Household composition and home health care utilization in young and middle-aged adults

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Abstract

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Purpose. Given the caregiving duties that women often assume in the United States and the paucity of research on the young and middle-aged adult home health care (HHC) population, the aim of this study was to describe the association between household composition and frequency of HHC utilization among utilizers 18-64 years old.

Methods. This study used data from a 2015 nationally representative health survey to conduct a descriptive, cross-sectional analysis. A negative binomial regression was used to test the association of interest and interaction effects.

Results. Compared to the presence of at least one female of caregiving age, the presence of at least one male of caregiving age only and households with no adult of caregiving age was not significantly associated with HHC utilization. Patient sex did not act as an effect modifier of the association.

Conclusions. The findings do not confirm that any significant relationships exist between household composition and frequency of HHC utilization. Further research is needed to refine the model and methods to better understand the patterns and drivers of HHC utilization in this population.

Introduction

Within the United States health care system, home health care (HHC) policies and services have been designed and implemented, in large part, to meet the HHC needs of the elderly population. Considerable research exists on this group, as the elderly account for the bulk of both the need and utilization of HHC.[1,2] Younger and middle-aged adults, however, may need HHC as well, but given the dearth of research on the young and middle-aged adult population of HHC users, we do not have a good understanding of their degree of access to HHC, what drives their utilizations patterns, nor do we know if our current systems and policies of HHC care are meeting their needs. A determining factor in whether a patient can remain at home instead of living in an institutional setting is the presence of a household member who is potentially capable of providing informal or formal caregiving services.[3,4]

The need for our health care system to support family caregivers is growing as the prevalence of family caregiving increases in the United States.[4] If a household member is willing and able to take on caregiving responsibilities, that household member may supplement and, in turn, may influence the quantity and diversity of formal HHC services provided to the patient. Often an unreimbursed resource, caregivers report providing a wide range of services, from help with activities of daily living (ADL), such as hygiene, dressing/undressing, and sitting/standing/lying down, to more clinical tasks requiring specialized skills, such as attending to wounds, medical equipment for breathing and feeding, and colostomy bags. Almost every self-identified caregiver provides some level of help to patients with ADLs.[5] Almost 60% of caregivers, regardless of skillset, report performing clinical tasks due to the belief that they do not have a choice in the matter, whether it be because of pressure they put on themselves, pressure from the patient or another family member, or because insurance does not cover the service.[5]

Despite men sharing more caregiving tasks than they have in the past,[4,6] women still are far more likely than men to take on caregiver roles in the United States.[4,7,8] Not only do women account for up to three-fourths of all caregivers,[9] but they also spend up to 50% more time providing care on average compared to their male counterparts.[10,11] One explanation for the large divide in sex differences among caregivers is social expectation. While 59% of people in a nationally representative sample of the United

States think men and women would generally do an equally good job of caring for a household member with a serious health condition, 40% of people believe that women would do a better job than men, leaving only 1% of people thinking that men would do a better job than women.[12] Expectations of caregiving responsibilities vary widely between men and women, where 45% of people say that the responsibilities of caring for an ill family member fall mostly on women and only 1% say the caregiving responsibilities fall mostly on men.[12]

The time and energy that a caregiver spends providing care, which can depend on the HHC patient's type of illness and its severity,[11] can result in caregiver burden. The effects of caregiving, especially negative effects, can be more pronounced for female caregivers compared to male. The work life of female caregivers can be more heavily impacted (e.g. lost wages due to decreased work hours or a leave of absence) compared to male caregivers.[13] Caregiving can also negatively impact the caregiver's physical, mental, and emotional health.[4,6,7,10,13,14]

Caregiver burden can affect men and women differently which can, in part, be due to the types of caregiving men and women provide and how each sex responds to caregiving responsibilities. For example, more women say they provide emotional support to their ill family member compared to men.[12] The frequency of emotional support also differs, with almost 40% of women frequently providing emotional support compared to 30% of men. Research has shown that female caregivers experience stress almost always in their lives twice as much as men.[15] Furthermore, the relationships and social networks of caregivers can be negatively impacted, leading caregivers to feel socially isolated and possibly affect their mental well-being; women are particularly vulnerable to the impact of lowered social support.[16] We also have evidence that men are likely to take on caregiving tasks less physically and emotionally burdensome, such as finance help and care coordination, compared to the tasks women tend to take on, such as bathing and toileting.[8]

HHC systems were originally designed in the United States to target acute illnesses, but they have been transitioning to a more chronic-disease model due to growing numbers of people living longer with multiple and complex conditions.[1,4,17] This shift is in part due to improvements and advancements in the science of medicine, innovative health technologies, and higher standards of care.[18] Caregivers of patients with chronic illnesses requiring long-term or life-long care are impacted more profoundly compared to caregivers of patients with acute illnesses due to the on-going nature of the needed care and highly critical tasks the caregivers may perform.[19] We have evidence that the reliance that our health care system may place on caregivers, particularly female caregivers given societal norms, may result in especially high caregiver burden when caring for high-need, chronically ill patients.[5]

While caregiving can be rewarding for both women and men,[14] public health and health services researchers have a responsibility to draw attention to the sex differences in caregiving given the well-documented unbalanced societal expectations and negative consequences that can result. A better understanding of how HHC services may be impacted based on not just the presence of a family or household member, but more specifically the sex of the household member, is needed to reduce possible structural or process barriers to optimize caregiver support.

HHC literature validates the need for and importance of shedding more light on HHC utilization in young and middle-aged adults and on the roles of male and female adults of caregiving age living with a young or middle-aged HHC patient. Women are higher utilizers of health care services in general[20] and specifically for HHC services compared to men.[2] Given the societal and cultural norms of female caregiving and the patient sex differences in health care utilization, one may speculate that any association found between HHC utilization and household configuration potentially could depend on the sex of the HHC patient.

