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Seniors' self-reported multimorbidity captured biopsychosocial factors not incorporated in two other data-based morbidity measures

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Abstract

Objective—To explore the constructs underlying a self-report assessment of multimorbidity.

Study design and setting—We conducted a cross-sectional survey of 352 HMO members age 65 or older with, at a minimum, diabetes, depression, and osteoarthritis. We assessed self-reported ‘disease burden’ (a severity-adjusted count of conditions) as a function of biopsychosocial factors, two data-based comorbidity indices, and demographic variables.

Results—In multivariate regression, age, ‘compound effects of conditions’ (treatments and symptoms interfering with each other), self-efficacy, financial constraints and physical functioning, were significantly ($p \leq 0.05$) associated with disease burden. An ICD-9-based morbidity index did not significantly contribute to disease burden, and a pharmacy-data based morbidity index was minimally significant.

Conclusion—This measure of self-reported disease burden represents an amalgamation of functional capabilities, social considerations, and medical conditions that are not captured by two administrative data-based measures of morbidity. This suggests that a) self-reported descriptions of multimorbidity incorporate biopsychosocial constructs that reflect the perceived burden of multimorbidity, b) a simple count of diagnoses should be supplemented by an assessment of activity limitations imposed by these conditions, and c) choice of morbidity measurement instrument should be based on the outcome of interest rather than the most convenient method of measurement.

Keywords

comorbidity; multimorbidity; health status; illness burden; chronic disease; geriatrics

In studying health outcomes of persons with chronic disease, it is important to consider the effects of coexisting chronic conditions. Multiple instruments have been developed to quantify morbidity for research and patient care, and the choice of instrument depends on the methodology and outcomes of the investigation. There are multiple advantages to using self-

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report to measure multimorbidity. Self-report of morbidity provides information that is not available elsewhere—especially with regard to the functional impact of a condition.(1) Compared with chart review, self-report requires fewer resources, may be more complete, and is not limited to a specific time period.(2) Self-report is also helpful in population surveys when patient records or administrative data are inaccessible.(3) Although self-report is theoretically subject to recall bias, self-report of conditions has been shown to correlate reasonably well with medical record review.(1;4-7)

Different methods of measuring morbidity are associated with different health outcomes. Self-reports of morbidity are most strongly associated with quality of life outcomes and are stronger predictors of these outcomes than are other methods of measuring morbidity. (8-13) However, self-report has also been associated with mortality, hospitalization rates, and health care costs. (8;10;12;14;15) Other methods of measuring morbidity and their associated outcomes include using pharmacy data to predict cost of care, using chart review to predict in-hospital mortality, and using administrative data to predict length of stay, hospitalization, and mortality. (16-22) These differences in association imply that factors incorporated into measures of self-assessed morbidity may differ from those captured by other assessment methods.

Given the many potential uses for self-report morbidity assessments and the differential associations with outcomes, it is important to understand the medical, psychological, and social constructs underlying individuals' assessment of their own morbidity. Information on these underlying constructs may be particularly useful in choosing morbidity assessment instruments for specific research investigations, and in the clinical arena to enhance patient-centered care management of persons with multimorbidities.

We have previously developed a self-report measure to assess the relationship between multimorbidity and health status.(7) This instrument allows individuals to enumerate conditions and rate their severity—as defined by their impact on daily activities—and produces a total score that we term 'disease burden'. In order to further explore the constructs underlying this measure, we assessed the association of multiple different biopsychosocial factors, and two other morbidity indices (based on ICD-9 diagnoses from administrative data and on pharmacy data respectively), with level of disease burden.

Due to the ability to self-report severity, we hypothesized that our instrument would capture the effects of conditions that are of particular importance to patients—either due to symptom burden or other associated biopsychosocial factors; and that in doing so the disease burden score would incorporate constructs that are not captured by other morbidity scores that are based on administrative data alone. This is illustrated in the conceptual model, Figure 1.

