Chapter 10
Health Disparities in Chronic Obstructive Pulmonary Disease

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Key Points

- Clinicians are more likely to diagnose women who have COPD as having asthma.
- Women may be more susceptible to developing COPD.
- In the US, more women report diagnosed COPD than do men, but more men have spirometric evidence of COPD.
- COPD is more likely to develop in poorer populations.
- Research funding for COPD is much less than funding for other chronic diseases relative to the number of annual deaths.
- COPD is perceived differently from other chronic diseases as one where the patients "brought this disease on themselves."

Introduction

Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity, mortality, and disability worldwide [1]. COPD is the fourth leading cause of death in the world and, as of 2010, the third leading cause of death in the U.S. The leading

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cause of COPD in the developed world is tobacco smoking, although an increasing proportion of COPD is being seen among never smokers [2]. While tobacco smoking remains an important risk factor in the developing world, other factors, such as exposure to biomass smoke and early life respiratory infections, are also important.

Disparities are central to understanding the epidemiology and outcomes of COPD. These run the gamut from disparities in who develops disease to disparities in outcomes to disparities in how COPD is perceived and how COPD-related research is funded. This review will examine a number of key disparities in COPD, along with a vision of how these disparities could be addressed in the future.

Disparities in Diagnosis

U.S. and international guidelines define COPD as a chronic respiratory condition with persistent airflow obstruction that is usually progressive and associated with an inflammatory response in the airways and lung parenchyma due to noxious particle or gases. Evidence of airflow obstruction following use of bronchodilators is required to diagnose persistent airflow obstruction. How COPD is defined and diagnosed is a core disparity important to understanding how COPD affects populations. There are several different components to disparities in COPD diagnosis: how COPD is defined in different areas, how COPD is diagnosed in different settings, and the likelihood of receiving a COPD diagnosis in different populations.

The precise definition of COPD can vary based on local practices and physician preference. In many settings, particularly in primary care, spirometry may not be part of the routine diagnostic paradigm for COPD [3, 4]. Even when spirometry is done, interpretation may not be uniform. For example, clinicians and pulmonary function laboratories can choose from a number of different prediction equations to be used to classify patients as normal or abnormal [5]. These prediction equations can be derived locally or from national or international consortia. A potential problem is that different prediction equations have the potential to classify the same patient as abnormal or abnormal, particularly when the degree of impairment is mild. Even when using the same prediction equation, a single spirometry can be classified differently based on which specific definition is used. For example, using a lower limit of normal approach (postbronchodilator FEV_1/FVC less than lower limit of normal) to classify obstruction will classify fewer older patients as abnormal than the fixed ratio (e.g., postbronchodilator FEV_1/FVC <70 %) approach [6].

Another component of diagnostic disparities is how COPD is actually diagnosed. In many settings, COPD is being diagnosed based on history and symptoms, in the absence of any objective data. A study by Celli et al. [7] showed that in a population of veterans with a COPD diagnosis, only 31 % of patients had evidence of spirometry. This is in contrast to congestive heart failure, where in that same study 78 % of patients had an echocardiogram. The converse of this problem is the finding in multiple studies that among people with spirometric evidence of COPD, only 27 % have been given a clinical diagnosis of COPD [8].

A final component of diagnostic disparities relates to how clinicians may differ in how they diagnose COPD based on other patient factors. A classic example of this disparity is a study by Chapman et al. that presented patient histories to clinicians and varied the sex of the case presented [9]. They found that clinicians were more likely to diagnose men with COPD and women with asthma. This study was replicated by Miravitlles in Spain and showed that this diagnostic bias persisted but was less than what was previously seen [10].

Disparities in Prevalence

The most recent U.S. prevalence rates of COPD are discussed in the CDC's COPD Surveillance-United States, 1999–2011, which presents prevalence data from two surveys [11]. The first is the 2011 Behavioral Risk Factor Surveillance System (BRFSS). This telephone-based survey collected data using patient report of physician-diagnosed COPD with the question: "Have you ever been told by a doctor or other health professional that you have COPD, emphysema, or bronchitis?" Data from 475,616 respondents at least 25 years of age across all U.S. states and the District of Columbia were presented. The age-adjusted prevalence of COPD based on this measure was 6.5 % or 13,724,000 people [11].

