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Multi-Level Analysis of the Determinants of Receipt of Clinical Preventive Services Among Reproductive-Age Women

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Abstract

Background—We investigate the impact of individual- and county-level contextual variables on women's receipt of a comprehensive panel of preventive services in a region that includes both urban and rural communities.

Methods—Outcome variables were: a s*creening and vaccination* index (a count of Papanicolaou test, blood pressure check, lipid panel, sexually transmitted infections or HIV test, and influenza vaccination received in the past 2 years) and a preventive *counseling* index (a count of topics discussed in the past 2 years: smoking and tobacco, alcohol or drugs, violence and safety, pregnancy planning or contraception, diet/nutrition, and sexually transmitted infections). Contextual covariates from the Area Resource File (2004-2005) were appended to prospective survey data from the Central Pennsylvania Women's Health Study. Individual-level variables included predisposing, enabling, and need-based measures. Contextual variables included community characteristics and healthcare resources, including a measure of primary care physician density specifically designed for this study of women's preventive care. Multi-level analyses were performed.

Results—We found low overall use of preventive services. In multi-level models, individual-level factors predicted receipt of both screening and vaccinations and counseling services; significant predictors differed for each index. One contextual variable (primary care physician density) predicted receipt of screenings and vaccinations.

Conclusions—Women's receipt of preventive services was determined primarily by individual-level variables. Different variables predicted receipt of screening and vaccination versus counseling services. A contextual measure, primary care physician density, predicted receipt of

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preventive screenings and vaccinations. Individual variability in women's receipt of counseling services is largely explained by psychosocial factors and seeing an obstetrician-gynecologist.

Keywords

Women; adult; preventive health services; cohort studies; U.S.

Introduction and Background

Many women do not receive clinical preventive services as recommended by the U.S. Preventive Services Task Force (USPSTF), the American College of Obstetricians and Gynecologists (ACOG), the Institute of Medicine (IOM) and other professional groups. Nationally, adults receive about 55% of recommended preventive services (McGlynn et al., 2003). Preventive services that are sex-specific, such as cervical and breast cancer screening, are generally underutilized, with 64-85% of women receiving Papanicolaou tests (Casey, Call & Klinger, 2001, Ruffin, Gorenflow & Woodman, 2000) and about 70% receiving mammograms (National Center for Health Statistics [NCHS], 2009) within recommended time periods. For preventive services that are not sex-specific, such as colorectal cancer screening, there is evidence that women may receive screening less frequently than men (Beydoun & Beydoun, 2008, Friedmann-Sanchez, Griffine & Partin, 2006, Guessous et al., 2010). Improving women's receipt of recommended clinical preventive services requires understanding multiple determinants including women's healthcare seeking behaviors, women's access to health care, and health system resources.

Much prior research has conceptualized receipt of preventive services as a function of individual-level variables such as age, education, race and ethnicity, income level, health insurance status, type(s) of health care providers seen, and attitudes toward prevention or screening (Behringer et al., 2007, Dorgan, Hutson, Gerding, & Duval, 2009, Henderson, Weisman, & Grason, 2002, Ioannu, Chapko, & Dominitz, 2003, Litaker & Tomolo, 2007, Sambamoorthi & McAlpine, 2003). Relatively little research has considered the effect of contextual variables on receipt of preventive services.

Contextual variables include characteristics of the communities in which women live, including their social and economic characteristics, as well as the availability of health care resources. Such community-level factors may influence women's receipt of preventive services independent of women's own characteristics (Coughlin, Leadbetter, Richards, & Sabatino, 2008, Diez Roux, 2001). For example, a well-educated woman who is aware of her need for cancer screening and has health insurance may not be able to obtain screening if she lives in an isolated rural area where providers of screening services are scarce. Alternatively, a low-income woman who is uninsured or underinsured may be more likely to receive screening if she lives in a community with many health care resources and outreach programs than if she lives in a medically underserved area. Clearer understanding of the relative influence of individual-level and contextual variables is needed for developing interventions to improve delivery of preventive services at the population level.

