psychological frailty indicators were found to be highly correlated.

Following evaluation of assumptions, descriptive statistics were computed to assess the distribution of the demographic and clinical characteristics and all values were found to be within the expected range. The means and standard deviations for all the indicators were found to be plausible. A summary of demographic and clinical characteristics are presented in a Table 7.

Hypothesis Testing

Specific aim1

A linear hierarchical block regression model was used to examine the association of demographic characteristics, physical frailty indicators, and psychological frailty indicators with HRQoL. The R^2 was reported as a measure of the proportion of variance in HRQoL explained by the frailty indicators in the multivariate analyses. In the regression models the B is the unstandardized coefficient. This means the coefficient is presented in the same scale of the original indicator. In the regression models the β is the standardized coefficient. This means the indicators in the model have been standardized by "z" scores to represent change in terms of standard deviation units. Standardized relationships say that for a one-standard deviation increment on the predictor indicator, the outcome indicator increases (or decreased) by some number of standard deviation corresponding to what the β is. The independent indicators were entered into the equation at each time point based on the theoretical concepts within the model of their related importance to add to the prediction of the HRQoL. The demographic characteristics were entered in the first block. The physical frailty indicators were entered in the second block. The psychological frailty indicators were entered in the final block.

Specific aim 2

The Kaplan-Meier method was used to analyze the physical and psychological frailty indicators with death. The Kaplan-Meier survival curve computes the probability of surviving a certain length of time while considering time in many small intervals (Goel, Khanna, & Kishore, 2010). Using the Kaplan-Meier assumes three criteria are met: 1) we assume the survival probabilities are similar for individuals recruited early or later in

the study, 2) we assume the event happens at the time specified, and 3) we assume that censored individuals have the same survival probability as those who are still in the study.

Specific aim 3

A linear block regression model was used to examine the association of demographic characteristics, clinical characteristics, physical frailty indicators, and psychological frailty indicators with health care utilization. The independent indicators were entered into the equation at each time point based on the theoretical concepts within the model. The demographic characteristics were entered in the first block. The clinical characteristics were entered in the second block. The physical frailty indicators were entered in the third block. The psychological frailty indicators were entered in the final block.

CHAPTER FOUR: RESULTS

Demographic and Clinical Characteristics

Demographic characteristics are summarized in Table 7. Participants had a mean age of 66.51 years of age. The majority were male (64.1%), white (94.3%), and married (64.9%). Only 16.9% of the sample had a bachelor's degree or higher and 21.1% of the sample had not graduated from high school. The majority of the sample had a household income ranging from $15,000 to $49,999 (62.7%).

Table 7.

Sample demographic characteristics at baseline (n =610)

Characteristics	*n* (%)
Age, yrs. (+SD)	66.51 ± 5.756
Gender	
Male	391 (64.1 %)
Female	219 (35.9%)
Ethnicity	
Caucasian (white)	575 (94.3%)
Non-white	35 (5.7%)
Marital status	
Single, never married	18 (3%)
Separated	12 (2%)
Divorced or annulled	88 (14.4%)
Widowed	96 (15.7%)
Married	396 (64.9%)
Education level	
Did not complete high school	129 (21.1%)
Completed high school	169 (27.7%)
Some college (post high school or training)	209 (34.3%)
Bachelor's degree or higher	103 (16.9%)
Economic status (per year income)*	
< $15,000	112 (18.4%)

$15,000-$29.999	204 (33.4%)
$30,000-$49,999	178 (29.2%)
$50,000 or more	115 (18.9%)

*Percentage does not add up to 100% due to 1 missing case

The sample was severe in their COPD disease classification (Table 8) with a mean post bronchodilator FEV_1 of 26.97% (7.11) of predicted value. Total lung capacity and residual volumes were increased in the sample while both mean DLCO and partial pressure of oxygen in arterial blood were decreased. The average smoking pack year history was 66.43 (32.84) pack years.

Table 8.

Sample clinical characteristics at baseline (n =610)

Characteristics	Mean ± SD
Forced expiratory volume one second (FEV1) % predicted	26.97 (7.11)
Diffusion capacity (DLCO) % predicted	28.39 (9.76)
Total lung capacity (TLC) % predicted	129.23 (14.04)
Residual volume (RV) % predicted	226.60 (48.19)
Partial pressure of oxygen in arterial blood (Pa02) mmHg (on room air)	64.55 (10.17)
Smoking history (pack years)	66.43 (32.83)

*DLCO not available on 4 subjects. Smoking history not available on 3 subjects.

Physical and Psychological Frailty Baseline Indicators

Approximately half of the sample (49.2%) was of normal weight with an average BMI of 24.87 (3.74). Only 3% of sample were considered underweight (BMI < 18.5) at the time of baseline screening. At the initial baseline screening the majority of the sample reported no difficulties with balance (92.3%) though difficulties with mobility were reported in 79.5% of the sample. At the initial baseline screening the majority of the sample did not report vision (90.7%) or hearing difficulties (72.3%) though 92.3% reported wearing glasses or contacts lenses. The majority of the sample reported no problems with cognition (96.4%) or coping (83.6%) at baseline. Slightly over half of the sample reported no depressive symptoms (59.2%) or anxiety issues (57.2%) at baseline.

The mean for endurance measured by peak watts during a cardio-pulmonary exercise bike test was 41.31 (22.06) watts for males and 26.68 (14.89) watts for females.

An independent-samples t-test was conducted and a significant difference in scores for males and females was found; t (572.58) = 9.60, p = < .001.

The linear relationships between demographic characteristics and physical and psychological frailty indicators at baseline are found in Table 9. There was a positive correlation between income and education, r = .320, n = 610, p = < .001; endurance and gender, r = .335, n = 610, p = < .001; anxiety and depression, r = .682, n = 610, p = < .001; coping and depression (r = .416, n = 610, p = < .001); and coping with anxiety (r = .389, n = 610, p = < .001).

Table 9.

Correlation matrix for demographic characteristics and physical and psychological indicators of frailty.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Age	1															
2. Gender	.132**	1														
3. Race	.054	-.052	1													
4. Marital status	.115**	.238**	.099*	1												
5. Education	.093*	-.031	.049	-.021	1											
6. Income	.171**	.110**	.085*	.426**	.320**	1										
7. Nutrition	-.088*	.071	.068	.020	-.058	-.028	1									
8. Endurance	-.023	.335**	-.013	.093*	.093*	.115**	.163**	1								
9. Balance	-.073	-.097*	.008	-.004	-.090*	-.074	.004	-.047	1							
10. Mobility	-.004	-.025	.059	.021	.018	.026	.008	-.183**	.094*	1						
11. Vision	.053	-.003	-.004	.003	.018	-.072	-.057	.030	-.004	-.040	1					
12. Hearing	.142**	.182**	.102*	.092*	.028	.112**	.000	.120**	.054	-.080	.040	1				
13. Cognition	.151**	.064	-.084*	.001	-.185**	-.068	-.084*	-.109**	-.009	-.017	.117**	.028	1			
14. Depression	-.155**	-.094*	-.015	-.042	-.102*	-.067	-.001	-.071	.089*	.140**	.022	-.064	.042	1		
15. Anxiety	-.147**	-.151**	-.037	-.061	-.134**	-.125**	-.045	-.109**	.141**	.141**	.056	-.032	.113**	.682**	1	
16. Coping	-.090*	-.115**	-.056	-.054	-.010	-.038	.007	-.054	.137**	.095*	.115**	-.039	-.068	.416**	.389**	1

Note: ** p <0.01, *p <0.05.

Health-Related Quality of Life outcome

Hierarchical regression was used to assess the ability of the demographic characteristics, physical frailty indicators, and psychological frailty indicators at baseline to predict HRQoL. The baseline model summary for HRQoL at baseline is provided below. The model summaries for the remaining time points are in the appendices. Age, gender, race, marital status, education, and income were entered at Step 1 (at baseline), explaining only 4% of the variance in HRQoL. At Step 2 after entry of the physical frailty indicators (nutrition, endurance, balance, mobility, vision, and hearing) the total variance explained by the model was 23%, F (12, 571) =13.97, p = < .001. In the final model at Step 3 after entry of the psychological frailty indicators (cognition, depression, anxiety, and coping) the total variance explained by the model was 36%, F (16, 567) = 20.31, p = < .001.

At baseline, in the final model summary both Model 2 and Model 3 overall were significant predictors (p = < .001) of HRQoL. Table 10 shows the R squared (R^2), F for change in R^2 for the models at baseline.

Table 10.

Model Summary for HRQOL at Baseline (n=604)

Model	R^2	*F* for change in R^2	*p*
Model 1	.039	3.94	.001*
Model 2	.227	23.11	<.001**
Model 3	.364	30.63	<.001**

**$p < .001$, *$p < .05$

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income/ nutrition, endurance, balance, mobility, vision, and hearing.
c. Model 3 includes: age, gender, race, marital status, education, income/ nutrition, endurance, balance, mobility, vision, hearing/ cognition, depression, anxiety and coping.

Table 11 shows the coefficients, (*B*), *t*-values and *p*-values for demographic characteristics, physical frailty indicators, and psychological frailty indicators as predictors of HRQoL for the final model summary at baseline. Age, gender, endurance, balance, mobility, coping, and depression were found to be significant ($p = < .05$) individual baseline indicators for predicting quality of life.

Table. 11.

Coefficients (β), t-values, and p-values for Demographic Characteristics and the Frailty Indicators as Predictor of Health Related Quality of Life in Final Model at Baseline (n=604)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	46.078		8.739	.001
Age	-.100	-.079	-2.216	.027
Race	1.149	.021	.607	.544
Income	.038	.003	.073	.942
Marital status	1.970	.073	1.893	.059
Education	-.882	-.055	-1.474	.141
Gender	3.002	.112	2.957	.003
Nutrition	.079	.023	.673	.501
Endurance	-.118	-.193	-5.138	.001
Balance	5.541	.106	3.086	.002
Mobility	7.620	.234	6.658	.001
Vision	-2.141	-.046	-1.328	.185
Hearing	.186	.006	.184	.854
Coping	3.492	.097	2.555	.011
Cognition	.046	.057	1.600	.110
Anxiety	.065	.053	1.097	.273
Depression	.645	.297	6.084	.001

At six months post randomization (Appendix Table F1) age, gender, endurance, balance, mobility, coping, and depression remained significant predictors in addition to education level (p= <0.05). The final summary model at 6 months post randomization can be found in Appendix Table F2. The final R^2 for 6 months post randomization was .438.

At twelve months post randomization (Appendix F3) education became less significant as a predictor of HRQoL (p = <.06) though age, gender, endurance, mobility, balance, coping and depression remained significant (p = <.05). The final summary model at 12 months post randomization can be found in Appendix Table F4. The final R^2 for 12 months post randomization was .399.

At twenty four months post randomization (Appendix F5) age, gender, and balance were no longer significant predictors though education once again became a significant predictor along with endurance, mobility, coping, and depression (p = <.05). The final summary model at 24 months post randomization can be found in Appendix Table F6. The final R^2 for 24 months post randomization was .356

. At thirty six months post randomization (Appendix Table F7) only mobility and coping remained as significant predictors of HRQoL (p = <.001). The final summary model at 36 months post randomization can be found in Appendix Table F8. The final R^2 for 36 months post randomization was .473.