The second data source for patient-reported physician-diagnosed COPD is the National Health Interview Survey (NHIS). The following questions were used: "Have you ever been told by a doctor or other health professional that you had emphysema?" and "During the past 12 months, have you been told by a doctor or other health professional that you had chronic bronchitis?" There were 33,014 respondents and the total 2011 national age-adjusted prevalence of COPD based on this measure was 5.7 % [11]. Note that the NHIS did not ask specifically about "COPD," which may explain the lower estimate (5.7 % vs. 6.5 %).

A problem with patient-reported COPD, which typically depends on a health care provider diagnosis, is that it is highly variable and may not be reliable [12]. This led to the development of more standardized means of assessing COPD, as shown by the Burden of Lung Disease (BOLD) study, which used spirometry to provide an estimate for the COPD burden in the population [13]. Estimates of prevalence based on patient-reported prevalence may differ when compared to estimates based on spirometry. For example, the US estimate of obstructive lung disease from the National Health and Nutrition Examination Survey (NHANES) 2007–2010 was 13.5 % for all levels of obstruction and 6.5 % for moderate to severe obstruction [14].

Differences in the prevalence of one or more risk factors for COPD in the study population also contribute to differences in the observed prevalence of COPD prevalence across studies. While cigarette smoking is a key risk factor for COPD [15], genetic, physiological, social, and environmental factors also contribute to COPD. This multiple risk factor model may help to explain some of the differences in prevalence between men and women, socioeconomic groups, and race/ethnic groups.

Gender Differences

Gender differences in COPD have been the focus of a recent review [16]. In the international BOLD study, COPD prevalence (based on spirometry) was higher in men in most countries [13]. This contrasts with the prevalence of patient-reported physician-diagnosed COPD, which in the US has been consistently 20–40 % higher among women. The 2011 BRFSS data reported by the CDC [11] showed a higher prevalence rate of COPD in women at 7.3 % compared to men at 5.7 %. There was an estimated 2,516,000 more women with COPD than men. Similarly, over the period 1999–2011, women consistently reported more physician-diagnosed COPD than men (Fig. 10.1) [11]. In contrast to patient-reported physician-diagnosed COPD, estimates of COPD using objective spirometric data from the NHANES 2007–2010 have found a higher prevalence of COPD in men (16.8 % vs. 10.4 % in women) [14]. The reasons for this discrepancy is not clear but could be related to gender differences in how men and women access the health care system (and therefore have the opportunity to be diagnosed with COPD).

There may be gender differences in the development of early onset COPD. In the COPDGene study, 66 % of subjects with severe early onset COPD were female, whereas only 43 % of older subjects with severe COPD were female [17]. Furthermore, females with COPD were 3.1 times more likely than males with COPD to have a severe early onset diagnosis.

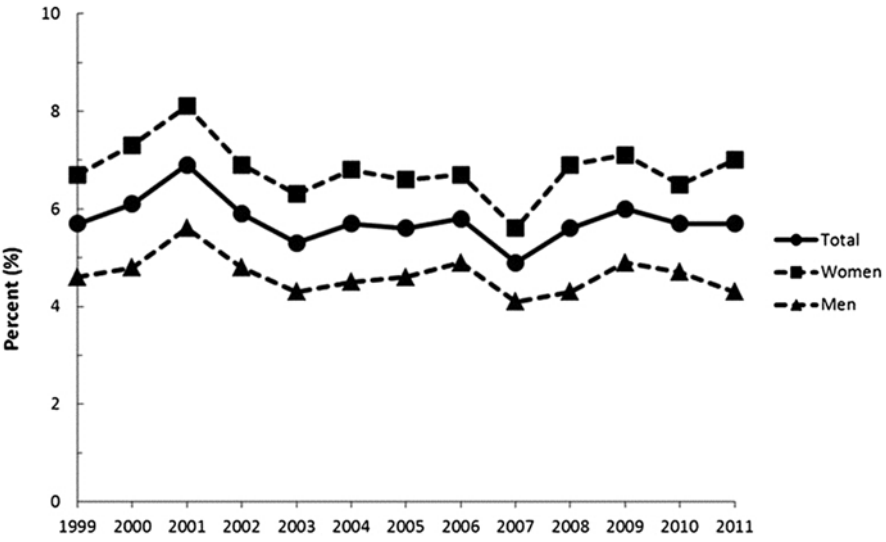

Fig. 10.1 Age-adjusted prevalence (%) of self-reported physician-diagnosed COPD among adults ≥25 years, by sex and year—United States, National Health Interview Survey, 1999–2011 [11]