Methods

Hypotheses

Given the caregiving duties that women often take on, I hypothesized that HHC utilization is lower in households with at least one women of caregiving age compared to households with no women. I further hypothesized that the sex of the patient modifies the association between HHC and household composition.

Data Source

This descriptive, cross-sectional study was a secondary analysis of the household component data file (HC-181), home health file (HC-178H), and medical conditions file (H-180) of the 2015 Medical Expenditure Panel Survey (MEPS), which collects data on utilization over the course of a year. These publicly available MEPS files provide data on a nationally representative civilian non-institutionalized population in the United States. MEPS collects patient self-reported data and data directly from health care providers, including HHC agencies.

Patient Population

I limited analyses to participants aged 18-64 who had >0 days of HHC provider days in 2015. Including patients with zero HHC days in the analysis would have been problematic, as the vast majority of these would have no clinical indication for HHC utilization, and there is no data in this dataset that allows us to ascertain whether HHC was clinically indicated, prescribed, or desired – only whether it was utilized. Patients who received HHC only associated with hospice care were excluded from the population as hospice care differs considerably from other HHC populations in terms of utilization patterns, provider options, and insurance coverage.

I excluded children from the analysis because their utilizations patterns for healthcare overall and HHC in particular are different than those of adults, and the role of household composition and household member caregiving is different, I assumed that at least one adult in the household of children is expected to provide some level of caregiving. I also excluded people who were Medicare age-eligible (65+ years old) given that my intention was to focus on the understudied young and middle-aged adult HHC population.

Variables

The outcome variable was the mean number of HHC provider days (range: 1-364 days). The count was derived from all months that documented the patient having had received any type of HHC discipline (i.e. both skilled and unskilled services).

The primary predictor variable was household composition. This mutually exclusive, collectively exhaustive categorical variable was defined as the HHC patient's household consisting of: (a) at least one female member of caregiver age (b) at least one male member of caregiver age and no female of caregiver age, or (c) no person of caregiver age. "Caregiver age" here was defined as a person between the ages of 18-74 years old. For the purposes of this study, I excluded children and elderly as potential caregivers in an effort to focus on household members who may more likely fall into roles related to caregiving.[11] Data for the predictor variable were based on the HHC patient's household members as of the end of the study year, December 31, 2015.

The Anderson-Newman Behavioral Model of Health Services Use[21,22] proposes that predisposing characteristics, enabling characteristics, and need characteristics are the three primary dynamics at play in determining a patient's usage of health services. The Anderson-Newman model offered the framework to identify this study's covariates (Figure 1). I hypothesized that patient age and sex would be predisposing factors that might confound the association between household composition and number of HHC visits. Age was treated as a continuous variable (18-64 years old) and patient sex was captured as a binary variable, male or female. Although race and education are sometimes included in regression models by default, here I chose to exclude them because of a lack of a hypothesized relationship with my primary association of interest.

Need factors included the presence of any children (<10 years old) in the HHC patient's household, perceived health care status, and the presence of chronic conditions. The children in the household variable was limited to children under 10 years old because young children represent a competing caregiver demand on adult members of the household to a greater degree than older children might, especially given that older children and adolescents may actually contribute caregiving capacity in a household. The MEPS survey collects perceived health care status up to three times over the course of the year. Each measure had the same Likert type scaling system of 1-5 (1=excellent, very good, good, fair, and 5=poor). Scores were averaged across all data collected for a subject (1-3 time points) to form one composite score.

Chronic condition categories were compiled using Hwang's Chronic Condition Indicator,[23] an algorithm developed as part of the Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project. The indicator categorized ICD-9 diagnostic codes into chronic or not chronic based on body systems. For the purposes of this study, body systems were included and grouped based on why patients may need HHC due to the chronic condition. The following conditions are grouped together because they likely involve chronic, life-long conditions that require not just frequent outpatient monitoring, but also HHC supply use (e.g. feeding tube, respiratory equipment, catheters): respiratory diseases; endocrine, nutritional, metabolic diseases, immunity disorders; genitourinary diseases; diseases of blood and blood-forming organs; and digestive diseases. Another group of chronic conditions was defined as potentially requiring HHC because of a physical need, perhaps due to mobility or developmental disabilities: congenital/perinatal anomalies, diseases of the nervous system and sense organs, and musculoskeletal diseases. A third chronic condition group included in this study is diseases of the circulatory system because 58% of adults aged 18-64 who received HHC had a chronic condition within this body system indicator.

An enabling factor included in the model is region, defined as Northeast, Midwest/West, and South of the United States. The unequal distribution of HHC agencies throughout the country[24] results in differences in patient access to HHC which is a necessary factor to facilitate HHC utilization.

Data Analysis

StataSE 14 (64-bit) was used for all analyses, with significance level set at alpha = 0.05. To test differences in patient characteristics across sex, I used a two-tailed student's t-test for the continuous variable (i.e. age) and chi-squared tests for the categorical variables for differences. Likewise, I also calculated the sample-weighted mean number of HHC provider days across patient characteristic categories and use two-tailed student's t-test to evaluate whether differences were statistically significant when stratified across sex.

Conditional on having a positive number of skilled HHC days, I used a standard negative binomial regression model due to the over-dispersed distribution of the non-negative and right-skewed dependent variable (weighted HHC days mean=69, median=16).