Death outcome

A K-means cluster analysis was done using the physical and psychological frailty indicators to determine high/ low frailty clusters and evaluate survival between the

groups. Cluster 1 (*n* =185; censored =84) was defined in this study as having a lower frailty likelihood. Cluster 1 is characterized by: higher endurance, higher nutrition (i.e., higher BMI), lower anxiety difficulties, lower cognition difficulties, and no problems with balance, coping, vision or hearing. Cluster 2 (*n* = 396; censored =88) was defined in this study as having a higher frailty likelihood). Cluster 2 is characterized by: lower endurance, lower nutrition (i.e., lower BMI) higher anxiety difficulties, higher cognition difficulties, and no balance, coping, vision or hearing difficulties. A Kaplan-Meier survival curve (Figure 4) was done using the two defined clusters to assess the probability of survival between those with lower frailty likelihood and those with higher frailty likelihood in people with severe COPD. Figure 4 includes the censored cases. The censored cases are those who dropped out of the study or the study ended for them. There was a statistically significant difference *(p* = < .001) between the groups. 50% of Cluster 1 (low frailty likelihood) survived 2718 (165.13) days. 50% of Cluster 2 (high frailty likelihood) survived 1702 days (93.78). This translates into 7.4 years compared to 4.7 years median survival time.

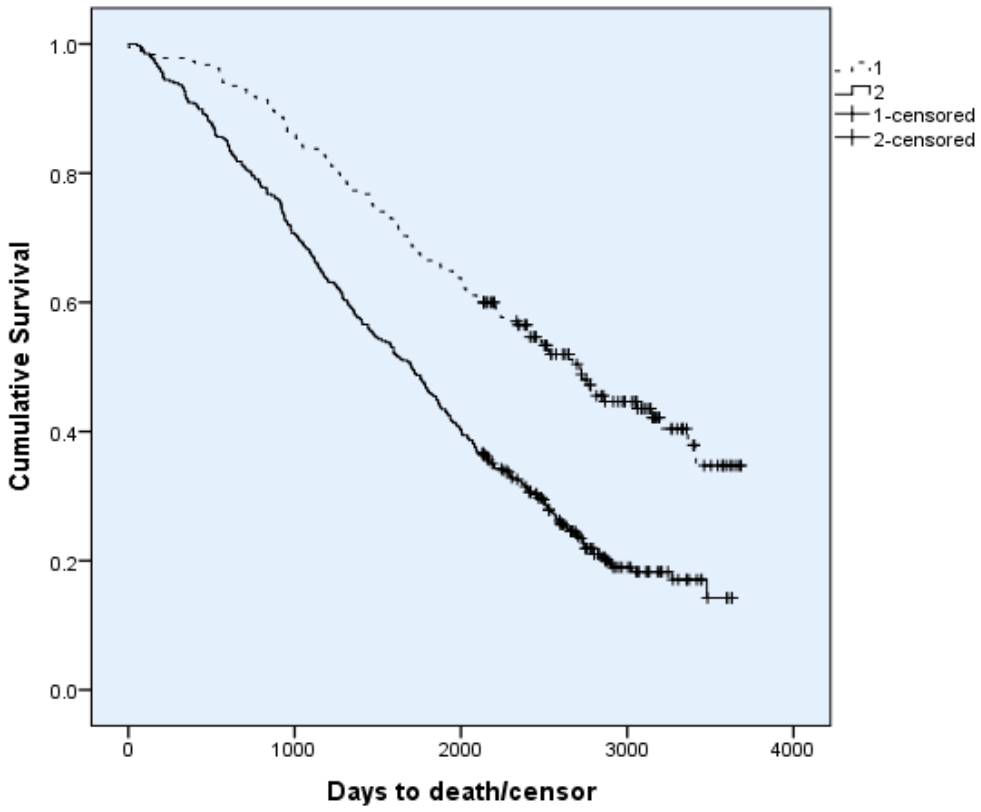


Figure 4. Kaplan Meier Curve for Probability of Survival for Cluster 1 and Cluster 2 (*n*=581)

Health care utilization outcome

A linear regression model method was used to assess the ability of the demographic and clinical characteristics, physical frailty indicators, and psychological frailty indicators to predict health care utilization. Health care utilization was assessed by three groups: Group 1) overnight stay to a facility; Group 2) a visit to a health care provider; Group 3) a home visit by a health care. The baseline model summaries for each health care utilization group are provided below. The model summaries for the remaining time points are in the appendicies.

Overnight stay in a hospital, acute/nonacute care facility, rehabilitation hospital, nursing home

For Group 1: In the model summary Model 1 (Table 12) demonstrated signifcance (p = <.05) at predicting an overnight stay in a hospital, acute care facility, rehabilitation hospital, nursing home, or a non acute care facility at baseline. Education and depression were significant individual indicators (p = <.05) predictive of an overnight stay in a hospital, acture care facility, rehabilitation hospital, nursing home or a non acture care facility in the model (Table 13).

Table 12.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of the number of overnight stays in a hospital, acute care facility, rehabilitation hospital, nursing home, or non-acute care facility at baseline (n=609)

Model	R^2	*F* for change in R^2	*P*
Model 1	.023	2.282	.035
Model 2	.035	1.213	.298
Model 3	.042	.617	.717
Model 4	.052	1.486	.205

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income/, TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income/ TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD)/ vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income/ TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD)/ vision, mobility, balance, hearing, nutrition, endurance/ coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table 13.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and the Frailty Indicators as predictors of the number of overnight stays in a hospital, acute care facility, rehabilitation hospital, nursing home, or non-acute care facility in final model at baseline (*n=609)*

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	.568		1.293	.197
Age	<.001	.004	.078	.938
Race	.110	.053	1.240	.216
Income	.006	.011	.229	.819
Marital status	-.012	-.012	-.246	.805
Education	-.070	-.116	-2.488	.013
Gender	-.055	-.055	-.931	.352
FEV_1 (PBD)	-.001	-.012	-.189	.850
TLC (PBD)	-.002	-.049	-.668	.505
RV (PBD)	.000	.014	.155	.877
PaO_2 (RA)	<.001	-.002	-.039	.969
DLCO (PBD)	-.003	-.053	-1.026	.305
Smoking (PY)	<.001	.021	.485	.628
Nutrition	<.001	.000	-.008	.993
Endurance	-.001	-.052	-.924	.356
Balance	.055	.028	.658	.511

Mobility	-.007	-.005	-.125	.900
Vision	.106	.060	1.409	.159
Hearing	-.042	-.039	-.900	.368
Coping	-.098	-.072	-1.546	.123
Cognition	-.001	-.019	-.417	.677
Anxiety	-.002	-.043	-.728	.467
Depression	.010	.127	2.115	.035

PBD = post bronchodilator, PY=pack years, RA = room air

At six months post randomization (Appendix Table G1) and 12 months post randomization (Appendix Table G3) none of the models were significant in predicting an overnight stay in a hospital, acute care facility, rehabilitation hospital, nursing home, or non acute care facility. There were no individual indicators at 6 months post randomization (Appendix Table G2) or 12 months post randomization (Appendix Table G4) found to be significant at predicting an overnight stay in a hospital, acute care facility, rehabilitation hospital, nursing home, or non acute care facility .

At twenty four months post randomization in the model summary, Model 3 (Appendix Table G5) was significant (p = .008) at predicting an overnight stay in a hospital, acute care facility, rehabilitation hospital, nursing home, or non acute care, The significant indicators (Appendix G6) were smoking history (p = .050) and balance (p = .001).

At thirty six months post randomizaton none of the models (Appendix Table G7) were significant at predicting an overnight stay in a hospital, acute care facility,

rehabilitation hospital, nursing home, or non acute care facility and there were no significant indicators (Appendix G8).

Visit to an emergency room (triage/urgent care) or health care provide (MD/PA/RN)

For Group 2 none of the models (Table 14) were significant at predicting a visit to an emergency room or health care provider at baseline. An isolated indicator (Table 15) of gender (p = .010) was found to be significant though again overall none of the models were significant at predicting a visit to an emergency room or health care provider.

Table 14.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of the number of visits to an emergency room (including triage and urgent care) or visits to a health care provider (physician, physician's assistant, nurse) at baseline (n=609)

Model	R^2	*F* for change in R^2	*P*
Model 1	.009	.858	.526
Model 2	.017	.767	.596
Model 3	.025	.780	.586
Model 4	.029	.568	.686

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income/ TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income/ TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD)/ vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income/ TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD)/ vision, mobility, balance, hearing, nutrition, endurance/ coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table 15.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of the number of visits to an emergency room (including triage and urgent care) or visits to a health care provider (physician, physician's assistant, nurse) in final model at baseline (n=609)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	1.035		2.883	.004
Age	-.007	-.100	-1.941	.053
Race	.048	.028	.658	.511
Income	.001	.002	.040	.968
Marital status	-.020	-.025	-.512	.609
Education	.008	.016	.336	.737
Gender	.125	.154	2.591	.010
FEV_1 (PBD)	.001	.013	.205	.838
TLC (PBD)	.003	.126	1.701	.090
RV (PBD)	-.001	-.150	-1.602	.110
PaO_2 (RA)	<.001	.009	.185	.853
DLCO (PBD)	-.003	-.064	-1.224	.222
Smoking (PY)	<.001	.002	.040	.968
Nutrition	.002	.017	.369	.712
Endurance	-.001	-.059	-1.020	.308
Balance	-.058	-.037	-.853	.394

Mobility	.014	.014	.312	.755
Vision	.086	.060	1.399	.162
Hearing	.018	.021	.474	.635
Coping	.008	.007	.151	.880
Cognition	<.001	.009	.205	.838
Anxiety	.002	.042	.698	.486
Depression	.002	.025	.405	.686

PBD = post bronchodilator, PY=pack years, RA = room air

At six months post randomization in the model summary (Appendix Table H1) Model 3 was significant (p = .003) at predicting a visit to an emergency room or health care provider. The significant indicators (Appendix Table H2) were FEV_1(PBD) (p = .021) and endurance (p = .001).

At twelve months post randomization none of the models (Appendix Table H3) were significant at predicting a visit to an emergency room or health care provider though income (p = .031) and PaO_2 (RA) (p = .039) were significant indicators (Appendix Table H4).

At twenty months post randomization (Appendix Table H5) and 36 months post randomization (Appendix Table H7) there was no model or indicators (Appendix Table H6 and Appendix Table H8) found to be significant at predicting a visit to an emergency room or health care provider.

Home care visit

For Group 3: In the model summary Model 2 (Table 16) was significant (p = < .001) at predicting a home visit by a health care provider. The significant indicators (Table 17) were PaO_2 (RA) (p = <.001) and DLCO (p = .004) at baseline.

Table 16.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of the number of home visits by a health care provider (home health agency nurse, physical therapist, occupational therapist) or health care service worker (aide/attendant, health equipment technician) at baseline (n=609)

Model	R^2	F for change in R^2	P
Model 1	.014	1.402	.211
Model 2	.160	16.463	<.001
Model 3	.169	1.074	.377
Model 4	.172	.493	.741

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income/ TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income/ TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD)/ vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income/ TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD)/ vision, mobility, balance, hearing, nutrition, endurance/ coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table 17.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and the Frailty Indicators as predictors of the number of home visits by a health care provider (home health agency nurse, physical therapist, occupational therapist) or health care service worker (aide/attendant, health equipment technician in final model at baseline (n=609)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	3.085		3.382	.001
Age	-.004	-.022	-.453	.651
Race	.069	.015	.375	.708
Income	-.012	-.011	-.237	.813
Marital status	-.076	-.034	-.761	.447
Education	-.019	-.014	-.326	.745
Gender	-.103	-.046	-.840	.401
FEV_1 (PBD)	-.016	-.106	-1.843	.066
TLC (PBD)	.007	.090	1.322	.187
RV (PBD)	-.002	-.088	-1.017	.310
PaO_2 (RA)	-.026	-.244	-5.641	<.001
DLCO (PBD)	-.015	-.140	-2.894	.004
Smoking (PY)	<.001	-.014	-.345	.730
Nutrition	.014	.049	1.143	.253
Endurance	-.005	-.103	-1.937	.053

Balance	-.043	-.010	-.250	.803
Mobility	-.008	-.003	-.073	.942
Vision	.107	.027	.685	.494
Hearing	.092	.038	.944	.346
Coping	-.046	-.015	-.347	.729
Cognition	.002	.035	.838	.402
Anxiety	.005	.053	.945	.345
Depression	-.008	-.046	-.824	.410

PBD = post bronchodilator, PY=pack years, RA = room air

At six months post randomization in the model summary (Appendix Table I1) Model 2 was significant (p = < .001) at predicting a home visit by a health care provider. The significant indicators (Appendix Table I2) were PaO_2 (RA) (p = <.001) and smoking history (p = .015).

