HHS Public Access

Author manuscript

Gen Hosp Psychiatry. Author manuscript; available in PMC 2016 May 01.

Published in final edited form as:

Gen Hosp Psychiatry. 2015 ; 37(3): 199–222. doi:10.1016/j.genhosppsych.2015.03.004.

Review of the Evidence: Prevalence of Medical Conditions in the United States Population with Serious Mental Illness

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Abstract

Objective—Persons with serious mental illness (SMI) have high rates of premature mortality from preventable medical conditions, but this group is underrepresented in epidemiologic surveys and we lack national estimates of the prevalence of conditions such as obesity and diabetes in this group. We performed a comprehensive review to synthesize estimates of the prevalence of 15 medical conditions among the population with SMI.

Method—We reviewed studies published in the peer-reviewed literature from January 2000-August 2012. Studies were included if they assessed prevalence in a sample of 100 or more US adults with schizophrenia or bipolar disorder.

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Competing interests
The authors declare that they have no competing interests.

Authors' contributions
All authors (EJ, EM, SA, DJB and GD): 1) have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) have been involved in drafting the manuscript or revising it critically for important intellectual content; and 3) have given final approval of the version to be published.

Results—57 studies were included in the review. For most medical conditions, the prevalence estimates varied considerably. For example, estimates of obesity prevalence ranged from 26% to 55%. This variation appeared to be due to differences in measurement (e.g. self-report versus clinical measures) and underlying differences in study populations. Few studies assessed prevalence in representative, community samples of persons with SMI.

Conclusions—In many studies, the prevalence of medical conditions among the population with SMI was higher than among the overall US population. Screening for and monitoring of these conditions should be common practice in clinical settings serving persons with SMI.

Keywords

Schizophrenia; Bipolar Disorder; Medical Co-morbidity; Prevalence

INTRODUCTION

Persons with serious mental illness (SMI) die prematurely of the same disorders that are common causes of death in the general population, such as cardiovascular disease and cancer.[1] Those with SMI experience high burden of conditions that heighten risk for cardiovascular disease, including obesity, hyperlipidemia, hypertension, and diabetes mellitus.[2] High rates of cardiovascular risk factors among this group appear to be driven by lack of physical activity,[3] poor diet,[4] high rates of smoking,[5] and side effects of commonly prescribed antipsychotic medications which include weight gain and altered glucose metabolism.[6] Importantly, some of these risk behaviors – such as poor diet and smoking – also place persons with SMI at heightened risk of cancer, which prior studies suggest is more likely to occur among persons with SMI.[7] Persons with SMI appear to be at heightened risk of experiencing other medical conditions, as well. Prevalence of kidney disease,[8] hepatitis,[9] and human immunodeficiency virus (HIV)[9] are heightened among persons with SMI. High prevalence of hepatitis and HIV may be driven by high rates of high-risk sexual behaviors and intravenous drug use among this vulnerable population.[10]

Elevated rates of co-morbid medical conditions in the population with SMI are likely caused by multiple factors. In addition to the health behaviors and metabolic side effects of antipsychotic medications described above, persons with SMI are more likely than those without SMI to experience social risk factors, such as poverty,[11] unemployment,[12] homelessness,[13] and disability.[14,15] A large body of research in the general US population has demonstrated that these social risk factors are associated with significantly increased risk of poor health outcomes.[16-18] These social factors are also associated with the unhealthy behaviors such as smoking and risky sexual activity which are overrepresented in the population with SMI.[16] There are multiple pathways through which social factors influence health behavior and health outcomes: for example, living in a socioeconomically disadvantaged neighborhood can lead to inadequate access to affordable healthy food and safe places to exercise.[18,19] Research suggests that overall, persons with SMI are less likely to receive preventive health services, such as screening for cardiovascular risk factors, and high-quality medical care than persons with SMI, although quality of care varies considerably by specific study population.[20] In addition, some research suggests that persons with SMI have difficulty effectively managing their chronic conditions,[21] although

others show that this group is as or more skilled at some aspect of self-management than persons without mental illness.[22]

In several European countries, population registries allow researchers and policy makers to track the prevalence and incidence of medical conditions among persons with SMI over time. Similar to US studies, these national registry-based studies show significantly increased risk for and prevalence of comorbid medical conditions among the population with SMI.[23-26] Unlike in nations with population registries, to date no national studies in the US measure both SMI and major medical conditions in the overall US population, making it impossible to generate nationally representative estimates of the prevalence of medical co-morbidities in the population with SMI. While the National Co-Morbidity Survey (NCS) assessed the prevalence of mental health and substance use disorders, including SMI, in a nationally representative sample of participants in 1990-1992 and again in 2001-2002 (NCS-Replication), these studies did not measure medical co-morbidities. Multiple national studies measure the prevalence of major medical conditions among the overall United States (US) population, but do not measures SMI diagnoses. Surveys such as the National Health Interview Survey (NHIS),[27] the Behavioral Risk Factor Surveillance System (BRFSS)[28] and the National Health and Nutrition Examination Survey[29] (NHANES) track prevalence of medical conditions over time in nationally representative samples of Americans. The NHANES and BRFSS measure depression using the PHQ-9,[28,29] and the NHIS measures psychological distress using the Kessler-6 Psychological Distress Scale.[27]