Methods

As part of a cross-sectional telephone survey that quantified barriers to self-management in 352 seniors with multimorbidities, we assessed disease burden by self-report.(23) Respondents were members of a not-for-profit HMO who were age 65 or older and who carried, at a minimum, the diagnoses of diabetes, osteoarthritis, and depression. These diagnoses were chosen based on the theory that these three conditions met the definition of 'discordant' conditions (those that have potentially conflicting symptoms and treatment strategies) and would permit assessment of potential barriers to medical self-management. In assessing their disease burden, respondents selected from a list of 21 common chronic diseases and additionally were allowed to add medical conditions not already on the list. They rated each condition on a five-point scale from 1 (interferes with daily activities "not at all") to 5 (interferes with daily activities "a lot"). The total score representing level of morbidity was thus the sum of conditions weighted by the level of interference assigned to each. Previous validation of this

instrument showed that it is strongly associated with subjective health status.(23) An earlier validation against medical records revealed that median sensitivity relative to a 'gold standard' of chart review was 75% (range 35% to 100%) and median specificity was 92% (range 61% to 100%). (13) Highest sensitivity was reported for asthma, back pain, thyroid disease, overweight and diabetes; and lowest sensitivity for kidney disease, coronary artery disease, and neurologic conditions.(13)

Respondents also completed a short validated depression screen and measure of health status, and answered questions designed to assess potential barriers to their medical self-management. (24-26) The potential barriers consisted primarily of biopsychosocial factors that had the potential to interfere with self-management and were based on both the self-management literature and a previous qualitative investigation.(27) In the current study, we analyzed these factors as potential correlates of disease burden. These biopsychosocial factors are listed (as part of the presentation of results) in Table 2. Additional details of the previous investigation are reported elsewhere.(23)

In addition to measuring subjective disease burden, we calculated morbidity scores for each respondent using both the Quan comorbidity index (which is based on ICD-9 codes for 30 conditions from the medical record) and the Chronic Disease Score (CDS) (which is based on automated pharmacy data).(17;19) The CDS score incorporates age and gender; disease states are weighted according to their severity and the complexity of the medication regimen used to treat them. (17) We used both inpatient and outpatient diagnoses in calculating the Quan index; the CDS incorporates all outpatient prescriptions. Both scores are based on data from the year prior to the survey.

In the original investigation, we estimated that we would need a minimum of 290 participants to have 80% power to detect an R-squared of 0.02 attributed to any given variable with a significance level of 0.05 and adjusted for an additional 10 independent variables.

Analysis

We used Wilcoxon rank-sum or Kruskal-Wallis tests to examine the bivariate relationship between the non-normally distributed variable for disease burden and the categorical demographic variables. In addition to calculating bivariate correlations between the outcome of disease burden and independent variables, we calculated partial correlation coefficients to measure the association between burden of disease and the biopsychosocial factors adjusting separately for the effect of the two other measures of morbidity (Quan and CDS). In order to assess the effect of the administrative data-based morbidity indices on the relationship between the biopsychosocial factors and disease burden, we tested the significance of the difference between the unadjusted and the partial correlation coefficients using bootstrapping samples. Bootstrapping is a technique for drawing statistical inferences from intermediate-sized data sets about the larger parent population when exact analytic solutions are unavailable. We re-sampled, with replacement, 1,000 times from our population to determine whether the correlation coefficients between each factor and disease burden was significantly different after adjusting for either of the comorbidity indices.

We examined the residuals to assure that the assumptions of linear regression were not violated. We developed three multiple linear regression models to evaluate disease burden as a function of the biopsychosocial factors, demographic characteristics, and the two data-based measures of morbidity. The first model consisted of an assessment of the baseline contribution of the independent variables without including a morbidity index in the model. The second model incorporated the Quan morbidity index, and the third incorporated the CDS. We used both forward selection and backward elimination to determine models with the best fit. Independent

variables significant at $p \leq 0.15$ in bivariate analyses were considered for inclusion in multivariate models. Once significant predictors were defined, we assessed potential positive or negative confounding by other covariates by adding them each individually to the model and quantifying the change in the regression parameters of the main effects. We also explored two-way interactions between main effects and between the main effects and other independent variables. All analyses were conducted using SAS Version 9.1 (SAS Institute, Cary, NC).

Results

Surveys were completed by 352 HMO members with diabetes, depression, and osteoarthritis as well as other conditions. There were slightly more female than male respondents, half were married, they were predominantly Caucasian, and had relatively low levels of household income. Twelve percent had excellent or very good health status, 38% good, 36% fair, and 14% reported poor health status. On average they had 9.2 chronic medical diseases. Characteristics of respondents are listed in Table 1. The distribution of disease burden scores in the study population is illustrated in Figure 2.

In bivariate analyses, multiple biopsychosocial factors and the Quan and CDS morbidity indices were significantly associated with our measure of disease burden. Table 2 presents these correlations as well as partial correlation coefficients for the association of disease burden with all of the biopsychosocial factors, adjusted for either the Quan morbidity index or the CDS. The partial correlation coefficients did not differ significantly from the unadjusted correlation coefficients indicating that neither data-based morbidity index significantly affected the correlation between the biopsychosocial factors and disease burden.