At twelve months post randomization in the model summary (Appendix Table I3) Model 2 was significant (p = < .001) at predicting a home visit by a health care provider. The significant indicators (Appendix Table I4) were TLC (p = .006), PaO_2 (RA) (p = <.001) and DLCO (p =.006).

At twenty four months post randomization in the model summary (Appendix Table I5) Model 2 was significant (p = < .05) at predicting a home visit by a health care provider. The significant indicators (Appendix Table I6) were PaO_2 (RA) (p = <.001), nutrition (p = .033), and endurance (p = .024).

At thirty six months post randomization in the model summary (Appendix Table I7) Model 2 was significant (p = < .05) at predicting a home visit by a health care

provider. The significant indicators (Appendix Table I8) were gender (p = .035), RV % predicted (PBD) (p= .020), PaO_2 (RA) (p = <.001) and endurance (p = <.001).

CHAPTER FIVE: DISCUSSON

This is the first study to examine frailty as a predictor of HRQOL longitudinally over time in people with severe COPD. At baseline the physical indicators of frailty accounted for a significant amount of the variance in HRQOL independent of demographic and clinical variables. The psychological indicators accounted for a significant amount of the variance in HRQOL independent of the effects of demographic characteristics, clinical variables and physical indicators of frailty. Mobility and coping at baseline were important predictors of long term HRQOL. High frailty predicted mortality, but did not predict health care utilization. Clinical variables of COPD severity predicted health care utilization.

These results highlight the importance of including both physical and psychological variables as indicators of frailty, especially when predicting HRQOL. Many of the physical and psychological indicators of frailty were significant predictors of HRQOL at one or two years, but only mobility and coping were significant predictors of HRQOL at three years. Most of the prior work with frailty has been using health care utilization and mortality as outcomes and psychological difficulties as a frailty indicator is indeed lacking in the literature.

Mobility is not typically included as an indicator of frailty in most models, but it performed well in our revised Gobben's model, suggesting that it may be useful to retain

mobility in future frailty research, especially for people with severe COPD. The importance of mobility could be explained by several factors. First, impairment in mobility is frequently seen in people with COPD (Jacome, Marques, Gabriel, & Figueiredo, 2013) and mobility is linked to subjective levels of dyspnea, an important activity-limiting symptom of COPD (Katajisto et al., 2012). Further research would be needed to determine if it was a useful frailty indicator for people in the earlier stages of COPD since there is likely less variability in earlier stages of the disease. Additionally, there has not been a lot of work done in early stage COPD because it is largely underdiagnosed.

It is interesting to note that endurance did not predict long term HRQOL, possibly because it is readily modified by physical activity. Endurance declines rapidly with inactivity and is sensitive to short term events thus less likely to be a good predictor of long term outcomes. Balance may behave similarly. In contrast walking is a very basic, low-level skill and is less sensitive to smaller changes in activity levels. As a low level skill walking is essential to many activities of daily living and people are slow to give up walking. Problems with walking can be treated with physical therapy, but the process is slow. So walking declines slowly and returns slowly with therapy. We suggest that this makes mobility a better predictor for long term HRQOL.

As noted coping was also a significant predictor of HRQOL. While coping was measured by only a single item these results are consistent with studies that demonstrate coping skills are vital in adjusting to one's disease limitations (Hesselink, Penninx, Schlösser, Wijnhoven, van der Windt, Kriegsman, & van Eijk, 2004; Ketelaars et al., 1996). Active coping skills have been shown to predict health-related quality of life in

those with chronic illnesses (Gibson, Rueda, Rourke, Bekele, Gardner, Fente, & Hart, 2011; Myaskovsky et al., 2003). Previous studies have demonstrated correlations between age and coping with HRQOL in those with COPD especially with very severe disease (Ferrer et al, 1997; Hesselink, Penninx, Schlösser, Wijnhoven, van der Windt, Kriegsman, & van EijkSource, 2004; McSweeny, Grant, Heaton, Adams, & Timms 1982; Stahl et al., 2005). This study supports those same findings. The results of this study are consistent with previous research.

It is well known that COPD patients have a less active lifestyle compared to healthy elderly persons (Pitta, Troosters, Probst, Decramer, & Gosselink, 2005; van Gestel et al., 2012). In a recent study, frailty in COPD was significantly associated with a reduction in activities of daily living (Park, Richardson, Holleman, & Larson, 2013). Decreased physical activity in COPD has also been correlated with a decreased HRQOL (Pitta, Troosters, Probst, Decramer, & Gosselink, 2005).

There is conflicting evidence to substantiate socioeconomic status as a predictor of HRQOL (McSweeny, Grant, Heaton, Adams, & Timms, 1982; Miravitlles, Naberan, Cantoni, & Azpeitia, 2011). We did not find income to be a significant predictor of HRQOL and while education was significant it was only significant at two time points (6 months post randomization and 24 post randomization). Surprisingly, this finding was not seen at baseline. It is difficult to explain the reason for this as education and socioeconomic (or income) status are related. Generally as one's education levels increase so does socioeconomic status. Lower education levels have long been associated with a lower quality of life (Jackson, Suzuki, Coultas, Singh, & Bae, 2013; Prigatano, Wright, & Levin, 1984).

Unexpectedly this study did not find anxiety to be a predictor of HRQOL. We do not know the disease duration of each person but since this study consisted of those with severe COPD it is conceivable that they have had their disease for some time and were better able to cope with the anxiety frequently seen with dyspnea (Mauer, et al., 2008; Lansing, Gracely, & Banzett, 2009). As disease progression occurs over time, this group may have adopted strategies to help in disease management thereby decreasing their anxiety. It is also plausible that this group had less anxiety because they were enrolled in an intervention trial and had just completed pulmonary rehabilitation. Patients had easy access to study staff by either in-person visits or phone contacts they may have felt less anxiety just by virtue of the close monitoring that comes with being a study participant.

As expected those individuals with more frailty had decreased survival time over those with less frailty. The relationship between frailty and mortality has been studied extensively and these results are similar to others demonstrating that people with frailty have an increased mortality (Buchman, Wilson, Bienias, & Bennett, 2009; Ensurd et al.; 2008; Fried et al., 2001; Mitnitski, Song & Rockwood, 2004). .

Our original hypothesis that frailty would be associated with increased health care utilization was not substantiated over 36 months of the study. The mean number of days for an overnight stay was 1.24 (SD=6.21) over 36 months of the study. The mean number of visits to an emergency room or health care provider was 2.69 (SD=2.82) over 36 months of the study. Our results seem low given the severity of the lung disease. There may be inaccuracies in the data set due to the method in which the health care utilization question was prefaced. That is, as noted in the methods section, patients were asked to report health care utilization for only 3 months out of every year. Health care utilization

could have occurred but not been captured with this methodology. It is also recognized that clinical practice may vary across the multiple sites for data collection. Specifically deciding when a person should be admitted to a health care facility, see a health care provider, or have a health care provider sent to their home can be quite varied. This is an independent decision of the health care providers and there are no universal guidelines as to how to best manage each person. Another explanation for this finding may be due to the number of comorbidities. Even though we do not have data about patients' comorbidities, we can assume that they were in a relatively healthy state (despite their chronic disease) because they were eligible to be randomized to the surgical arm of the study.

The mean number of home visits by a health care provider or health care service worker was 4.61 (9.75) over 36 months of the study. We did find an increased use of home health care services at each time point. Health care utilization, such as emergency room visits, hospital admissions, and physician visits are all increased with frail individuals (Kiely, Cupples, & Lipsitz, 2009; Romero-Ortuno, Walsh, Lawlor, & Kenny, 2010).

It is interesting to note that disease severity was a better predictor of home visits than frailty indicators. As pulmonary status deteriorated more home care visits were required. This is not a surprising finding and it is recognized that predictors associated with the use of health services require careful interpretation due to the variability of health care institutions and providers across the country. It is difficult to tease out the effects of frailty and practice patterns from this study.

Clinical Implications

In Gobbens' (2010) conceptual model there are theoretical time intervals along the model's continuum that interventions could be done to prevent frailty, delay frailty, diminish frailty and decrease the adverse outcomes such as death. Further work is needed in designing studies with targeted interventions at appropriate time intervals to achieve these goals.

Certainly, mobility is an important component of doing basic ADL's and thus is an important construct to focus on with this population. At present, one method of creating a more active lifestyle is pulmonary rehabilitation. Pulmonary rehabilitation has been proven to relieve fatigue and dyspnea, improve mental capacity, and increase patients' control over their disease (Lacasse, Martin, Lasserson, & Goldenstein, 2007). It improves symptoms and exercise capacity thereby improving health-related quality of life (Fabbri & Hurd, 2003; GOLD 2009; Nici et al., 2006). Increased muscle strength, gait speed, and stair climbing have been observed in frail COPD patients who have participated in a structured pulmonary rehabilitation program (Fiatarone et al., 1994). Increased endurance can allow for an increased independence in activities of daily living and a greater sense of satisfaction that coincides with this accomplishment. Clinicians should encourage pulmonary rehabilitation as it results in increased physical activity and endurance thereby preventing or delaying frailty

Given that coping was the other significant frailty psychological indicator for HRQOL, it should be retained as part of the frailty model. Though coping in this study, was operationalized as feeling like one had control over events in their life, the importance of it as a predictor of long term HRQOL is note-worthy. A lower sense of

control reflects a sense of uncertainty about the future and may be an important indicator of the long term outlook for an individual. Adequate coping can serve as protective factors for patients struggling with chronic illness.

As evidenced by the findings optimization of health-related quality of life is a relevant goal for care of patients with COPD. Future studies should be done to determine if improving the other significant findings (endurance, balance, and depression) would improve HRQOL.

From a clinical perspective, meeting the needs of this chronically ill disease population may necessitate increasing home visits as this could play a role in decreasing emergency room visits, decreasing COPD exacerbations, and hospital overnight visits. Additionally, since mobility and coping were significant indicators over time of HRQOL it could useful to have objective measures of mobility and coping done by clinicians at a clinic visit to assess for difficulties or declines in these indicators.

Limitations

A major limitation is that it is a secondary data analysis. All the indicators one would like to include in a study may not be available and the methodology in which they were collected may be different than if the study was being done as a primary study. The sample size was large but there was little heterogeneity in the disease state since they were all severe in their disease classification. Future studies should aim to validate the prospective frailty indicators in COPD and include those of varied disease severity.

Many of the indicators used in this study were self-reported. A self-report instrument with excessive length or difficult comprehension may be a limiting factor with

older people. This may lead to errors and may have caused bias during the data collection process.