There is significant variation in measurement techniques across these national studies, which have important implications for prevalence estimates. Self-report of medical conditions through national surveys has been shown to lead to underestimation of true prevalence, as has use of administrative claims data to identify medical conditions.[30] Supplementing self-reported medical history with physical examination and laboratory data, such as available in the NHANES, provides more valid measurements for most conditions.[30] Critically, none of these national studies measure diagnoses of psychotic disorders, such as schizophrenia or bipolar disorder. Researchers using the NCS data have defined SMI as presence of any mental disorder associated with substantial interference in one or more major life activities,[31] and the Kessler-6 scale included in the NHIS is a symptomatology-based measure shown to have poor specificity.[32] These broad definitions of SMI include individuals with a variety of diagnoses and are more inclusive than diagnostic-based definitions of SMI that include people with schizophrenia or bipolar disorder. Schizophrenia and bipolar disorder, the two diagnoses most commonly used to define SMI in prior research,[33-35] are rare conditions: an estimated 1.1%[36] of Americans have schizophrenia and 2.6%[37] have bipolar disorder. As a result, oversampling persons with SMI in national epidemiologic studies – a strategy commonly used to create representative samples of other subpopulations of interest[38] – would be very costly: if 1% of the population has schizophrenia, 100,000 individuals would need to be screened in order to identify 1,000 potential survey participants. In addition, prior research has shown that SMI diagnoses are under-reported, potentially due to stigma. As a result, the gold standard for identifying SMI is use a structured diagnostic interview, which takes significant time and is administered in-person by a trained interviewer.[39] Including such an interview in national surveys is likely infeasible due to cost and interviewer and respondent burden. Persons with SMI comprise a

vulnerable population with high rates of premature mortality from preventable medical conditions. In the absence of national data, it is important to assess the variation in and quality of existing prevalence estimates. For researchers and practitioners working to ameliorate the burden of medical conditions among the population with SMI, a synthesis of existing prevalence estimates could inform the design and implementation of interventions targeting this vulnerable group. To our knowledge, to date no such synthesis exists. To fill this gap, we reviewed studies published between January 2000 and August 2012 to summarize the prevalence of fifteen medical comorbidities in study populations with SMI. The goal of this review is to summarize prevalence estimates of co-morbid conditions among study populations published in the recent peer-reviewed literature. We envision this review as a first step in synthesizing the existing research on this topic. While studies of the incidence and etiology of co-morbid medical conditions among persons with SMI are critically important, they are outside the scope of this review. Examination of the state of the science on these topics warrants consideration in future reviews. Results of our review should inform data collection efforts, service-delivery, and research on the burden of prevalent medical comorbid conditions in this high risk population. As different nations have very different data collection and service delivery systems, as well as different social and cultural risk factors for medical co-morbidities in SMI (e.g. socioeconomic status and dietary habits), the National Institute of Mental Health (NIMH), which funded the review, asked us to limit our review to US study populations.

MATERIAL AND METHODS

PICOT Framework

Development of our review followed a modified PICOT (population, intervention, comparison, outcome, and time) framework, the accepted standard for designing literature reviews.[40] The goal of our review was to summarize prevalence estimates of medical conditions in the population with SMI, and as a result, the intervention and comparison categories of the PICOT framework did not apply to our study. We used the remaining elements of the framework to inform our design. The population of interest was defined as persons with schizophrenia and bipolar disorder. In the prior research, these two diagnoses are consistently associated with heightened morbidity and mortality due to medical conditions. The outcomes of interest were defined as fifteen major medical conditions identified as potentially important contributors to morbidity and premature mortality among persons with schizophrenia and bipolar disorder based on the epidemiologic literature and expert stakeholder feedback (see below). In order to focus upon the recent prevalence estimates most likely to inform policy and practice, we reviewed studies published in 2000 or later.

Topic Development and Review Design

On September 10-11, 2012, NIMH convened the meeting Improving Health and Longevity of People with Severe Mental Illness, bringing together diverse stakeholders to identify the most critically needed research to reduce premature mortality in people with SMI. Meeting participants included leading researchers on medical comorbidities in people with SMI and on prevention of and treatment for diabetes, heart disease, tobacco use, and drug abuse in the

general population. They were joined by state-level leaders who have implemented innovative programs to address comorbid medical conditions and risk factors in people with SMI; advocates for people with SMI; community mental health center leaders; representatives from other NIH institutes; and representatives from the Substance Abuse and Mental Health Services Administration (SAMHSA) and the Agency for Healthcare Research and Quality (AHRQ).

One recommendation that came out of this meeting was the need for a comprehensive review summarizing existing estimates of the prevalence of major medical conditions in the population with SMI. At the meeting, two of the authors of this manuscript (Drs. Daumit and McGinty) presented an overview of the epidemiologic literature on prevalence of major medical conditions in the population with SMI. Informed by this information, the expert stakeholders made recommendations regarding the inclusion and exclusion criteria for the review and identified major medical conditions of interest. NIMH contracted with this study's senior author (Dr. Daumit) to conduct the literature review. To complete the review, we identified studies meeting inclusion criteria, extracted prevalence estimates using a structured review protocol, and summarized the evidence regarding prevalence of major medical conditions among persons with SMI.

Definition of Major Medical Conditions

We identified major medical conditions and risk factors for morbidity and premature mortality among persons with SMI based upon the epidemiologic literature. Our final review assessed prevalence of 15 medical comorbidities among persons with SMI: (1) overweight; (2) obesity; (3) hyperlipidemia; (4) hypertension; (5) diabetes mellitus; (6) coronary heart disease; (7) congestive heart failure; (8) cerebrovascular disease; (9) overall cardiovascular disease; (10) chronic obstructive pulmonary disease (COPD); (11) kidney disease; (12) cancer; (13) hepatitis B; (14) hepatitis C and (15) HIV.

