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Multiple Chronic Conditions and Labor Force Outcomes: A Population Study of U.S. Adults

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Abstract

Background—Although 1-in-5 adults have multiple (≥2) chronic conditions, limited attention has been given to the association between multiple chronic conditions and employment.

Methods—Cross-sectional data (2011 National Health Interview Survey) and multivariate regression analyses were used to examine the association among multiple chronic conditions, employment, and labor force outcomes for U.S. adults aged 18–64 years, controlling for covariates.

Results—Among U.S. adults aged 18–64 years (unweighted n=25,458), having multiple chronic conditions reduced employment probability by 11%–29%. Some individual chronic conditions decreased employment probability. Among employed adults (unweighted n=16,096), having multiple chronic conditions increased the average number of work days missed due to injury/illness in the past year by 3–9 days.

Conclusions—Multiple chronic conditions are be a barrier to employment and increase the number of work days missed, placing affected individuals at a financial disadvantage. Researchers interested in examining consequences of multiple chronic conditions should give consideration to labor force outcomes.

Keywords

chronic disease; employment; work hours; sick days; personal earnings

INTRODUCTION

One in five adults in the United States have multiple (≥2) chronic conditions (MCC) (Schneider et al., 2009; Vogeli et al., 2007; Ward and Schiller, 2013; Ward et al., 2014), and the prevalence of MCC has been increasing over the past decade (Ward and Schiller, 2013). As a result, concern over MCC has been growing (Agborsangaya et al., 2012; Fortin et al.,

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Conflict of Interest Statement:

The author reports no conflicts of interest with the work contained in this manuscript. All views expressed in this manuscript belong to the author and do not necessarily represent the official views of the National Center for Health Statistics, Centers for Disease Control and Prevention, or U.S. Department of Health and Human Services.

2005; van Oostrom et al., 2012). Formal objectives and strategies to improve other health characteristics of persons with MCC are being established, including the creation of guidelines for care management of MCC (Bayliss et al., 2007; Parekh et al., 2011; U.S. DHHS, 2011). Having MCC can also be related to a number of adverse consequences. For example, studies have found the prevalence of functional disability increases as the number of conditions increases (Marengoni et al., 2011). Healthcare costs are greater among individuals with MCC than in those without (Paez et al., 2009) and increase with each additional condition present (Lehnert et al., 2011).

Limited attention has been given to the association between having MCC and employment, yet studies have found individual chronic conditions such as asthma (Eisner et al., 2006), diabetes (Minor, 2011; Tunceli et al., 2005), hepatitis (DiBonaventura et al., 2011), and rheumatoid arthritis (Kessler et al., 2008) to be associated with either a decrease in the likelihood of employment or an increase in adverse work-related outcomes such as work missed due to illness. In addition, other research has found that poor health is a risk factor for exiting the labor force (Van Rijn et al., 2014), and severity of a condition (in this case, musculoskeletal pain) related to loss of employment (Kamaleri et al., 2009).

Of the few studies that have examined the influence of having MCC on adults' labor force activity (all in Australia), one found that having a greater number of chronic conditions was associated with a higher odds of being out of the labor force (Schofield et al., 2008). Another study of adults with back problems found that the presence of MCC predicted an increase in the likelihood of being out of the labor force (Schofield et al., 2012). Waghorn et al. (2011) showed among adults with psychiatric disorders, the presence of MCC was negatively associated with currently being employed; however, the specific combination and extent of conditions determined how employment was affected (Waghorn et al., 2011). These findings suggest both the number and type of chronic conditions influence labor force activity.

The present study aims to add knowledge to the association between having MCC and labor force activity as it is the first to examine this association among U.S. adults, and examines not just employment, but additional labor force outcomes. It is hypothesized that among U.S. adults aged 18–64 years, there is a negative association between having MCC and employment, number of hours worked the previous week, and personal earnings, and a positive association between having MCC and the number of work days missed due to illness/injury. Here "MCC" is defined as ≥2 of any of the following conditions: cancer, hypertension, coronary heart disease (CHD), stroke, chronic obstructive pulmonary disease (COPD), current asthma, diabetes, arthritis, hepatitis, weak/failing kidneys. It is also hypothesized that there is a negative association between the individual chronic condition present and employment, number of hours worked the previous week, and personal earnings, and a positive association between the individual condition and number of work days missed due to illness/injury. To test these hypotheses, a cross-sectional data source representative of the U.S. adult population aged 18–64 years was used to examine the association of having MCC on employment and other labor force outcomes.

METHODS

Data and Sample

This study analyzed cross-sectional data from the 2011 National Health Interview Survey (NHIS), a multi-stage population health survey representative of the U.S. civilian, noninstitutionalized population that was conducted continuously throughout the calendar year (Schiller et al., 2012). The 2011 NHIS was approved by the Research Ethics Review Board of the National Center for Health Statistics (Protocol #2009–16) and the U.S. Office of Management and Budget (Control #0920-0214). Written consent for participation in the 2011 NHIS was not received; instead all respondents provided oral consent prior to participation.

Two main components of the NHIS questionnaire were used in this study: the Family and Sample Adult Cores. In the Family Core, an adult family respondent reports for him/herself and reports as a proxy for the remainder of the family. In the Sample Adult Core, a randomly selected "sample adult" from each family self-reports for him/herself (unless a health condition requires a proxy respondent) (Schiller et al., 2012). The 2011 NHIS included 33,014 sample adult respondents who participated in both the Family and Sample Adult Core components. The Family Core final response rate was 81.3%; the Sample Adult Core final response rate was 66.3%.

For this study, two analytic samples were created, representing two different populations. To create the first analytic sample for this study, all cases with missing information on employment status, chronic conditions, or selected demographic characteristics were removed, resulting in a final analytic sample of n=25,458 that could generalize to U.S. adults aged 18–64 years. A comparison between the original 2011 NHIS sample (n=33,014) and this first analytic sample of U.S. adults (n=25,458) showed there to be only small differences in magnitude among each variable (Supplemental Table I).

