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Symptom Burden Predicts Hospitalization Independent of Comorbidity in Community-Dwelling Older Adults

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Abstract

OBJECTIVES—To determine if cumulative symptom burden predicted hospitalizations or emergency department (ED) visits in a cohort of older adults.

DESIGN—Prospective, observational study with a baseline in-home assessment of symptom burden.

SETTING—Central Alabama.

PARTICIPANTS—980 community-dwelling adults age 65 years or older recruited from a random sample of Medicare beneficiaries, stratified by sex, race, and urban/rural residence.

MEASUREMENTS—Symptom burden score (range 0–10). One point was added to the score for each symptom reported: shortness of breath, tiredness/fatigue, problems with balance/dizziness, leg weakness, poor appetite, pain, stiffness, constipation, anxiety, and loss of interest in activities. Dependent variables: Hospitalizations and ED visits assessed every 6 months during the 8.5 year follow-up period. Using Cox proportional hazard models, we determined time from the baseline in-home assessment to the first hospitalization and first hospitalization or ED visit.

RESULTS—During the 8.5 year follow up period, 545 (55.6%) participants were hospitalized or had an ED visit. The participants' mean age was 75.3 years $\pm$ 6.7. Compared to those with lower scores, participants with greater symptom burden had higher risk of hospitalization (hazard ratio

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(HR)=1.09, 95% confidence interval=1.05–1.14) and hospitalization or ED visit (HR=1.10, 95% CI=1.06–1.14). Participants living in rural areas had significantly lower risk of hospitalization (HR=0.83, 95% CI= 0.69–0.99) and hospitalization or ED visit (HR=0.80, 95% CI=0.70–0.95) compared to individuals in urban areas, independent of symptom burden and comorbidity.

CONCLUSION—Greater symptom burden was associated with higher risk of hospitalization and ED visits in community-dwelling older adults. Health care providers treating older adults should consider symptom burden as an additional risk factor for subsequent hospital utilization.

Keywords

healthcare utilization; symptom; older adults; comorbidity

INTRODUCTION

The prevalence of multimorbidity, the presence of 2 or more chronic conditions, increases with age.¹ To assess the impact of multimorbidity, indices like the Charlson Comorbidity Index (CCI) were developed to predict mortality and health care utilization, or used for case-mix adjustment.^{2–4} However, simple counts of conditions or weighted indices fail to capture the burden of diseases like osteoarthritis. The mortality associated with osteoarthritis is low compared to cancer or dementia^{5, 6}; however, the morbidity and functional limitations of older adults with osteoarthritis can be significant.^{6, 7}

One approach to estimating disease impact has been to determine the presence and severity of symptoms. Most symptom assessment tools are condition-specific, for diagnoses ranging from dermatitis to cancer.^{8, 9} Yet, patients with multimorbidity do not experience their conditions in isolation.^{10, 11} For example, patients with dyspnea feel short of breath regardless of whether their illness is due to chronic obstructive pulmonary disease (COPD) or congestive heart failure (CHF).

Patient-reported outcomes, including symptom burden, may be an alternate way to assess disease impact, distinct from comorbidity counts. We sought to understand the relationship between symptom burden and hospital utilization. Specifically, our objective was to determine if cumulative symptom burden predicted hospital utilization in a cohort of community-dwelling older adults. We hypothesized that older adults reporting greater symptom burden would have increased risk for subsequent hospitalizations or hospital ED visit use compared to those with less symptom burden.

METHODS

Study design and setting

We utilized data from the University of Alabama at Birmingham (UAB) Study of Aging. The UAB Study of Aging is a prospective, observational cohort study of 1,000 community-dwelling adults recruited from a random sample of Medicare beneficiaries living in five counties in central Alabama, stratified by gender, race, and urban/rural residence. The methods utilized for the initial recruitment have been described previously.¹² Briefly, a recruitment letter signed by the Medicare administrator was mailed to potential participants explaining the study's purpose. Shortly thereafter, we called to recruit eligible individuals for the in-home assessment. Persons were excluded if they were younger than 65 years of age, lived in a nursing home, or were unable to schedule their own appointments. Participants signed informed consents approved by the University of Alabama at Birmingham Institutional Review Board.