This study combines a unique regional data set with county-level contextual variables derived from the Area Resource File (U.S. Department of Health and Human Services [U.S. DHHS], 2010) to examine the influence of both individual-level and contextual variables on receipt of a comprehensive set of clinical preventive services among women of reproductive age residing in a region that includes both urban and rural communities. The preventive services examined include both screenings and vaccinations and counseling services. We hypothesized that both individual- and county-level characteristics would predict receipt of

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these preventive services. We further investigate potential interactions between individual and contextual characteristics.

Methods

Sample

Individual-level data are from the Central Pennsylvania Women's Health Study (CePAWHS), which included a representative population-based cohort study of women ages 18-45 in a 28-county region of Central Pennsylvania. Participants residing in both urban and rural areas were interviewed by telephone at baseline and two years later (n = 1,420). The design of this study has been previously described (Weisman et al., 2006 Weisman et al., 2009). Briefly, the baseline random-digit dial survey was conducted by the Penn State Survey Research Center from September 2004 to March 2005. Residents of rural communities were oversampled in this survey to ensure representation in the sample (Weisman et al., 2006). The response rate was 52% and the cooperation rate was 63%; the final sample was highly representative of the target population with respect to key demographics (age, race/ethnicity, educational level, and income). The follow-up survey conducted two years later attained a response rate of 79%. The Pennsylvania State University College of Medicine Institutional Review Board reviewed and approved the study and a Certificate of Confidentiality (CC-HD-04024) was obtained from the National Institutes of Health. All subjects provided verbal informed consent prior to completing the interview.

The interview contained a comprehensive set of questions about health status and health risks, as well as women's health care utilization patterns and receipt of clinical preventive services. In the present study, the dependent variables (receipt of preventive services) were measured at the two-year follow-up, and the individual-level independent variables derived from the survey were measured at baseline. Thus, baseline variables are "predicting" preventive services received during the two-year follow-up period.

Variables

The dependent variables for this analysis are two multi-item indices of receipt of a comprehensive set of recommended age-appropriate clinical preventive services based on data from the follow-up CePAWHS interview. A composite measure of preventive services received recognizes the need for multiple preventive interventions in a single individual and can identify factors that impact preventive service receipt across multiple disease categories (Shenson, Adams, & Bolen, 2008). Furthermore, a composite measure allows for variation within the population of the need for specific services. We created two indices – one for *screening and vaccination services* and one for *counseling services* -- because we hypothesize that individual-level and contextual influences may differ for the two types of services.

The first index, receipt of *screenings and vaccinations*, is a count of five services received at least once in the past two years. Participants were asked, "In the *past 2 years*, have you received any of the following health services?" The services measured included Papanicolaou test, blood pressure check, cholesterol test, test for any sexually transmitted infection (STI) or HIV test, and influenza vaccine. All services selected for inclusion in the index are recommended by one or more national agency, expert panel, or professional group: the USPSTF, the Centers for Disease Control and Prevention (CDC), ACOG, and the National Cholesterol Education Program (NCEP) Expert Panel, and the IOM (ACOG, 2009, CDC, 2010, CDC, 2006, NCEP, 2002, USPSTF, 2010, IOM, 2011).

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The second index, *counseling*, is a count of six topics for which any counseling services were received in the past two years. Participants were asked, "In the past 2 years, has a doctor or other health professional *asked you* or *talked to you* about any of the following things?" From the list of topics that followed, we selected six topics for which history taking, screening, or preventive counseling are currently recommended by one or more national agency, expert panel, or professional group. Topics selected for inclusion were smoking or tobacco use, alcohol or drug use, violence or safety in the home, STIs or HIV, reproductive planning (i.e., receipt of either birth control counseling or pregnancy planning counseling), and weight management (i.e., receipt of either diet or nutrition counseling, weight management counseling, or exercise or physical activity counseling). History taking, screening, and/or preventive counseling in each these areas is -recommended by one or more of the following agencies or groups: the USPSTF, the CDC, the American College of Preventive Medicine, (ACPM), ACOG, and the Family Violence Prevention Fund (FVPF), and the IOM (ACOG, 2009, CDC, 2006, FVPF, 2004, Johnson, et al., 2006, Nawaz and Katz, 2001, USPSTF, 2010, IOM 2011). Note that although we label this variable "*counseling*," we do not imply that comprehensive therapeutic counseling was received, only that a topic was mentioned or discussed with the physician; thus, the physician's inquiry regarding a topic would qualify as counseling for our purposes.