To create a second analytic sample that was used to examine additional labor force outcomes, the analytic sample for adults aged 18–64 years was used, and only adults who met the definition of "employed" (i.e., having been employed anytime in the past 12 months) were identified, resulting in a sample of 19,553 employed adults. Then, among this group of employed adults, cases that included missing values for the additional labor force outcomes or worker/workplace characteristics were removed to create a second analytic sample of n=16,096 employed adults aged 18–64 years. Differences in magnitude among characteristics between the original (n=19,553) and final analytic (n=16,096) samples of employed adults were minor (Supplemental Table I).

Labor Force Outcome Measures

Employment status was determined by whether an adult was employed anytime in the past 12 months (0=no; 1=yes). For the remainder of the manuscript, adults employed anytime in the past 12 months are simply referred to as "employed adults." Among employed adults, continuous variables were used to capture the number of hours worked the previous week, the number of days of work missed due to injury/illness in the past 12 months (not distinguishing between full/partial days), and gross personal earnings (U.S. dollars) in the

past year. Due to the large number of missing values for personal earnings, data from the NHIS imputed income files (NCHS, 2012; Schenker et al., 2006) were used. Of the 16,096 respondents in the final analytic sample of employed adults, 2,052 had personal earnings data multiply imputed. Pearson correlations among number of hours worked the previous week, number of days of work missed, and gross personal earnings were low (Supplemental Table II).

Chronic Conditions Measures

Using a categorical variable, adults were identified as having 0, 1, 2–3, or ≥4 of 10 selected chronic conditions. These categories were based on previous NHIS research (Ward and Schiller, 2013; Ward et al., 2012) and guidelines for care management of MCC (Parekh et al., 2011; U.S. DHHS, 2011). Conditions included in this study were identified by whether the adult had ever been told by a doctor or other health professional that s/he had hypertension, CHD, stroke, diabetes, cancer, arthritis, or hepatitis; had experienced weak/failing kidneys during the past 12 months; currently had asthma; and had COPD (assessed using responses from two survey questions asking if the adult ever had emphysema or chronic bronchitis in the past 12 months). Inclusion of these ten chronic conditions is justified in Goodman et al. (2013). In addition to the absolute number of chronic conditions, this analysis accounted for which specific condition(s) were associated with labor force outcomes. Ten dichotomous variables were created to indicate whether an adult had been told s/he had a specific condition (e.g., ever been told s/he has cancer; 0=no, 1=yes). Given differences in the prevalence of the selected chronic conditions, the prevalence of different combinations of conditions among U.S. adults aged 18–64 years are presented in Supplemental Table III.

Demographic and Worker/Workplace Covariates

Demographic covariates included in the multivariate regression analyses were the adult's age (0=18–40 years; 1=45–64 years), sex (0=female; 1=male), race/ethnicity (Hispanic, non-Hispanic white, non-Hispanic black, non-Hispanic Asian, non-Hispanic other race), marital status (married/cohabitating, widowed, divorced/separated, never married), health relative to 12 months earlier (worse, about the same, better), education level (less than high school, high school diploma/equivalent, some college, bachelor's degree or higher), place of residence (not in a metropolitan statistical area, small metropolitan statistical area, large metropolitan statistical area), number of children in his/her household, and number of members in his/her family. In multivariate analyses using the employed sample, additional covariates related to the worker/workplace were included in the model: number of years worked for current/most recent employer, employer sector of current/most recent job (private, government, self-employed), and number of employees at current/most recent job (0, 1–9, 10–24, 25–49, 50–99, 100–249, 250–499, 500–999, ≥1,000).

Statistical Analyses

Descriptive estimates for each labor force outcome were generated by number of chronic conditions, with significance tests used to test differences. A probit model was used to regress employment on number of chronic conditions and demographic covariates for all U.S. adults aged 18–64 years. With each probit model marginal effects are presented, and in

the text are interpreted as the average percentage change in the probability of employment. Previous research has encouraged the use of log-binomial regression models (Williamson et al. 2013), but when an attempt was made to use this type of regression in the present study, the model failed to converge. As a result, a probit model was chosen as the alternative, drawing from precedent set by previous health economics research (Minor, 2011). The reference category used in all analyses for number of chronic conditions was "1 condition."

Among employed adults, separate ordinary least squares models were used to regress number of hours worked in the previous week, number of work days missed due to injury/illness, and personal earnings upon number of chronic conditions and demographic and worker/workplace covariates. Note that in all instances where ordinary least squares models were used, these analyses were replicated using general linear models with a log link and gamma distribution, resulting in patterns similar to those found in the ordinary least squares models.

As past research has found that in addition to having MCC, individual conditions and their severity determined how employment was affected (Waghorn et al., 2011), this study also sought to examine the association between labor force outcomes and individual chronic conditions. To examine this association, additional multivariate analyses were conducted. Probit models were used with employment as the outcome, where Model 1 included each individual chronic condition and demographic covariates, Model 2 was further adjusted for having MCC, and Model 3 included an interaction term between having MCC and each individual chronic condition.

Separate ordinary least squares models were run for the outcomes number of hours worked in the previous week, work days missed due to injury/illness, and personal earnings. Model 1 included each individual chronic condition, worker/workplace covariates, and demographic covariates, Model 2 was further adjusted for having MCC, and Model 3 included an interaction term between having MCC and each individual chronic condition. A Bonferroni correction ($\alpha/10$) was used here to adjust for multiple comparisons. These different models were able to estimate if a specific condition still had a significant relationship with each labor force outcome after controlling for the association between the outcome and having MCC, and if the association between having MCC and each labor force outcome was modified by any individual condition. Separate regression models were used not only to determine how the addition of a MCC indicator variable changed the relationship between a specific condition and labor force outcome, but also to reduce the problem of multicollinearity (which diagnostic testing showed no signs of in the preceding analyses).