Racial/Ethnic Differences

Data from the US have shown dramatic differences in COPD prevalence in different racial and ethnic groups, ranging from a low of 2.5 % in Asian/Pacific Islanders to 11.0 % in American Indian/Alaskan Natives [11] (Fig. 10.2). This can be contrasted with spirometrically determined COPD from NHANES 2007–2010 data, where 15.3 % of whites, 10.7 % of blacks, 6.3 % of Mexican-Americans, and 9.7 % of people of other races had evidence of COPD [14].

Recent data suggests that the characteristics of COPD may vary by race. For example, an analysis of the COPDGene computed tomography data suggests that blacks had less emphysema than whites (13.1 % vs. 16.1 %) [18].

As noted above, Hispanic ethnicity is protective against the development of COPD in most US populations. A study of New Mexico Hispanics that used both self-reported and DNA confirmed ethnicity found a lower risk of COPD (vs. whites: OR 0.5) and a lower risk of lung function decline (OR 0.5).

Internationally, it was demonstrated by combining both the BOLD [13] and PLATINO [19] data that countries with the lowest prevalence of COPD were predominantly Hispanic (Fig. 10.3) [20]. The large differences noted here probably reflect a combination of racial, ethnic, geographic, genetic, and exposure factors.

Socioeconomic Differences

One of the most consistent disparities in estimates of COPD prevalence is that related to socioeconomic status (SES). In a number of different studies based in different countries and using different measures of SES, a higher prevalence of

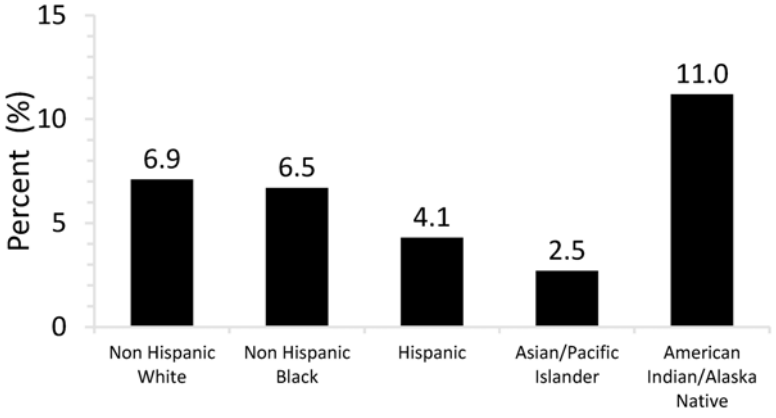

Fig. 10.2 Age-adjusted prevalence of self-reported, physician-diagnosed COPD among adults aged >25, by race/ethnicity: United States (Behavioral Risk Factor Surveillance Survey):2011 [N=475,616] data from [11]