An assessment of the percent change (±10%) in the primary predictor (household composition) regression coefficient was my mechanism for deciding which bivariate associations to include in my final model (Figure 5). I included variables that were available, relevant, and common enough (i.e. relatively high frequency for my population of interest) to put in my model. The stacking order of chronic conditions were based on highest to lowest frequency in these data. Once variables were identified as confounders (i.e. ≥10% change in the household composition coefficient), I included those variables in the multiple negative binomial regression analysis to estimate the association between household composition and mean number of HHC provider days.

Model without interaction term:

$$\ln E(\mathit{HHC\ provider\ days}) = \beta_0 + \beta_1 \mathit{HouseholdComposition} + \beta_2 \mathit{PtSex} + \beta_3 \mathit{PtAge} + \beta_4 \mathit{Region} + \beta_5 \mathit{Resp/Endo/Genitour/Blood/DigestCC} + \beta_6 \mathit{Congen/Nerv/MusculoskelCC} + \beta_7 \mathit{CirculatoryCC} + \beta_8 \mathit{ChildInHousehold} + \mathcal{E}$$

I conducted another negative binomial regression to assess the modifying effect of patient sex on the relationship between the mean number of HHC days and household composition. The coefficients of the interaction terms were analyzed across each of the three categories of the household composition variable.

Model with interaction term:

$$\ln E(\mathit{HHC\ provider\ days}) = \beta_0 + \beta_1 \mathit{HouseholdSexInteraction} + \beta_2 \mathit{PtAge} + \beta_3 \mathit{Region} + \beta_4 \mathit{Resp/Endo/Genitour/Blood/DigestCC} + \beta_5 \mathit{Congen/Nerv/MusculoskelCC} + \beta_6 \mathit{CirculatoryCC} + \beta_7 \mathit{ChildInHousehold} + \mathcal{E}$$

Ultimately, predicted probabilities were calculated using the following negative binomial formula (i.e. prvalue[25] Stata command):

$$\hat{P}(y \mid X) = \frac{\Gamma\left(y + \alpha^{-1}\right)}{y!\,\Gamma\left(\alpha^{-1}\right)} \left(\frac{\alpha^{-1}}{\alpha^{-1} + \hat{\mu}} \right)^{\alpha^{-1}} \left(\frac{\hat{\mu}}{\alpha^{-1} + \hat{\mu}} \right)^{y}$$

All analyses accounted for the complex survey and sampling design of MEPS, such as clustering, multiple stages of selection, disproportionate sampling, and survey nonresponse, to obtain accurate standard error estimates, using the person-level sample weights.

This study was exempt from Institutional Review Board approval, as it used a publicly available, deidentified dataset.

Results

Among 35,427 survey participants (out of approximately 321,423,251 individuals in the United States in 2015), 344 participants between 18-64 years old had at least 1 HHC provider day, representing a weighted population of 3,083,770 or 1% of the weighted total population of MEPS participants in 2015 (Figure 2). The study sample was comprised of 55% females and 45% males, having a mean age of 50 and 47 years, respectively (Table 1). All model variables had similar distributions across patient sex (Table 1), with the exception of respiratory chronic condition being significantly more common in females. The mean number of HHC provider days were significantly different by patient sex across all variables examined (Table 2), with greater HHC days on average for males than females in all subgroups except for the following where greater HHC days were observed within females: households with young children and chronic conditions affecting the genitourinary, blood, digestive, and musculoskeletal body systems.

Primary analysis

In adjusted analyses, negative binomial regression estimates of HHC provider days were not significantly different for households with at least one caregiving-aged male adult (with no female) and households with no caregiving-aged adult of patients age 18-65 years old as compared to households with at least one caregiving-aged female (Table 3). I do not discuss statistically significant findings among confounding variables because the purpose of this model was to determine the association between household composition and HHC days; as this purpose drove the model selection process, the coefficients for the individual confounders do not represent what effects might have been observed in a model built specifically to test those variables as predictors of the outcome.

Regression findings show the difference in the logs of the expected number of HHC provider days between households with one caregiver-aged male (no female) and those with at least one caregiver -aged female to be -0.28 HHC days (95%CI: -0.86, 0.30), given the other variables in the model are held constant. As this 95% confidence interval considerably overlaps zero, the finding is non-significant and in fact it is possible that the true effect (if we had a complete sample of every eligible patient in the country) might be either negative or positive. In other words, the incident rate of HHC days for patients in households with a caregiver-aged male only is 0.75 (95 % CI: 0.42, 1.35) times the incident rate for patients in households with at least one caregiver-aged female, holding all other variables constant (Table 3).

When no caregiver-aged adult is present in the patient household, the difference in the logs of the expected number of HHC provider days is expected to change by 0.13 days compared to patient households with at least one caregiver -aged female (95% CI: -0.40, 0.67), given the other predictor variables in the model are held constant. In other words, the incident rate of HHC days for patients in households with no caregiver adult is 1.14 (95% CI: 0.67, 1.95) times the incident rate for patients in households with at least one caregiver female, holding all other variables constant (Table 3).

Patient sex does not statistically significantly modify the association between household composition and HHC days. (Table 4). Analysis of the predicted probabilities shows that the predicted number of HHC days for a male and female patient in a household with at least 1 caregiver female is 62 days (95% CI: 35, 89) and 43 (95% CI: 23, 64), respectively, holding all other model variables constant. The predicted number of HHC days for a male and female patient in a household with at least 1 caregiver male (no female) is 47 days (95% CI: 19, 74) and 33 days (95% CI: 17, 48), respectively, holding all other model variables constant. The predicted number of HHC days for a male and female patient in a household with no caregiver adults is 71 days (95% CI: 31, 110) and 49 days (95% CI: 25, 74), respectively, holding all other model variables constant (Figure 3).