Individual-level independent variables for this analysis were derived from the baseline CePAWHS interview and were selected in accordance with the *Behavioral Model of Health Services Utilization* (Andersen, 1995). This robust and widely used model (Goodwin & Andersen, 2002) conceptualizes individuals' use of health services as a function of three types of individual-level variables: 1) variables that *predispose* individuals to use services; 2) variables that *enable* access to care; and 3) variables that govern the *need* for health services.

Predisposing variables expected to increase the likelihood that women will seek preventive care included higher educational level, non-Hispanic white race and ethnicity, and several psychosocial indicators. Higher self-esteem was hypothesized to predispose participants to utilize preventive services and was measured using the Rosenberg self-esteem scale (Rosenberg, 1965), dichotomized at the median. Psychosocial stress, measured using a modified version of the Psychosocial Hassles Scale (Curry, Campbell, & Christian, 1994, Weisman et al., 2006), dichotomized at the response median, was hypothesized to predispose to preventive service utilization. High risk of psychological distress due to depression was measured using a scale based on the Center for Epidemiologic Studies Depression Scale, and dichotomized at a validated cutpoint (Radloff, 1977, Sherborne, Dwight-Johnson, & Klap, 2001). Despite overall increased healthcare utilization, depressed patients generally receive fewer preventive services (Hutter, Schnurr, & Baumeister, 2007, Peytremann-Bridevaux, Voellinger, & Santos-Eggimann, 2008). Exposure to intimate partner violence (IPV) in the past year was hypothesized to decrease overall receipt of preventive services (Loxton, Powers, Schofield, Hussain, & Hoskins, 2009), perhaps due to partner control tactics (McCloskey et al., 2007). IPV was measured as an affirmative response to any one of 8 items adapted from the Conflict Tactics Scale (Straus, 1979), as used in the Commonwealth Fund 1998 Survey of Women's Health (Collins et al., 1999).

Enabling variables included both social and economic factors expected to increase women's access to health services. We included two measures of social support hypothesized to enable preventive service receipt. Measures of *tangible support* and *emotional or informational support* were taken from the Medical Outcomes Survey social support scale (Sherborne & Stewart, 1991), modified to reduce respondent burden to two items from each scale, and dichotomized at the sample median. Additional enabling factors included having a regular health care provider, seeing an obstetrician-gynecologist (because obstetrician-

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gynecologists are key providers of preventive services for women such as Papanicolaou tests and tests for STIs [Henderson et al., 2002]), not living in poverty (poverty status computed from household income and family size, using federal poverty standards), having continuous health insurance coverage for the past 12 months, and never forgoing care in the past 12 months due to cost.

Need was assumed based on guidelines and consensus statements, as described above. Additional need variables included a single-item measure of overall health status from the SF-12 (Ware, Kosinski, Turner-Bowker, & Gandek, 2002), coded as excellent versus all other (very good/good/fair/poor), and having at least one chronic medical conditions from a list of twenty (e.g., hypertension, high cholesterol, heart disease, diabetes).

Contextual variables were derived from the Area Resource File (ARF), a compilation of data from several sources that provides county-level measures of population characteristics and health care resources (U.S. DHHS, 2010). The ARF does not have annual data available for all measures; ARF variables were selected from the year most near 2005 to closely correspond to county-level characteristics at the time of the CePAWHS interview.