We were unable to contact 451 (14.5%) of potential subjects; 362 (11.7%) were not contacted as the recruitment goal of 1000 participants was reached prior to scheduling the in-home assessments. Of 2188 people contacted to arrange in-home assessments, 1143 (52.3%) refused and 43 (2.0%) were ineligible. Recruitment ranged from 35–50% of eligible subjects in urban areas and 44–55% in rural areas.

In-home assessments for baseline data were performed by trained interviewers between December 1999 and February 2001. The following information was collected at baseline: age, gender, race, urban/rural residence, comorbidities, smoking status, and body mass index (BMI). Participants' comorbidities were considered verified if participants reported using a prescription medication for the disease, if the primary care physician reported the condition on the study's standardized questionnaire, or if the diagnosis was recorded on a hospital discharge summary within three years of the baseline assessment. Based on the verified comorbidity data, we calculated an unweighted comorbidity count for each participant, assigning one point for each diagnosis in the Charlson Comorbidity Index.² BMI was categorized into 4 strata: <18.5 (underweight), 18.5–25 (normal weight, referent group), 25–30 (overweight), 30–35 (obese), and >35 (morbidly obese). Social support was assessed by asking participants whether they felt family or friends were available for assistance during the past month using a 5-point Likert-type scale (1 = never, 2 = almost never, 3 = sometimes, 4 = very often, 5 = always). Participants who answered "always" or "very often" were coded as reporting available assistance, whereas those who said "sometimes" or less frequently were coded as lacking available assistance.

Symptom burden measure

The symptom burden measure consists of 10 dichotomous indicators for symptoms that are negative perceptions of a person's health experience. The symptoms were self-reported by at least 10% of the study population and were not specific for a condition or diagnosis. Patients were asked about shortness of breath, feeling tired or fatigued, problems with balance or dizziness, leg weakness, constipation, poor appetite, pain, stiffness, anhedonia, and anxiety. Six of the symptoms were asked with dichotomous yes/no questions. For the other four items (anxiety, anhedonia, pain, poor appetite), questions using Likert-type response scales were used in the original survey instrument; we later applied dichotomous categorizations to the responses. For anxiety and anhedonia, participants were asked, "During the past weeks how often have you a) been bothered by nervousness or your nerves (anxiety), and b) had little interest or pleasure in doing things (anhedonia)." Responses were recorded on a 5-point scale (always, very often, sometimes, almost never, or never), and those who answered "very often" or more often were coded as having the symptom, whereas those who said "never", "almost never", or "sometimes" were coded as not reporting the symptom. For pain, participants were asked, "How frequently over the past four weeks have you experienced pain?" Answers were coded as daily, 4–6 times per week, 1–3 times per week, less than once a week, or not at all. The distribution was bimodal, with most participants saying either "daily" (38.6%) or "not at all" (26.0%). Those who said "daily" were characterized as having regular pain as a symptom. For appetite, participants were asked, "Would you say your appetite is usually very good, good, fair, or poor?" Those who answered "fair" or "poor" were characterized as having poor appetite, and those who said "very good" or "good" were characterized as having good appetite.

The sum of these 10 dichotomous symptom items was used as an overall measure of symptom burden. A Cronbach's alpha of 0.76 indicated sufficient internal consistency for the total count.

Hospital utilization measure

Reports of hospitalizations and emergency department (ED) visits were obtained during follow-up telephone interviews every 6 months after baseline assessment. Maximum follow up time was 8.5 years. When a hospitalization or ED visit was reported, participants or their alternate contacts provided the date of the hospital admission or ED visit. If the exact date was unknown by the respondent, the admission date or date of ED visit was defined as the midpoint for the period of time during which the respondent indicated that the event had occurred. For example, if a respondent indicated that a hospital admission occurred during a specific week or month of the previous six-month interval, but the respondent did not recall the specific day, the admission date was defined as the midpoint of the admission week or month, respectively.

Statistical approach

The dependent variables were time to first hospitalization and time to first hospital utilization. Hospital utilization was defined as hospitalization or an ED visit. Time to first hospitalization was determined as the difference in days between the baseline assessment and subsequent hospital admission during the follow-up period. For participants who were not hospitalized during this time period, censoring occurred at the time of the last interview for the participant, dropout, or participant death, whichever occurred first. Time to first hospital utilization was determined as the difference in days between the baseline assessment and subsequent hospital admission or ED visit during the follow-up period. For participants who were not hospitalized or did not visit the ED during this time period, censoring occurred at the time of the last interview for the participant, dropout, or participant death, whichever occurred first.