Discussion

This study did not find differences in household composition associated with HHC utilization, nor did it find that patient sex modifies the effect. Future research may consider edits to the hypothesized model (i.e. theorized covariates), methods used, and definitions of variables for a more refined study that better attends to the association of interest.

The primary predictor variable of household composition is clearly defined for this study but has limitations. First, households may not be static over the course of a year. For example, some participants may be considered part of the household but do not live there full-time, or vice-versa. Deaths, births, and extended travel are all factors that can change the composition of a household from one time to another. Second, this variable as defined in this study makes several assumptions. I assume that anyone between 18-74 years old who is coded in MEPS as a member of a HHC patient's household is potentially eligible for providing care to the patient. It is possible, however, that household members are unable or unwilling to step into a caregiving role. Furthermore, patients likely have preferences about who provides and who does not provide them with caregiving services to supplement or complement HHC. I also assume that people older than 74 and younger than 18 are not as capable for stepping into caregiver-type roles due to a higher likelihood of physical or cognitive limitations to do so.

Interaction testing shows similar results for households with a male of caregiving age only (no female) and households with no adults of caregiving age. Meanwhile, the interaction test for households with at least 1 female of caregiving age is unlike the other two household categories (Table 4). Given these interaction results, future research may want to consider restructuring the predictor variable from three categories to two (i.e. grouping the households without any female of caregiving age and comparing them to households with a female of caregiving age).

Important to note is that in the MEPS dataset, I did not know who was actually acting as a caregiver and to whom in each household. We do not know how much caregiving was actually happening (e.g. which household members taking on a caregiving role for the HHC patient) during our time period of interest. Future research could focus on describing in greater detail what typical households are like for male and female patients in this population. For example, for a household with at least one female adult of caregiving age in the home with a female HHC patient, how many other adults and children are in the home and what are the relationships between them? Are any married and to whom? Is the household intergenerational? Are any members consider not family? Answers to all of these questions could be potentially relevant because of caregiving expectations. Some household members may have a higher likelihood of ability or willingness to provide care for a HHC patient. Furthermore, the degree of caregiving may differ among the different household compositions which may partially explain why we see the effects that we do in this study.

Great care must be paid to the interpretation of this study's findings. It appears that household composition, as defined in this study, is not a barrier driving differences in HHC utilization, and therefore it's possible that there are probably other stronger predictors of HHC use for this age group. We may want to place consideration on HHC decision making and service delivery in this young and middle-age adult population because this study demonstrates significantly patient sex biases which may concern researchers that there may be big disparities in access between men and women. For example, we see significantly patient sex differences among the household composition groups (Table 2), but from a purely clinical perspective, we would not expect to see such differences in the distribution of HHC days. Especially worth further investigation is that even between male and female patients who don't have another adult in the household, the distribution is significantly different.

While including the patient's types of chronic condition was necessary to include as confounders, the variables used to measure chronic and complex conditions were not ideal for this study's hypotheses. The HCUP algorithm categorizes chronic conditions by body system, but a patient's need for and use of HHC is dependent on the severity of chronic condition and resulting functional limitations rather than the particular body systems involved. Ideally, the chronic conditions variables for future studies interested in similar hypotheses would discern which chronic conditions have an expected higher likelihood of on-going HHC services needs (skilled or otherwise) and/or supply needs (e.g. feeding tubes, colostomy bags, ventilation equipment), to be able to assess which populations may be receiving less HHC than potentially clinically indicated. Chronic condition variables may also want to take into account data on the disease history, trajectory, and relevant comorbidities for each patient. For example, incorporating the dates of diagnoses, severity of symptoms, and prognoses could better determine the need and use of HHC.

Although the current study is not underpowered, appending more years of data would yield a more powerful analysis, especially for effect modification analyses. If future studies choose to increase the number of years represented using MEPS data, methods from this study potentially could be duplicated while including additional steps to account for unique survey weights for each year and duplicate patients in consecutive years since MEPS follows participants for two years.

HHC utilization as this study's outcome was chosen, in part, because of the availability of the data. However, HHC policy makers, service providers, and insurance companies may be more likely to be responsive to research with an outcome focused further downstream, such as patient satisfaction with HHC or improved patient symptoms from either a clinical assessment perspective or a subjective patient perspective due to HHC.

Finally, future research could focus on findings that were not of primary interest for this study. For example, in bivariate analyses, we see that HHC days are significantly higher for men in 15 categories and only 4 for women (Table 2). Researchers may be curious to explore potential drivers of such differences. For instance, a researcher may investigate the possibility of clinical reasons to explain the patient sex divide in HHC services provided to patients with chronic respiratory conditions. Among other possible future research that could be spawned from Table 2 (and Table 1 for that matter), one particularly curious finding that may deserve future investigation is the large difference found in mean HHC day between male and female patients who live with no adult of caregiving age in their household (103 days and 54 days, respectively). Researchers may find, for example, that differences found in these bivariate analyses could be explained in part by utilization pattern differences or survival bias between men and women. Survival bias could be addressed through a sensitivity analysis that excludes everyone who dies during the study year.

The focus on young and middle-aged adults may spur interest in researchers to build new models to hypothesize ways in which these HHC utilization patterns found in this study may compare to adults who are Medicare-age eligible and to children. This study's findings have implications for the preparation of future research that may shape more effective HHC policy and practice for young and middle-aged adults. Prioritizing research to gain a greater understanding of HHC utilization among young and middle-aged adults could lead to more efficient and effective utilization of HHC services that can impact the patient and potentially the patient's household members.

Keywords

home health care utilization, sex disparities, non-elderly patients, young and middle-aged adults, predictors of home care

Abbreviations

HHC=home health care

MEPS=Medical Expenditures Panel Survey

CC=Chronic and Complex Condition

CG=Caregiver

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Conflict of Interest Statement

None declared.