In multivariate analyses five biopsychosocial factors and the pharmacy-based (CDS) morbidity score contributed differentially to the three regression models. In order to determine the relative associations of each of the independent variables with disease burden, we calculated the standardized regression coefficients in addition to the parameter estimates. These show the change in outcome for a change in one standard deviation of the independent variable. The models with the best goodness-of-fit (as determined by R^2) can be seen in Table 3.

In the baseline model in which the other morbidity indices were not included, age and compound effects of conditions, along with self-efficacy (confidence in managing one's medical conditions), financial constraints, and physical functioning, were significantly associated with disease burden. Adding the Quan morbidity index (model 2) did not significantly change these multivariate associations and the Quan itself was not significantly associated with the outcome of disease burden. The CDS was significantly associated with subjective disease burden. However, incorporating this score (model 3) did not appreciably increase the R-square value over baseline. The variables of physical functioning, financial constraints, self-efficacy, and compound effects of conditions were consistently associated with disease burden regardless of whether the data-based morbidity indices were in the models.

Discussion

These results indicate that our measure of self-reported disease burden represents a complex amalgamation of functional capabilities, social considerations, and medical conditions that are not captured by two data-based measures of morbidity. This suggests that a) self-reported descriptions of multimorbidity incorporate biopsychosocial constructs that reflect the perceived burden of multimorbidity, b) a simple count of diagnoses should be supplemented by an assessment of limitations imposed by these conditions, and c) choice of morbidity measurement instrument should be based on the outcome of interest rather than the most convenient method of measurement.

These findings are consistent with previous investigations that demonstrate that the incorporation of severity assessment improves the predictive validity of self-report morbidity measures, and that severity assessment is particularly important when morbidity is measured as part of investigations assessing functional or general health status outcomes.(5;8;9;14;15; 28-32) We expand on these findings to explore the constructs underlying self-report of conditions with associated severity assessment.

When respondents with multimorbidities in this investigation quantified their level of morbidity, they incorporated the effect of conditions on their level of physical functioning, reflected their level of confidence in managing their medical conditions (self-efficacy), and reflected the burden of financial constraints imposed by their multimorbidities. They also captured the concept that having discordant chronic conditions in which symptoms and/or treatments interfere with each other ('compound effects of conditions') adds to disease burden.

We were not surprised to find that respondents incorporated level of physical functioning into their assessment of their own disease burden—especially since the instrument was worded to capture how much their conditions “interfered with daily activities”. This concept would not be fully captured by either ICD-9 diagnoses, or morbidity assessments based on pharmacy data.

The significance of financial constraints in this model may reflect the particular burden of multimorbidity for seniors on fixed incomes (even in an insured HMO population) and is consistent with other suggestions that social constructs such as socioeconomic status affect the complexity of patient care.(32-34) For example, the questions that inquired about financial constraints in the survey asked whether respondents had cut down on other purchases as a result of health care expenses and whether they were able to pay for all their health care needs and prescriptions. These concepts might be partially captured by a pharmacy-based index, but would not necessarily be captured by the ICD-9-based Quan index.

Self-efficacy is an important personal resource that can substantially affect successful self-care and health outcomes for persons with chronic conditions.(35-37) The current self-report measure suggests that low self-efficacy may magnify limitations imposed by chronic conditions and that a higher burden of chronic conditions is independently associated with lower self-efficacy. This is particularly important given that interventions to improve self-efficacy in heterogeneous populations can result in improved health outcomes.(36)

The final factor captured by disease burden is what we term ‘compound effects of conditions.’ This is the concept that, for certain coexisting conditions, symptoms and/or treatments interfere with each other. For respondents with these discordant conditions, their disease burden is more than the sum of the parts of their diagnoses. This concept is particularly difficult to capture using data-based morbidity assessments, which is an argument for including self-report as part of a complete assessment of health status in persons with multiple chronic conditions.