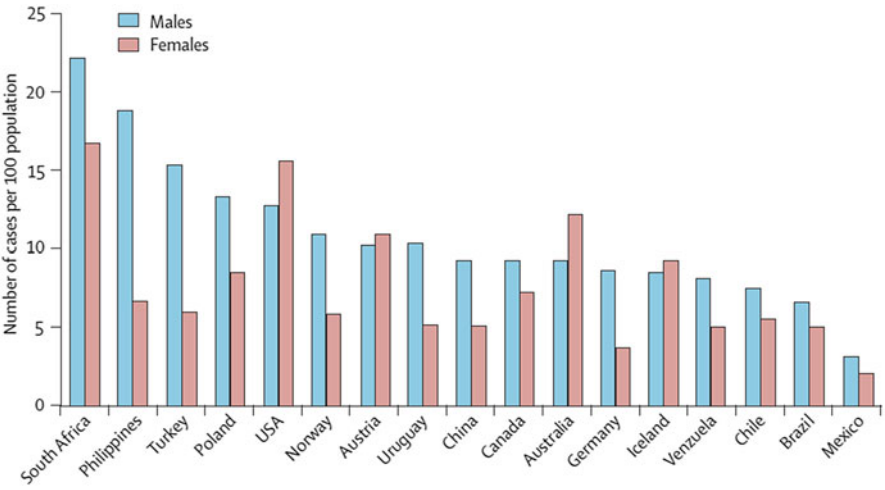

Fig. 10.3 Estimated prevalence of GOLD Stage 2 or higher COPD. Data taken from the BOLD [13] and PLATINO [19] studies. Estimates are for small regions and do not necessarily represent national prevalence estimates [20]

COPD is observed in lower SES populations (Table 10.1). Although a lower SES is typically related to COPD risk factors such as smoking, multivariate regression models continue to show an SES gradient. For example, in the Yin study of a Chinese population, the low-income group had a significantly higher risk of COPD (OR 2.1) relative to the high-income group.

Geographic Differences

As noted above, the BOLD and PLATINO studies demonstrated a great deal of variability in the prevalence of COPD between different populations in different countries (Fig. 10.3) [13]. In the BOLD study, COPD among women ranged from 5·1 % in Guangzhou, China, to 16·7 % in Cape Town, South Africa, and in men it ranged from 8·5 % in Reykjavik, Iceland, to 22·2 % in Cape Town, South Africa.

In the United States, the rate of COPD varies from state to state, from a low of 4.3 % in Utah to a high of 10.6 % in Kentucky [11]. Smaller area data are not yet available for COPD prevalence, although it is highly likely that prevalence rates in counties or health districts also show considerable variation. This variation is related to a number of factors including the key COPD risk factors like smoking and occupational exposures, in addition to poverty, early life respiratory infections, diet, physician diagnostic differences, and other factors [20].

Table 10.1 Socioeconomic status and COPD prevalence from selected studies

Author/year	Country	SES indicator	Level	COPD prevalence men or overall (%)	COPD prevalence women (%)
Chen/2000 [40]	Canada	Income adequacy	High	1.6	2.6
			Middle	2.4	4.6
			Low	6.6	6.6
Ferre/2012 [41][a]	France	Annual income	High	1.9	
			Middle	3.6	
			Low	3.4	
			Very Low	5.3	
Kanervisto/ 2011 [42]	Finland	Household income	High	3.1	
			Middle	3.4	
			Low	9.2	
Yin/2011 [43]	China	Income	High	2.0	
			Middle	2.4	
			Low	4.2	
Ford/2013 [14]	United States	Education (years)	>12	12.4	
			12	15.7	
			<12	14.3	
Danielsson/ 2012 [44]	Sweden	Education (years)	>12	11.4	
			12	12.6	
			<12	28.0	

[a]Chronic bronchitis

Disparities in Treatment

Access to care and use of efficacious medications can help avoid harm in patients with COPD. Few studies have specifically examined differences in access to care or use of COPD treatments across patient populations, but the available evidence suggests that disparities in treatment exist across different patient groups. Tiotropium, introduced in the U.S. in 2004, is a long-acting analog of the inhaled anticholinergic medication ipratropium bromide. In placebo-controlled randomized clinical trials, tiotropium has been shown to significantly improve health-related quality of life (St. George's Respiratory Questionnaire) and dyspnea (Transitional Dyspnoea Index); lung function; and lower the risk of exacerbations, hospitalizations, and mortality [21–23]. In a study conducted 2 years after the introduction of tiotropium in the U.S., investigators observed that a lower SES was strongly associated with decreased odds of using tiotropium, even after taking into account measures of disease severity [24]. Patients with lower levels of education (less than or equal to high school) or income (<$20,000) had one-third the odds of using tiotropium compared to their more advantaged counterparts. Results of a more recent

study among patients enrolled in COPDGene (published as an abstract in 2010) also suggest that black race is associated with significantly lower use of tiotropium [25]. Differences in access to therapy probably exist for other types of COPD interventions, including medications, noninvasive ventilation, and lung transplantation [26, 27]. Thus, these findings raise concerns about the potential for differences in the quality of care contributing to COPD disparities in outcomes.