References

1. Landers S, Madigan E, Leff B, et al. The Future of Home Health Care: A Strategic Framework for Optimizing Value. *Home Health Care Manag Pract.* 2016;28(4):262-278.
2. Jones AL, Harris-Kojetin L, Valverde R. Characteristics and use of home health care by men and women aged 65 and over. *Natl Health Stat Report.* 2012(52):1-7.
3. U.S. Administration on Aging. America's Families Care: A report on the needs of America's family caregivers. Fall 2000. In.
4. Schulz R, Czaja SJ. Family Caregiving: A Vision for the Future. *Am J Geriatr Psychiatry.* 2017.
5. AARP and United Health Hospital Fund. (2012). Home Alone: Family Caregivers Providing Complex Chronic Care. In.
6. Sharma N, Chakrabarti S, Grover S. Gender differences in caregiving among family - caregivers of people with mental illnesses. *World J Psychiatry.* 2016;6(1):7-17.
7. Caregiving NAf, Institute APP. Caregiving in the U.S. 2015. In.
8. National Alliance for Caregiving and AARP. (2009). Caregiving in the U.S. In.
9. Institute on Aging. (2016). Read How IOA Views Aging in America. In.
10. AARP (2011). V*aluing the Invaluable 2011 update. a*ssets.aarp.org/rgcenter/ppi/ltc/i51-caregiving.pdf. In.
11. National Alliance for Caregiving and AARP Public Policy Institute. Caregiving in the U.S. 2015.
12. Pew Research Center, Social & Demographic Trends. Gender and Caregiving. 2017. In.
13. MetLife Mature Market Institute, National Alliance for Caregiving, & The National Center on Women and Aging. (1999, November). T*he Metlife juggling act study: Balancing caregiving with work and the costs involved* . In.
14. Marks, N. Lambert, J. D., & Choi, H. (2002). Transitions to caregiving, gender, and psychological well-being: A prospective U.S. national study. J*ournal of Marriage and Family, 64,* 657–667. In.
15. MetLife Mature Market Institute, National Alliance for Caregiving & University of Pittsburgh Institute on Aging (2010). T*he MetLife Study of Working Caregivers and Employer Health Care Costs: New Insights and Innovations for Reducing Health Care Costs for Employers*. In.
16. Womens Health Victoria (2008) Women and Informal Caregiving. In.
17. 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:E65.
18. Goodman RA, Posner SF, Huang ES, Parekh AK, Koh HK. Defining and measuring chronic conditions: imperatives for research, policy, program, and practice. *Prev Chronic Dis.* 2013;10:E66.
19. AARP Public Policy Institute. (2002). W*omen and long-term care* (Fact Sheet). Washington, DC: Gregory, S. R., & Pandya, S. M. In.
20. Bertakis KD, Azari R, Helms LJ, Callahan EJ, Robbins JA. Gender differences in the utilization of health care services. *J Fam Pract.* 2000;49(2):147-152.
21. Andersen R, Newman JF. Societal and individual determinants of medical care utilization in the United States. *Milbank Mem Fund Q Health Soc.* 1973;51(1):95-124.
22. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? *J Health Soc Behav.* 1995;36(1):1-10.
23. Hwang W, Weller W, Ireys H, Anderson G. Out-of-pocket medical spending for care of chronic conditions. *Health Aff (Millwood).* 2001;20(6):267-278.
24. Wang Y, Leifheit-Limson EC, Fine J, et al. National Trends and Geographic Variation in Availability of Home Health Care: 2002-2015. *J Am Geriatr Soc.* 2017;65(7):1434-1440.
25. Long JS. Regression Models for Categorical and Limited Dependent Variables. In. Thousand Oaks, CA: Sage; 1996.

Table 1. Weighted (wgt) baseline characteristics with at least one HHC provider day.

	Overall n=353 wgt n=3,233,235	**Male Patients** n=138 wgt n=1,429,737	**Female Patients** n=215 wgt n=1,803,498	**p-value**[a]
Age, mean				
18-44 years old	29%	35%	25%	0.08
45-64 years old	71%	65%	75%	
Children in household				
<10 years old	11%	8%	12%	0.25
10-17 years old	10%	10%	10%	0.85
Region				
Northeast	22%	17%	26%	
Midwest/West	40%	47%	35%	0.53
South	38%	36%	39%	
Chronic/Complex Conditions[b]				
Respiratory	24%	17%	30%	0.04
Endocrine	43%	39%	46%	0.41
Genitourinary	7%	3%	11%	0.08
Blood	5%	6%	5%	0.84
Digestive	5%	4%	6%	0.42
Musculoskeletal	9%	4%	14%	0.03
Congenital	3%	5%	2%	0.21
Nervous	30%	31%	30%	0.90
Circulatory	56%	54%	57%	0.65
Household Composition				
Female adult in home	37%	50%	27%	
Male adult in home, no female	27%	7%	42%	0.47
No adult in home	36%	43%	30%	

[a] p-values compare male with female patients
[b] variables not mutually exclusive (i.e. percentages may not add to 100%)

Table 2. Sample-weighted bivariate analysis of mean number of HHC provider days.