Health care resources variables included a measure of the density of primary care physicians (PCPs) per 100,000 female population, presented in quartiles. This variable was constructed specifically for this study. Although uniform definitions of primary care are not always applied (Grumbach et al, 1995; Bennett, 1996), typically, primary care providers for adults are defined as general internists and family practitioners (AAFP, accessed 4/28/11). However, we incorporated obstetrician-gynecologists in our definition of primary care providers, because they are key providers of preventive health care services to women (Henderson et al, 2002), and because this modification is recommended by federal policy (Budetti et al., 1993) and obstetrician-gynecologists (Brown, 1999; Hurd, Barhan and Rogers, 2001). Due to a large rural sample, we further refined this variable to assess doctors of osteopathy, who often provide primary care in in rural areas (Miller, Hooker, Mains, 2006). This is an important refinement of the measure of PCP density for this study, and provides a more comprehensive picture of providers of preventive services to women in urban and rural areas.

The ARF derives information regarding MDs from the AMA Physician Masterfile and regarding DOs from the American Osteopathic Association (National Center for Health Workforce Analysis). We defined PCP density as office-based, non-federally affiliated family practice physicians, general internists, and obstetrician-gynecologist allopathic medical doctors (MDs). To this count of allopathic physicians, we added the number of general practice doctors of osteopathy (DOs) identifying as non-federally affiliated general or family practice physicians. Primary care physician density was thus defined as the sum of allopathic and osteopathic physicians defined as above per 100,000 female population and presented in quartiles.

We also included an indicator of whether one or more Federally Qualified Health Center or Centers for Medicaid Services-certified Rural Health Clinic were present in the county. An additional indicator of whether the county included a Health Professional Shortage Area for primary care was excluded because 25 of the 28 counties in our target region contained partial shortage areas; thus, this indicator lacked sufficient variability for inclusion in the statistical models. However, this exclusion was unlikely to affect our findings because our PCP density variable would likely account for county-level variability in service provider availability.

Community characteristics included in this study were percentage of persons in poverty in the county and the percent of persons in the county who are uninsured. For analytic purposes

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we divided these variables into county level-quartiles, based on the 28-counties we included in our region. Each county was additionally rated on the county-level Rural-Urban Continuum (USDA, 2010), which distinguishes metropolitan (metro) counties by the population size of their metro area, and nonmetropolitan (nonmetro) counties by degree of urbanization and adjacency to a metro area or areas. For ease of description, we use the nomenclature of the USDA to describe the county's Rural-Urban Continuum: metropolitan county; nonmetro, urban county; and nonmetro, rural county.

Statistical Analysis

Bivariate analyses were conducted using chi-square tests to examine the association between the independent variables and receiving greater or fewer services compared to the sample median. Independent variables were examined for multi-collinearity within each cluster – predisposing, enabling, need, healthcare resources, and community characteristics. Variables were excluded if correlations with the other variables were excessive (>.80). Remaining collinearity was examined by evaluating variable inflation factors. There is no significant multicollinearity among the final list of variables.

Multi-level modeling was used to assess the association of the individual-level and contextual predictors with the two ordinal variable indices. Random intercept partial proportional odds generalized linear mixed models were used for the analyses (Peterson & Harrell, 1990). For these models, the cumulative logits of the ordinal outcomes are treated as the dependent variables and examined simultaneously. To construct the models, individual-level variables (first level) were included as predictors in the regression equation, and the intercept for each regression was modeled as a linear function of the contextual predictors (second level), added to a county-specific random error. All interactions between individual and contextual predictors were examined by adding individual interactions to the model separately and removing if not considered significant after adjusting for multiple comparisons.

To examine bias due to confounding from unobserved county characteristics, fixed effects models treating county effects as fixed instead of random were additionally fit on the data and the estimates compared. The proportional odds assumption was then tested using a Brant test (Brant, 1990). If a statistically significant violation was detected, variables for which the assumption could be relaxed were identified (Williams, 2006). Resulting random effects models were then fit using generalized linear latent and mixed methods described by Rabe-Hesketh and colleagues (2004).

Of note, for the preventive screening and vaccination services model, the Brant test was significant ($p<0.001$). The proportional odds assumption was thus relaxed for the obstetrician-gynecologist variable and the individual-level poverty indicator to correct model fit. For the counseling services model, the overall Brant test detected no violation ($p = 0.114$).