A complete description of health includes a range of perspectives from those that are completely subjective (such as the perception of pain) to those that are more objective (such as the observation of dementia).(38) This disease burden instrument primarily measures aspects of health (and morbidity) that are subjective in nature: the perceived limitation due to a constellation of medical conditions (and the underlying equally subjective biopsychosocial constructs). Likewise, a complete description of health status can be described in terms of multiple outcomes. These include more ‘objective’ outcomes such as cost, as well as more ‘subjective’ outcomes such as quality of life. Although the two administrative data-based morbidity instruments that we used (Quan and CDS) did not contribute to our measure of disease burden, these measures have been extensively validated against other health outcomes such as utilization and cost of care.(17;19) Choosing the correct instrument to assess morbidity

burden for any outcome requires knowledge of the components captured by different measures. Often the richest assessment will result from incorporation of more than one morbidity measure.⁽³⁹⁾ Choice of morbidity measurement instruments should be based on the outcomes of interest rather than simply on the most convenient methods for measurement. Furthermore, complete measurement of morbidity to reflect overall health status likely requires the use of self-report in addition to other measures.

Limitations

In this investigation, we report a self-reported subjective outcome (disease burden) as a function of self-reported biopsychosocial constructs. These analytic methods raise the possibility of misclassification bias in which respondents are inclined to bias their reports of exposures (the biopsychosocial constructs) in the same direction as their reports of outcomes (disease burden)—creating an artificially significant association between the two. However we would argue that it is the intention of a self-report measure to capture the subjective perspective of health status (and associated biopsychosocial constructs as we illustrate here) just as other measures of morbidity capture different, more objective perspectives of health status. For example, persons who report greater severity of disease burden may perceive greater limitations in physical functioning and self-efficacy. We propose that these are valid perceptions, and that measuring subjective health status is by definition measuring ‘personal bias’.

This exploration of constructs underlying a self-report morbidity assessment tool is limited by a relatively small sample of respondents from a single health care setting. Participation in the survey may have been negatively affected by the length of the survey (30 minutes)—especially for frail persons. If so, our results would be biased to reflect higher-functioning respondents. However we are reassured by a relatively normal distribution of reported health status including substantial numbers with fair or poor health. In this sample, we found that certain biopsychosocial factors were not significantly associated with disease burden although we thought that they might be. For example, a positive depression screen was not associated with disease burden. As depression is an important comorbidity for persons with chronic illness, this should always be assessed as part of any full evaluation of health status. Furthermore, the factors that we assessed as independent variables only accounted for 38% of the variance in the disease burden score, suggesting that other predictors of disease burden remain unexplained. Based on the lack of significance of the data-based morbidity measures in predicting disease burden, it is unlikely that these complexities will be explained by medical diagnoses alone.

Conclusions

Subjective weighting of conditions in measuring morbidity incorporates multiple biopsychosocial factors that are not captured by two other data-based methods of measuring morbidity. It is important to incorporate severity into morbidity assessments, rather than relying on simple counts of conditions; and the choice of morbidity measurement instrument should be based on the outcome of interest rather than on the most convenient methods for measurement.

In the clinical arena, self-report of disease burden may prompt exploration of self-efficacy for self-management of illness, physical abilities, financial constraints, and patient treatment priorities. These assessments could then be coupled with appropriate clinical support to improve health outcomes. Further investigation will be required to determine if this or similar subjective multimorbidity assessment instruments prove useful for clinical assessment and for following morbidity over time.

What is New?**Key finding:**

- A measure of self-reported disease burden integrates functional capabilities, social considerations, and medical conditions that are not captured by two administrative data-based measures of morbidity.

What this adds to what was known:

- Self-reported descriptions of multimorbidity incorporate biopsychosocial constructs that reflect the perceived burden of multimorbidity.

What is the implication? What should change now?

- In order to assess the impact of multimorbidity, a simple count of diagnoses should be supplemented by an assessment of activity limitations imposed by these conditions.
- Such a measure may be particularly well suited to investigations of patient-centered outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Figure 1.
Conceptual model of components of self-reported morbidity: 'disease burden'.

Figure 2. Range of disease burden among respondents

Table 1

Characteristics of participants (N = 352)

Characteristic	N (%)
Male gender	121 (34)
Age group	
65-74	193 (55)
75+	159 (45)
Education	
Some high school or less	36 (10)
High school graduate/GED	124 (35)
Some college/2-year degree	109 (31)
4-year college graduate or more	78 (22)
Marital status	
Married	187 (53)
Divorced/Separated	50 (14)
Never married	6 (2)
Widowed	103 (29)
Race	
Black/African American	7 (2)
White/Caucasian	306 (90)
Other	29 (8)
Ethnicity	
Hispanic/Latino	37 (11)
Non-Hispanic/Latino	308 (88)
Income	
< \$45,000	269 (76)
\$45,000+	59 (17)
Subjective health status	
Excellent	5 (1)
Very Good	39 (11)
Good	132 (38)
Fair	125 (36)
Poor	51 (14)
Mean Quan morbidity score (s.d.) ¹	4.8 (2.5)
Mean RxRisk score (s.d.) ²	8.4 (3.4)
Mean number of self-reported diagnoses (s.d.) ³	9.2 (2.9)
Mean disease burden (s.d.)	20.0 (10.4)

¹Range 0 to 14.²Range 0 to 21.³From a list of 21 conditions, plus (up to 4) conditions added by the respondent. Range 1 to 17.