Disparities in Outcomes

This section will examine differences and disparities in morbidity and mortality among patients with COPD.

Morbidity

Key measures of COPD-related morbidity include exacerbation events and health-related quality of life (HRQOL). Exacerbations of COPD are related to a number of factors [28] and commonly result in emergency room visits and hospitalizations. In 2010 the United States had an estimated 699,000 hospitalizations, or an age-adjusted rate of 32.2 per 10,000 U.S. civilians, for patients at least 25 years of age with a first-listed diagnosis of COPD [11]. Hospitalization rates were similar between men (31.6 per 10,000) and women (33.4 per 10,000) but were higher in blacks (39.5 per 10,000) compared with whites (29.5 per 10,000). This is in spite of a national trend observed with hospitalization rates decreasing for all adults between 1999 and 2010 [11].

When observing only Medicare enrollees of at least 65 years of age, there were 312,654 hospital discharge claims, or an age-adjusted rate of 11.18 per 1000 enrollees, with a first-listed diagnosis of COPD in 2010. Hospitalization rates for Medicare enrollees were similar for men (11.6 per 1000) and women (10.0 per 1000). With respect to race and ethnicity, the hospitalization rates were the highest for Native American enrollees (13.2 per 1000), followed by black enrollees (12.4 per 1000), white enrollees (11.3 per 1000), Hispanic enrollees (9.7 per 1000), and Asian enrollees (4.8 per 1000). From 1999 to 2010, Medicare hospitalizations decreased for enrollees overall and for men, but not significantly for women or any specific race/ethnicity group (Fig. 10.4) [11].

A COPD-related hospitalization increases the risk of subsequent mortality independent of the baseline level of lung function [29]. African Americans hospitalized with COPD exacerbations have a higher 30-day readmission rate compared with white patients (23.1 % vs. 20.5 %) [30]. Income is also associated with 30-day readmission rates after COPD exacerbations; patients living in areas with a median household income in the lowest quartile have a higher readmission rate compared with patients living in areas with the highest quartile of income (21.5 % vs. 20.2 %).

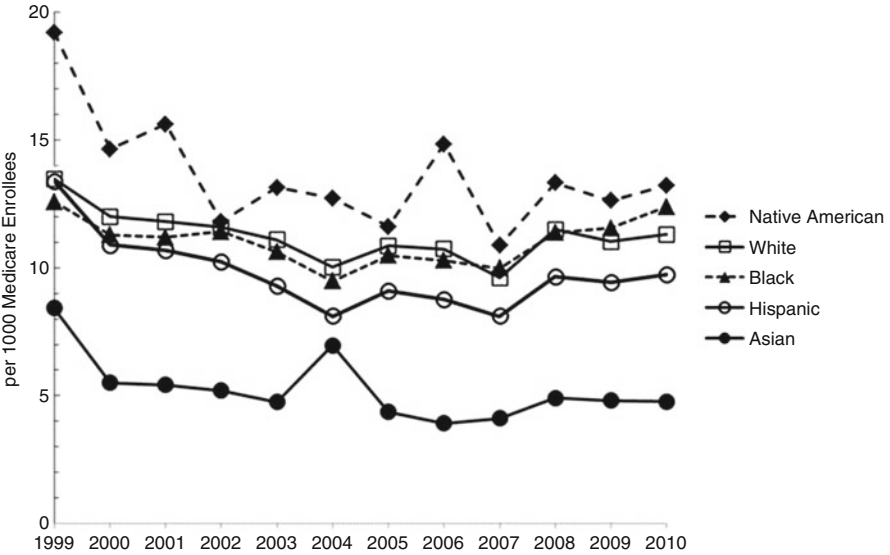

Fig. 10.4 Race-specific age-adjusted rates (per 1000 Medicare enrollees) of Medicare hospitalizations for COPD as the first-listed discharge diagnosis among Medicare enrollees aged >65 years, by year—United States, Medicare Part A hospital claims, 1999–2010 [11]