Finally, supplemental analyses were conducted that replicated the aforementioned analyses among all adults aged 18 years and over (n=32,050), to determine if similar patterns were found among this population compared to the population aged 18–64 years. For all analyses the multi-stage cluster sample design of the NHIS was accounted for by using the sample design variables available with the 2011 NHIS data. Weights available with the 2011 NHIS were used to produce estimates representative to the civilian, non-institutionalized U.S. adult population.

RESULTS

Number of Chronic Conditions and Labor Force Outcomes

Employment in the Past 12 Months—Descriptive estimates showed that adults with a larger number of chronic conditions had a lower percentage of employment (Table I). Similar results were found in the multivariate analyses (Table II). Marginal effects show that when controlling for demographic characteristics, adults with no chronic conditions had a 3% greater probability of employment in the past 12 months than adults with one condition. On the other hand, relative to adults with a single condition there was a 11% reduction in probability of employment among adults with 2–3 conditions, and an even larger reduction (29%) among adults with ≥4 conditions.

Number of Hours Worked During the Previous Week—Employed adults worked a mean of 40 hours during the week prior to being interviewed for the NHIS (Table I). When examined by number of conditions, the average number of hours worked during the previous week did not significantly differ among categories, with one exception: adults with one condition worked a mean of approximately 50 minutes (or 0.8 hours) more in the previous week than adults with no conditions. Although statistically significant, this difference is small. To further examine the association, an ordinary least squares regression model that also contained demographic and worker/workplace covariates was estimated. Model estimates showed that relative to having one chronic condition, having either zero, 2–3, or ≥4 condition(s) was not significantly associated with the average number of hours worked during the previous week by employed adults (Table III).

Days of Work Missed Due to Injury/Illness in Past 12 Months—Descriptive estimates showed that there was a strong, positive relationship between number of chronic conditions and number of days of work missed due to injury/illness in the past 12 months (Table I). For the multivariate analyses, when demographic and worker/workplace covariates were included in the model, this association persisted (Table III). Compared to U.S. adults who were employed and had one chronic condition, those who had no conditions missed on average approximately 1 fewer work day, while those with 2–3 chronic conditions missed 3 more work days on average, and those with ≥4 chronic conditions missed 9 more work days on average than those with one condition.

Personal Earnings in Past Year—Descriptive results showed that employed adults with one chronic condition and 2–3 chronic conditions had significantly higher personal earnings than employed adults with no chronic conditions (Table I). However, when ordinary least squares regression estimates were calculated, there were no significant differences in personal earnings in the past year between employed adults with a single condition and employed adults with no conditions, or between employed adults with a single chronic condition and employed adults with MCC (Table III).

As multiply imputed data were used for personal earnings, and using multiply imputed values for an outcome variable could potentially introduce bias, a sensitivity analysis was conducted by running the same ordinary least squares regression model using the method of “multiple imputation, then deletion” (von Hippel, 2007). As with the initial analysis that

used imputed data, the results of this sensitivity analysis also found no significant differences for personal earnings in the past year by number of chronic conditions (results not shown).

Individual Chronic Conditions and Labor Force Outcomes

Employment in the Past 12 Months—Table IV presents the results from probit models that regressed variables for specific individual chronic conditions, having MCC, and selected demographic covariates on employment in the past 12 months. In the first model (not controlling for having MCC), results show a significant reduction in the probability of employment, regardless of the specific chronic condition examined. The conditions related to the largest reductions in employment compared to no condition were stroke (23% reduction), CHD (21% reduction), weak/failing kidneys (19% reduction), and COPD (13% reduction). In the second series of probit regression models, a variable for having MCC (0=not having MCC [<2 conditions]; 1=having MCC [≥2 conditions]) was added. When having MCC were controlled for, the association between some conditions (i.e., cancer, hypertension, current asthma, diabetes, and hepatitis) and employment was no longer significant when correcting for multiple comparisons. For the remaining conditions (i.e., CHD, stroke, COPD, arthritis, and weak/failing kidneys), when controlling for having MCC each was still associated with a significant and substantial reduction in the probability of employment.

To further examine the association between number of chronic conditions, specific types of chronic conditions, and employment among US adults aged 18–64 years, an additional series of probit regression models were estimated that also included an interaction term for each specific condition and having MCC (Table IV, Model 3). When correcting for multiple comparisons, no interactions were not significant.

Number of Hours Worked During the Previous Week—Among employed adults, ordinary least squares models were used to regress number of hours worked the previous week on each individual chronic condition along with demographic and worker/workplace covariates. Only one individual condition (arthritis) was initially shown to be related to average hours worked per week (Supplemental Table IV, Model 1); however, when accounting for multiple comparisons this did not remain significant. When having MCC was added to the model (Model 2), the association between hours worked and ever having arthritis experienced only a minor mean increase in magnitude (1 hour) but still was not significant when correcting for multiple comparisons. Additional models were run that included an interaction term between each condition and having MCC (Model 3), but no interaction terms were significant after applying the Bonferroni correction.

Work Days Missed Due to Injury/Illness in Past 12 Months—The ordinary least squares models that regressed work days missed in the past 12 months due to injury/illness on measures for each individual chronic condition and covariates showed that a number of conditions (i.e., cancer, hypertension, diabetes, and arthritis) were (correcting for multiple comparisons) significantly associated with missing more work days due to injury/illness on average, relative to employed adults who did not have that specific condition (Table V,

Model 1). Of the significant associations, the conditions that had the strongest association with average number of work days missed in the past 12 months were ever having cancer (mean 5 days), followed by ever having diabetes (mean 4 days), ever having arthritis (mean 3 days), and ever having hypertension (mean 2 days).

When having MCC was added to the models (Model 2), applying the Bonferroni correction none of the associations between individual chronic conditions and the mean number of work days missed due to injury/illness was significant. The association with work days missed and interaction terms between individual types of conditions and having MCC was also examined (Model 3); however, no significant relationships resulted.