While this study had longitudinal data, the indicators of anxiety and depression were only obtained at baseline and the scores replicated at subsequent time points. The scores for these indicators may have changed over the course of the study though this was a group of severe COPD people already receiving maximal medical therapies and since anxiety and depression are associated with respiratory symptoms it is rather unlikely that they would improve since the chronic nature of the disease itself precludes improvement without interventions (Ben-Shlomo & Kuh 2002).

Conclusion

In summary, though this study was not aimed at developing another frailty model it does provide information on additional frailty indicators to consider in this population. Frailty is a challenging concept to define and it beckons us to collectively consider the best methodology to collect accurate data in not only defining the disease but potential interventions to prevent it. The results of this study indicate associations between frailty and the outcomes of HRQOL and death in those with severe COPD. As frailty exerts a substantial impact on HRQoL and mortality, our study has important implications for future interventions aimed at preventing or delaying the development of frailty among older adults.

APPENDIX

A. Frailty Criteria used to Define Frailty (Fried 2001)

• **Weight loss:** "In the last year, have you lost more than 10 pounds unintentionally (i.e., not due to dieting or exercise)?" If yes, then frail for weight loss criterion. At follow-up, weight loss was calculated as: (Weight in previous year – current measured weight)/(weight in previous year) = K. If $K \geq 0.05$ and the subject does not report that he/she was trying to lose weight (i.e., unintentional weight loss of at least 5% of previous year's body weight), then frail for weight loss = Yes.

• **Exhaustion:** Using the CES–D Depression Scale, the following two statements are read. (a) I felt that everything I did was an effort; (b) I could not get going. The question is asked "How often in the last week did you feel this way?" 0 = rarely or none of the time (<1 day), 1 = some or a little of the time (1–2 days), 2 = a moderate amount of the time (3–4 days), or 3 = most of the time. Subjects answering "2" or "3" to either of these questions are categorized as frail by the exhaustion criterion.

• **Physical Activity:** Based on the short version of the Minnesota Leisure Time Activity questionnaire, asking about walking, chores (moderately strenuous), mowing the lawn, raking, gardening, hiking, jogging, biking, exercise cycling, dancing, aerobics, bowling, golf, singles tennis, doubles tennis, racquetball, calisthenics, swimming. Kcals per week expended are calculated using standardized algorithm. This variable is stratified by gender.
Men: Those with Kcals of physical activity per week <383 are frail.
Women: Those with Kcals per week <270 are frail.

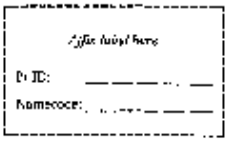
• **Walk Time**, stratified by gender and height (gender-specific cutoff a medium height).

Men	Cutoff for Time to Walk 15 feet criterion for frailty
Height ≤ 173 cm	≥7 seconds
Height > 173 cm	≥6 seconds
Women	
Height ≤ 159 cm	≥7 seconds
Height > 159 cm	≥6 seconds

• **Grip Strength**, stratified by gender and body mass index (BMI) quartiles:

Men	Cutoff for grip strength (Kg) criterion for frailty
BMI ≤ 24	≤29
BMI 24.1–26	≤30
BMI 26.1–28	≤30
BMI > 28	≤32
Women	
BMI ≤ 23	≤17
BMI 23.1–26	≤17.3
BMI 26.1–29	≤18
BMI > 29	≤21

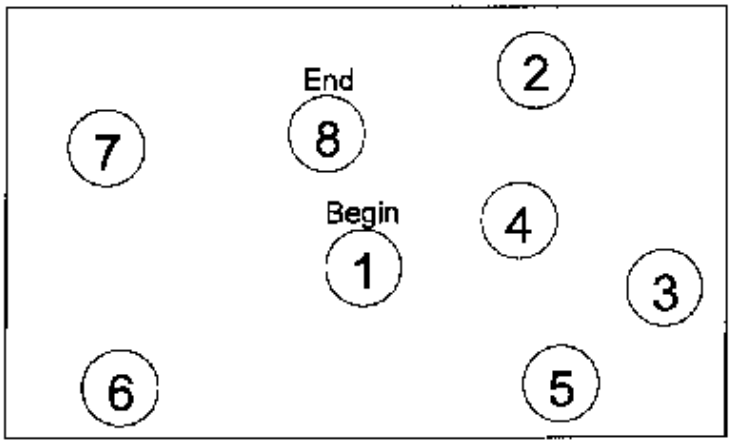
B. Trail Making Part A

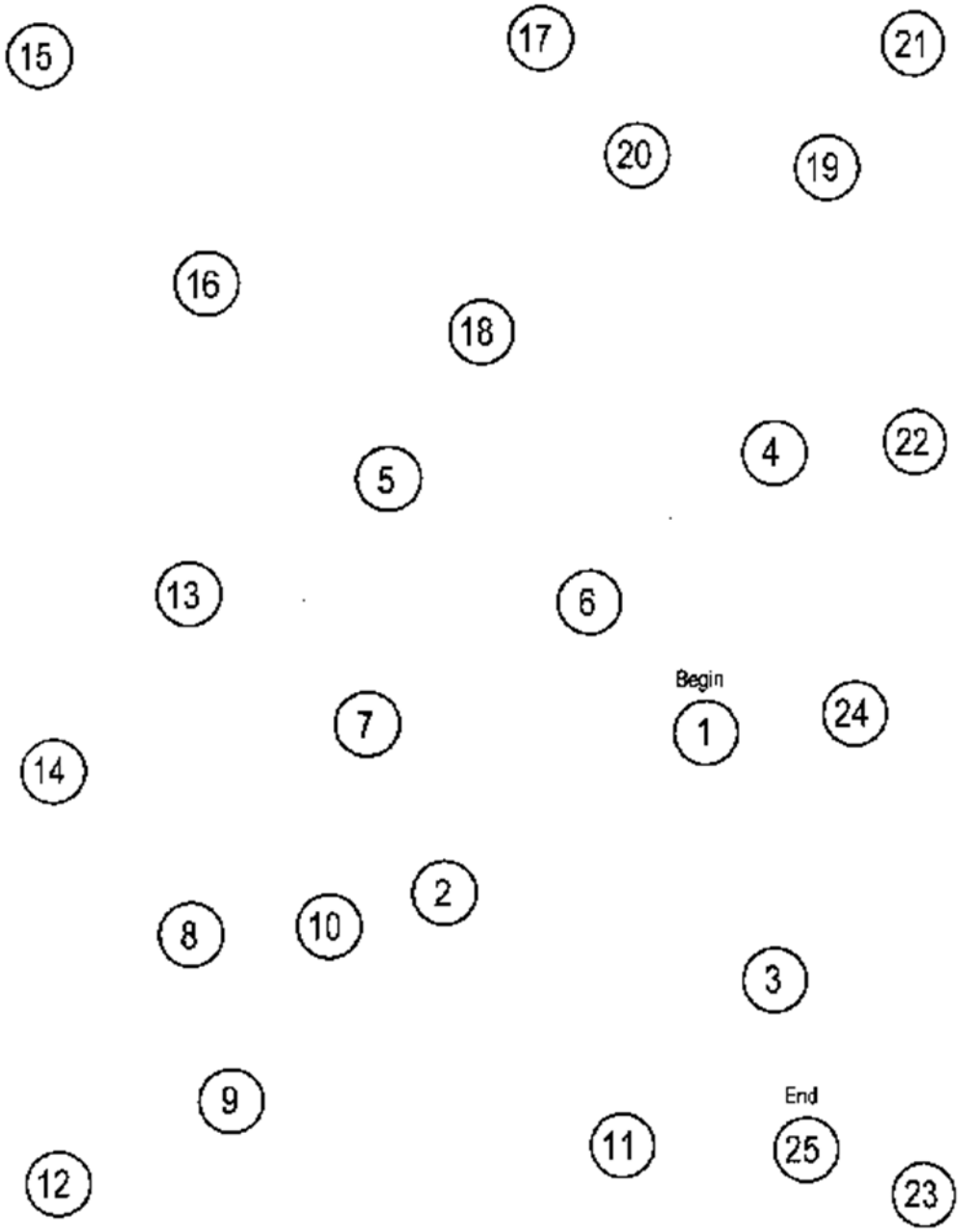


TRAIL MAKING

Part A

SAMPLE

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End
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23

C. Beck Depression Inventory

National Emphysema Treatment Trial
NETT

Affix label here
Pt ID: _ _ _ _ _ _
Namecode: _ _ _ _ _ _

Beck Depression Inventory

Date: _____

		Circle One
A. (1)	I do not feel sad	0
	I feel sad	1
	I am sad all the time and I can't snap out of it	2
	I am so sad or unhappy that I can't stand it	3
B. (2)	I am not particularly discouraged about the future	0
	I feel discouraged about the future	1
	I feel I have nothing to look forward to	2
	I feel that the future is hopeless and that things cannot improve	3
C. (3)	I do not feel like a failure	0
	I feel I have failed more than the average person	1
	As I look back on my life, all I can see is a lot of failures	2
	I feel I am a complete failure as a person	3

Affix label here
Pt ID: ___ ___ ___ ___ ___
Namecode: ___ ___ ___ ___

Circle One

D. (4) I get as much satisfaction out of things as I used to 0

I don't enjoy things the way I used to 1

I don't get real satisfaction out of anything anymore 2

I am dissatisfied or bored with everything 3

E. (5) I don't feel I am particularly guilty 0

I feel guilty a good part of the time 1

I feel quite guilty most of the time 2

I feel guilty all of the time 3

F. (6) I don't feel I am being punished 0

I feel I may be punished 1

I expect to be punished 2

I feel I am being punished 3

G. (7) I don't feel disappointed in myself 0

I am disappointed in myself 1

I am disgusted with myself 2

I hate myself 3

Affix label here
Pt ID: _ _ _ _ _ _
Namecode: _ _ _ _ _

Circle One

H. (8) I don't feel I am any worse than anybody else 0

I am critical of myself for my weakness or mistakes 1

I blame myself all the time for my faults 2

I blame myself for everything that happens 3

I. (9) I don't have thoughts of killing myself 0

I have thoughts of killing myself, but I would not carry them out 1

I would like to kill myself 2

I would kill myself if I had the chance 3

J. (10) I don't cry any more than usual 0

I cry more now than I used to 1

I cry all the time now 2

I used to be able to cry, but now I can't even cry even though I want to 3

Affix label here
Pt ID: ___ ___ ___ ___ ___
Namecode: ___ ___ ___ ___ ___

Circle One

K. (11) I am no more irritated now then I ever am 0

I get annoyed or irritated more easily than I used to 1

I feel irritated all the time now 2

I don't get irritated at all by the things that used to irritate me 3

L. (12) I have not lost interest in other people 0

I am less interested in other people than I used to be 1

I have lost most of my interest in other people 2

I have lost all my interests in other people 3

M. (13) I make decisions about as well as I ever could 0

I put off making decisions more than I used to 1

I have greater difficulty in making decisions than before 2

I can't make decisions at all anymore 3

Affix label here
Pt ID: _ _ _ _ _ _ _
Namecode: _ _ _ _ _ _

Circle One

N. (14) I don't feel I look any worse than I used to 0

I am worried that I am looking old or unattractive 1

I feel that there are permanent changes in my appearance that make me look unattractive 2