We performed survival analyses predicting time to first hospitalization and first hospital utilization using a Cox proportional hazards model as conducted in SAS Proc PHREG. Covariates in the models included comorbidity count, age, race, gender, rural/urban residence, availability of family/friends, BMI category, and smoking status. Hazard ratios (HR) and 95% confidence intervals (CI) are reported. All analyses were performed in SAS version 9.2 (Cary, NC).

In sensitivity analyses, we excluded participants who had died during the study period. Additionally, we determined the hazard ratios for surgical versus non-surgical hospitalizations using the same covariates listed above.

RESULTS

Table 1 displays the baseline characteristics of the study population. Of the 980 participants with complete baseline data, 545 (55.6%) were hospitalized or seen in an ED during the 8.5 year observation period. The majority of utilization reflected hospitalizations (n=496). Hospitalization or ED visits occurred at a mean of 1,353 days after baseline assessment, with a standard deviation (SD) of 1,080 days, while hospitalization occurred at a mean of 1,478 days, SD 1,077 days. The mean age of the participants was 75.3 years (standard deviation $\pm$ 6.7). Due to stratified sampling described above, half of the cohort were men, African American, and lived in rural areas. Twelve percent (n=115) of participants had zero co-morbid conditions. More than half of participants (n=600, 61%) had 0–2 comorbid conditions. The mean number of symptoms was 3.7 (SD $\pm$ 2.7). Thirteen percent of participants (n=129) endorsed no symptoms. More than 40% of the participants (n=411) endorsed 4 or more symptoms at baseline. The list of symptoms and number of participants endorsing each symptom are displayed in Table 2.

Table 3 shows the results of the survival analyses. Participants with greater symptom burden, i.e. higher cumulative symptom burden scores, had higher risk of hospitalization (HR 1.09, 95% CI 1.05–1.14) and hospitalization or ED visits (HR 1.10, 95% CI 1.06–1.14) than participants endorsing fewer symptoms. In other words, for every additional symptom there was nearly a 10% increase in the risk of hospital utilization. Similarly, participants with higher comorbidity counts had higher risk of hospitalization (HR 1.21, 95% CI 1.14–1.28) and hospitalization or ED visits (HR 1.19, 95% CI 1.13–1.26) than participants with no comorbidities. Participants living in rural areas had significantly lower risk of hospitalization (HR 0.83, 95% CI 0.69–0.99) and hospitalization or ED visits (HR 0.80, 95% CI 0.67–0.95) compared to individuals living in urban areas, independent of symptom burden and comorbidity count.

Additionally, we collapsed the symptom burden scores into quartiles (≤ 1 , 2–3, 4–6, 7–10) and graphed those 4 categories as a function of the probability of no hospital utilization (Figure 1) and probability of no hospitalization (Figure 2). We repeated the analysis with symptom burden score as a categorical variable as opposed to a continuous variable, and the results were the same—more symptoms meant an increased risk of hospitalization. Specifically, participants with symptom burden scores of 7–10 (fourth quartile) had an overall risk of hospitalization 86% greater than participants with symptom burden scores of 0–1 (first quartile). The figures present the direct adjusted survival curves for the symptom burden score quartiles based on the methods of Zhang and colleagues.¹³ The figures illustrate the steeper decline in probability of *no* hospitalization/utilization over time for the 3rd and 4th quartiles of symptom burden scores vs. the 1st quartile.

In sensitivity analyses, the risks of hospitalization and hospitalization or ED visit were similar in magnitude and direction when participants who had died were excluded (data not shown). The cumulative symptom burden score did not predict hospitalizations during which surgical procedures were performed. Analogous to the main analysis, however, greater cumulative symptom burden score and higher comorbidity counts were predictive of greater rates of non-surgical hospitalizations. Likewise, participants from rural areas had lower rates of non-surgical hospitalization.

