Published in final edited form as:

Int J Geriatr Psychiatry. 2008 December ; 23(12): 1266–1270. doi:10.1002/gps.2061.

Population projection of US adults with lifetime experience of depressive disorder by age and sex from year 2005 to 2050

Moonseong Heo^{1,*}, Christopher F. Murphy¹, Kevin R. Fontaine², Martha L. Bruce¹, and George S. Alexopoulos¹

¹Department of Psychiatry, Weill Medical College of Cornell University, White Plains, NY, USA

²Division of Rheumatology, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, USA

Summary

Objective—To estimate the projected population of US adults aged 18 years or older with lifetime experience of doctor-diagnosed depressive disorder from 2005–2050.

Methods—Based on nationally representative survey data from the year 2006 Behavioral Risk Factor Surveillance Survey (BRFSS), prevalence estimates of doctor-diagnosed depression (minor or major, and dysthymia) were weighted to incorporate the complex sampling design and increase generalizability of the findings. The weighted prevalence data by age and sex in 2006 were then used to estimate the projected adult population with lifetime experience of depressive disorder based on the sex-specific US Census national population projections from year 2005–2050.

Results—In year 2006 the (weighted) prevalence of lifetime experience of depressive disorder was 15.7% among 188,292 respondents aged 18 years or older. Female prevalence was 20.6%, which was about twice as high as the prevalence among males (11%). From year 2005–2050, the total number of US adults with depressive disorder will increase from 33.9 million to 45.8 million, a 35% increase. The increase is projected to be greater in the elderly population aged ≥65 years (3.8–8.2, a 117% increase) than in the young population aged <65 years (30.1–37.7, a 25% increase).

Conclusions—By year 2050, approximately 46 million US adults aged 18 years or older will be diagnosed with a depressive disorder. The increase will be more pronounced in adults aged 65 or older. Prevention, detection, and treatment of depressive disorders might attenuate the magnitude of this estimate.

Keywords

depression; prevalence; population projection; BRFSS 2006; elderly

Copyright © 2008 John Wiley & Sons, Ltd.

*Correspondence to: Dr M. Heo, Department of Psychiatry, Weill Medical College of Cornell University, 21 Bloomingdale Road, White Plains, NY 10605, USA. moh2002@med.cornell.edu.

Conflict of Interest: Dr Alexopoulos provided consultation to Forest Pharmaceuticals, received honoraria from Forest Pharmaceuticals, Janssen, Cephalon, Pfizer Inc., Bristol-Myers Squibb, Eli Lilly Inc. and Glaxo Wellcome, and received grants from Forest Pharmaceuticals and Cephalon. Dr Bruce has research support from NIH and the United Hospital Foundation; an educational grant from Ortho-McNeil Janssen; and consulting relationships with NIH projects funded to Washington University (St Louis), University of Iowa, University of Rochester and with MediSpin, Inc. and the United Jewish Appeal. Drs Heo, Murphy and Fontaine do not have any potential conflict to acknowledge.

Introduction

Depression is an important public health concern; it imposes personal, social, medical, familial and economic burdens. Further, major depression is the leading cause of disability and accounts of more than two-thirds of suicides each year (US Department of Health and Human Services, 2000). Therefore, estimation of projected numbers of persons with depression in the coming decades would inform the public health sector about the infrastructure needs of the service delivery system, and highlight the need for identification, prevention, and treatment. Although there has been a great deal of literature reporting prevalence of depression as reviewed by Ebmeier *et al.* (2006), prevalence estimates based on a nationally representative sample have been scarce, let alone projections.

Effects of depression in older adults may be distinctive from those in younger adults. For instance, the recent Surgeon General's report noted, 'Depression in older adults not only causes distress and suffering but also leads to impairments in physical, mental, and social functioning' (US Department of Health and Human Services, 2006). We expect that such impact of depression on elderly will only increase over the next half-century, as the elderly are a rapidly growing segment of the population (Day, 1996). Even if the current age-gender specific prevalence of depression were constant for the coming years (as the incidence rates were shown to be stable over the past 24 years (Eaton *et al.*, 2007)), the upcoming demographic shift would lead to a greater size of the elderly population and thus increase the number of elders who suffer from depression and are at risk for poor outcomes. As such, we attempt to estimate both the current prevalence and the projected population of US adults with a lifetime experience of depressive disorder between younger (aged 18–64 years) and older (aged 65 or over) from year 2005–2050. In this study, prevalence estimates are based on subjects' report of having received the diagnosis of depression from physicians.