All analyses were conducted using STATA (SE Version 11, College Station, TX) and SAS software (Version 9.0, Cary, NC). The resulting odds ratios describe the overall odds that an individual is receiving greater versus fewer preventive services.

Results

The two dependent variables are described in Table 1. The median number of screening and vaccination services received in the past two years was three, and only 5% of women received all five services. Blood pressure checks and Papanicolaou tests were the most prevalent services received. The median number of counseling services received was one,

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and only 3% of women received counseling on all six topics. Weight management was the most common counseling topic.

Table 2 shows bivariate analyses. Indices are dichotomized at the sample medians. As expected both individual-level and contextual variables were significantly associated with receipt of screening and vaccinations and with receipt of counseling services. Individual level variables associated with greater receipt of screening and vaccination services were: higher self-esteem, higher educational status, race/ethnicity other than non-Hispanic white (contrary to our hypothesis), having a regular provider, seeing an obstetrician-gynecologist, having continuous health insurance coverage for the past year, lower self-reported health status, and having at least one chronic medical condition. Contextual variables associated with greater receipt of preventive screening and vaccinations included a higher density of primary care physicians, fewer persons in poverty in the county, and a more metropolitan county of residence.

Likewise, higher receipt of preventive counseling services was associated with the following individual variables: greater psychosocial stress, greater depression risk, higher social support, seeing an obstetrician-gynecologist, living in poverty, and having at least one chronic medical condition. Greater preventive counseling was also associated with contextual variables including increased primary care physician density and more metropolitan county of residence. It is notable that for both outcome measures, we found significant associations in each identified domain defined at both the individual (predisposing, enabling and need) and county (healthcare resources, community characteristics) level.

Tables 3 and 4 show the results of multi-level modeling for the two indices of preventive services receipt, treated as ordinal variables. Of note, no significant interactions between individual and contextual covariates were detected. Concordant with our hypothesis, variables in each of the relevant individual-level domains - *predisposing, enabling* and *need* - are associated with receipt of greater preventive services. Specifically, as shown in Table 3, receiving more *screening and vaccination services* is associated with: higher self-esteem, higher educational attainment, seeing an obstetrician-gynecologist, continuous health insurance coverage, lower self-reported health status and having one or more chronic condition. Of note, as shown in Table 3, the effects of seeing an obstetrician-gynecologist and poverty level on receipt of preventive screening and vaccination services varied depending on the level of services examined. The association between poverty and service receipt was especially complex - at low levels of service receipt, more poverty predicted fewer services, but at higher levels of service receipt, this trend reversed. For preventive screening and vaccination services, a *contextual effect* of PCP density was found when comparing the lowest density quartile (Quartile 1. Up to 170) to the second density quartile (Quartile 2. 171-193), showing residence in a county with a higher density of primary care physicians is associated with increased odds of receiving screening and vaccination services.

In Table 4, *counseling* receipt was associated with individual level variables in all three domains, including increased psychosocial stress, higher educational attainment, greater depression risk, higher social support (emotional), seeing an obstetrician-gynecologist, and having a chronic condition. We found no significant contextual effects on the receipt of preventive counseling services.

Conclusions and Discussion

In a geographically diverse region of Central Pennsylvania, many women did not receive clinical preventive services within the two-year study period, consistent with prior research.

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The receipt of counseling services was particularly limited, falling short of what might be expected in optimal primary care. A number of individual-level variables and contextual variables were associated with receipt of services in both indices in bivariate analysis. In multivariable analysis, however, contextual factors were associated with increased receipt of preventive screening and vaccination services only. Specifically, we found that seeing an obstetrician-gynecologist is a strong predictor of receiving more screening and vaccinations, as is increased density of primary care physicians at the county level. The latter finding is particularly noteworthy because we used a measure of the density of primary care physicians that included general obstetrician-gynecologists and doctors of osteopathy in addition to other generalist physicians. The contextual effect of primary care physician density defined this way suggests that policies to increase resources for primary care for women must be conceptualized differently than for men.