	Overall days (SE)	**Male Patients** days (SE)	**Female Patients** days (SE)	**p-value**[a]
HHC provider days, mean	67 days (8)	86 days (15)	52 days (6)	<0.01
Age, mean				
18-44 years old	80 days (16)	94 days (26)	64 days (13)	<0.05
45-64 years old	62 days (10)	82 days (17)	48 days (7)	
Child <10 years old in household				
Yes	53 days (19)	48 days (16)	55 days (27)	<0.05
No	69 days (9)	90 days (16)	51 days (6)	
Region				
Northeast	62 days (-)	65 days (-)	60 days (-)	<0.05
Midwest/West	65 days (13)	79 days (20)	48 days (12)	
South	79 days (15)	110 days (29)	55 days (8)	
Chronic/Complex Conditions*				
Respiratory	77 days (13)	83 days (25)	74 days (16)	<0.001
Endocrine	68 days (10)	89 days (17)	53 days (10)	<0.05
Genitourinary	69 days (-)	55 days (-)	73 days (-)	<0.05
Blood	43 days (13)	31 days (10)	54 days (24)	<0.05
Digestive	99 days (-)	21 days (-)	137 days (-)	<0.01
Musculoskeletal	49 days (-)	28 days (-)	54 days (-)	<0.05
Congenital	172 days (-)	211 days (-)	81 days (-)	<0.001
Nervous	81 days (-)	120 days (-)	49 days (-)	<0.05
Circulatory	89 days (12)	114 days (21)	69 days (9)	<0.001
Household Composition				
Female adult in home	64 days (13)	73 days (18)	52 days (16)	<0.05
Male adult in home, no female	47 days (10)	81 days (43)	43 days (9)	
No adult in home	85 days (15)	103 days (25)	64 days (10)	

[a] p-values compare male with female patients

SE=standard error

- = no standard error; too few sampling units in category

in green: higher values compared to other sex

Table 3. Negative binomial regression estimates* of mean number of HHC provider days.

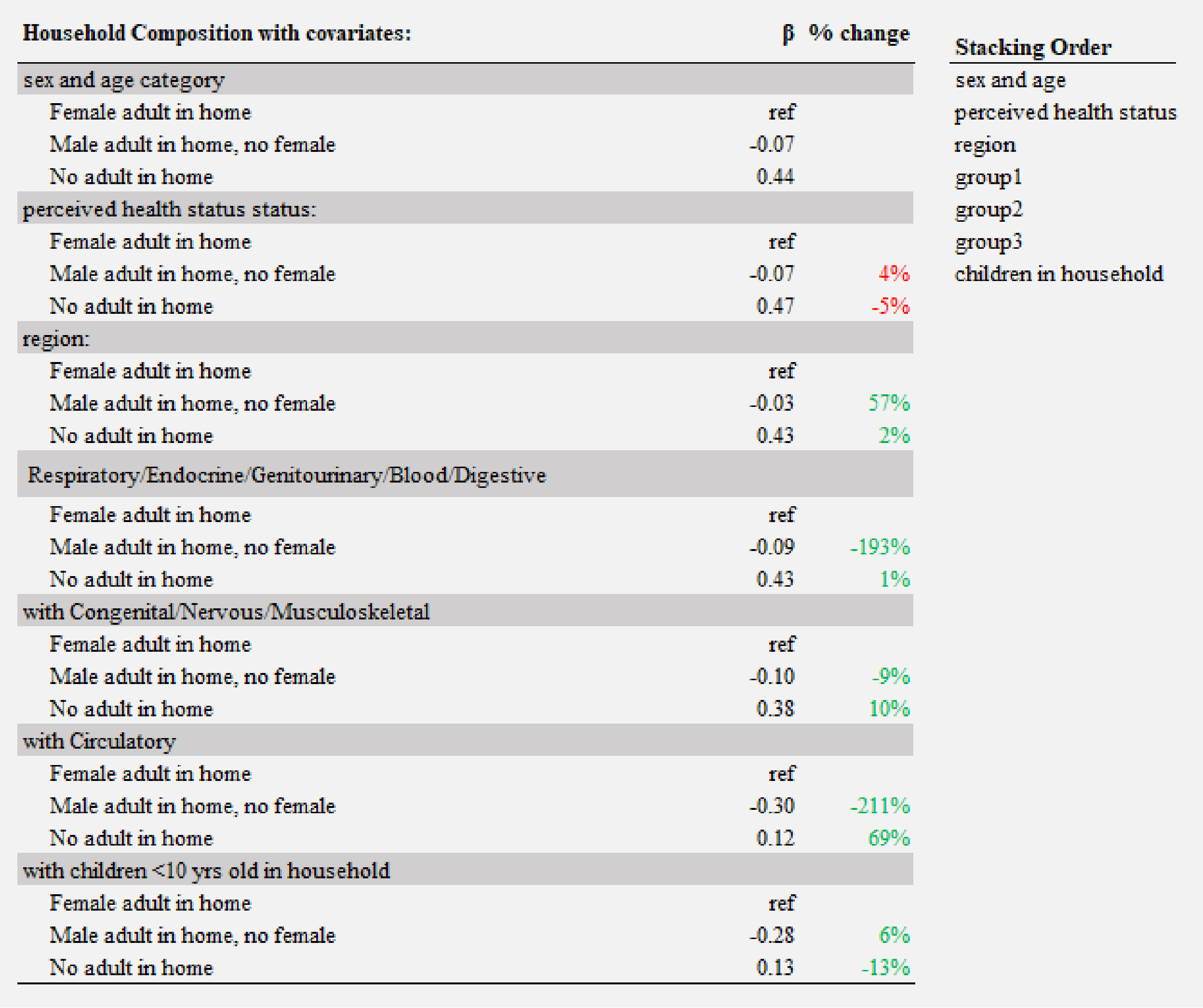
	β	**p-value**	**95% CI**
Household Composition			
Female adult in home	**ref**	**ref**	**ref**
Male adult in home, no female	**-0.28**	**0.34**	**-0.86, 0.30**
No adult in home	**0.13**	**0.62**	**-0.40, 0.67**
Female	-0.34	0.06	-0.68, 0.01
Age in years	-0.02	<0.05	-0.04, -0.004
Region			
Northeast	ref	ref	ref
Midwest/West	-0.09	0.74	-0.59, 0.42
South	0.04	0.88	-0.45, 0.53
Chronic/Complex Conditions			
Resp, Endocrine, Blood, Digestive	0.02	0.95	-0.45, 0.48
Congenital, Nervous	0.23	0.27	-0.18, 0.65
Circulatory	1.01	<.001	0.57, 1.44
Child <10 yrs old in household	0.06	0.88	-0.70, 0.82

*adjusted for the following HHC patient characteristics: sex, age, region, presence of chronic illness types, and child <10 yrs old in household

Table 4. Interaction effect of patient sex on the association between mean number of HHC provider days and household composition.