Methods

We used nationally representative data from the 2006 Behavioral Risk Factor Surveillance Survey (BRFSS) (CDC, 2006) in conjunction with US Census projections (Population Projections Bureau, 2000). The BRFSS is conducted annually by the Center for Disease Control and Prevention and is the world's largest ongoing cross-sectional telephone health surveillance survey of the non-institutionalized civilian adult population. The core questionnaire of the annual survey is administered in all 50 states, the District of Columbia, and two US territories (Puerto Rico and the US Virgin Islands), while supplementary modules are often administered in a proportion of the US states and territories. Detailed information on the design and sampling methods used are reported elsewhere (Gentry *et al.*, 1985).

Subjects and outcome

Subjects are respondents of the BRFSS in year 2006. In this study, respondents were defined as having doctor-diagnosed depressive disorder if they answered 'yes' to the question: 'Has a doctor or other healthcare provider EVER told you that you have a depressive disorder (including depression, major depression, dysthymia, or minor)?' Therefore, a prevalence estimate based on this question is, by definition, that of self-reported lifetime experience of doctor-diagnosed depressive disorder. That particular item was a part of the Anxiety and Depression module that was administered in 36 states including the District of Columbia and the two US territories resulting in a total of 188,134 respondents.

Prevalence analysis

The current prevalence estimates of doctor-diagnosed depressive disorder for 2006 were stratified by age (18–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, and 80+) and sex. All prevalence data were estimated with a sampling weight assigned to each respondent to increase generalizability of the findings to the US population. Specifically, the age and sex-specific prevalence estimates were weighted as the proportion of respondents with depressive disorder. In this analysis, we eliminated participants who did not know or were not sure ($n = 473$), or refused to answer ($n = 369$) the question, resulting in a total of 187,292 respondents: 71,406 men (38.1%) and 115,886 women (61.9%). The respondents who were omitted from the analysis represent less than 0.5% of the 188,134 respondents and had virtually no effect on the prevalence estimates.

Projection analysis

To project sex and age-specific population with depressive disorder, we first multiplied the sex and age-specific prevalence estimates by the sex and age-stratified US Census projections for every five years from 2005–2050 (Hollman^{Q1} *et al.*, 2000). Over these years, the sex and age-specific prevalence estimates were assumed to be constant. For instance, the year 2006 prevalence estimate for female subjects aged 60–64 was used for calculation of population aged 60–64 with depressive disorder for all the years from 2005–2050. We then summed those age-specific projections to obtain projections for two age groups, 18–65 years and ≥65 years for each sex.

Results

The prevalence estimates of US adults with diagnosed depressive disorder by age for the year 2006 are presented in Figure 1. The overall weighted prevalence was 15.7%. Female prevalence (20.1%) was about twice as high as male prevalence (11.0%). The prevalence was highest for women aged 50–54 (26.0%) and for men aged 55–59 (15.8%). For both sexes, the prevalence was lowest for elderly aged 85 or over (8.3% and 5.8% for women and men, respectively).

Table 1 presents the projected population with doctor-diagnosed depressive disorder. Based on US Census Bureau Population Projections, the US population aged 18 or older will increase from 216.2 million in year 2005 to 307.9 million in year 2050, a 42.4% increase. During the same period, the population with depressive disorder will increase by 35.1% from 33.9 to 45.8 million. Among adults aged 18–64 years depressive disorder will increase by 25.3% from 30.1 to 37.7 million whereas among adults aged 65 years and over depressive disorder will increase by 116.8% from 3.8 to 8.2 million. Women with depressive disorder will increase by 24.6% from 19.9 to 24.8 million and men counterparts will increase by 26.2% from 10.3 to 13.0 million.

Age and sex-specific projections of the US population with depressive disorder are presented in Figures 2 and 3 for younger and older adults, respectively. Younger women with depressive disorder will increase by 24.6% from 19.9 to 24.8 million while younger men will increase by 26.2% from 10.3 to 13.0 million. In contrast, older women with depressive disorder will increase by 107.7% from 2.6 to 5.4 million while older men will increase by 125% from 1.2 to 2.7 million.