Contrary to our finding of a contextual effect for preventive screenings and vaccinations, in multi-level models only individual-level variables predicted receipt of preventive counseling. The finding that only individual-level variables predicted receipt of counseling is interesting and could reflect the richness of the CePAWHS survey in capturing key individual-level variables that predispose or enable women to obtain counseling, such as psychosocial stress and social support. Prior work examining county-level contextual effects on individual receipt of preventive services (Coughlin et al., 2008) included less detail on psychosocial factors relevant to preventive service receipt than included in our study. Alternatively, the relative lack of findings regarding contextual variables could mean that the county level of measurement is too diffuse to capture the impact of place of residence on receipt of services. Smaller geographic areas, such as neighborhoods, may be more salient determinants of receipt of preventive counseling (Diaz Roux, 2001).

The predictors of receipt of preventive services varied depending on the outcome examined. One noteworthy example is the finding that whereas higher self-esteem significantly increased the odds of receiving preventive screenings and vaccinations, this was not so for receiving preventive counseling. These results suggest that higher self-esteem may translate to better self-care and greater likelihood of assent to those preventive services for which the woman is required to actively agree to a procedure (a screening test or vaccination). Conversely, women with lower self-esteem may be less proactive about their health and thus less likely to seek preventive healthcare counseling.

Another example pertains to social support. Prior research has emphasized the importance of social support for receipt of preventive services (Zhang, Oldenburg, & Turrell, 2009). However, our study suggests that emotional social support may be particularly salient for preventive counseling, and is not salient for obtaining preventive screenings and vaccinations. It is possible that women with greater emotional social support may be more receptive to receiving counseling or may have friends or family who encourage them to seek help for specific problems.

Our study has several important strengths and offers a unique contribution to the existing literature. First, use of the CePAWHS dataset offers greater detail on psychosocial measures than is available in most national datasets, such as the Behavioral Risk Factor Surveillance System (Coughlin, et al. 2008). Thus, in our study we are able to more accurately characterize the relevant psychosocial determinants of preventive service receipt. Additionally, our data reveal how the factors associated with receipt of screenings and vaccination differ from those associated with preventive counseling within the same population. Further, we use composite indices of a comprehensive panel of women's preventive services, rather than examining multiple individual services separately, allowing for greater exploration of factors associated with receipt of preventive services across a

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range of healthcare needs within the population. Use of indices acknowledges that physicians must choose from a multiplicity of guidelines regarding preventive services to apply to individual patients (U.S. DHHS, National Guideline Clearinghouse).

Our definition of the primary care physician density variable, which was a significant contextual predictor of screening and vaccination service receipt, included general obstetrician-gynecologists and osteopathic physicians as well as other generalist physicians, providing a more comprehensive indicator of physicians providing primary care services to women in rural and urban communities. This contrasts with definitions of primary care that exclude generalist obstetrician-gynecologists (Grumbach et al., 1995) or doctors of osteopathy. Our variable was uniquely designed for this study of women's preventive services, and is a strength of this work. Finally, compared to most prior contextual studies of preventive service receipt (Coughlin et al, 2008, Litaker and Tomolo, 2007), we use a prospective cohort. This allows for determining how baseline variables impact receipt of preventive services during a two-year follow-up period.

Our study has several important limitations. First, although all of the services included in the two indices are currently recommended by one or more agency, consensus panel or professional group, specifics of these recommendations, such as appropriate frequency for service delivery, could not be captured in this analysis. Second, all data are self-report and therefore subject to recall bias. Third, the region in which this research was conducted is largely white, and findings may not be extrapolated to areas that are more racially or ethnically diverse.