Identification of Relevant Studies

We searched EMBASE, PsychInfo, PubMed, SCOPUS and Web of Science for studies published from January 2000 through August 2012 that measured prevalence of the major medical conditions listed above in the population with SMI. Full search strategies are included in Appendix A. The titles and abstracts of all articles identified using these search strategies were independently reviewed by two reviewers (EM and GD) to determine if a given article met the inclusion criteria described below. Titles and abstracts deemed relevant by both authors were included in the study sample. In the case of discrepancy, the authors reviewed the full article and then conferred in order to make a final determination of whether or not it met inclusion criteria.

Inclusion and Exclusion Criteria

Studies were included in our comprehensive review if (1) they were published between January 2000 and August 2012; (2) they were published in English; (3) they measured prevalence in a US population; (4) they included participants aged 18 years or older; (5) the study sample included 100 or more participants and (6) the study population included persons with schizophrenia or bipolar disorder (studies that included persons with other

diagnoses, such as major depression or PTSD, were included only if the study also included participants with schizophrenia or bipolar disorder). Prevalence of medical conditions in the population with SMI may be calculated in a variety of study designs. For example, prevalence could be estimated at baseline in an intervention study, or as the primary outcome of interest in an observational epidemiologic study. As a result, we did not specify study type in our inclusion criteria.

Data Extraction

Data extraction was performed using a standardized review protocol (Appendix B). Prior to final data extraction, the standardized review protocol was piloted on 10 studies by two reviewers (EJ and EM) in order to refine the protocol and ensure consistency in extraction across two reviewers. Following piloting, one reviewer (EJ) extracted data from all articles included in the review, including year the study was published, year data was collected, the definition of the outcome measure, SMI diagnoses in the study population, and the prevalence of the outcome of interest. In addition, descriptors of the study population were extracted, including population size, population setting (inpatient, outpatient, community or other), and type of measurement (claims data, clinical, self-report or other).

Measures

With the exception of overweight and obesity, we included prevalence estimates of medical conditions among the population with SMI generated using administrative claims data (hospital data or insurance claims data), clinical measurement (data from a medical chart, or measured directly by a medical care provider), or self-report. Because claims data systematically undercounts overweight and obesity,[41] we excluded prevalence estimates for these conditions calculated using administrative claims data.

Following data extraction, we examined available measures for medical conditions of interest and selected key measures widely used in research and, when possible, established as valid and reliable by prior work (Table 1). Our final summaries of prevalence estimates included only these measures. When studies measured prevalence at multiple time points, we included the most recent estimate only.

Analysis

We calculated the median, mean, and range of prevalence estimates for each medical condition of interest. We stratified estimates by measurement type (administrative claims data, clinical measurement, self-report, other) and by study population (inpatient, outpatient, community, other). To allow for descriptive comparisons between prevalence estimates in the population with SMI and the overall US population, in our summary of results for each medical condition of interest we include the most recently available published national prevalence estimates. We include prevalence estimates from two nationally representative surveys of the US population: the NHANES and the Behavioral Risk Factor Surveillance System (BRFSS). Given that measurement differences lead to variation in prevalence estimates, when available we provide two separate national prevalence estimates based on clinical and self-report data. As no national administrative claims dataset exists in the US, we do not report claims-based prevalence estimates for the overall US population.

RESULTS

A total of 57 studies were included in our review (see Figure 1). Key results for each condition from all studies are summarized in Table 2. The same results presented in Table 2 are displayed visually in figures 1-30 in Appendix C. For most medical conditions, the range in prevalence estimates among study populations with SMI was large. For example, estimates of obesity prevalence among persons with SMI ranged from 26.0% to 55.0% and estimates of hypertension prevalence ranged from 10.0% to 68.0%. Some of the variation in prevalence estimates within conditions appears to be due to differences in measurement. However, the range of prevalence estimates drawn from clinical measurements, which should be the most accurate,[42] was still quite large. For example, clinical measurements of the prevalence of hyperlipidemia among persons with SMI ranged from 10.8% to 61.0%. This suggests that in addition to differences in measurement, the characteristics (e.g. demographic factors, level of disability, and antipsychotic medication use) of different study populations of persons with SMI contribute to the variation in prevalence estimates. Most studies in our review focused on populations receiving inpatient or outpatient care. Prevalence estimates for only three conditions (overweight, obesity, and hypertension) were calculated using community samples of persons with SMI.

Overweight and Obesity

Estimates of the prevalence of overweight (median: 29.0%; range: 25.0%-58.0%) and obesity (median: 40.6%; range: 26.0%-55.0%) in persons with SMI were extracted from 16 studies[43-57] (23 measures). More studies used clinical measurements than self-reported measurements to estimate overweight (n=9 vs. n=3) and obesity (n=10 vs. n=4). In studies that used clinical measurements, estimates of the prevalence of overweight ranged from 25.0% to 58.0% and estimates of the prevalence of obesity ranged from 26.0% to 55.0%. For overweight, median prevalence estimates were similar among studies using clinical (29.5%) and self-report (27.8%) data. For obesity, the median prevalence estimate based on studies using clinical data (42.0%) was somewhat higher than the median estimate among studies using self-report data (36.3%). Estimates of overweight prevalence were higher in the one study using a community sample (41.4%) than in studies using inpatient (median prevalence 32.7%) or outpatient (median prevalence 29.0%) study populations. Estimates of obesity prevalence were higher in studies using outpatient samples (median prevalence 46.2%) opposed to inpatient (median prevalence 37.0%) or community (median prevalence 37.8%) study populations. In the overall US adult population, prevalence estimates of overweight and obesity calculated using clinical data are 33.1% and 35.7% (NHANES, 2009-2012).[58] Prevalence estimates for these two conditions calculated using self-report data are 35.4% and 29.4% (BRFSS 2013).[59]