Personal Earnings in Past Year—Finally, personal earnings in the past year among employed adults were examined using ordinary least squares models containing an indicator variable for individual chronic conditions and demographic and worker/workplace covariates (Supplemental Table V). When these models were estimated and adjustments made for multiple comparisons, the only condition that had a significant association with personal earnings in the past year was CHD: not accounting for having MCC (Model 1), employed adults with CHD earned $9,661 less in the past year compared to employed adults without this condition. When a variable for having MCC was included in the model (Model 2), this relationship between CHD and personal earnings remained – employed adults with CHD earned $9,032 less in the past year compared to employed adults without this condition. However, when accounting for multiple comparisons, no significant relationships resulted when the association to personal earnings and the interaction terms between individual types of conditions and having MCC was examined (Model 3).

Additional Analysis for Adults Aged 18 Years and Over

Samples used in the present study were limited to “working-age” adults (aged 18–64 years), and did not include persons aged 65 years and over to allow for generalizations to the entire U.S. adult population. However, a series of supplemental analyses were conducted among all adults aged 18 years and over (n=32,050) that regressed employment on chronic conditions (results not shown). These results indicated the same significant associations between employment and having MCC; however, the magnitudes of these reductions in employment were lower than among U.S. adults aged 18–64 years. Additional analyses were also conducted to replicate the remaining analyses presented in this manuscript for all employed adults aged 18 years and over (n=16,654) and resulted in associations similar to those found among employed adults aged 18–64 years (results not shown).

DISCUSSION

Using cross-sectional data from the 2011 NHIS, this research examined the association between having MCC and labor force outcomes. The overarching story is that among U.S. adults aged 18–64 years, a clear association was found between having MCC and a reduction in the probability of employment. Furthermore, among U.S. adults aged 18–64 years employed in the past 12 months, having MCC was associated with an increase in the average number of work days missed in the past year due to injury/illness. When controlling for having MCC, similar to previous literature (Waghorn et al., 2011) selected chronic

conditions (i.e., CHD, stroke, COPD, arthritis, and weak/failing kidneys) also decreased the probability of employment. In contrast, when controlling for having MCC, multivariate analyses showed no association among specific individual chronic conditions and the remaining labor force outcomes. For instances where both having MCC and selected chronic conditions were found to be significantly associated with labor force outcomes, interaction terms showed there was no evidence that the association between having MCC and labor force outcomes was modified by any specific individual condition(s) being present.

In regards to employment, the results indicated that compared to U.S. adults aged 18–64 years with one chronic condition, adults with no chronic conditions had an increased probability of employment, while adults with MCC had a reduced probability of being employed. The magnitude of this reduction in probability further decreased for those adults with a larger number of MCC; a finding similar to results from previous Australian studies (Schofield et al., 2008, 2012). In regards to the relationship between specific chronic conditions and employment, results initially showed that all ten conditions examined reduced the probability of employment among U.S. adults aged 18–64 years. However, when having MCC was controlled for in the model and adjustment for multiple comparisons was made, the results showed that the reduction in probability of employment only remained for five specific conditions: CHD, stroke, COPD, arthritis, and weak/failing kidneys. Thus, not only does having MCC appear to be a barrier to employment in the past 12 months, but the specific types of chronic conditions experienced also reduce the likelihood of employment. Note that interaction terms showed the association between having MCC and employment is not modified by any single specific condition.

For U.S. adults aged 18–64 years who had been employed sometime in the past 12 months, the relation between having MCC and additional labor force outcomes was examined, including the number of hours worked in the previous week, number of work days missed in the past year due to injury/illness, and personal earnings for the past year. Among these three outcomes, having MCC was related to a higher average number of work days missed due to injury/illness in the past 12 months. When individual conditions were examined, initially four of the ten conditions (i.e., cancer, hypertension, diabetes, and arthritis) had a positive relationship with number of work days missed. However, when controlling for having MCC and adjusting for multiple comparisons, the results showed that none of the ten conditions retained a significant relationship with work days missed due to illness/injury.

As for the remaining two labor force outcomes examined, number of hours worked during the previous week and personal earnings in the past year, when adjusting for multiple comparisons no significant relationship was found with having MCC, any of the individual chronic conditions examined (with one exception: CHD was associated with fewer personal earnings), or any of the interaction terms between having MCC and specific conditions.

There are limitations to this study worth noting. The 2011 NHIS asked about ten different chronic conditions (Goodman et al., 2013). Furthermore, the NHIS only asks about chronic conditions identified by a doctor or health professional (i.e., diagnosed conditions), potentially leading to the underreporting of undiagnosed conditions. Any potential underreporting of these conditions could be further exacerbated by respondents not properly

recalling the diagnosis of specific condition(s). Among employed adults, only three specific labor force outcomes were examined, but there may be others. The analytical approach chosen to examine the association between the outcome variables, and individual chronic conditions, having MCC, and specific condition*MCC interactions (see Tables IV–V; Supplemental Tables IV–V) allowed determination of whether any significant association of having MCC became non-significant when controlling for a specific condition, and if the main effect of having MCC is qualified by an interaction between having MCC and the specific condition. This is only one analytical approach; however, as there are other possible approaches that could yield additional information and understanding of the association of having MCC to labor force outcomes.

Another potential limitation was that multiply imputed data were used in the measure of personal earnings, and using multiply imputed values for an outcome variable could potentially bias the results (although it is worth noting that the alternative method of multiple imputation, then deletion [see von Hippel, 2007] was used and showed no indication of bias). Finally, in research that uses incomplete data with multivariate analyses, there is the possibility of bias being introduced as cases are dropped from the final sample, particularly if there exists some systematic reason as to why these cases were incomplete.