Table 2
Correlations between biopsychosocial factors and morbidity indices and subjective disease burden. Partial correlation coefficients adjusted for morbidity indices

Independent variable	Correlation coefficient ¹	Partial correlation coefficients ²	
	Unadjusted	Adjusted for Quan morbidity index	Adjusted for CDS
Physical functioning	- 0.512*	-0.467	-0.456
Compound effects: conditions interfere ³	- 0.406*	-0.389	-0.396
Self-efficacy	- 0.378*	-0.389	-0.379
Financial constraints	- 0.365*	-0.345	-0.335
Overwhelmed by single condition	- 0.332*	-0.318	-0.313
Depression screen	- 0.286*	0.279	0.296
Medication adherence	- 0.247*	-0.278	-0.280
Compound effects: medications interfere ³	- 0.222*	-0.204	-0.197
Knowledge about conditions	- 0.211*	-0.213	-0.219
Patient-provider communication	- 0.202*	-0.213	-0.208
Social activity	- 0.181**	-0.168	-0.164
Medication knowledge	- 0.159**	-0.166	-0.161
Health literacy	- 0.131 [^]	-0.104	-0.116
Compound effects: medications help ³	0.055	0.032	0.021
Compound effects: conditions help ³	0.003	0.002	-0.008
Quan morbidity index	0.226*	---	---
Chronic Disease Score	0.263*	---	---
Self-report list of conditions	0.807*	---	---

¹* p < 0.001; ** p < 0.01; [^] p < 0.05 for association between independent variable and disease burden.

² Adjusted for Quan morbidity index or CDS. The significance of the difference between the unadjusted total and the partial correlation coefficients was tested using 1,000 bootstrapping samples. None of the differences was found to be significantly different from zero, indicating that adjusting for either of these two co-morbidity measures does not change the relationship between the independent variable and burden.

³ We defined 'compound effects of conditions' as a report of treatments or symptoms for different conditions either interfering with or helping each other. (E.g. 'my arthritis makes it hard for me to exercise to treat my diabetes.')

Table 3

Multivariate regression: Factors associated with disease burden

Independent variable (range)	Baseline Model ^I (R ² = .37)				Model 1 ^I (R ² = .37)			Model 2 ^I (R ² = .38)		
	Parameter Estimate	95% CL	Standardized Estimate		Parameter Estimate	95% CL	Standardized Estimate	Parameter Estimate	95% CL	Standardized Estimate
Physical functioning (0-100)	-0.143 (-0.178, -0.108)		-0.373		-0.138 (-0.175, -0.102)		-0.361	-0.131 (-167, -0.095)		-0.342
Financial constraints (0-100)	-0.063 (-0.100, -0.027)		-0.160		-0.063 (-0.099, -0.026)		-0.159	-0.061 (-0.098, -0.025)		-0.155
Compound effects of conditions (0-100)	-0.091 (-0.138, -0.044)		-0.196		-0.090 (-0.136, -0.043)		-0.193	-0.091 (-0.137, -0.045)		-0.197
Self-efficacy (0-100)	-0.056 (-0.110, -0.002)		-0.104		-0.058 (-0.112, -0.003)		-0.107	-0.058 (-0.112, -0.004)		-0.107
Age group (65-74, 75+)	-1.968 (-3.737, -0.200)		-0.094		-2.037 (-3.812, -0.262)		-0.098	-1.913 (-3.672, -0.154)		-0.092
Quan comorbidity index (0-14)	----	----	----		0.168 (-0.203, 0.539)		0.041	----	----	----
Chronic Disease Score (0-21)	----	----	----		----		----	0.306 (0.030, 0.583)		0.098

^IThe three multiple linear regression models evaluate disease burden as a function of the biopsychosocial factors, demographic characteristics, and different data-based measures of morbidity. The first model consists of an assessment of the baseline contribution of the independent variables without including a morbidity index in the model. The second model incorporates the Quan morbidity index, and the third incorporates the CDS.