Supplemental analyses were conducted to examine whether the total symptom burden score added predictive validity over and above what would be provided by any single symptom. Tables 4 and 5 (in Online Supplement) demonstrate that for hospitalization or ED visit and hospitalization models, respectively, symptom burden remained a significant predictor ($p < 0.05$). These results indicate that no single symptom, such as pain, captures the full predictive utility of the total symptom measure.

DISCUSSION

In this study of community-dwelling older adults, greater cumulative symptom burden predicted hospital utilization, independent of comorbidity count. One additional report of the ten symptoms assessed resulted in an increase of nearly 10% in the hazard risk ratio for either a hospitalization or an ED visit. We also found about a 20% lower hazard risk ratio for hospital utilization comparing rural and urban participants. Our study's uniqueness stems from utilizing a set of symptoms representative of community-dwelling older adults with a wide array of conditions, whereas most symptom scales are oriented to a particular condition or disease. The questions asked of participants reflect both physical and mental health symptoms, providing a more global view of symptom burden than indices measuring functional impairment, general health status, or health-related quality of life (HRQOL).

For our study we focused on a measure of symptom burden instead of HRQOL. HRQOL measures, such as the Duke Health Profile¹⁴, Short Form-36¹⁵, and the Sickness Impact Profile¹⁶, determine functional or general health status and assess the impact of symptoms on the individual.¹⁷ The Sickness Impact Profile, for example, also asks how an individual's health affects work and leisure pursuits.¹⁶ Although important in understanding the overall significance of illness, HRQOL measures are less commonly integrated into routine clinical practice and are clinically less actionable compared to measures of symptoms. Health care providers can potentially alter treatment regimens to address symptoms directly. In the present study older adults reported a variety of symptoms which could potentially guide the provider to pursue interventions to lessen symptom burden. Additionally, we did not rely on scales that had been derived or validated from individuals with a specific condition like cancer, since the majority of individuals in our sample had multiple comorbid conditions.¹⁸

Symptoms and symptom burden may be driving the behavior to seek medical care and partially explain our results. For example, pain can be one symptom that predicts hospitalization. Using pain scales during outpatient evaluations, Wagner-Johnston et al. noted that cancer patients with higher pain scores were more likely to be hospitalized within 30 days.¹⁹ Additionally, in a general adult population including urban and rural inhabitants, chronic widespread musculoskeletal pain predicted at least one hospitalization for varied medical conditions over a ten-year observation period.²⁰

We postulate that the lower rate of hospital utilization by rural participants may be due to individual- and system-level factors. Rural inhabitants may have decreased access to acute care facilities; however, prior studies have demonstrated higher hospitalization rates for ambulatory-care sensitive conditions (i.e. preventable admissions) as level of rurality increases.²¹ Our sample selection was different in that we did not limit our analyses to participants with ambulatory-care sensitive conditions, nor did we assess whether hospitalizations were preventable.

Several possible limitations of our study must be considered. First, we assessed the presence and approximate frequency of symptoms, not the acuity or severity of them. Symptom assessment only occurred at one time point (baseline) and was not followed over time. Moreover, aside from symptoms, this analysis does not address other factors that may drive hospital utilization, like access to health care, quality of care, financial resources, transportation, or supply of hospital beds. We did not have data on the use of home health or hospice services by participants. The symptom and hospital utilization questions were self-reported and therefore subject to recall bias. Lastly, the generalizability of our data from a sample of older Alabamians may be limited, though the stratified design ensured oversampling of underrepresented populations.

CONCLUSION

In summary, hospital utilization by community-dwelling older adults was greater for individuals with higher symptom burden independent of comorbidity. Furthermore, the totality of symptom burden captured more of the predictive effect than any individual symptom did. Health care providers treating older adults should utilize cumulative symptom burden as an additional risk factor for hospital utilization and pursue appropriate symptom management strategies in order to potentially reduce risk of subsequent hospitalization. Finally, measures of symptom burden and other patient-reported outcomes provide a wider view of the impact of disease and multimorbidity on health and highlight the need for additional research and interventions to address the impact of symptom burden among older adults.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Adjusted time to hospital utilization curves

^aAdjusted for age, gender, race, comorbidity count, rural residence, availability of family/friends, body mass index (BMI), and smoking status.

Legend for Figure 1.

— Symptom burden <=1 - - - Symptom burden 2-3
 . . . Symptom burden 4-6 - . . . Symptom burden 7-10

Figure 2.