To address these limitations, there are a number of steps future research may take. Additional chronic conditions (those related to both physical and mental health) may be considered. Additional labor force outcomes may be worth studying, or additional covariates worth including (e.g., industry and occupation classification, the MCC-related healthcare costs paid for by one’s employer, the amount of paid sick leave provided by an employer). Also, alternative analytical approaches may be taken that could yield additional information and understanding of the association of having MCC with labor force outcomes; for example, examining the additive and multiplicative effects of specific chronic condition dyads (i.e., cancer and hypertension).

This study presents a clear pattern for U.S. adults: having a chronic condition acts as a barrier to employment. This barrier is even greater when MCC are present, regardless of the specific condition present. A potential result of this lower probability of employment may be that adults with MCC are at a financial disadvantage relative to other adults with zero or one chronic condition. This inference may especially hold true for those aged 18–64 years who, unlike adults aged 65 years and over, may be less likely to be receiving income from other sources. Among employed adults, there is a higher likelihood of needing to take time off from work for illness/injury. These missed days of work may pose a financial burden, even if it is indirect. In these situations, the financial burden falls on the employers who must not only compensate the worker for this leave, but also experience decreased production from the worker on the day(s) s/he takes this sick leave. Results from this study show investigators interested in examining MCC and the consequences of MCC should give consideration in their research to aspects related to the labor force.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

Agborsangaya CB, Lau D, Lahtinen M, Cooke T, Johnson JA. Multimorbidity prevalence and patterns across socioeconomic determinants: a cross-sectional survey. BMC Public Health. 2012; 12:201. http://www.biomedcentral.com/1471-2458/12/201. [PubMed: 22429338]

Bayliss EA, Bosworth HB, Noel PH, Wolff JL, Damush TM, McIver L. Supporting self management for patients with complex medical needs: recommendations for a working group. Chronic Illn. 2007; 3(2):167–175. [PubMed: 18083671]

DiBonaventura MD, Wagner J-S, Yuan Y, L'Italien G, Langley P, Kim WR. The impact of hepatitis C on labor force participation, absenteeism, presenteeism and non-work activities. J Med Econ. 2011; 14(2):253–261. [PubMed: 21385147]

Eisner MD, Yelin EH, Katz PP, Lactao G, Iribarren C, Blanc PD. Risk factors for work disability in severe asthma adults. Am J Med. 2006; 119(10):884–891. [PubMed: 17000221]

Fortin M, Bravo G, Hudon C, Vanasse A, Lapointe L. Prevalence of multimorbidity among adults seen in family practice. Ann Fam Med. 2005; 3(3):223–228. [PubMed: 15928225]

Goodman RA, Posner SF, Huang ES, Parekh AK, Koh HK. Defining and measuring multiple chronic conditions: imperatives for research, policy, program, and practice. Prev Chronic Dis. 2013; 10:120239. http://www.cdc.gov/pcd/issues/2013/12_0239.htm.

Kamaleri Y, Natvig B, Ihlebaek CM, Bruusgaard D. Does the number of musculoskeletal pain sites predict work disability? A 14-year prospective study. Eur J Pain. 2009; 13(4):426–430. [PubMed: 18599328]

Kessler RC, Maclean JR, Petukhova M, Sarawate CA, Short L, Li TT, Stang PE. The effects of rheumatoid arthritis on labor force participation, work performance, and healthcare costs in two workplace samples. J Occup Environ Med. 2008; 50(1):88–98. [PubMed: 18188086]

Lehnert T, Heider D, Leicht H, Heinrich S, Corrieri S, Luppa M, Reidel-Heller S, König H-H. Health care utilization and costs of elderly persons with multiple chronic conditions. Med Care Res Rev. 2011; 68(4):387–420. [PubMed: 21813576]

Marengoni A, Angleman S, Fratiglioni L. Prevalence of disability according to multimorbidity and disease clustering: a population-based study. Journal of Comorbidity. 1(1):11–18.

Minor T. The effect of diabetes on female labor force decisions: new evidence from the National Health interview Survey. Health Econ. 2011; 20(12):1468–1486. [PubMed: 22025390]

National Center for Health Statistics. 2011 Imputed family income/personal earnings files: dataset documentation. National Center for Health Statistics; Hyattsville, MD: 2012. http://www.cdc.gov/nchs/nhis/2011imputedincome.htm

Paez KA, Zhao L, Hwang W. Rising out-of-pocket spending for chronic conditions: a ten year trend. Health Aff. 2009; 28(1):15–25.

Parekh AK, Goodman RA, Gordon C, Koh HK. HHS Interagency Workgroup on Multiple Chronic Conditions. Managing multiple chronic conditions: a strategic framework for improving health outcomes and quality of life. Public Health Rep. 2011; 126(4):460–471. [PubMed: 21800741]

Schenker N, Raghunathan TE, Chiu P-L, Makuc DM, Zhang G, Cohen AJ. Multiple imputation of missing income data in the National Health Interview Survey. J Am Stat Assoc. 2006; 101(475): 924–933.

Schiller JS, Lucas JW, Peregoy JA. Summary health statistics for U.S. adults: National Health Interview Survey, 2011. Vital Health Stat. 2012; 10(256):1–208.

Schneider KM, O'Donnell BE, Dean D. Prevalence of multiple chronic conditions in the United States' Medicare population. Health Qual Life Outcomes. 2011; 7:82. http://www.hqlo.com/content/7/1/82. [PubMed: 19737412]

Schofield DJ, Callander EJ, Shrestha RN, Passey ME, Percival R, Kelly SJ. Association between co-morbidities and labour force participation amongst persons with back problems. Pain. 2012; 153(10):2068–2072. [PubMed: 22840571]

Schofield DJ, Shrestha RN, Passey ME, Fletcher SL. Chronic disease and labour force participation among older Australians. Med J Aust. 2008; 189(8):447–450. [PubMed: 18928439]

Tunceli K, Bradley CJ, Nerenz D, Williams LK, Pladevall M, Lafata JE. The impact of diabetes on employment and work productivity. Diabetes Care. 2005; 28(11):2662–2667. [PubMed: 16249536]