I believe that I look ugly 3

O. (15) I can work about as well as before 0

It takes an extra effort to get started at doing something 1

I have to push myself very hard to do anything 2

I can't do any work at all 3

P. (16) I can sleep as well as usual 0

I don't sleep as well as I used to 1

I wake up 1-2 hours earlier than usual and find it hard to get back to sleep 2

I wake up several hours earlier than I used to and cannot get back to sleep 3

Affix label here
Pt ID: _____
Namecode: _____

Circle One

Q. (17) I don't get more tired than usual 0

I get tired more easily than I used to 1

I get tired from doing almost anything 2

I am too tired to do anything 3

R. (18) My appetite is no worse than usual 0

My appetite is not as good as it used to be 1

My appetite is much worse now 2

I have no appetite at all anymore 3

S. (19) I haven't lost much weight, if any, lately 0

I have lost more than 5 pounds 1

I have lost more than 10 pounds 2

I have lost more than 15 pounds 3

I am purposely trying to lose weight by eating less Yes _____ No _____

Affix label here
Pt ID: _ _ _ _ _ _
Namecode: _ _ _ _ _ _

Circle One

T. (20) I am no more worried about my health than usual 0

I am worried about physical problems such as aches and pains; or upset stomach; or constipation 1

I am very worried about physical problems and it's hard to think of much else 2

I am so worried about my physical problems, that I cannot think about anything else 3

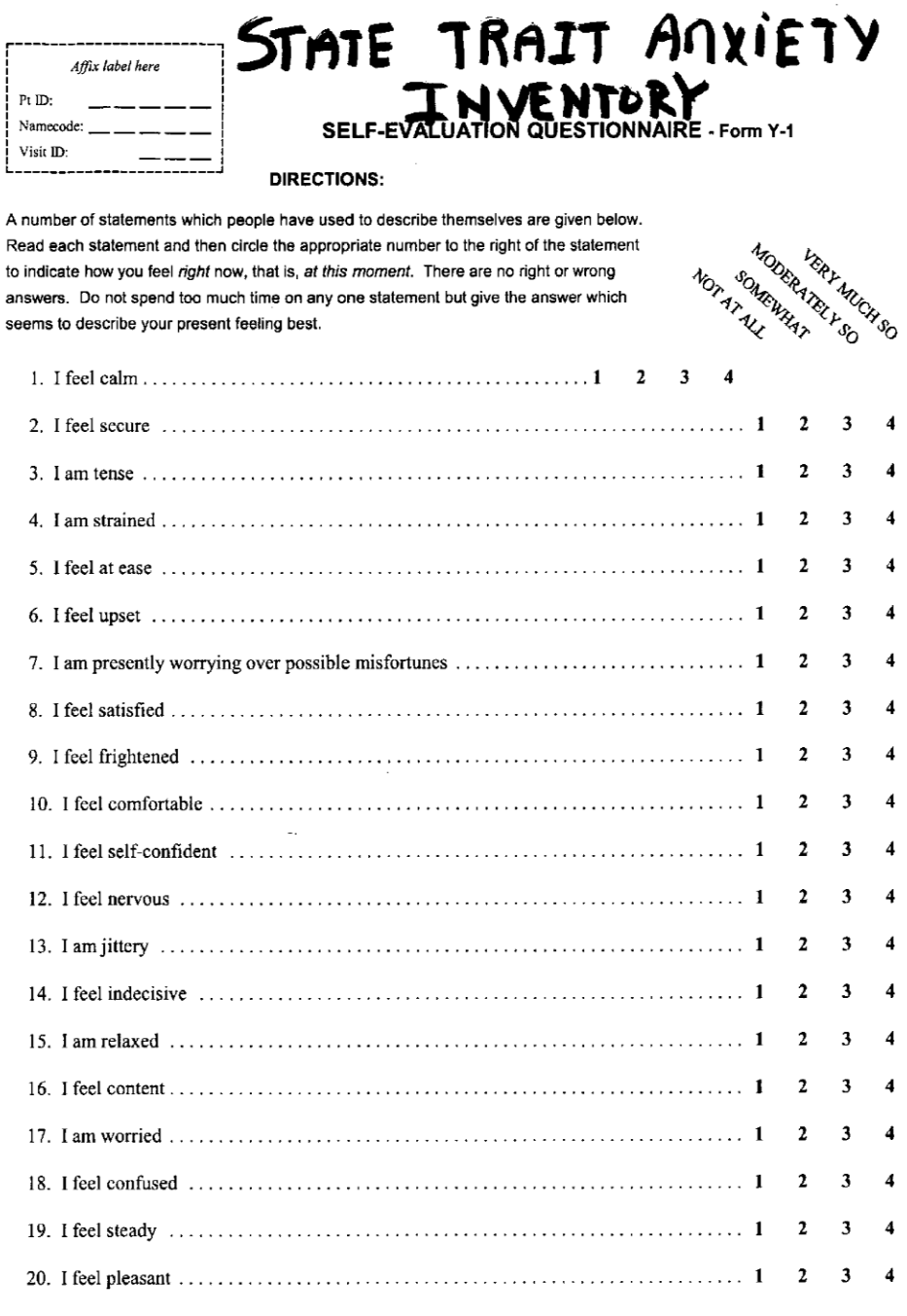
U. (21) I have not noticed any recent change in my interest in sex 0

I am less interested in sex than I used to be 1

I am much less interested in sex now 2

I have lost interest in sex completely 3

D. State Trait Anxiety Inventory



Affix label here

Pt ID: ___ ___ ___ ___

Namecode: ___ ___ ___ ___

Visit ID: ___ ___

STATE TRAIT ANXIETY INVENTORY

SELF-EVALUATION QUESTIONNAIRE - Form Y-1

DIRECTIONS:

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feeling best.

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I am strained	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel satisfied	1	2	3	4
9. I feel frightened	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel indecisive	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel confused	1	2	3	4
19. I feel steady	1	2	3	4
20. I feel pleasant	1	2	3	4

 STAIP-AD Test Form Y

Affix label here

Pt ID: _ _ _ _ _ _

Namecode: _ _ _ _ _ _

Visit ID: _ _ _

SELF-EVALUATION QUESTIONNAIRE - Form Y-2

DIRECTIONS:

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you *generally* feel.

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21. I feel pleasant	1	2	3	4
22. I feel nervous and restless	1	2	3	4
23. I feel satisfied with myself	1	2	3	4
24. I wish I could be as happy as others seem to be	1	2	3	4
25. I feel like a failure	1	2	3	4
26. I feel rested	1	2	3	4
27. I am "calm, cool, and collected"	1	2	3	4
28. I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
29. I worry too much over something that really doesn't matter	1	2	3	4
30. I am happy	1	2	3	4
31. I have disturbing thoughts	1	2	3	4
32. I lack self-confidence	1	2	3	4
33. I feel secure	1	2	3	4
34. I make decisions easily	1	2	3	4
35. I feel inadequate	1	2	3	4
36. I am content	1	2	3	4
37. Some unimportant thought runs through my mind and bothers me	1	2	3	4
38. I take disappointments so keenly that I can't put them out of my mind	1	2	3	4
39. I am a steady person	1	2	3	4
40. I get in a state of tension or turmoil as I think over my recent concerns and interests	1	2	3	4

 STAIP-AD Test Form Y

Affix label here

Pt ID: _ _ _ _ _ _

Namecode: _ _ _ _ _ _

Visit ID: _ _ _

SELF-EVALUATION QUESTIONNAIRE SCORING KEY (Form Y-1, Y-2)

DIRECTIONS:

To use this stencil, fold this sheet in half and line up with the appropriate test page, either Form Y-1 or Form Y-2. Simply total the scoring **weights** shown on the stencil for each response category. For example, for question #1, if the respondent marked 3, then the **weight** would be 2.

Form Y-1	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1.	4	3	2	1
2.	4	3	2	1
3.	1	2	3	4
4.	1	2	3	4
5.	4	3	2	1
6.	1	2	3	4
7.	1	2	3	4
8.	4	3	2	1
9.	1	2	3	4
10.	4	3	2	1
11.	4	3	2	1
12.	1	2	3	4
13.	1	2	3	4
14.	1	2	3	4
15.	4	3	2	1
16.	4	3	2	1
17.	1	2	3	4
18.	1	2	3	4
19.	4	3	2	1
20.	4	3	2	1

Form Y-2	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
21.	4	3	2	1
22.	1	2	3	4
23.	4	3	2	1
24.	1	2	3	4
25.	1	2	3	4
26.	4	3	2	1
27.	4	3	2	1
28.	1	2	3	4
29.	1	2	3	4
30.	4	3	2	1
31.	1	2	3	4
32.	1	2	3	4
33.	4	3	2	1
34.	4	3	2	1
35.	1	2	3	4
36.	4	3	2	1
37.	1	2	3	4
38.	1	2	3	4
39.	4	3	2	1
40.	1	2	3	4

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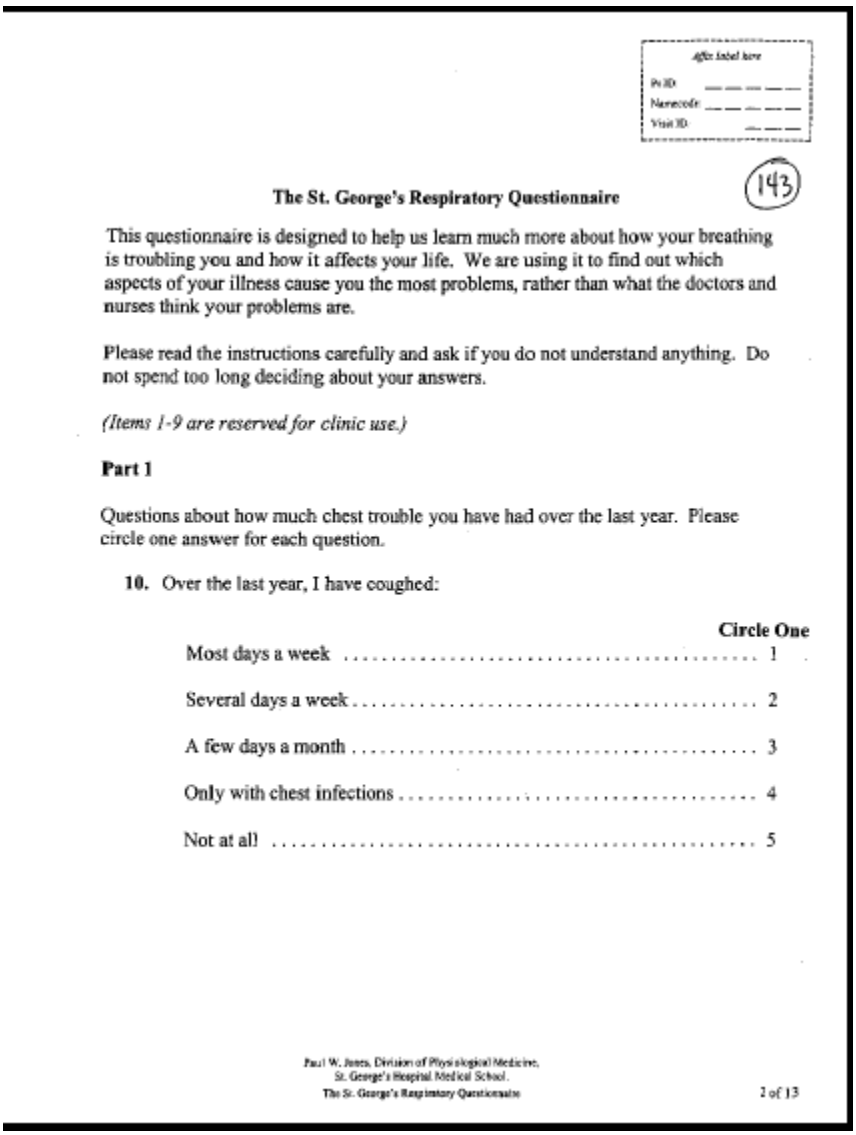
 SPAID-AD Scoring Key

E. St. George's Respiratory Questionnaire



Affix label here

Pt ID: ___ ___ ___ ___ ___

Name code: ___ ___ ___ ___ ___

Visit ID: ___ ___ ___

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The St. George's Respiratory Questionnaire

This questionnaire is designed to help us learn much more about how your breathing is troubling you and how it affects your life. We are using it to find out which aspects of your illness cause you the most problems, rather than what the doctors and nurses think your problems are.

