

# Prevalence of Multimorbidity in a Geographically Defined American Population: Patterns by Age, Sex, and Race/Ethnicity

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## Abstract

**Objective:** To describe the prevalence of multimorbidity involving 20 selected chronic conditions in a geographically defined US population, emphasizing age, sex, and racial/ethnic differences.

**Patients and Methods:** Using the Rochester Epidemiology Project records linkage system, we identified all residents of Olmsted County, Minnesota, on April 1, 2010, and electronically extracted the *International Classification of Diseases, Ninth Revision* codes associated with all health care visits made between April 1, 2005, and March 31, 2010 (5-year capture frame). Using these codes, we defined the 20 common chronic conditions recommended by the US Department of Health and Human Services. We counted only persons who received at least 2 codes for a given condition separated by more than 30 days, and we calculated the age-, sex-, and race/ethnicity-specific prevalence of multimorbidity.

**Results:** Of the 138,858 study participants, 52.4% were women (n=72,732) and 38.9% had 1 or more conditions (n=54,012), 22.6% had 2 or more conditions (n=31,444), and 4.9% had 5 or more conditions (n=6853). The prevalence of multimorbidity ( $\geq 2$  conditions) increased steeply with older age and reached 77.3% at 65 years and older. However, the absolute number of people affected by multimorbidity was higher in those younger than 65 years. Although the prevalence of multimorbidity was similar in men and women overall, the most common dyads and triads of conditions varied by sex. Compared with white persons, the prevalence of multimorbidity was slightly higher in black persons and slightly lower in Asian persons.

**Conclusion:** Multimorbidity is common in the general population; it increases steeply with older age, has different patterns in men and women, and varies by race/ethnicity.

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Current population growth in the United States, increases in the older adult population, and changes in disease dynamics predict major increases in the prevalence of chronic diseases and combinations of chronic conditions (ie, multimorbidity) and threaten the public health and the financial health of the country. Medical, public health, and social programs have traditionally focused on single chronic diseases without considering the broader context of multiple risk factors and multimorbidity. Consequently, clinical practice guidelines focusing on a single disease may be inadequate when applied to persons with multimorbidity and may increase polypharmacy.<sup>1,2</sup> The high prevalence of multiple chronic conditions necessitates the

planning of preventive, treatment, and public health programs.<sup>2-11</sup>

In response to this health crisis, in 2010 the US Department of Health and Human Services developed a list of 20 conditions considered public health priorities for the nation and created a strategic framework for optimizing health and quality of life for individuals with multimorbidity.<sup>3,4</sup> Despite national concerns, the United States has no comprehensive, clinical records-based data sets for all ages and for all regions of the nation in which to study multimorbidity.<sup>7</sup> Therefore, important information may come from smaller populations for which a data collection infrastructure is in place. We used the records linkage system maintained by the Rochester Epidemiology

Project (REP) to study patterns of multimorbidity in a geographically defined US population, with emphasis on its distribution by age, sex, and race/ethnicity.<sup>12</sup> The characterization of multimorbidity patterns in a geographically defined population allows comparisons with other localized populations in the United States or worldwide to investigate geographic similarities or differences. In addition, these findings can be used to guide decisions for clinical practice or public health in the local community. Therefore, this study has important implications for a broad number of practitioners locally and at the national and international levels.

## PATIENTS AND METHODS

### Study Population

Most medical care in Olmsted County, Minnesota, has been provided historically and is currently provided by a few health care institutions: Olmsted Medical Center and its affiliated hospital, Mayo Clinic and its two affiliated hospitals, Rochester Family Medicine Clinic, and a few smaller care facilities. The health care records from these institutions are linked together through the REP records linkage system.<sup>12-14</sup> Persons are considered residents of Olmsted County at the time of each health care visit based on their address (REP Census). The population counts obtained by the REP Census are similar to those obtained by the US Census, suggesting that virtually the entire population of the county is captured by the system.<sup>13,15</sup> We used the REP Census to identify all individuals who resided in Olmsted County on April 1, 2010, but we excluded those who had not given permission to use their medical records for research.<sup>13,16,17</sup>

### Definition of 20 Selected Chronic Conditions

The diagnostic indices of the REP were searched electronically to identify the *International Classification of Diseases, Ninth Revision (ICD-9)* codes associated with any health care visit between April 1, 2005, and March 31, 2010 (5-year capture frame). We then pooled the ICD-9 codes to define the 20 groups of chronic conditions proposed by the US Department of Health and Human Services.<sup>3,4,18</sup> The list of the 20 conditions and the corresponding ICD-9 codes used in this study are provided in

Supplemental Table 1 (available online at <http://www.mayoclinicproceedings.org>).<sup>3,18</sup>

To decrease the risk of false-positive diagnoses, only persons who received 2 codes for a given condition separated by more than 30 days within the 5-year capture frame were considered prevalent for a given condition. We defined multimorbidity as the presence of 2 or more of the 20 conditions in the 5 years before April 1, 2010 (the prevalence date). To explore more complex patterns of multimorbidity, we also counted the number of people with 5 or more of the 20 conditions within the same time frame. We used the term *multimorbidity* rather than its predecessor, *comorbidity*, because we did not consider any specific index condition (the 20 conditions were all treated equally).<sup>5</sup>

### Statistical Analyses

The point prevalence of each chronic condition and of multimorbidity was measured using April 1, 2010, as the prevalence date and a 5-year capture frame (the 5 years preceding the prevalence date).<sup>19</sup> We also computed the age-, sex-, and race/ethnicity-specific prevalence of multimorbidity, defined as combinations of 2 or more chronic conditions or of 5 or more chronic conditions. For analyses stratified by race/ethnic group, we used the 3 most common groups in the local population: white, black, and Asian individuals (as defined by the US Census). In addition, for each age and sex group, we described the most common combinations of 2 of the 20 conditions (dyads) or of 3 of the 20 conditions (triads). Dyads and triads were considered independently; therefore, a person with 3 of the 20 conditions was considered to have 3 distinct dyads and 1 triad. For example, a person affected by the triad of hyperlipidemia, hypertension, and diabetes generated 3 distinct dyads: hyperlipidemia and hypertension, hypertension and diabetes, and hyperlipidemia and diabetes.

We developed a heat map to show the co-occurrence of each pair of the 18 most common conditions using absolute frequencies. The top-left triangle of the map refers to women, and the lower-right triangle refers to men. Hotter colors (darker orange) correspond to a higher frequency of co-occurrence (a higher prevalence of a dyad). We also developed a second heat map to show the ratios of observed vs expected frequencies of co-occurrence (accounting for

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