U.S. Department of Health and Human Services. US Department of Health and Human Services inventory of programs, activities, and initiatives focused on improving the health of individuals with multiple chronic conditions. U.S. Department of Health and Human Services; Washington, DC: 2011. http://www.hhs.gov/ash/initiatives/mcc/mcc-inventory-20111018.pdf

Van Oostrom SH, Picavet HSJ, van Gelder BM, Lemmens LC, Hoeymans N, van Dijk CE, Verheij RA, Schellevis FG, Baan CA. Multimorbidity and comorbidity in the Dutch population – data for general practices. BMC Public Health. 2012; 12:715. http://www.biomedcentral.com/1471-2458/12/715. [PubMed: 22935268]

Van Rijn RM, Robroek SJW, Brouwer S, Burdorf A. Influence of poor health on exit from paid employment: a systematic review. Occup Environ Med. 2014; 71(4):295–301. [PubMed: 24169931]

Vogeli C, Shields AE, Lee TA, Gibson TB, Marder WD, Weiss KB, Blumenthal D. Multiple chronic conditions: prevalence, health consequences, and implications for quality, care management, and costs. J Gen Intern Med. 2007; 22(Supp 3):391–395. [PubMed: 18026807]

Von Hippel PT. Regression with missing ys: an improved strategy for analyzing multiply imputed data. Sociological Methodology. 2007; 37:83–117.

Waghorn G, Chant D, Jonsdottir. Comorbidity and labor force activity among people with psychiatric disorders. J Occup Environ Med. 2011; 53(1):68–73. [PubMed: 21187789]

Ward BW, Schiller JS. Prevalence of multiple chronic conditions among US adults: estimates from the National Health Interview Survey, 2010. Prev Chronic Dis. 2013; 10:120203. http://www.cdc.gov/pcd/issues/2013/12_0203.htm.

Ward BW, Schiller JS, Goodman RA. Multiple chronic conditions among US adults: a 2012 update. Prev Chronic Dis. 2014; 11:130389. http://www.cdc.gov/pcd/issues/2014/13_0389.htm.

Williamson T, Eliasziw M, Fick GH. Log-binomial models: exploring failed convergence. Emerg Themes Epidemiol. 2013; 10:14. http://www.ete-online.com/content/10/1/14. [PubMed: 24330636]

TABLE I

Prevalence of Selected Labor Force Outcomes for U.S. Adults Aged 18–64 Years, by Number of Chronic Conditions

	U.S. Adults		Employed U.S. Adults	
	Employment in Past 12 Months (n=25,458)	Hours Worked in Previous Week (n=16,096)	No. of Work Days Missed due to Injury/Illness in Past 12 Months (n=16,096)	Personal Earnings in Past Year [a] (n=16,096)
No. Chronic Conditions	% (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
0	82.0 (81.1–82.8)	39.9 (39.6–40.2)	2.1 (1.95–2.34)	44.4 (43.0–45.9)
1	78.5 (77.2–79.8)	40.7 (40.2–41.1)	4.0 (3.52–4.57)	49.0 (47.0–51.0)
2–3	64.6 (62.7–66.5)	40.5 (39.8–41.2)	7.4 (6.22–8.56)	47.7 (45.2–50.3)
≥4	39.2 (35.0–43.5)	41.6 (38.9–44.2)	14.5 (8.85–20.1)	43.4 (36.3–50.5)
Total	77.3 (76.6–77.9)	40.2 (39.9–40.5)	3.48 (3.23–3.73)	46.0 (44.9–47.2)

Data: National Health Interview Survey (NHIS), 2011

Notes: Estimates account for the complex sample design of the NHIS and were weighted using the NHIS sample adult weights. n = unweighted sample sizes; CI = confidence interval.

[a] Estimates are gross earnings in thousands of dollars.

TABLE II

Probit Regression of Employment in the Past 12 Months on Number of Chronic Conditions and Selected Covariates, for U.S. Adults Aged 18–64 Years (unweighted n=25,458)

	β	(SE)	Marginal Effect [a]
No. of chronic conditions			
0	0.106***	(0.029)	0.028
1	*(ref)*	*(ref)*	*(ref)*
2–3	−0.353***	(0.035)	−0.108
≥4	−0.872***	(0.065)	−0.294
Aged 45–64 years	−0.196***	(0.028)	−0.055
Male	0.402***	(0.024)	0.112
No. of children in household	0.005	(0.019)	0.001
No. of persons in family	−0.062***	(0.014)	−0.017
Race/ethnicity			
Hispanic	0.003	(0.032)	0.001
NH white	*(ref)*	*(ref)*	*(ref)*
NH black	−0.019	(0.034)	−0.005
NH Asian	−0.195***	(0.048)	−0.057
NH other race	−0.160*	(0.065)	−0.046
Marital status			
Married/cohabitating	0.348***	(0.030)	0.101
Widowed	0.094	(0.069)	0.029
Divorced/separated	0.290***	(0.039)	0.085
Never married	*(ref)*	*(ref)*	*(ref)*
Health relative to 12 months earlier			
Worse health	−0.394***	(0.038)	−0.121
About the same health	*(ref)*	*(ref)*	*(ref)*
Better health	0.043	(0.031)	0.012
Education level			
Less than high school	−0.857***	(0.041)	−0.251
High school diploma/GED	−0.516***	(0.035)	−0.136
Some college	−0.341***	(0.033)	−0.084
Bachelor's degree or higher	*(ref)*	*(ref)*	*(ref)*
Place of residence			
Not in metropolitan statistical area	*(ref)*	*(ref)*	*(ref)*
Small metropolitan statistical area	0.049	(0.039)	0.014
Large metropolitan statistical area	0.051	(0.037)	0.014
Constant	1.005***	(0.057)	
Wald statistic	χ^2 (21) = 3,964		

Data: National Health Interview Survey (NHIS), 2011

Notes: Estimates account for the complex sample design of the NHIS and were weighted using the NHIS sample adult weights. β = unstandardized coefficient; SE = standard error; *ref* = reference category; NH = non-Hispanic.