Please read the instructions carefully and ask if you do not understand anything. Do not spend too long deciding about your answers.

(Items 1-9 are reserved for clinic use.)

Part 1

Questions about how much chest trouble you have had over the last year. Please circle one answer for each question.

10. Over the last year, I have coughed:

	Circle One
Most days a week	1
Several days a week	2
A few days a month	3
Only with chest infections	4
Not at all	5

Paul W. Jones, Division of Physiological Medicine,
St. George's Hospital Medical School.
The St. George's Respiratory Questionnaire

2 of 13

Affix label here

Pt ID: _ _ _ _ _ _

Namecode: _ _ _ _ _ _

Visit ID: _ _ _

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11. Over the last year, I have brought up phlegm (sputum):

Circle One

Most days a week 1

Several days a week 2

A few days a month 3

Only with chest infections 4

Not at all 5

12. Over the last year, I have had shortness of breath:

Most days a week 1

Several days a week 2

A few days a month 3

Only with chest infections 4

Not at all 5

Affix label here

Pt ID: _____

Namecode: _____

Visit ID: _____

(145)

13. Over the last year, I have had attacks of wheezing:

Circle One

Most days a week 1

Several days a week 2

A few days a month 3

Only with chest infections 4

Not at all 5

14. During the last year, how many severe or very unpleasant attacks of chest trouble have you had:

More than 3 attacks 1

3 attacks 2

2 attacks 3

1 attack 4

No attacks 5

Go to 16. ↵

Affix label here

Pt ID: _ _ _ _ _ _

Namecode: _ _ _ _ _ _ _

Visit ID: _ _ _ _

(146)

15. How long did the worst attack of chest trouble last:

Circle One

A week or more 1

3 or more days 2

1 or 2 days 3

Less than a day 4

16. Over the last year, in an average week, how many good days (with little chest trouble) have you had:

No good days 1

1 or 2 good days 2

3 or 4 good days 3

Nearly every day is good 4

Every day is good 5

17. If you have a wheeze, is it worse in the morning:

No 1

Yes 2

Don't have a wheeze 3

Affix label here

Pt ID: _ _ _ _ _ _ _ _

Namecode: _ _ _ _ _ _ _ _

Visit ID: _ _ _ _ _ _

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Part 2

Section I

18. How would you describe your chest condition:

	Circle One
The most important problem I have	1
Causes me quite a lot of problems	2
Causes me a few problems	3
Causes no problem	4

19. If you have ever had paid employment:

My chest trouble made me stop work	1
My chest trouble interferes/interfered with my work or made me change my work	2
My chest trouble does not/did not affect my work	3
Never had paid employment	4

Affix label here
Pt ID: _ _ _ _ _ _ _ _
Namecode: _ _ _ _ _ _ _ _
Visit ID: _ _ _ _ _

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Section 2

Questions about what activities usually make you feel breathless these days. For each item, please circle either 1 for True or 2 for False as it applies to you.

	Circle One TRUE	FALSE
20. Sitting or lying still:	1	2
21. Getting washed or dressed:	1	2
22. Walking around the home:	1	2
23. Walking outside on the level:	1	2
24. Walking up a flight of stairs:	1	2
25. Walking hills:	1	2
26. Playing sports or games:	1	2

Section 3

Some more questions about your cough and breathlessness these days. For each item, please circle either 1 for True or 2 for False as it applies to you.

	Circle One TRUE	FALSE
27. My cough hurts:	1	2
28. My cough makes me tired:	1	2

Affix label here
Pt ID:
Barcode:
Visit ID:

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	Circle One TRUE	FALSE
29. I am breathless when I talk:	1	2
30. I am breathless when I bend over:	1	2
31. My cough or breathing disturbs my sleep:	1	2
32. I get exhausted easily:	1	2

Section 4

Questions about other effects that your chest trouble may have on you these days.
For each item, please circle 1 for True or 2 for False as it applies to you.

	Circle One TRUE	FALSE
33. My cough or breathing is embarrassing in public:	1	2
34. My chest trouble is a nuisance to my family, friends, or neighbors:	1	2
35. I get afraid or panic when I cannot get my breath:	1	2
36. I feel that I am not in control of my chest problem:	1	2
37. I do not expect my chest to get any better:	1	2
38. I have become frail or an invalid because of my chest:	1	2

Affix label here
Pt ID:
Namecode:
Visit ID:

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	Circle One TRUE	FALSE
39. Exercise is not safe for me:	1	2
40. Everything seems too much of an effort:	1	2

Section 5

	YES	NO
41a. Do you take any medications:	1	2
		Go to 45.

Questions about your medication. To complete this section, please circle either 1 for True or 2 for False as it applies to you.

	Circle One TRUE	FALSE
41. My medication does not help me very much:	1	2
42. I get embarrassed using my medication in public:	1	2
43. I have unpleasant side effects from my medication:	1	2
44. My medication interferes with my life a lot:	1	2

Affix label here

Pt ID: _ _ _ _ _ _ _ _

Namecode: _ _ _ _ _ _ _ _

Visit ID: _ _ _ _ _ _

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Section 6

These are questions about how your activities might be affected by your breathing. For each question, please circle 1 for True if one or more parts applies to you because of your breathing. Otherwise, circle 2 for False.

		Circle One TRUE	FALSE
45.	I take a long time to get washed or dressed:	1	2
46.	I cannot take a bath or shower, or I take a long time:	1	2
47.	I walk slower than other people, or I stop for rests:	1	2
48.	Jobs such as housework take a long time, or I have to stop for rests:	1	2
49.	If I walk up one flight of stairs, I have to go slowly or stop:	1	2
50.	If I hurry or walk fast, I have to stop or slow down:	1	2
51.	My breathing makes it difficult to do things such as walk up hills, carrying things up stairs, light gardening such as weeding, dance, play bowls, or play golf:	1	2
52.	My breathing makes it difficult to do things such as carry heavy loads, dig the garden or shovel snow, jog or walk at 5 miles per hour, play tennis or swim:	1	2
53.	My breathing makes it difficult to do things such as very heavy manual work, run, cycle, swim fast or play competitive sports:	1	2

Affix label here
PAID: _ _ _ _ _ _ _
Barcode: _ _ _ _ _ _ _
Visit ID: _ _ _ _

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Section 7

We would like to know how your chest trouble usually affects your daily life. Please circle either 1 for True or 2 for False as it applies to you because of your chest trouble. (Remember that True only applies to you if you can not do something because of your breathing.)

	Circle One TRUE	FALSE
54. I cannot play sports or games:	1	2
55. I cannot go out for entertainment or recreation:	1	2
56. I cannot go out of the house to do the shopping:	1	2
57. I cannot do housework:	1	2
58. I cannot move far from my bed or chair:	1	2

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Here is a list of other activities that your chest trouble may prevent you doing. (You do not have to circle these, they are just to remind you of ways in which your breathlessness may affect you):

Going for walks or walking the dog

Doing things at home or in the garden

Sexual intercourse

Going out to church, or place of entertainment

Going out in bad weather or into smoky rooms

Visiting family or friends or playing with children

Please write in any other important activities that your chest trouble may stop you doing:

Affix label here

Pt ID: _ _ _ _ _ _ _ _

Namecode: _ _ _ _ _ _ _ _

Visit ID: _ _ _ _

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59. Now, would you circle (one only) which you think best describes how your chest affects you:

	Circle One
It does not stop me doing anything I would like to do	1
It stops me doing one or two things I would like to do	2
It stops me doing most of the things I would like to do	3
It stops me doing everything I would like to do	4

60. Date completed:

_____

Please bring this completed questionnaire with your to your scheduled NETT clinic visit.

F.

Table. F1.

Coefficients (β), t-values, and p-values for Demographic Characteristics and the Frailty Indicators as Predictor of Health Related Quality of Life in Final Model at 6 months post randomization (n=496)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	60.399		9.217	.000
Age	-.173	-.124	-3.097	.002
Race	1.052	.017	.450	.653
Income	-.057	-.004	-.089	.929
Marital status	.938	.032	.732	.465
Education	-1.552	-.087	-2.110	.035
Gender	4.466	.152	3.492	.001
Nutrition	-.202	-.053	-1.341	.181
Endurance	-.121	-.197	-4.472	<.001
Balance	4.935	.090	2.306	.022
Mobility	10.463	.334	8.207	<.001
Vision	-2.032	-.037	-.973	.331
Hearing	2.327	.072	1.861	.064
Coping	7.441	.226	5.474	<.001
Anxiety	.020	.015	.274	.784
Depression	.500	.209	3.853	<.001

Table F2.

Model Summary at 6 months post randomization (*n*=496)

Model	R^2	*F* for change in R^2	*p*
Model 1	.034	2.374	.029*
Model 2	.319	28.202	<.001**
Model 3	.438	28.260	<.001**.

**$p < .001$, *$p < .05$

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, nutrition, endurance, balance, mobility, vision, and hearing.
c. Model 3 includes: age, gender, race, marital status, education, income, nutrition, endurance, balance, mobility, vision, hearing, depression, anxiety and coping.

Table. F3.

Coefficients (β), t-values, and p-values for Demographic Characteristics and the Frailty Indicators as Predictor of Health Related Quality of Life in Final Model at 12 months post randomization (n=428)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	64.309		8.375	.000
Age	-.184	-.134	-2.775	.006
Race	1.934	.032	.698	.486
Income	-.056	-.004	-.074	.941
Marital status	-.338	-.012	-.222	.824
Education	-1.640	-.094	-1.893	.059
Gender	3.129	.108	2.007	.046
Nutrition	-.251	-.066	-1.412	.159
Endurance	-.111	-.188	-3.448	.001
Balance	5.859	.118	2.563	.011
Mobility	10.264	.307	6.180	<.001
Vision	-4.421	-.088	-1.923	.055
Hearing	2.728	.087	1.856	.064
Coping	7.818	.237	4.860	<.001
Cognition	.044	.049	1.021	.308
Anxiety	-.061	-.046	-.722	.471
Depression	.444	.188	2.956	.003

Table F4.

Model Summary at 12 months post randomization (n=428)

Model	R^2	*F* for change in R^2	*p*
Model 1	.042	2.242	.039*
Model 2	.307	19.266	<.001**
Model 3	.399	11.370	<.001**

**$p < .001$, *$p < .05$

a. Model 1 includes: age, gender, race, marital status, education, and income.

b. Model 2 includes: age, gender, race, marital status, education, income, nutrition, endurance, balance, mobility, vision, and hearing.

c. Model 3 includes: age, gender, race, marital status, education, income, nutrition, endurance, balance, mobility, vision, hearing, cognition, depression, anxiety and coping.

Table. F5.

