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How to weight chronic diseases in multimorbidity indices? Development of a new method on the basis of individual data from five population-based studies

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Abstract

Objective: In multimorbidity indices, chronic conditions are often weighted according to their severity or their impact on different outcomes. These weights are mostly developed on the basis of only one study population by using very specific study participants, such as hospital patients. To overcome the limited validity of the indices, mean weights across five population-based studies were calculated according to the impact of diseases on self-reported health status.

Study Design and Setting: Individual data was provided from the National Health Interview and Examination Survey ($n = 1{,}010$), Dortmund Health Study ($n = 281$), Memory and Morbidity in Augsburg Elderly Study ($n = 385$), Survey of Health, Aging and Retirement in Europe Study ($n = 1{,}278$), and Study of Health in Pomerania Study ($n = 962$). By using logistic regression analysis, odds ratios (ORs) were calculated for reporting a fair or poor health status resulting from one of 10 different chronic conditions compared with a reference group without the specific disease, controlling for age and sex. If the results were homogenous across studies ($I^2 < 40\%$), significant pooled ORs were considered valid weights for a multimorbidity index.

Results: Myocardial infarction has the highest impact on self-reported health status across studies with a pooled OR of 3.9, followed by chronic obstructive pulmonary disease (pooled OR: 3.1). A medium impact was observed for arthrosis, asthma, diabetes mellitus, and osteoporosis.

Conclusion: This method provided valid weights for seven chronic conditions.

Keywords: Chronic diseases; Health status; Multimorbidity; Index; Weights; Pooled odds ratios

1. Objective

The demographic change is a worldwide phenomenon, leading to a progressive aging of the population. Because age is associated with many health problems, the number of people suffering from multimorbidity—defined as the coexistence of two or more chronic conditions [1]—will also rise in future. For the United States, it is estimated that by 2020, 24% of the population will suffer from two or more conditions [2].

Multimorbidity has a substantial impact both on the individual and on the health care system. It is associated with a higher mortality risk [3], decreasing quality of life [4], and declining functional status [5]. Furthermore, multimorbidity causes longer hospital stays, postoperative complications [6], and higher overall health care utilization and costs. For example, in the United States the annual Medicare payment for beneficiaries in 2005 ranged from $7,172 for individuals with one chronic condition to $32,498 with three or more diseases [7]. Despite the growing importance of multimorbidity, there are conceptual differences in the understanding and a lack of standardization in instruments—referred to as multimorbidity indices—to describe the prevalence and impact of multiple chronic diseases [8]. Existing instruments are characterized by their large heterogeneity in terms of the number, type, and weighting of conditions to be considered. Although some researchers only include five

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What is new?

- Individual data from five population-based studies were used to calculate valid weights for diseases included in multimorbidity indices.
- Homogenous results for the impact of seven out of 10 chronic diseases on self-reported health status across five studies were obtained.
- Compared with past approaches, where weights were mostly calculated on the basis of very specific study population such as hospital patients, it is the first attempt to use representative data from more than one study population.
- The method can be extended to other outcomes such as functional impairment, mortality, or health care costs.

selected diseases in an index, for example cancer, diabetes, hypertension, coronary heart diseases, and stroke [9], others consider up to 185 different diagnoses [10]. Apart from the number of diseases, the spectrum of conditions is also wide. This is further enhanced by the fact that indices focus on different organ systems, such as cardiovascular or psychiatric diseases, or by highly distinct disease differentiation, for example between lymphocytic leukemia and myelogenous leukemia [11].

The heterogeneity between instruments continues in the application of weights to different conditions. Weights allow the adaptation of an index to a specific outcome, but use and definition of weights vary widely across instruments. The most frequently used method is to base the weight on the perceived severity [12,13] or the level of impairment [14] caused by a disease. By calculating the mean self-reported burden for each disease, a final index is developed.

Another established method is the empirical derivation of weights according to the impact of diseases on different outcomes, such as mortality [11,15], daily functioning [16], or on hospital stays [17]. Dependent on the outcome, the specific weights are calculated from odds or hazard ratios, relative risks (RRs) or regression coefficients.

Finally, specific criteria, such as the cholesterol level, provide the basis for classifying diseases according to their level of severity. One example is the ''Chronic Disease Score,'' which derives information on the severity of diseases from the type of prescribed medicine [18].

Overall, most of the weighted indices are developed on the basis of hospitalized, older patients [11,13,15,19–23], veterans [12,24], Medicare enrollees [3], or members of the Health Maintenance Organization [14]. Only a few indices, such as the Chronic Disease Score [18] use data from general population studies. However, weights are usually derived from only one single study population. This limits their generalizability and their transferability to other studies or to the general population.

This, the objective of this analysis is to present a method how to calculate weights for different chronic conditions according to their impact on self-reported health status across five population-based studies. This outcome has become increasingly important in multimorbidity research as a treatment objective [14].

2. Study design and setting

2.1. Setting and sample

For the calculation of weights, we used individual data from five population-based studies conducted in Germany including the National Health Interview and Examination Survey 1998 (NHIES) [25], the Dortmund Health Study (DHS) [26], Memory and Morbidity in Augsburg Elderly (MEMO) Study [27], German participants of the Survey of Health, Aging and Retirement in Europe (SHARE) [28], and the Study of Health in Pomerania (SHIP) [29]. To increase the homogeneity between the data sources, we only included participants aged ≥65 years in the analysis. Informed consent was obtained from all the patients.

The *NHIES* was conducted from 1997 to 1998 by the Robert Koch Institute (RKI) on behalf of the Federal Ministry of Health. It was the first survey to provide representative information on the health status of citizens between 18 and 79 years in the reunified Germany [25]. All 7,124 participants underwent a physical examination and filled out a questionnaire, covering information on health-related behavior and living conditions, health risk factors, physical activity, diet, chronic diseases, and quality of life. For our analysis, data from 1,010 participants ≥65 years were used from the public-use file.

The *DHS* is a prospective study on the prevalence, determinants, and effects of headache and other chronic diseases in the city of Dortmund in Germany [26]. A total of 1,313 randomly selected citizens between 25 and 74 years participated in a personal interview, providing information on their socioeconomic status, health problems, quality of life, and physical functions. Baseline data was collected in 2003 and 2004. Two hundred eighty-one people ≥65 years were eligible for our analysis.

The *MEMO* Study is a cross-sectional study [27] including 385 seniors between 65 and 84 years, who were recruited from former participants of the MONICA-project (Monitoring Trends and Determinants in cardiovascular Disease) in Augsburg in Germany. The primary objective of MEMO was to assess the impact of cardiovascular risk factors on cognitive decline and dementia. Between 1997 and 1998, information on the prevalence of chronic diseases, quality of life, cognitive functions, and health care utilization was collected.

SHARE is a longitudinal, cross-national database on health, socioeconomic status, and social and family