[a]Marginal effects are displayed here as the average change in the probability of employment relative to the reference stratum (*ref*).

* p≤.05;

** p≤.01;

*** p≤.001

TABLE III

Ordinary Least Squares Regression of Hours Worked, Work Days Missed, and Personal Earnings on Number of Chronic Conditions and Selected Covariates, for Employed U.S. Adults Aged 18–64 Years (unweighted n=16,096)

	Hours Worked in Previous Week		Work Days Missed due to Injury/Illness in Past 12 Months		Personal Earnings in Past Year [a]	
	β	(SE)	β	(SE)	β	(SE)
No. of chronic conditions						
0	−0.022	(0.276)	−1.412***	(0.267)	0.621	(1.060)
1	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*
2–3	−0.260	(0.403)	2.771***	(0.637)	−1.060	(1.312)
≥ 4	0.967	(1.378)	9.162**	(2.893)	−5.507	(3.172)
No. of yrs. worked for employer	0.138***	(0.017)	0.011	(0.023)	0.996***	(0.081)
Employer sector						
Private	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*
Government	−1.387***	(0.289)	−0.338	(0.293)	−6.988***	(1.057)
Self-employed	0.295	(0.626)	0.168	(0.506)	1.199	(2.192)
No. of employees at workplace	0.512***	(0.050)	0.170**	(0.059)	2.217***	(0.211)
Aged 45–64 years	0.015	(0.292)	−0.137	(0.340)	7.667***	(1.224)
Male	5.270***	(0.241)	−0.635**	(0.232)	18.329***	(0.903)
No. of children in household	1.000***	(0.211)	0.249	(0.171)	5.274***	(0.739)
No. of persons in family	−1.030***	(0.178)	−0.316**	(0.120)	−2.281***	(0.519)
Race/ethnicity						
Hispanic	−0.099	(0.331)	0.016	(0.456)	−7.566***	(1.031)
NH white	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*
NH black	−0.119	(0.355)	−0.272	(0.406)	−5.361***	(1.610)
NH Asian	0.249	(0.472)	−0.852**	(0.278)	−2.462	(1.932)
NH other race	0.043	(0.920)	0.043	(0.730)	−2.696	(1.838)
Marital status						
Married/cohabitating	3.530***	(0.350)	0.233	(0.313)	11.825***	(0.993)

	Hours Worked in Previous Week		Work Days Missed due to Injury/Illness in Past 12 Months		Personal Earnings in Past Year [a]	
	β	(SE)	β	(SE)	β	(SE)
Widowed	4.210***	(1.113)	2.706	(2.371)	1.530	(2.139)
Divorced/separated	3.754***	(0.417)	−0.218	(0.431)	8.886***	(1.189)
Never married	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*
Health relative to 12 months earlier						
Worse health	−1.132	(0.653)	7.978***	(1.143)	−3.355*	(1.634)
About the same health	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*
Better health	0.203	(0.320)	3.205***	(0.404)	0.451	(1.073)
Education level						
Less than high school	−3.574***	(0.481)	0.758	(0.449)	−39.608***	(1.484)
High school diploma/GED	−2.407***	(0.339)	1.221***	(0.358)	−32.506***	(1.401)
Some college	−1.916***	(0.302)	1.042***	(0.305)	−26.422***	(1.261)
Bachelor's degree or higher	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*
Place of residence						
Not in metropolitan statistical area	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*	*(ref)*
Small metropolitan statistical area	−2.121***	(0.389)	0.197	(0.400)	2.560*	(1.078)
Large metropolitan statistical area	−1.380***	(0.380)	−0.113	(0.351)	11.075***	(1.157)
Constant	36.918***	(0.630)	2.486***	(0.654)	25.945***	(1.906)
R^2	0.096		0.049		0.242	
F-statistic	(25, 3960) = 40.83		(25, 3960) = 11.42		(25,2769) = 92.68	

Data: National Health Interview Survey (NHIS), 2011

Notes: Employed adults were those who had been employed in the past 12 months. Estimates account for the complex sample design of the NHIS and were weighted using the NHIS sample adult weights. β = unstandardized coefficient; SE = standard error; *ref* = reference category; NH = non-Hispanic.

[a] Estimates are gross earnings in thousands of dollars.

* p ≤.05;

** p ≤.01;

*** p ≤.001

TABLE IV

Probit Regression of Employment in the Past 12 Months on Individual Chronic Condition, Having Multiple Chronic Conditions (MCC), Specific Condition* MCC Interaction, and Selected Covariates among U.S. Adults Aged 18–64 Years (unweighted n=25,458)

	Model 1			Model 2			Model 3		
	β	(SE)	Marg.[a]	β	(SE)	Marg.[a]	β	(SE)	Marg.[a]
Cancer	−0.259***	(0.050)	−0.079	−0.056	(0.051)	−0.016	−0.052	(0.095)	−0.015
MCC				−0.479***	(0.031)	−0.148	−0.479***	(0.032)	−0.148
Cancer* MCC							−0.006	(0.112)	−0.002
Hypertension	−0.285***	(0.027)	−0.085	−0.070*	(0.031)	−0.020	−0.098*	(0.039)	−0.028
MCC				−0.448***	(0.035)	−0.138	−0.490***	(0.049)	−0.152
Hypertension* MCC							0.079	(0.065)	0.022
CHD	−0.642***	(0.066)	−0.210	−0.396***	(0.069)	−0.123	−0.571*	(0.231)	−0.182
MCC				−0.447***	(0.031)	−0.137	−0.450***	(0.031)	−0.138
CHD* MCC							0.197	(0.235)	0.052
Stroke	−0.690***	(0.084)	−0.228	−0.446***	(0.084)	−0.140	0.039	(0.215)	0.011
MCC				−0.459***	(0.031)	−0.141	−0.453***	(0.031)	−0.139
Stroke* MCC							−0.548*	(0.236)	−0.175
COPD	−0.423***	(0.049)	−0.134	−0.181***	(0.052)	−0.054	−0.146	(0.125)	−0.043
MCC				−0.453***	(0.032)	−0.139	−0.451***	(0.032)	−0.139
COPD* MCC							−0.044	(0.138)	−0.013
Current asthma	−0.235***	(0.038)	−0.071	−0.037	(0.041)	−0.010	0.039	(0.072)	0.011
MCC				−0.479***	(0.032)	−0.148	−0.460***	(0.033)	−0.142
Current asthma* MCC							−0.132	(0.090)	−0.039
Diabetes	−0.347***	(0.039)	−0.108	−0.081*	(0.041)	−0.023	−0.014	(0.091)	−0.004