Coefficients (β), t-values, and p-values for Demographic Characteristics and the Frailty Indicators Predictor of Health Related Quality of Life in Final Model at 24 months post randomization (n=349)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	52.007		5.194	.000
Age	-.051	-.036	-.606	.545
Race	5.460	.089	1.560	.120
Income	.024	.002	.026	.979
Marital status	1.033	.034	.543	.587
Education	-2.406	-.134	-2.263	.025
Gender	3.017	.101	1.618	.107
Nutrition	-.126	-.032	-.560	.576
Endurance	-.107	-.172	-2.643	.009
Balance	1.815	.039	.688	.492
Mobility	11.209	.340	5.875	<.001
Vision	2.099	.040	.719	.473
Hearing	1.127	.036	.629	.530
Coping	8.503	.254	4.277	<.001
Cognition	.039	.039	.673	.502
Anxiety	-.164	-.120	-1.519	.130
Depression	.579	.239	3.077	.002

Table F6.

Model Summary at 24 months post randomization (n=349)

Model	R^2	*F* for change in R^2	*p*
Model 1	.033	1.298	.259
Model 2	.258	11.317	<.001**
Model 3	.356	8.383	<.001**

**$p < .001$, *$p < .05$

a. Model 1 includes: age, gender, race, marital status, education, and income.

b. Model 2 includes: age, gender, race, marital status, education, income, nutrition, endurance, balance, mobility, vision, and hearing.

c. Model 3 includes: age, gender, race, marital status, education, income, nutrition, endurance, balance, mobility, vision, hearing, cognition, depression, anxiety and coping.

Table. F7

Coefficients (β), t-values, and p-values for Demographic Characteristics and the Frailty Indicators Predictor of Health Related Quality of Life in Final Model at 36 months post randomization (n=215)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	28.187		2.190	.030
Age	.165	.112	1.547	.124
Race	5.245	.082	1.193	.235
Income	-.803	-.054	-.675	.501
Marital status	-.324	-.010	-.135	.893
Education	-2.280	-.122	-1.650	.102
Gender	4.756	.154	1.934	.055
Nutrition	.061	.016	.215	.830
Endurance	-.094	-.155	-1.864	.065
Balance	-.286	-.007	-.095	.924
Mobility	13.969	.421	5.560	<.001
Vision	.138	.003	.047	.963
Hearing	-1.786	-.055	-.768	.444
Coping	9.963	.302	4.056	<.001
Cognition	.112	.113	1.630	.106
Anxiety	-.013	-.009	-.096	.923
Depression	.201	.080	.824	.412

Table F8. Model Summary at 36 months post randomization (n=215)

Model	R^2	F for change in R^2	p
Model 1	.032	.714	.639
Model 2	.367	11.052	<.001**
Model 3	.473	6.057	<.001**

**p < .001, *p < .05

a. Model 1 includes: age, gender, race, marital status, education, and income.

b. Model 2 includes: age, gender, race, marital status, education, income, nutrition, endurance, balance, mobility, vision, and hearing.

c. Model 3 includes: age, gender, race, marital status, education, income, nutrition, endurance, balance, mobility, vision, hearing, cognition, depression, anxiety and coping.

F.

Table G1.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of overnight stays (hospital, acute care facility, rehabilitation hospital, nursing home, or non-acute care facility) at 6 months post randomization (n=401)

Model	R^2	*F* for change in R^2	*p*
Model 1	.009	.615	.718
Model 2	.032	1.917	.090
Model 3	.041	.658	.683
Model 4	.049	1.131	.336

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table G2.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of overnight stays (hospital, acute care facility, rehabilitation hospital, nursing home, or non-acute care facility) in final model at 6 months post randomization (n=401)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	1.814		2.890	.004
Age	-.009	-.091	-1.436	.152
Race	.126	.052	1.010	.313
Income	-.004	-.007	-.119	.906
Marital status	-.033	-.028	-.487	.627
Education	-.035	-.050	-.899	.369
Gender	.069	.059	.839	.402
FEV_1 (PBD)	-.007	-.088	-1.175	.241
TLC (PBD)	.003	.086	.942	.347
RV (PBD)	-.003	-.239	-2.052	.041
PaO_2 (RA)	-.004	-.072	-1.378	.169
Smoking (PY)	-.001	-.053	-1.007	.315
Nutrition	-.009	-.056	-1.039	.299
Endurance	-.003	-.104	-1.527	.128
Balance	.043	.019	.379	.705
Mobility	-.034	-.027	-.512	.609

Vision	-.045	-.020	-.404	.686
Hearing	.033	.025	.493	.622
Coping	.026	.019	.357	.722
Anxiety	-.006	-.111	-1.563	.119
Depression	.011	.119	1.669	.096

PBD = post bronchodilator, PY=pack years, RA = room air

Table G3.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of overnight stays (hospital, acute care facility, rehabilitation hospital, nursing home, or non-acute care facility) at 12 months post randomization (n=289)

Model	R^2	*F* for change in R^2	*p*
Model 1	.034	1.806	.098
Model 2	.057	1.241	.285
Model 3	.078	1.085	.372
Model 4	.080	.190	.943

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table G4.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of overnight stays (hospital, acute care facility, rehabilitation hospital, nursing home, or non-acute care facility) in final model at 12 months post randomization (n=289)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	1.710		1.987	.048
Age	-.006	-.051	-.693	.489
Race	-.177	-.059	-1.003	.316
Income	.048	.068	.999	.319
Marital status	-.039	-.027	-.404	.687
Education	-.107	-.122	-1.932	.054
Gender	-.074	-.052	-.570	.569
FEV_1 (PBD)	-.005	-.060	-.693	.489
TLC (PBD)	-.003	-.061	-.554	.580
RV (PBD)	.000	-.025	-.168	.867
PaO_2 (RA)	-.005	-.087	-1.265	.207
DLCO (PBD)	.005	.072	.984	.326
Smoking (PY)	-.001	-.065	-1.075	.283
Nutrition	.008	.042	.663	.508
Endurance	-.003	-.108	-1.223	.222
Balance	.279	.113	1.942	.053

Mobility	-.046	-.027	-.434	.664
Vision	.066	.026	.452	.652
Hearing	.069	.044	.752	.453
Coping	-.022	-.014	-.220	.826
Cognition	.002	.045	.737	.461
Anxiety	.002	.029	.360	.719
Depression	-.004	-.031	-.390	.697

PBD = post bronchodilator, PY=pack years, RA = room air

Table G5.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of overnight stays (hospital, acute care facility, rehabilitation hospital, nursing home, or non-acute care facility) at 24 months post randomization (n=223)

Model	R^2	*F* for change in R^2	*p*
Model 1	.019	.751	.609
Model 2	.056	1.751	.124
Model 3	.127	2.977	.008
Model 4	.136	.525	.718

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table G6.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of overnight stays (hospital, acute care facility, rehabilitation hospital, nursing home, or non-acute care facility) in final model at 24 months post randomization (n=223)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	2.376		2.565	.011
Age	-.019	-.166	-1.950	.053
Race	-.047	-.016	-.236	.814
Income	-.063	-.093	-1.205	.230
Marital status	.138	.098	1.304	.194
Education	.047	.056	.792	.429
Gender	-.091	-.065	-.674	.501
FEV_1 (PBD)	.000	.003	.028	.977
TLC (PBD)	-.004	-.094	-.722	.471
RV (PBD)	.000	-.009	-.053	.958
PaO_2 (RA)	-.003	-.039	-.545	.586
Smoking (PY)	.003	.136	1.974	.050
Nutrition	-.010	-.055	-.798	.426
Endurance	-.003	-.102	-1.137	.257
Balance	.512	.232	3.412	.001
Mobility	-.064	-.041	-.594	.553

Vision	.285	.115	1.743	.083
Hearing	.079	.053	.781	.436
Coping	-.099	-.063	-.887	.376
Cognition	.002	.045	.647	.518
Anxiety	.003	.041	.437	.663
Depression	-.009	-.079	-.867	.387

PBD = post bronchodilator, PY=pack years, RA = room air

Table G7.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of overnight stays (hospital, acute care facility, rehabilitation hospital, nursing home, or non-acute care facility) at 36 months post randomization (n=126)

Model	R^2	*F* for change in R^2	*p*
Model 1	.042	.927	.478
Model 2	.068	.707	.619
Model 3	.102	.727	.629
Model 4	.132	.969	.427

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table. G8.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of overnight stays (hospital, acute care facility, rehabilitation hospital, nursing home, or non-acute care facility) in final model at 36 months post randomization (n=126)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	1.896		2.024	.045
Age	-.016	-.195	-1.790	.076
Race	.186	.093	.991	.324
Income	.065	.141	1.314	.191
Marital status	-.123	-.127	-1.232	.220
Education	-.026	-.044	-.438	.662
Gender	-.004	-.004	-.033	.974
FEV_1 (PBD)	.007	.128	.998	.320
TLC (PBD)	-.006	-.198	-1.230	.221
RV (PBD)	.001	.068	.342	.733
PaO_2 (RA)	-.002	-.045	-.455	.650
Smoking (PY)	.000	-.025	-.258	.797
Nutrition	-.016	-.133	-1.276	.204
Endurance	.001	.077	.625	.533
Balance	-.003	-.002	-.022	.983
Mobility	.016	.015	.146	.884

Vision	-.006	-.004	-.044	.965
Hearing	.119	.118	1.193	.235
Coping	.149	.145	1.439	.153
Cognition	000	-.002	-.018	.986
Anxiety	.001	.013	.101	.920
Depression	-.014	-.174	-1.325	.188

PBD = post bronchodilator, PY=pack years, RA = room air

G.

Table H1.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of visits to an emergency room (including triage and urgent care) or visits to a health care provider (physician, physician's assistant, nurse) at 6 months post randomization (n=401)

Model	R^2	*F* for change in R^2	*p*
Model 1	.008	.581	.745
Model 2	.023	1.166	.325
Model 3	.070	3.376	.003
Model 4	.073	.495	.686

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table H2.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of visits to an emergency room (including triage and urgent care) or visits to a health care provider (physician, physician's assistant, nurse) in final model at 6 months post randomization (n=401)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	.985		1.828	.068
Age	-.005	-.055	-.889	.374
Race	.021	.010	.197	.844
Income	.030	.061	1.038	.300
Marital status	-.064	-.062	-1.102	.271
Education	-.025	-.040	-.741	.459
Gender	.053	.051	.745	.457
FEV_1 (PBD)	.011	.171	2.322	.021
TLC (PBD)	-.004	-.125	-1.397	.163
RV (PBD)	.001	.145	1.264	.207
PaO_2 (RA)	.002	.048	.924	.356
Smoking (PY)	.001	.058	1.125	.261
Nutrition	-.001	-.008	-.152	.880
Endurance	-.005	-.231	-3.436	.001
Balance	.097	.050	.998	.319
Mobility	.096	.088	1.663	.097

Vision	.029	.015	.303	.762
Hearing	.023	.021	.406	.685
Coping	-.028	-.024	-.447	.655
Anxiety	.004	.082	1.177	.240
Depression	-.004	-.046	-.654	.513

PBD = post bronchodilator, PY=pack years, RA = room air

Table H3.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of visits to an emergency room (including triage and urgent care) or visits to a health care provider (physician, physician's assistant, nurse) at 12 months post randomization (n=289)

Model	R^2	*F* for change in R^2	*p*
Model 1	.022	1.161	.327
Model 2	.047	1.331	.243
Model 3	.060	.691	.657
Model 4	.069	.638	.636

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table H4.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of visits to an emergency room (including triage and urgent care) or visits to a health care provider (physician, physician's assistant, nurse) in final model at 12 months post randomization (n=289)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	1.161		1.791	.074
Age	.001	.006	.080	.936
Race	-.047	-.021	-.357	.721
Income	-.078	-.150	-2.172	.031
Marital status	.137	.126	1.892	.060
Education	.038	.058	.904	.367
Gender	-.024	-.022	-.239	.811
FEV_1 (PBD)	.006	.102	1.167	.244
TLC (PBD)	-.002	-.070	-.630	.529
RV (PBD)	.000	.009	.061	.951
PaO_2 (RA)	-.007	-.143	-2.069	.039
DLCO (PBD)	.004	.072	.982	.327
Smoking (PY)	.000	-.017	-.282	.778
Nutrition	.004	.028	.436	.663
Endurance	-.001	-.036	-.412	.681
Balance	.101	.055	.934	.351