Other Cardiovascular Disease Risk Factors

Estimates of the prevalence of hyperlipidemia (median: 26.6%; range: 9.0%-61.0%) in persons with SMI were extracted from 14 studies[43,57,60-71] (20 measures). The median prevalence estimates of hyperlipidemia among studies using claims (28.8%) and other (e.g. combined clinical and claims, 26.0%) data were higher than median prevalence estimates calculated using clinical (11.7%) or self-report (14.0%) data. Median estimates of

hyperlipidemia prevalence among inpatient (33.8%) and outpatient (30.0%) populations were similar and slightly higher than the median estimate among other study populations (24.8%). In the overall US adult population, the estimated prevalence of hyperlipidemia based on clinical data is 13.4% (NHANES, 2009-2010).[72] Estimates of the prevalence of hypertension (median: 35.0%; range: 10.0%-68.0%) among persons with SMI were extracted from 29 studies[43,46,47,50,53,56,57,60-68,70,71,73-83] (37 measures). The median prevalence estimates of hypertension among studies using claims (35.3%), clinical (37.8%) and other (e.g. a combination of claims and clinical, 34.0%) data were similar and higher than the median estimate among studies using self-report data (24.7%). Median estimates of hypertension were higher in the one study using a community population (47.0%) than in studies using inpatient (31.7%), outpatient (34.0%) or other (35.2%) samples. In the overall US adult population, prevalence estimates of hypertension are 28.6% using clinical data (NHANES, 2009-2010)[84] and 31.4% using self-report data (BRFSS 2013).[59] Estimates of the prevalence of diabetes mellitus (median: 12.5%; range: 6.9%-34.0%) among persons with SMI were extracted from six studies[43,66,71,78,79,85] (6 measures). All studies measuring prevalence of diabetes mellitus used clinical data. Median diabetes mellitus prevalence estimates were higher in studies using outpatient (13.0%) versus inpatient (6.9%) data. In the overall US adult population, prevalence estimates of diabetes mellitus are 12.3% using clinical data (NHANES 2009-2012)[86] and 8.7% using self-report data (BRFSS 2010).[59]

Cardiovascular Disease

A total of 16 studies[56,57,60-64,66,70,73,77,82,83,87-89] reported prevalence of one or more cardiovascular conditions among persons with SMI. Most studies (10 studies, 17 measures) reported on overall cardiovascular disease, followed by coronary heart disease (8 studies, 14 measures), cerebrovascular disease (5 studies, 10 measures), and congestive heart failure (5 studies, 6 measures). Median prevalence of coronary heart disease, congestive heart failure, cerebrovascular disease and overall cardiovascular disease was 5.4% (range: 1.0%-22.5%), 1.8% (range: 1.0%-12.5%), 2.8% (range: 1.3%-7.8%), and 12.4% (range: 4.8%-55.3%) respectively. Three of four cardiovascular conditions measured (coronary heart disease, congestive heart failure, and cerebrovascular disease) did not have any studies that reported prevalence using clinical measures. Only one study measuring the prevalence of overall cardiovascular disease used clinical data. Claims data and self-report data were most frequently used to calculate prevalence of cardiovascular disease among study populations with SMI. The majority of studies measuring prevalence of cardiovascular disease used outpatient data; no studies estimated prevalence of congestive heart failure or cerebrovascular disease among inpatient populations. In the overall US adult population, prevalence estimates of coronary heart disease, cerebrovascular disease, and congestive heart failure are 3.2% (NHANES 2009-2010),[90] 2.7% (BRFSS 2010),[91] and 2.0% (NHANES 2009-2010)[90] using self-report data.

Chronic Obstructive Pulmonary Disease (COPD), Kidney Disease, and Cancer

Estimates of the prevalence of COPD (median: 8.9%; range: 2.0%-12.9%) among persons with SMI were extracted from six studies[61-63,70,82,87] (6 measures). The median prevalence estimate of COPD among studies using claims data (10.7%) was higher than the median estimate in studies using self-report data (4.6%). No estimates of COPD prevalence among

the population with SMI were calculated using clinical data, and all estimates came from studies using outpatient (median prevalence: 6.6%) or other (median prevalence: 10.7%) study populations. In the overall US adult population, the estimated prevalence of COPD is 6.3% based on self-report data (BRFSS 2011).[92] Estimates of the prevalence of kidney disease (median: 2.3%; range: 0.7%-6.9%) were extracted from five studies[61-63,75,77] (8 measures). The median prevalence estimate of kidney disease in the one study using self-report data (3.4%) was higher than the median prevalence estimate among studies using claims (1.4%) or clinical (0.7%) data. One study estimated the prevalence of kidney disease among persons with SMI using an inpatient population (0.7%), one study estimated kidney disease prevalence using an outpatient population (3.4%), and three studies used another type of study population (e.g. a combination of inpatients and outpatients, median prevalence 1.4%). In the overall US adult population, the estimated prevalence of kidney disease is 15.2% based on clinical data (NHANES 2003-2006).[93] Estimates of the prevalence of cancer (median: 2.5%; range: 0.4%-5.2%) were extracted from four studies[61,73,75,77] (6 measures). The median prevalence estimate of cancer was higher in the one study using self-report data (5.2%) than in studies using claims (2.2%) or clinical (0.4%) data. One study estimated cancer prevalence in an inpatient population (0.4%), one study estimated cancer prevalence in an outpatient population (5.2%), and three studies estimated cancer prevalence in other (median prevalence 2.5%) study populations. In the overall US adult population, the estimated lifetime prevalence of cancer, excluding non-melanoma skin cancer, is 7.2% based on self-report data (BRFSS 2009).[94]