	Model 1			Model 2			Model 3		
	β	(SE)	Marg.[a]	β	(SE)	Marg.[a]	β	(SE)	Marg.[a]
MCC				−0.466***	(0.032)	−0.144	−0.460***	(0.033)	−0.142
Diabetes* MCC							−0.084	(0.102)	−0.024
Arthritis	−0.364***	(0.028)	−0.111	−0.166***	(0.032)	−0.048	−0.103*	(0.045)	−0.030
MCC				−0.408***	(0.034)	−0.124	−0.355***	(0.043)	−0.107
Arthritis* MCC							−0.134*	(0.064)	−0.039
Hepatitis	−0.195***	(0.058)	−0.059	−0.019	(0.059)	−0.005	0.034	(0.098)	0.009
MCC				−0.486***	(0.030)	−0.150	−0.483***	(0.031)	−0.149
Hepatitis* MCC							−0.081	(0.125)	−0.023
Weak/failing kidneys	−0.595***	(0.091)	−0.194	−0.347***	(0.093)	−0.107	−0.137	(0.309)	−0.040
MCC				−0.468***	(0.030)	−0.144	−0.465***	(0.030)	−0.143
Weak/failing kidneys* MCC							−0.249	(0.321)	−0.075

Data: National Health Interview Survey (NHIS), 2011

Notes: Estimates account for the complex sample design of the NHIS and were weighted using the NHIS sample adult weights. Model 1 included each individual chronic condition and demographic covariates, Model 2 further adjusted for having MCC, and Model 3 included an interaction term between having MCC and each individual chronic condition. β = unstandardized coefficient; SE = standard error; Marg. = marginal effects; MCC = multiple chronic conditions; CHD = coronary heart disease; COPD = chronic obstructive pulmonary disease.

[a]Marginal effects are displayed here as the average change in the probability of employment.

*p≤.05;

**p≤.01;

***p≤.001

TABLE V

Ordinary Least Squares Regression of Work Days Missed[a] on Individual Chronic Condition, Having Multiple Chronic Conditions (MCC), Specific Condition* MCC Interaction, and Selected Covariates among Employed U.S. Adults Aged 18–64 Years (unweighted n=16,906)

	Model 1		Model 2		Model 3	
	β	(SE)	β	(SE)	β	(SE)
Cancer	4.638***	(1.181)	3.131*	(1.251)	4.778**	(1.764)
MCC			3.730***	(0.063)	3.999***	(0.640)
Cancer* MCC					−2.943	(2.385)
Hypertension	1.576***	(0.398)	−0.261	(0.446)	0.063	(0.349)
MCC			4.320***	(0.678)	5.097***	(1.265)
Hypertension* MCC					−1.327	(1.475)
CHD	3.744*	(1.713)	1.206	(1.771)	0.879	(1.435)
MCC			4.064***	(0.618)	4.057***	(0.631)
CHD* MCC					0.384	(2.519)
Stroke	8.363*	(3.922)	6.331	(3.897)	0.938	(1.746)
MCC			3.962***	(0.581)	3.881***	(0.581)
Stroke* MCC					7.202	(5.405)
COPD	3.208**	(1.235)	1.022	(1.311)	2.315	(2.411)
MCC			4.021***	(4.021)	4.127***	(0.642)
COPD* MCC					−1.878	(2.793)
Current asthma	1.608**	(0.601)	0.082	(0.642)	0.818	(0.634)
MCC			4.153***	(0.632)	4.414***	(0.708)
Current asthma* MCC					−1.685	(1.370)
Diabetes	3.994***	(0.967)	1.734	(1.018)	1.412	(1.078)

	Model 1		Model 2		Model 3	
	β	(SE)	β	(SE)	β	(SE)
MCC			3.733***	(0.630)	3.696***	(0.670)
Diabetes* MCC					0.441	(1.734)
Arthritis	2.754***	(0.546)	1.204*	(0.576)	1.451**	(0.550)
MCC			3.624***	(0.633)	3.903***	(0.848)
Arthritis* MCC					−0.678	(1.277)
Hepatitis	1.952	(1.395)	0.462	(1.370)	−0.868	(0.478)
MCC			4.136***	(0.591)	4.003***	(0.614)
Hepatitis* MCC					2.543	(2.645)
Weak/failing kidneys	7.357**	(2.365)	5.229*	(2.373)	5.043	(2.958)
MCC			4.007***	(0.599)	4.004***	(0.603)
Weak/failing kidneys* MCC					0.254	(4.284)

Data: National Health Interview Survey (NHIS), 2011

Notes: Estimates account for the complex sample design of the NHIS and were weighted using the NHIS sample adult weights. Model 1 included each individual chronic condition, worker/workplace covariates, and demographic covariates, Model 2 further adjusted for having MCC, and Model 3 included an interaction term between having MCC and each individual chronic condition. β = unstandardized coefficient; SE = standard error; MCC = multiple chronic conditions; CHD = coronary heart disease; COPD = chronic obstructive pulmonary disease.

[a]Work days missed due to injury/illness in past 12 months.

*p≤.05;

**p≤.01;

***p≤.001