Interaction	**Regression Results**			**Interaction Testing**		
	β	**95% CI**	**p-value**	**Δ**	**95% CI for Δ**	**p-value for Δ**
Male Pt w/ CG female	ref	ref	ref			
Female Pt w/ CG female	-0.12	-0.84, 0.60	0.74	-0.12	-0.84, 0.60	0.74
Male Pt w/ CG male only	-0.02	-0.88, 0.83	0.96			
Female Pt w/ CG male only	-0.56	-1.12, 0.01	0.06	-0.53	-1.32, 0.26	0.19
Male Pt w/ no CG	0.30	-0.36, 0.97	0.37			
Female Pt w/ no CG	-0.18	-0.74, 0.38	0.53	-0.48	-0.97, -0.01	0.06

Table 5. Model selection process.



Household Composition with covariates:	**β**	**% change**
sex and age category		
Female adult in home	ref	
Male adult in home, no female	-0.07	
No adult in home	0.44	
perceived health status status:		
Female adult in home	ref	
Male adult in home, no female	-0.07	4%
No adult in home	0.47	-5%
region:		
Female adult in home	ref	
Male adult in home, no female	-0.03	57%
No adult in home	0.43	2%
Respiratory/Endocrine/Genitourinary/Blood/Digestive		
Female adult in home	ref	
Male adult in home, no female	-0.09	-193%
No adult in home	0.43	1%
with Congenital/Nervous/Musculoskeletal		
Female adult in home	ref	
Male adult in home, no female	-0.10	-9%
No adult in home	0.38	10%
with Circulatory		
Female adult in home	ref	
Male adult in home, no female	-0.30	-211%
No adult in home	0.12	69%
with children <10 yrs old in household		
Female adult in home	ref	
Male adult in home, no female	-0.28	6%
No adult in home	0.13	-13%

Stacking Order

sex and age
perceived health status
region
group1
group2
group3
children in household

Figure 1. Directed acyclic graph of theoretical model.