Many factors can affect HRQOL in COPD patients, including age and sex. Other factors that affect HRQOL, such as lung function, smoking history, current smoking status, and education, tend to vary by race. However, even after adjusting for these and additional confounders, disparities in HRQOL can still be found between African Americans and Caucasians. Data from the COPDGene study was used to examine differences in HRQOL according to the St. George Respiratory Questionnaire (SGRQ) [31]. For COPD patients with no exacerbations reported in the prior year, SGRQ scores were similar for African Americans and Caucasian patients. However, African American patients that reported exacerbations in the previous year averaged 1.89 points higher (i.e., worse HRQOL) on the SGRQ per exacerbation than Caucasians. Additionally, more African Americans had at least one exacerbation requiring hospitalization (32 %) than Caucasians (16 %). Of those patients reporting exacerbations requiring hospitalization, African Americans tended to score 4.19 points higher on the SGRQ measure per exacerbation than Caucasians.

Similarly, outcomes of COPD severity, pulmonary function, physical function limitations, and risk of exacerbation have been shown to vary by certain demographic factors. A cohort of COPD patients from the Function, Living, Outcomes, and Work study were analyzed for associations between outcomes and demographic factors of race, education, and income after controlling for a multitude of covariates [32]. Both lower education and lower household income were associated with higher COPD severity and poorer lung function (FEV1%) when compared to their

high education and income counterparts. Lower income groups also performed poorer in physical function than did the high-income group. The lowest education and income groups were found to have more severe airflow obstruction (FEV1/FVC) and a higher risk of exacerbation requiring hospitalization when compared to the highest education and income groups. The lowest education group also showed poorer physical function relative to the highest education group. With respect to race, black subjects had better lung function (FEV1%) but poorer physical function when compared to white subjects.

Mortality

There were 133,575 deaths in the U.S. in 2010 that were attributed to COPD, corresponding to an age-adjusted rate of 63.1 per 100,000 people. This death rate decreased from 1999 to 2010 for men, but did not change in women or overall. Death rates were highest in 2010 among whites (70.2 per 100,000), followed by American Indian/Alaska Natives (62.9 per 100,000), blacks (41.8 per 100,000), Hispanics (28.5 per 100,000), and Asian/Pacific Islanders (19.0 per 100,000) [11] (Fig. 10.5). Of note, between 1980 and 2002, death rates for African American COPD patients increased at a higher rate than for Caucasian COPD patients [33].

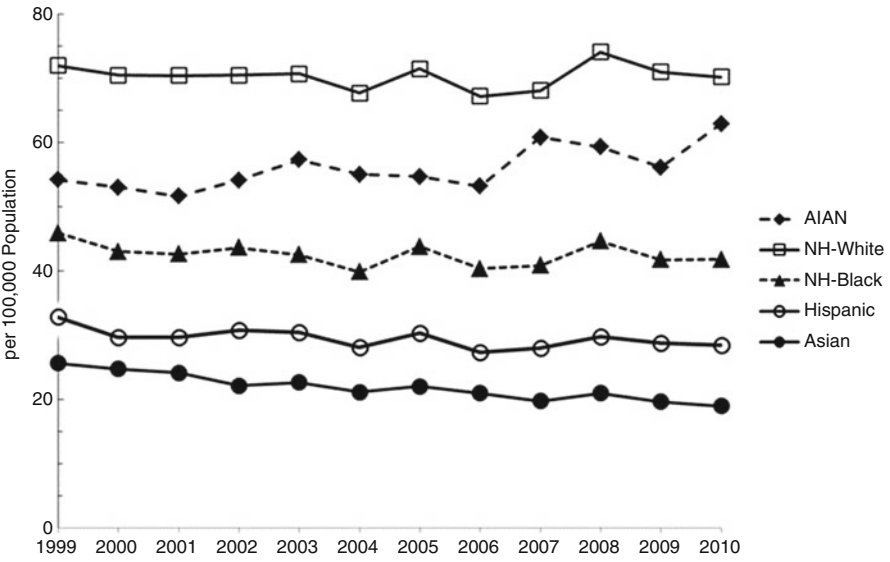

Fig. 10.5 Race-specific age-adjusted death rates (per 100,000) for COPD as the underlying cause of death among adults aged >25 years, by year—United States, Mortality Component of the National Vital Statistics System, 1999–2010 [11]

Disparities in Research Funding

Another key disparity in COPD relates to the research funding this disease receives relative to the impact of the disease on the US population. When Gillum et al. evaluated this looking at 2006 data, they found that COPD was one of the most underfund diseases by the National Institutes of Health relative to the number of disability adjusted life years for COPD [34] (Fig. 10.6). Since 2006, COPD federal funding has increased dramatically with projects such as COPDGene [35] and the Long-Term Oxygen Treatment Trial (LOTT).