Hepatitis B, Hepatitis C, and HIV

Estimates of the prevalence of hepatitis B (median: 20.2%; range: 12.5%-49.5%) in persons with SMI were extracted from 5 studies[49,95-98] (8 measures). All hepatitis B prevalence estimates were calculated using clinical data. The median prevalence estimate of hepatitis B was higher in inpatient (26.7%) than in other (18.9%) study populations. Estimates of the prevalence of hepatitis C (median: 12.3%; range: 0.7%-25.4%) in persons with SMI were extracted from 14 studies[49,61,63,70,87,95,97-104] (18 measures). In the overall US adult population, the estimated prevalence of hepatitis B is 0.3% based on clinical data (NHANES 2005-2006).[105] The median prevalence estimate of hepatitis C among studies using clinical data (17.2%) was higher than the median estimate among studies using claims (7.1%) or self-report (4.0%) data. The median hepatitis C prevalence estimate was higher among inpatient (20.0%) compared to outpatient (1.9%) and other (10.6%) study populations. In the overall US adult population, the estimated prevalence of hepatitis C is 1.0% based on clinical data (NHANES 2003-2010).[106] Estimates of the prevalence of HIV (median: 1.8%; range: 0.1%-5.0%) among persons with SMI were extracted from 12 studies[61,63,70,75,87,96,97,103,107-110] (15 measures). The median prevalence estimate of HIV among studies using clinical data (2.7%) was higher than the median estimate among studies using claims (1.4%) or self-report (1.5%) data. Median HIV prevalence was higher among inpatient (3.8%) compared to outpatient (1.9%) and other (1.6%) study populations. In the overall US adult population, the estimated prevalence of HIV is 0.5% based on clinical data (NHANES 1999-2006).[111]

DISCUSSION

In many of the studies we reviewed, the prevalence of major medical conditions among the population with SMI was higher than among the overall US population. For many conditions, such as hypertension, hyperlipidemia, and overall cardiovascular disease, prevalence estimates across studies varied considerably, likely due to differences in age, gender, race, socioeconomic status, disability, antipsychotic medication use and other factors – as well as measurement error – across specific study samples. For other conditions, prevalence estimates were more consistent. For example, prevalence estimates of obesity among the population with SMI were consistently higher than estimates in the overall US population. The median prevalence estimate of obesity in the studies we reviewed was 40.6%, with an upper range of 55.0%. In contrast, the prevalence of obesity among adults in the overall US population was 35.4% in 2009-2012.

The results of our review suggest a need for improved estimates of the prevalence of medical conditions among persons with SMI. Our review found few studies that estimated prevalence of medical conditions in community populations with SMI, and many studies used self-report and administrative claims data, which can lead to biased prevalence estimates.[112,113] Ideally, future studies should use research-quality clinical measurements to assess medical conditions among persons with SMI. The only national health study to date that employs clinical measures is the NHANES, which includes interview, clinical examination, and laboratory components.[29] One option for generating high-quality national estimates of the prevalence of medical conditions among persons with SMI is to add assessment of SMI into ongoing NHANES data collection efforts. This option faces significant barriers, however. As discussed in the introduction of this manuscript, in order to develop valid estimates of the prevalence of medical comorbidities among persons with SMI, the NHANES would need to oversample this population and integrate time-consuming diagnostic interviews into the NHANES clinical examination. These additions would require significant additional resources and are unlikely to prove feasible.

An alternative and potentially more feasible strategy may be to develop national data collection systems in partnership with government insurance programs. Eighty-seven percent of persons with schizophrenia are insured by Medicaid or Medicare, and another 8% are insured by the Veteran's Health Administration.[114] The Centers for Medicare and Medicaid services (CMS) and the Veteran's Administration (VA) are federal agencies that already have access to national administrative claims datasets for their beneficiaries. While Medicaid is directly administered at the state level, state agencies are required to report administrative data to CMS, facilitating calculation of national claims-based estimates of cost and quality of care. As insurers and delivery systems shift their orientation toward population health-management under Affordable Care Act Initiatives such as Accountable Care Organizations and other delivery system reforms,[115] there may be opportunities to develop comparable systems for collecting and aggregating clinical data for the large majority of persons with SMI who are insured by these government programs. A hallmark of population health-oriented care is use of population health management databases that enable tracking of key health outcomes, such as hypertension and diabetes, among a defined patient population.[115-117] The feasibility of such databases is significantly enhanced by the

widespread adoption of electronic health records, from which many health outcomes of interest can be drawn. Medicaid programs in states including Maryland and Missouri have already created such databases, which include information including BMI, fasting glucose, and blood pressure readings for beneficiaries with SMI participating in the health home programs in those states. [118,119] The data is then transmitted to the state Medicaid agency, where it can be used to inform policy and program planning. Implementation of similar systems in other states, combined with required reporting of standardized clinical data to federal agencies, could greatly enhance our ability to measure and monitor the prevalence of co-morbid medical conditions in the population with SMI over time. While uniform reporting from all states is likely a decade or more away, ongoing efforts to develop population health management databases provide great promise for measurement and tracking of medical conditions in the population with SMI.