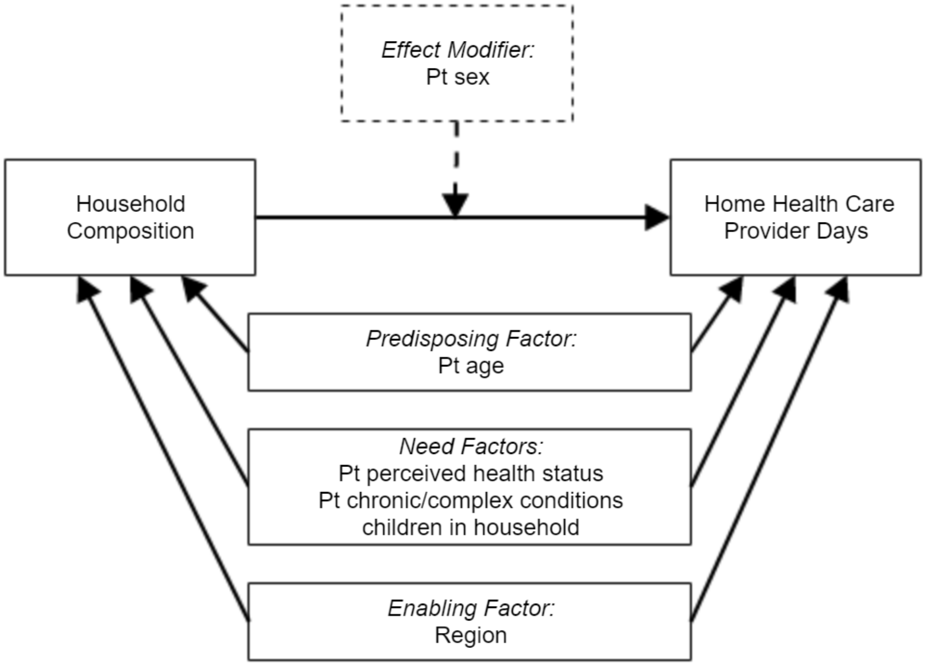
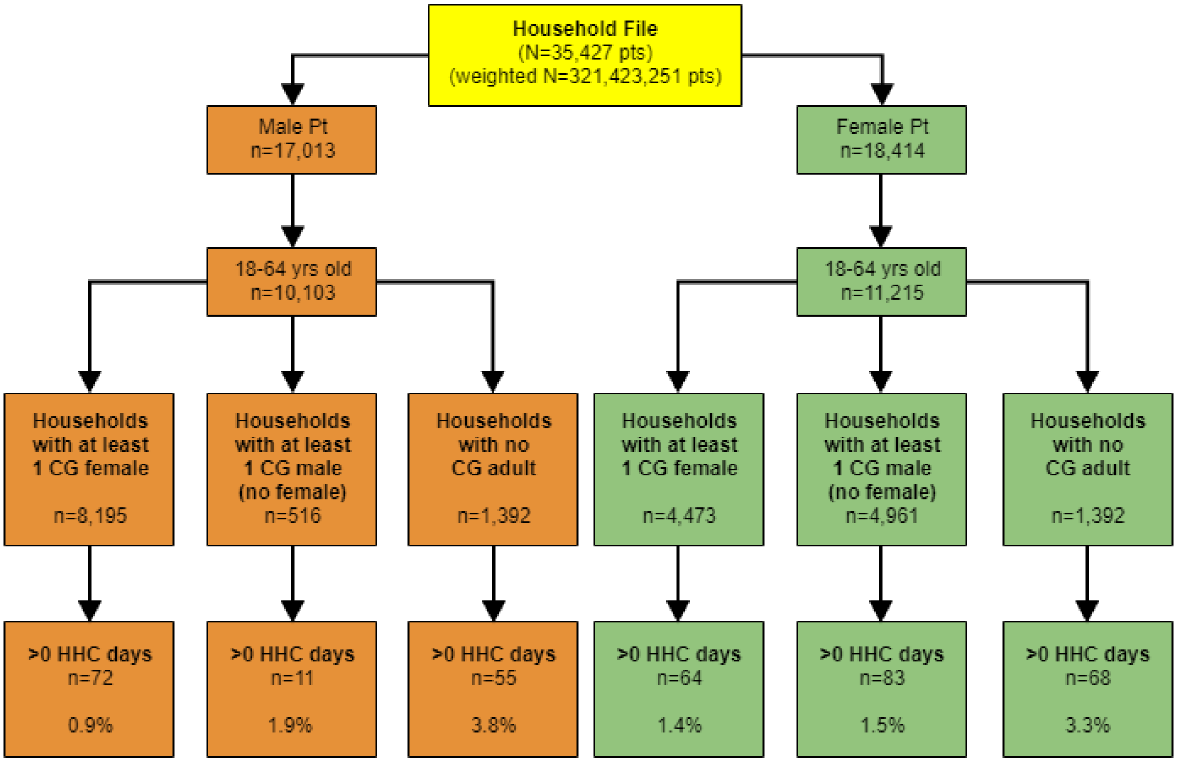
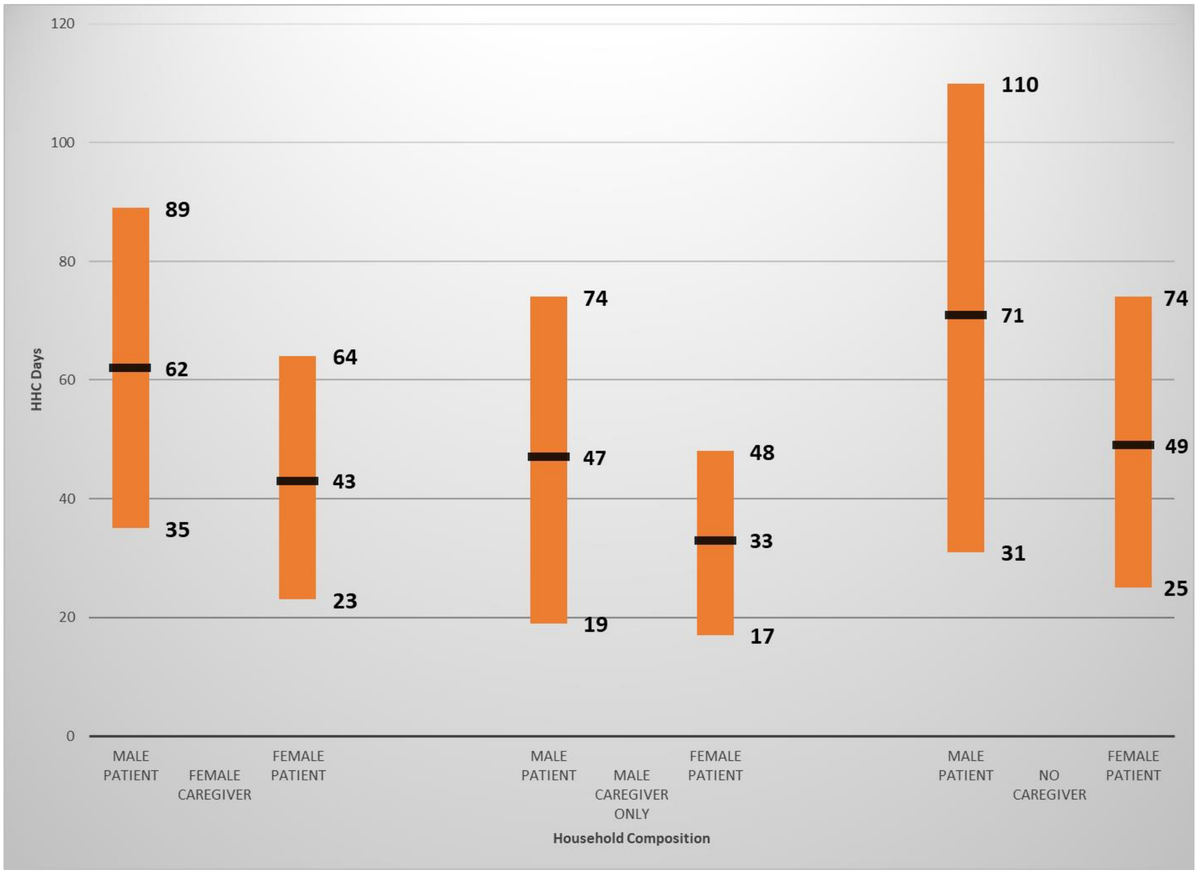


Figure 2. Study population.



%=weighted column percent

Figure 3. Predicted probabilities of mean number* of HHC provider days.



*includes confidence interval values