Disparities in Patient and Public Perception of COPD

Another key historical disparity is how COPD has been perceived by patients and the public. This is, in large part, due to COPD's association with cigarette smoking in most of the developed world [36]. People tend to "blame" themselves for having

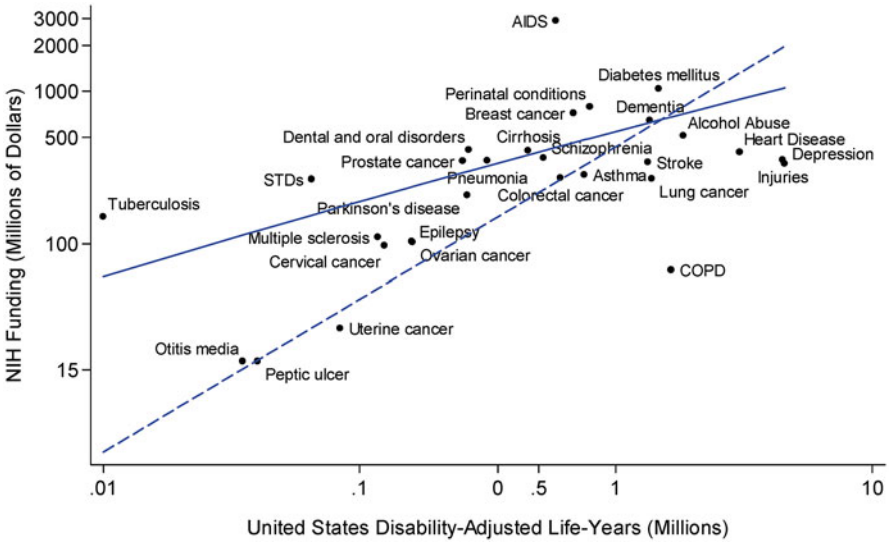

Fig. 10.6 NIH Funding in 2006 and US Disease Burden in DALYs in 2004 for 29 Common Medical Conditions. The *solid line* represents the results of a traditional multivariable analysis, showing the relationship between US disease-specific DALYs burden and actual 2006 NIH funding dollars. The *dashed line* projects NIH funding levels in a similar multivariable model that requires that a disease with no burden receives no funding (constrained model). Though the models produce similar results, several diseases that would be considered overfunded in one model are considered underfunded in the other. For example, cervical cancer appears to be overfunded relative to the *dashed line*, while it is underfunded relative to the *solid one* [34]

"brought this disease upon themselves" and are embarrassed to even admit that they have the disease. Even among patients who have stopped smoking many years before there is a tendency for self-blame by saying "I should have stopped smoking earlier." Many of these same features are often associated with the tobacco-related disease of lung cancer, where a typical question asked of a newly diagnosed patient revolves around their smoking history, again with the presumption that this person brought this disease upon himself.

Cigarette smoking is linked to a number of other diseases, including heart disease, colon cancer, cervical cancer, and diabetes [37], yet none of these diseases suffer from the "shame and blame" attitudes that permeate COPD.

Fortunately, these attitudes are changing. In the US over 25 % of adults with evidence of COPD have never smoked [11]. In addition, in recent years patients with COPD have become more empowered about their disease management in general and their expectations of better therapies and better outcomes compared to what was expected 20 years ago. In 2011 the CDC released a task force report to approach COPD as a public health problem, going well beyond the "burning cigarette" as the only area where interventions could occur [38].

Resources to Learn More About COPD

Prior to the formation of the U.S. COPD Coalition in 2001 and the COPD Foundation in 2004, there were no patient advocacy organizations solely dedicated to serving the COPD community and as a result, resources for patients were scarce. Today there are numerous COPD-related resources available online that provide high-quality information for health care providers and patients and their families but disparities in the dissemination and use of these materials still exist. Some of these are noted below.