Discussion

The principal finding of this study is that the number of adults with doctor-diagnosed depression will increase markedly in adults from year 2005–2050. The increase will be most pronounced, by 125%, among men aged 65 years and over. This increase is by far higher

than 42% increase of the total adult population over the same period. The increase in older adults with depressive disorder is in parallel to the increase in the total elderly population, which is likely propelled by advancement of baby boomers into geriatric ages within the next 10 years. Indeed, the increase in the overall geriatric population will rise sharply between 2010 and 2030 (Table 1 and Figure 3).

Increase in depression in late life is particularly concerning because it worsens age-associated medical comorbidity and increase mortality (Alexopoulos, 2006). For instance, as reflected on Figure 1, decline in prevalence of adults with lifetime experience of depressive disorder after age sixty may be associated with high mortality among depressed adults (Cuijpers and Smith, 2002). In addition, suicide in elderly is associated with depressive syndromes (Conwell *et al.*, 1996). Furthermore, depressed adults tend to be undertreated. For instance, only 23% of adults diagnosed with depression received treatment in 1997 based on the National Household Survey on Drug Abuse (NHSDA) year 1997 data. Even if treated, psychosocial stigma attached to depression can serve as a major barrier to continuation of treatment (Sirey *et al.*, 2001). Therefore, the mortality in depressed elderly, if left untreated, will increase over the years, as depressed elderly population will be doubled in 30 years (Table 1).

At the same time, the decline after age 60 is also likely due to potential cohort effect and underreporting because the prevalence estimates refer to lifetime experience, not necessarily 'current' experience, of the depressive disorder by the definition of the question use for this study. Given the property that the prevalence of lifetime experience must increase with age due to addition of new onsets, those substantial declines in the lifetime experience cannot solely be attributable to mortality. The potential cohort effect is that the current elderly generation's attitudes toward mental health might be less psychologically minded and less likely to present for depression care. This effect may have led to lower diagnosis rates in the current cohort. On the other hand, as the baby boomers advance into geriatric age, diagnosis rates may increase if this population is more psychologically minded and therefore more likely to seek care. Nevertheless, the potential bases for cohort differences are considerably more varied and complex, including a differing propensity to develop depressive illness because of a changing psychological or biological substrate. Given such a complexity inherent in the cohort effect, exact trade-off in attribution to those declines in the prevalence estimates among mortality, cohort effect and underreporting cannot be inferred based only on the questionnaire item that was used for this study.

Nevertheless, the results reported herein should alert policy makers about a need for modification of our health systems to accommodate these increased numbers of older adults with affective illness. The modification may be oriented to improved functional status or effectiveness of depression detection and treatment on one side of the ledger and alleviation of exacerbated mental healthcare workforce shortages and restricted access to care on the other. Therefore, efforts of treatment initiation in conjunction with early detection should be put into elevating adequacy of treatment in the depressed population. Early detection at the community level may be possible through development of instruments with preferably fewer but more potent items. All of those efforts, if put together, would prevent depressed persons from worsening depression symptoms and help them alleviate their associated medical comorbidities.

Our findings are subject to several limitations. Because the BRFSS is a telephone survey, our projections are based on respondents' self-report of having a doctor diagnosed depressive disorder. In the absence of verification of the depressive disorder, the reliability of recall or report must be called into question. Moreover, since much of the doctor-diagnosed depression was likely to be made by primary care physicians, the diagnosis may

not always be accurate and may instead represent other disorders such as personality disorders. Another limitation is that our projections are based on the assumption that the sex and age-specific rates (presented in Figure 1) of depressive disorder will remain unchanged over time. That is, our analysis does not incorporate recent secular trends in depression. Thus, our projections are likely to be somewhat imprecise and possibly underestimated due to potential self-underreporting. Finally, the BRFSS does not include persons without telephone service or those in institutions or in the military.

Conclusion

In conclusion, our projections indicate that depressive disorders will become an even more pressing public health problem in the future. Because depression often produces functional impairment, disability and poor quality of life, the personal, social, and economic burden imposed by depressive disorders will be more substantial in the coming years, perhaps even more in older adults if they are left undetected and untreated..

Acknowledgments

Supported in part with grants from the NIH: P30MH068638, K23MH67702, R24MH64608, K23AR049720 and R01AR053168. We are grateful to the two reviewers for their valuable comments that improved the manuscript.