Mobility	.047	.038	.594	.553
Vision	-.033	-.018	-.302	.763
Hearing	.077	.066	1.115	.266
Coping	-.039	-.032	-.510	.610
Cognition	.002	.072	1.181	.239
Anxiety	.001	.027	.338	.736
Depression	.003	.039	.488	.626

PBD = post bronchodilator, PY=pack years, RA = room air

Table H5.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of visits to an emergency room (including triage and urgent care) or visits to a health care provider (physician, physician's assistant, nurse) at 24 months post randomization (n=223)

Model	R^2	*F* for change in R^2	*p*
Model 1	.012	.454	.842
Model 2	.027	.711	.615
Model 3	.052	.964	.450
Model 4	.064	.703	.591

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table H6.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of visits to an emergency room (including triage and urgent care) or visits to a health care provider (physician, physician's assistant, nurse) in final model at 24 months post randomization (n=223)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	1.173		1.518	.130
Age	-.001	-.014	-.154	.878
Race	-.040	-.017	-.241	.810
Income	.022	.041	.512	.609
Marital status	.034	.030	.387	.699
Education	.003	.005	.068	.946
Gender	-.027	-.024	-.238	.812
FEV_1 (PBD)	.001	.020	.197	.844
TLC (PBD)	-.001	-.015	-.110	.912
RV (PBD)	-.001	-.114	-.640	.523
PaO_2 (RA)	.000	-.005	-.067	.947
Smoking (PY)	.001	.041	.572	.568
Nutrition	.003	.022	.302	.763
Endurance	-.002	-.090	-.958	.339
Balance	.139	.079	1.112	.268
Mobility	-.017	-.013	-.187	.852

Vision	.151	.076	1.111	.268
Hearing	.060	.051	.719	.473
Coping	.101	.080	1.088	.278
Cognition	.003	.082	1.138	.256
Anxiety	-.003	-.049	-.510	.611
Depression	.003	.030	.314	.754

PBD = post bronchodilator, PY=pack years, RA = room air

Table H7.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of visits to an emergency room (including triage and urgent care) or visits to a health care provider (physician, physician's assistant, nurse) at 36 months post randomization (n=126)

Model	R^2	*F* for change in R^2	*p*
Model 1	.014	.313	.929
Model 2	.059	1.152	.337
Model 3	.086	.578	.747
Model 4	.117	1.019	.401

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table H8.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of visits to an emergency room (including triage and urgent care) or visits to a health care provider (physician, physician's assistant, nurse) in final model at 36 months post randomization (n=126)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	1.292		1.366	.175
Age	-.003	-.032	-.293	.770
Race	.058	.029	.307	.759
Income	.033	.072	.666	.507
Marital status	-.109	-.112	-1.078	.283
Education	-.034	-.058	-.577	.565
Gender	.025	.026	.207	.837
FEV_1 (PBD)	.008	.157	1.215	.227
TLC (PBD)	-.003	-.083	-.515	.608
RV (PBD)	.000	.003	.017	.986
PaO_2 (RA)	.006	.142	1.428	.156
Smoking (PY)	.000	-.017	-.176	.860
Nutrition	-.006	-.053	-.506	.614
Endurance	-.003	-.151	-1.211	.228
Balance	.029	.022	.225	.823
Mobility	.032	.031	.298	.766

Vision	-.054	-.040	-.418	.676
Hearing	.036	.036	.361	.719
Coping	.076	.074	.724	.471
Cognition	.000	-.015	-.159	.874
Anxiety	-.009	-.210	-1.632	.106
Depression	.017	.216	1.637	.104

PBD = post bronchodilator, PY=pack years, RA = room air

H.

Table I1.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of home visits by a health care provider (home health agency nurse, physical therapist, occupational therapist) or health care service worker (aide/attendant, health equipment) at 6 months post randomization (n=401)

Model	R^2	*F* for change in R^2	*p*
Model 1	.004	.266	.953
Model 2	.146	13.476	<.001
Model 3	.150	.286	.944
Model 4	.155	.812	.488

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, anxiety, and depression.

PBD = post bronchodilator, PY=pack years, RA = room air

Table I2.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of home visits by a health care provider (home health agency nurse, physical therapist, occupational therapist) or health care service worker (aide/attendant, health equipment technician) in final model at 6 months post randomization (n=401)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	3.144		2.762	.006
Age	.001	.005	.091	.928
Race	-.190	-.040	-.841	.401
Income	.002	.001	.025	.980
Marital status	.024	.011	.198	.843
Education	.108	.079	1.507	.133
Gender	-.143	-.063	-.956	.340
FEV_1 (PBD)	-.020	-.137	-1.949	.052
TLC (PBD)	.000	.006	.065	.949
RV (PBD)	.000	-.001	-.013	.989
PaO_2 (RA)	-.032	-.305	-6.174	<.001
Smoking (PY)	.004	.120	2.442	.015
Nutrition	-.002	-.007	-.142	.887
Endurance	-.002	-.038	-.587	.557
Balance	.199	.047	.974	.331

Mobility	.076	.032	.624	.533
Vision	-.011	-.003	-.057	.955
Hearing	.032	.013	.264	.792
Coping	-.133	-.052	-1.014	.311
Anxiety	.007	.069	1.031	.303
Depression	-.012	-.067	-1.006	.315

PBD = post bronchodilator, PY=pack years, RA = room air

Table I3.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of home visits by a health care provider (home health agency nurse, physical therapist, occupational therapist) or health care service worker (aide/attendant, health equipment technician) at 12 months post randomization (n=289)

Model	R^2	*F* for change in R^2	*p*
Model 1	.007	.377	.893
Model 2	.262	17.408	<.001
Model 3	.281	1.266	.273
Model 4	.292	1.123	.346

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), DLCO % predicted (PDB), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table I4.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of home visits by a health care provider (home health agency nurse, physical therapist, occupational therapist) or health care service worker (aide/attendant, health equipment technician) in final model at 12 months post randomization (n=289)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	2.920		2.443	.015
Age	-.003	-.018	-.269	.788
Race	-.157	-.033	-.643	.521
Income	.061	.055	.921	.358
Marital status	.014	.006	.103	.918
Education	-.049	-.035	-.638	.524
Gender	.191	.083	1.052	.294
FEV_1 (PBD)	-.014	-.108	-1.427	.155
TLC (PBD)	.020	.269	2.776	.006
RV (PBD)	-.005	-.223	-1.732	.084
PaO_2 (RA)	-.033	-.334	-5.561	<.001
DLCO (PBD)	-.020	-.179	-2.791	.006
Smoking (PY)	.001	.029	.543	.587
Nutrition	.022	.074	1.322	.187
Endurance	-.007	-.146	-1.888	.060

Balance	.084	.022	.422	.674
Mobility	.018	.007	.123	.902
Vision	.032	.008	.157	.875
Hearing	.199	.081	1.556	.121
Coping	-.045	-.017	-.317	.751
Cognition	-.006	-.088	-1.646	.101
Anxiety	-.008	-.073	-1.027	.305
Depression	.006	.033	.476	.635

PBD = post bronchodilator, PY=pack years, RA = room air

Table I5.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of home visits by a health care provider (home health agency nurse, physical therapist, occupational therapist) or health care service worker (aide/attendant, health equipment) at 24 months post randomization (n=223)

Model	R^2	*F* for change in R^2	*p*
Model 1	.019	.726	.629
Model 2	.219	11.553	<.001
Model 3	.276	2.844	.011
Model 4	.287	.878	.478

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table I6.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of home visits by a health care provider (home health agency nurse, physical therapist, occupational therapist) or health care service worker (aide/attendant, health equipment technician) in final model at 24 months post randomization (n=223)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	5.215		4.554	.000
Age	-.014	-.125	-1.644	.102
Race	.340	.072	1.153	.250
Income	.074	.067	.964	.336
Marital status	.017	.007	.107	.915
Education	-.126	-.091	-1.440	.151
Gender	.165	.072	.830	.408
FEV_1 (PBD)	-.015	-.121	-1.378	.170
TLC (PBD)	.010	.132	1.115	.266
RV (PBD)	-.003	-.133	-.855	.394
PaO_2 (RA)	-.036	-.335	-5.197	<.001
Smoking (PY)	.000	-.011	-.175	.861
Nutrition	-.042	-.140	-2.243	.026
Endurance	-.010	-.209	-2.549	.011
Balance	.233	.065	1.051	.294

Mobility	-.112	-.044	-.706	.481
Vision	.462	.115	1.917	.057
Hearing	-.103	-.043	-.687	.493
Coping	-.069	-.027	-.422	.674
Cognition	.004	.055	.904	.367
Anxiety	-.008	-.080	-.953	.342
Depression	.023	.124	1.495	.136

PBD = post bronchodilator, PY=pack years, RA = room air

Table I7.

Model Summary for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of home visits by a health care provider (home health agency nurse, physical therapist, occupational therapist) or health care service worker (aide/attendant, health equipment) at 36 months post randomization (n=126)

Model	R^2	*F* for change in R^2	*p*
Model 1	.004	.083	.998
Model 2	.261	8.537	<.001
Model 3	.379	3.716	.002
Model 4	.385	.288	.885

a. Model 1 includes: age, gender, race, marital status, education, and income.
b. Model 2 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), and RV % predicted (PBD).
c. Model 3 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, and endurance.
d. Model 4 includes: age, gender, race, marital status, education, income, TLC % predicted (PBD), smoking history (PY), PaO2 (RA), FEV1 % predicted (PBD), RV % predicted (PBD) vision, mobility, balance, hearing, nutrition, endurance, coping, cognition, anxiety, and depression.
PBD = post bronchodilator, PY=pack years, RA = room air

Table I8.

Coefficients (β), t-values, and p-values for Demographic Characteristics, Clinical Characteristics, and Frailty Indicators as predictors of number of home visits by a health care provider (home health agency nurse, physical therapist, occupational therapist) or health care service worker (aide/attendant, health equipment technician) in final model at 36 months post randomization (n=126)

Indicators	*B*	*β*	*t*-value	*p*-value
(Intercept)	5.792		3.070	.003
Age	-.022	-.113	-1.231	.221
Race	.289	.061	.766	.445
Income	-.002	-.002	-.019	.985
Marital status	.120	.052	.598	.551
Education	-.048	-.034	-.405	.686
Gender	.520	.225	2.136	.035
FEV_1 (PBD)	-.026	-.212	-1.961	.052
TLC (PBD)	.018	.242	1.790	.076
RV (PBD)	-.010	-.396	-2.365	.020
PaO_2 (RA)	-.034	-.350	-4.225	<.001
Smoking (PY)	-.001	-.026	-.317	.752
Nutrition	-.012	-.043	-.485	.629
Endurance	-.017	-.376	-3.628	<.001
Balance	.403	.126	1.554	.123

Mobility	-.015	-.006	-.068	.946
Vision	.163	.051	.637	.526
Hearing	.071	.029	.354	.724
Coping	.134	.055	.643	.522
Cognition	.000	-.006	-.074	.941
Anxiety	-.009	-.086	-.803	.423
Depression	.002	.012	.106	.916

PBD = post bronchodilator, PY=pack years, RA = room air

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