For Health Care Providers

1. COPD Foundation—www.copdfoundation.org 1-866-316-(COPD) 2673
   The COPD Foundation, with guidance from its Medical and Scientific Advisory Committee produced the Pocket Consultant Guide for the Diagnosis and Management of COPD and a corresponding interactive website for healthcare providers to discuss clinical issues in COPD. The COPD Foundation also publishes a quarterly clinical magazine on lung health, the *Lung Health Professional* and produces several live and enduring CME resources throughout the year.
2. Global Initiative on Chronic Obstructive Lung Disease (GOLD)—www.goldcopd.org

GOLD resources available for download include the Global Strategy for Diagnosis, Management, and Prevention of COPD and its corresponding At-A-Glance Desk Reference and Pocket Guide.

3. American Lung Association—www.lung.org

   The ALA has developed the COPD Action Plan document that providers can give to patients to help them understand what medication they are taking, signs of exacerbations, and what to do based on certain physical symptoms.

4. American Thoracic Society—www.thoracic.org

   Standards for the Diagnosis and Management of COPD are available for download on the ATS website along with several web-based pages highlighting key points for the management of specific issues in COPD, monthly clinical case web features on multiple lung health issues including COPD and references related to coding and billing. ATS publishes the American Journal of Respiratory and Clinical Care Medicine and Annals of the ATS, both of which address COPD research.

5. European Respiratory Society—www.ersnet.org

   ERS publishes the European Respiratory Journal and a number of topical handbooks and position statements related to COPD, coauthors COPD Guidelines with the ATS and puts on a large respiratory congress each year where original COPD research is presented.

6. National Heart, Lung and Blood Institute—www.nhlbi.nih.gov

   NHLBI, through their COPD: *Learn More Breathe Better* Campaign provides COPD essentials fact sheets for providers along with periodic workshops and research funding in COPD.

For Patients and Their Families

1. COPD Foundation—www.copdfoundation.org 1-866-316-(COPD) 2673

   The COPD Foundation has created an extensive list of resources specifically for COPD patients and their families. The Information Line is staffed by trained patients and caregivers and available toll-free Monday–Friday 9 am–9 pm ET. The *COPD Digest* is a free quarterly publication with clinical, lifestyle, and policy information related to COPD. Comprehensive educational materials are available free for download or can be ordered by patients for free by calling the COPD Information Line.

2. Alpha-1 Foundation—www.alpha-1foundation.org

   Individuals with Alpha-1 Antitrypsin Deficiency can access educational materials written specifically about the genetic condition. The Alpha-1 Foundation also provides a free confidential, mail-based, testing program for Alpha-1.

3. American Lung Association—www.lung.org

The ALA supports the Better Breathers Clubs, a network of support groups for individuals with all types of lung disease. In addition, the ALA hosts a lung helpline and produces written educational materials about COPD.

4. WebMD—www.webmd.com

   WebMD hosts the COPD Help Center, a virtual home for information about COPD symptoms, diagnosis, treatment, and more.

5. American Association for Respiratory Care—www.yourlunghealth.org

The American Association for Respiratory Care is a professional association of respiratory therapists and other allied health practitioners who assist physicians in the treatment and care of patients with lung disorders. Education of patients is an important part of their mission. This web site provides useful information on a number of respiratory diseases and their treatments.

Looking Toward the Future

A great deal of progress has been made in reducing COPD-related disparities in the past 20 years. Moving away from the sole focus on tobacco smoking has been key. This shift is critical, because even if every smoker in the country were to stop smoking today, the morbidity and mortality related to COPD would remain unchanged for the next 25–30 years [39]. Increasing research funding to better understand who is at risk and how interventions can be better targeted is also important.

Conclusion

COPD represents a group of related diseases that have been associated with a number of disparities over the years. These range from disparities in diagnosis, treatment, and outcomes to disparities in public perception and research funding. In recent years, there has been movement toward the elimination of these disparities by increasing research funding, developing better therapies, and increasing awareness of the risk factors beyond tobacco smoke that lead to COPD. The future for COPD looks very different from its past, with movement from nihilism to optimism, and a greater global acceptance of the diversity of disease phenotypes, therapies, and outcomes.

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