References

- Alexopoulos GS. Depression in the elderly. *Lancet*. 2006; 365:1961–1970. [PubMed: 15936426]
- Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Data. US Department of Health and Human Services; Atlanta, GA: 2006.
- Conwell Y, Duberstein PR, Herrmann JH, et al. Relationship of age and axis I diagnosis in victims of completed suicide: a psychological autopsy. *Am J Psychiatry*. 1996; 153:1001–1008. [PubMed: 8678167]
- Cuijpers P, Smith F. Excess mortality in depression: a meta analysis of community studies. *J Affect Disord*. 2002; 72:227–236. [PubMed: 12450639]
- Day, J. Population Projections of the United States by Age, Sex, Race, and Hispanic Origin: 1995 to 2050. United States Bureau of Census, US Government Printing Office; Washington, DC: 1996.
- Eaton WW, Kalaydjian A, Schrfstein DO, et al. Prevalence and incidence of depressive disorder: the Baltimore ECA follow-up, 1981–2004. *Acta Psychiatr Scand*. 2007; 116:182–188. [PubMed: 17655559]
- Ebmeier KP, Donaghey C, Steele D. Recent developments and current controversies in depression. *Lancet*. 2006; 367:933–940.
- Gentry EM, Kalsbeek WD, Hogelin GC, et al. The behavioral risk factor surveys: II Design, methods, and estimates from combined state data. *Am J Prev Med*. 1985; 1:9–14. [PubMed: 3870927]
- Hollman, FW.; Mulder, TJ.; Kallan, JE. Methodology and Assumptions for the Population Projections of the United States: 1999 to 2100 Working paper no 38. Population Projections Branch, Population Division, Bureau of the Census; Washington, DC: 2005.
- Population Projections Bureau, Population Division, US Census Bureau. Summary File (NP-T3): Projections of the Total Resident Population by 5-year Age Groups, and Sex with Special Age Categories: Middle Series. 2000. Available at www.census.gov/population/www/projections/natsum-T3.html
- Sirey JA, Bruce ML, Alexopoulos GS, et al. Perceived stigma as a predictor of treatment discontinuation in young and older outpatients with depression. *Am J Psychiatry*. 2001; 158:479–481. [PubMed: 11229992]
- US Department of Health and Human Services. Healthy People 2010: Understanding and Improving Health. 2nd. US Government Printing Office; Washington, DC: 2000.
- US Department of Health and Human Services. The Road Ahead: Research Partnerships to Transform Services. A report by the National Advisory Mental Health Council's Workgroup on Services and

Clinical Epidemiology Research, National Institutes of Health, National Institute of Mental Health; Bethesda, MD: 2006.

Figure 1. Weighted prevalence of lifetime experience of depressive disorder by age and sex in year 2006

Figure 2. Projected population with lifetime experience of depressive disorder for adults aged 18–64 years

Figure 3. Projected population with lifetime experience of depressive disorder for adults aged 65 years and over

Table 1

Projected US population (in millions) of adults and prevalence of lifetime experience of depressive disorder, 2005–2050.

Year	Projected Population			Projected Population (prevalence) with depressive disorder		
	Ages 18–64	Ages 65 +	Total	Ages 18–64	Ages 65 +	Total
2005	179.8	36.4	216.2	30.1 (16.8%)	3.8 (10.4%)	33.9 (15.7%)
2010	187.7	39.7	227.4	31.6 (16.8%)	4.2 (10.5%)	35.7 (15.7%)
2015	192.0	46.0	238.0	32.3 (16.8%)	4.9 (10.7%)	37.2 (15.6%)
2020	194.0	53.7	247.7	32.5 (16.8%)	5.8 (10.7%)	38.3 (15.5%)
2025	194.8	62.6	257.5	32.5 (16.7%)	6.7 (10.7%)	39.2 (15.2%)
2030	197.5	70.3	267.8	32.9 (16.7%)	7.4 (10.5%)	40.3 (15.0%)
2035	203.5	74.8	278.3	33.9 (16.7%)	7.6 (10.2%)	41.6 (14.9%)
2040	211.2	77.2	288.3	35.2 (16.7%)	7.7 (10.0%)	43.0 (14.9%)
2045	218.9	79.1	298.1	36.5 (16.7%)	7.9 (9.9%)	44.4 (14.9%)
2050	225.9	82.0	307.9	37.7 (16.7%)	8.2 (10.0%)	45.8 (14.9%)