In the absence of prevalence rates estimated in nationally representative samples of persons with SMI, researchers and practitioners should carefully consider the underlying factors that may render some groups of persons with SMI at particularly elevated risk of developing co-morbid medical conditions and target interventions toward high-risk groups. For example, prevalence of cardiovascular risk factors such as hyperlipidemia and diabetes is likely to be particularly heightened among older persons with SMI and users of antipsychotic medications shown to cause weight gain.[120]

The results of our review should be considered in the context of several important limitations. The variation in prevalence estimates in the studies we reviewed is likely due to differences in sample selection and measurement error. While we excluded studies that calculated prevalence estimates in less than 100 persons with SMI, we were unable to limit our review to studies with representative samples or research-quality measurements. As a result, we found that prevalence of major medical conditions among those with SMI was typically estimated using inpatient or outpatient samples. These samples varied by demographic characteristics, level of disability, antipsychotic use and other factors which influence prevalence of medical conditions. Furthermore, many prevalence estimates were based on administrative claims or self-report data, both of which are subject to measurement error.[30] Even when estimates were based on clinical measurements, those measurements were often extracted from medical records or assessed during usual clinical practice, which likely does not yield research-quality measurements. As a result of these factors, estimates of the prevalence of medical conditions among the population with SMI in the studies we reviewed varied considerably, depending upon the specific study sample and measurement techniques. Due to this variation, we did not attempt to generate average prevalence estimates by aggregating the estimates extracted in our review. Due to the wide variation in study population characteristics, settings, and measurement techniques across the prevalence estimates included in our review, we were unable to generate summary measures of excess prevalence in the population with SMI compared to the general US population. Critically, our study did not examine the state of the science related to incidence and etiology of co-morbid medical conditions in the population with SMI. These topics should be considered in future reviews, and longitudinal studies designed to better elucidate the complex relationship between SMI and co-morbid conditions are needed.

CONCLUSIONS

Our findings suggest a need for nationally representative estimates of medical conditions among persons with SMI using research-quality clinical measurements. The consistently high prevalence of medical conditions among persons with SMI in the studies we reviewed suggests that screening for and monitoring of these conditions should be common practice in clinical settings serving persons with SMI. Future research should examine methods to ensure consistent screening, monitoring, and linkage to high-quality services for medical conditions among the population with SMI. In addition, future research should consider the longitudinal course and different mechanisms underlying medical comorbidities among persons with SMI. Such research should consider complex and interacting roles of factors including socioeconomic risk factors, health behaviors, antipsychotic medication-related etiology, access to and quality of healthcare services, self-management, and social support, with a focus on identifying modifiable targets for intervention.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

This study was commissioned and supported by the National Institute of Mental Health (NIMH).

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Table 1

Key Outcome Measures Included, by Medical Condition

Condition	Outcome Measures
Overweight	Body mass index (BMI) between 25 kg/m^2 and 30kg/m^2
Obesity	Body mass index (BMI) greater than 30kg/m^2
Hyperlipidemia	Any measure of hyperlipidemia
Hypertension	Overall measures of hypertension or high blood pressure (excluded measures of systolic or diastolic blood pressure only)
Diabetes mellitus	Fasting blood glucose >125 mg/dl
Coronary heart disease	Any measure of coronary heart disease
Congestive heart failure	Any measure of congestive heart failure
Cerebrovascular disease	Any measure of cerebrovascular disease
Chronic Obstructive Pulmonary Disease	Overall COPD (excluded specific measures such as respiratory disease, emphysema, and chronic bronchitis)
Kidney Disease	Fluid and electrolyte disorders, renal failure, weak/failing kidneys, and overall kidney disease
Cancer	Any measure of overall cancer (excluded specific cancer prevalence measures)
Hepatitis B	Any measure of hepatitis B
Hepatitis C	Any measure of hepatitis C
HIV	Any measure of HIV

Table 2

Prevalence of Medical Conditions in the Population with SMI by Measurement Type, Study Population, and Overall

Overweight									
	Measurement Type				Study Population				Overall
	Claims Data (0)	Clinical Measurement [43-51] (9)	Self-Report [52-54] (3)	Other (0)	Inpatient [47,49] (2)	Outpatient [43,44,46,48,52-54] (7)	Community[45] (1)	Other [20,21] (2)	Total (12)
Median Prevalence	n/a	29.5%	27.8%	n/a	32.7%	29.0%	41.4%	28.0%	29.0%
Mean Prevalence	n/a	32.6%	28.9%	n/a	30.3%	32.2%	41.4%	28.0%	31.9%
Highest Prevalence	n/a	58.0%	32.0%	n/a	25.0%	32.0%	41.4%	28.0%	58.0%
Lowest Prevalence	n/a	25.0%	27.8%	n/a	32.7%	30.0%	41.4%	28.0%	25.0%
Obesity									
	Measurement Type				Study Population				Overall
	Claims Data (0)	Clinical Measurement [43,44,46-51,53,57] (10)	Self-Report [52,54-56] (4)	Other (0)	Inpatient [17,19,25] (3)	Outpatient [43,44,46,48,52-54,56] (8)	Community[55] (1)	Other [20,21] (2)	Total (13)
Median Prevalence	n/a	42.0%	36.3%	n/a	37.0%	46.2%	37.8%	46.0%	40.6%
Mean Prevalence	n/a	42.0%	36.1%	n/a	37.5%	42.3%	37.8%	40.1%	40.4%
Highest	n/a	55.0%	46.2%	n/a	41.9%	55.0%	39.2%	47.3%	55.0%
Lowest Prevalence	n/a	26.0%	28.9%	n/a	34.0%	26.0%	36.3%	27.0%	26.0%
Hyperlipidemia									
	Measurement Type				Study Population				Overall
	Claims Data [57,60-65] (7)	Clinical Measurement[43,66-69] (5)	Self-Report[70] (1)	Other [71]	Inpatient [57,66] (2)	Outpatient [43,65,68,69,71] (5)	Community (0)	Other[60-64,67,70] (7)	Total (14)