Adjusted time to hospitalization curves

^aAdjusted for age, gender, race, comorbidity count, rural residence, availability of family/friends, body mass index (BMI), and smoking status.

Legend for Figure 2.

— Symptom burden ≤1 - - - Symptom burden 2-3
 . . . Symptom burden 4-6 - . . . Symptom burden 7-10

Table 1

Descriptive statistics of the UAB Study of Aging participants, N = 980

Variable	N (Percentage) or Mean (SD)
Symptom burden score	
<=1	290 (29.6%)
2-3	279 (28.5%)
4-6	308 (31.4%)
7-10	103 (10.5%)
Comorbidity count	
0-2	600 (61.2%)
3-5	349 (35.6%)
6-9	31 (3.2%)
Age	75.3 (6.7)
Male	495 (50.5%)
African American	486 (49.6%)
Rural residence	505 (51.5%)
Family/friends not available ^a	76 (7.8%)
BMI ^b <18.5	21 (2.1%)
BMI 18.5-25	288 (29.4%)
BMI 25-30	369 (37.7%)
BMI 30-35	199 (20.3%)
BMI 35+	103 (10.5%)
Quit smoking	421 (43.0%)
Current smoker	98 (10.0%)
Never smoked	461 (47.0%)

^aSometimes, almost never, or never available^bBMI=body mass index (kg/(m)²)

Table 2

Symptom questions asked of participants and number of positive responses

Symptom	Question	Number of positive responses (%)
Shortness of breath	Do you have problems with shortness of breath?	344 (35.1)
Tired or fatigued	Do you have problems with feeling tired or fatigued?	471 (48.1)
Balance or dizziness	Do you have problems with balance or dizziness?	347 (35.4)
Leg weakness	Do you have problems with weakness in your legs?	379 (38.7)
Poor appetite	Would you say your appetite now is usually fair or poor? ^a	166 (16.9)
Pain	How frequently over the past 4 weeks have you experienced any pain? ^b	376 (38.4) with daily pain
Stiffness	Do you have problems with stiffness?	477 (48.7)
Constipation	Do you have any constipation?	355 (36.2)
Anhedonia	Over the last 4 weeks, how often have you had little interest or pleasure in doing things? ^c	110 (11.2)
Anxiety	During the past 4 weeks, how often have you been bothered by nervousness or your nerves? ^c	111 (11.3)

^aPossible answers included very good, good, fair, poor, don't know or refused.

^bPossible answers included not at all, less than once a week, 1–3 times a week, 4–6 times a week, or daily.

^cPositive answers included always and very often. Negative answers included sometimes, almost never, and never.

Table 3

Survival analyses predicting time to first hospital utilization and first hospitalization.

Variable	Time to 1 st Hospital Utilization		Time to 1 st Hospitalization	
	Hazard Ratio (95% confidence interval) ^a	p-value	Hazard Ratio (95% confidence interval) ^a	p-value
Symptom burden	1.10 (1.06–1.14)	<0.001	1.09 (1.05–1.14)	<0.001
Comorbidity count	1.19 (1.13–1.26)	<0.001	1.21 (1.14–1.28)	<0.001
Race	0.62 (0.52–0.75)	<0.001	0.59 (0.49–0.71)	<0.001
Rural residence	0.80 (0.67–0.95)	0.01	0.83 (0.69–0.99)	0.04
Family/friends available	0.92 (0.66–1.29)	0.62	0.92 (0.64–1.31)	0.64
BMI ^b <18.5	0.85 (0.43–1.67)	0.64	0.62 (0.27–1.41)	0.26
BMI 18.5–25	REFERENT		REFERENT	
BMI 25–30	1.11 (0.89–1.38)	0.36	1.06 (0.85–1.34)	0.59
BMI 30–35	1.10 (0.85–1.42)	0.47	1.00 (0.77–1.31)	0.98
BMI 35+	0.97 (0.70–1.34)	0.85	0.94 (0.67–1.33)	0.74
Quit smoking	1.09 (0.89–1.34)	0.41	1.14 (0.92–1.42)	0.22
Current smoker	1.04 (0.75–1.45)	0.82	1.07 (0.76–1.52)	0.70

^a Adjusted for age and gender.^b BMI = Body mass index (kg/(m)²)