Median Prevalence	28.8%	11.7%	14.0%	26.0%	33.8%	30.0%	n/a	24.8%	26.6%
Mean Prevalence	29.1%	17.5%	14.0%	26.0%	33.8%	33.9%	n/a	23.3%	27.0%
Highest Prevalence	55.9%	61.0%	14.0%	26.0%	55.9%	61.0%	n/a	35.2%	61.0%
Lowest Prevalence	12.3%	10.8%	14.0%	9.0%	11.7%	9.0%	n/a	10.8%	9.0%

Hypertension

	Measurement Type				Study Population				Overall
	Claims Data [57,60-64,73,74] (8)	Clinical Measurement [43,46,47,50,65,67,68,75,76,78] (10)	Self-Report [56,70,77,81-83] (6)	Other [53,66,71,79,80] (5)	Inpatient [47,57,66,73-76] (7)	Outpatient [43,46,53,56,65,67,68,71,77-82] (14)	Community [83] (1)	Other [50,60-64,70] (7)	Total (29)
Median Prevalence	35.3%	37.8%	24.7%	34.0%	31.7%	34.0%	47.0%	35.2%	35.0%
Mean Prevalence	34.7%	40.9%	27.8%	37.9%	34.3%	37.0%	47.0%	34.3%	35.8%
Highest Prevalence	61.6%	68.0%	47.0%	68.0%	61.6%	68.0%	47.0%	59.1%	68.0%
Lowest Prevalence	10.0%	14.4%	20.0%	15.9%	10.0%	22.1%	47.0%	16.5%	10.0%

Diabetes Mellitus

	Measurement Type				Study Population				Overall
	Claims Data (0)	Clinical Measurement [66,71] (2)	Self-Report (0)	Other [43,78,79,85] (4)	Inpatient [66] (1)	Outpatient 43,71,78,79,85 (5)	Community (0)	Other (0)	Total (6)
Median Prevalence	n/a	9.2%	n/a	16.0%	6.9%	13.0%	n/a	n/a	12.5%
Mean Prevalence	n/a	9.2%	n/a	19.5%	6.9%	17.9%	n/a	n/a	16.1%
Highest Prevalence	n/a	11.5%	n/a	34.0%	6.9%	34.0%	n/a	n/a	34.0%
Lowest Preval	n/a	6.9%	n/a	12.0%	6.9%	11.5%	n/a	n/a	6.9%

ence									
Coronary Heart Disease									
	Measurement Type				Study Population				Overall
	Claims Data [57,60-63] (5)	Clinical Measurement (0)	Self-Report [70,77,89] (3)	Other (0)	Inpatient [57,89] (2)	Outpatient [77] (1)	Community (0)	Other [60-63,70] (5)	Total (8)
Median Prevalence	5.9%	n/a	1.0%	n/a	19.1%	1.0%	n/a	5.2%	5.4%
Mean Prevalence	10.8%	n/a	12.50%	n/a	17.2%	1.0%	n/a	5.0%	7.9%
Highest Prevalence	22.5%	n/a	1400.0%	n/a	22.5%	1.0%	n/a	10.6%	22.5%
Lowest Prevalence	2.3%	n/a	1100.0%	n/a	8.1%	1.0%	n/a	1.0%	1.0%
Congestive Heart Failure									
	Measurement Type				Study Population				Overall
	Claims Data [61-63] (3)	Clinical Measurement (0)	Self-Report[77] (1)	Other88 (1)	Inpatient (0)	Outpatient [77,88] (2)	Community (0)	Other[61-63] (3)	Total (5)
Median Prevalence	1.5%	n/a	1.5%	12.5%	n/a	2.0%	n/a	1.5%	1.8%
Mean Prevalence	2.0%	n/a	1.5%	12.5%	n/a	5.2%	n/a	2.0%	3.6%
Highest Prevalence	3.2%	n/a	2.0%	12.5%	n/a	12.5%	n/a	3.2%	12.5%
Lowest Prevalence	1.2%	n/a	1.0%	12.5%	n/a	1.0%	n/a	1.2%	1.0%
Cerebrovascular Disease									
	Measurement Type				Study Population				Overall
	Claims Data [60-64] (5)	Clinical Measurement (0)	Self-Report (0)	Other (0)	Inpatient (0)	Outpatient (0)	Community (0)	Other [60-64] (5)	Total (5)
Median Prevalence	2.8%	n/a	n/a	n/a	n/a	n/a	n/a	2.8%	2.8%

Mean Prevalence	3.1%	n/a	n/a	n/a	n/a	n/a	n/a	3.1%	3.1 %
Highest Prevalence	7.8%	n/a	n/a	n/a	n/a	n/a	n/a	7.8%	7.8 %
Lowest Prevalence	1.3%	n/a	n/a	n/a	n/a	n/a	n/a	1.3%	1.3 %

Overall Cardiovascular Disease

	Measurement Type				Study Population				Overall
	Claims Data [57,60,64, 73,87] (5)	Clinical Measurement[66] (1)	Self-Report [56,77,82,83] (4)	Other (0)	Inpatient [57,66] (2)	Outpatient [56,77,82,83,87] (5)	Community (0)	Other [60,64,73] (3)	Total (10)
Median Prevalence	22.5%	4.8%	9.0%	n/a	20.9%	9.6%	n/a	39.5%	12.4%
Mean Prevalence	29.8%	4.8%	10.5 %	n/a	16.1%	10.5%	n/a	34.2%	22.7%
Highest Prevalence	55.3%	4.8%	19.0 %	n/a	22.5%	19.0%	n/a	55.3%	55.3%
Lowest Prevalence	8.8%	4.8%	6.0%	n/a	4.8%	6.0%	n/a	8.8%	4.8 %

Chronic Obstructive Pulmonary Disease

	Measurement Type				Study Population				Overall
	Claims Data [61-63,87] (4)	Clinical Measurement (0)	Self-Report [70,82] (2)	Other (0)	Inpatient (0)	Outpatient [82,87] (2)	Community (0)	Other [61-63,70] (4)	Total (6)
Median Prevalence	10.7%	n/a	4.6%	n/a	n/a	6.6%	n/a	10.7%	8.9 %
Mean Prevalence	10.1%	n/a	4.6%	n/a	n/a	6.6%	n/a	9.1%	8.3 %
Highest Prevalence	12.9%	n/a	7.1%	n/a	n/a	7.1%	n/a	12.9%	12.9%
Lowest Prevalence	6.1%	n/a	2.0%	n/a	n/a	6.1%	n/a	2.0%	2.0 %

Kidney Disease

	Measurement Type				Study Population				Overall
	Claims Data [61-63] (3)	Clinical Measurement [75] (1)	Self-Report[77] (1)	Other (0)	Inpatient [75] (1)	Outpatient [77] (1)	Community (0)	Other [61-63] (3)	Total (5)
Median Prevalence	1.4%	0.7%	3.4%	n/a	0.7%	3.4%	n/a	1.4%	2.3%
Mean Prevalence	3.2%	0.7%	3.4%	n/a	0.7%	3.4%	n/a	3.2%	3.0%
Highest Prevalence	6.9%	0.7%	3.7%	n/a	0.7%	3.7%	n/a	6.9%	6.9%
Lowest Prevalence	0.8%	0.7%	3.1%	n/a	0.7%	3.1%	n/a	0.8%	0.7%
Cancer									
	Measurement Type				Study Population				Overall
	Claims Data [61,73] (2)	Clinical Measurement[75] (1)	Self-Report[77] (1)	Other (0)	Inpatient [75] (1)	Outpatient [77] (1)	Community (0)	Other [61,73] (2)	Total (4)
Median Prevalence	2.2%	0.4%	5.2%	n/a	0.4%	5.2%	n/a	2.2%	2.5%
Mean Prevalence	1.9%	0.4%	5.2%	n/a	0.4%	5.2%	n/a	1.9%	2.7%
Highest Prevalence	2.8%	0.4%	5.2%	n/a	0.4%	5.2%	n/a	2.8%	5.2%
Lowest Prevalence	0.6%	0.4%	5.2%	n/a	0.4%	5.2%	n/a	0.6%	0.4%
Hepatitis B									
	Measurement Type				Study Population				Overall
	Claims Data (0)	Clinical Measurement [49,95-98] (5)	Self-Report (0)	Other (0)	Inpatient [49,95,96] (3)	Outpatient (0)	Community (0)	Other [97,98] (2)	Total (5)
Median Prevalence	n/a	20.2%	n/a	n/a	26.7%	n/a	n/a	18.9%	20.2%
Mean Prevalence	n/a	25.1%	n/a	n/a	30.3%	n/a	n/a	19.9%	25.1%
Highest	n/a	49.5%	n/a	n/a	49.5%	n/a	n/a	29.3%	49.5%

Prevalence									
Lowest Prevalence	n/a	12.5%	n/a	n/a	18.3%	n/a	n/a	12.5%	12.5%
Hepatitis C									
	Measurement Type				Study Population				Overall
	Claims Data [61,63,87, 103,104] (5)	Clinical Measurement [49,95,97-102] (8)	Self-Report [70] (1)	Other (0)	Inpatient [49,95] (2)	Outpatient [87] (1)	Community (0)	Other [61,63,70,97-104] (11)	Total (14)
Median Prevalence	7.1%	17.2%	4.0%	n/a	20.0%	1.9%	n/a	10.6%	12.3%
Mean Prevalence	8.0%	16.5%	4.0%	n/a	20.0%	1.9%	n/a	12.2%	12.5%
Highest Prevalence	16.5%	25.4%	4.0%	n/a	21.0%	1.9%	n/a	25.4%	25.4%
Lowest Prevalence	0.7%	7.1%	4.0%	n/a	18.9%	1.9%	n/a	0.7%	0.7%
HIV									
	Measurement Type				Study Population				Overall
	Claims Data [61,63,87, 103,108-110] (7)	Clinical Measurement [75,96,97] (3)	Self-Report [70,107] (2)	Other (0)	Inpatient [75,96] (2)	Outpatient [70,87,107,108] (4)	Community (0)	Other [61,63,97,103,109,110] (6)	Total (12)
Median Prevalence	1.4%	2.7%	1.5%	n/a	3.8%	1.9%	n/a	1.6%	1.8%
Mean Prevalence	1.4%	3.4%	1.5%	n/a	3.8%	1.9%	n/a	1.8%	2.1%
Highest Prevalence	2.8%	5.0%	2.0%	n/a	4.8%	2.8%	n/a	5.0%	5.0%
Lowest Prevalence	0.1%	1.7%	1.0%	n/a	2.7%	1.0%	n/a	0.1%	0.1%