This study has several important implications. Improving women's receipt of clinical preventive services requires attention to increasing the availability of primary care providers for women specifically (a contextual variable) as well as addressing key factors at the individual level that determine women's predispositions to seek and access preventive care. The enabling factors of continuous health insurance and poverty appear to be pivotal for receipt of screenings and vaccinations, while psychosocial predisposing factors are central to the receipt of counseling services. Raising awareness among women of the importance of talking to their health care providers about their health concerns is one approach for addressing the psychosocial barriers to effective counseling. In addition, because women who see an obstetrician-gynecologist are significantly more likely to receive preventive services -- including screenings, vaccinations, and counseling – other types of physicians who provide primary care to women may assume that these preventive services are not within their area of expertise. This suggests the need for greater awareness and training in the delivery of preventive services among all providers who provide primary care to women.

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Table 1

Indices of Preventive Services Received in Past 2 Years, Central Pennsylvania Women's Health Study (n = 1,420)

	Percent Receiving Service
Screening and Vaccination Services	
Blood pressure check	94.1%
Pap test	85.6%
Cholesterol test	49.8%
Influenza vaccine	30.2%
STI/HIV test	24.6%
Mean scale score (range: 0 - 5) (STD[a])	2.84 (1.10)
Median number of services received (IQR[b])	3 (2, 4)
Counseling Services	
Weight management	53.3%
Reproductive planning	37.5%
Tobacco use	35.9%
Alcohol or drug use	15.2%
Safety or violence in home	10.7%
STI	10.0%
Mean scale score (range: 0 – 6) (STD[a])	1.63 (1.54)
Median number of services received (IQR[b])	1 (0, 2)

[a] STD = standard deviation

[b] IQR = interquartile range, defined as the 25th and 75th percentile of the distribution.

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Table 2

Bivariate Analysis, Receipt of High versus Low Preventive Services, Central Pennsylvania Women's Health Study (N = 1417)

	Preventive Screening and Vaccination Services				**Preventive Counseling Services**			
	Low (0-3)	**High (4+)**	**total**	**p-value**	**Low (0-1)**	**High (2+)**	**total**	**p-value**
	N=1032	**N=385**	**1417**		**N=803**	**N = 614**	**N=1417**	
Level 1. Individual Level Covariates								
Predisposing								
Higher self-esteem	**440 (43%)**	**188 (49%)**	**628 (44%)**	**0.037**	372 (46%)	256 (42%)	628 (44%)	0.082
Low Psychosocial Stress	561 (54%)	298 (51%)	759 (54%)	0.325	**478 (60%)**	**281 (46%)**	**759 (54%)**	**<.001**
Greater than high school education	**637 (62%)**	**264 (69%)**	**901 (64%)**	**0.017**	506 (63%)	395 (64%)	901 (64%)	0.609
White, non-Hispanic	**960 (93%)**	**344 (90%)**	**1304 (92%)**	**0.020**	741 (93%)	563 (92%)	1304 (92%)	0.585
Depression risk	193 (19%)	83 (22%)	276 (20%)	0.222	**129 (16%)**	**147 (24%)**	**276 (20%)**	**<.001**
No intimate partner violence	986 (95%)	366 (95%)	1352 (95%)	0.702	771 (96%)	581 (95%)	1352 (95%)	0.215
Enabling								
High social support-tangible	598 (58%)	213 (55%)	811 (57%)	0.375	444 (55%)	367 (60%)	811 (57%)	0.091
High social support-emotional/informational	642 (62%)	241 (63%)	883 (62%)	0.893	**484 (60%)**	**399 (65%)**	**883 (63%)**	**0.070**
Sees any obstetrician-gynecologist	**736 (71%)**	**294 (76%)**	**1030 (73%)**	**0.058**	**557 (69%)**	**473 (77%)**	**1030 (73%)**	**0.001**
Usual source of care	**923 (90%)**	**360 (94%)**	**1283 (91%)**	**0.022**	733 (91%)	550 (90%)	1283 (91%)	0.319
Continuous insurance coverage for past year	**845 (82%)**	**334 (87%)**	**1179 (83%)**	**0.029**	678 (84%)	501 (82%)	1179 (83%)	0.157

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	Preventive Screening and Vaccination Services				Preventive Counseling Services			
	Low (0-3)	**High (4+)**	**total**	**p-value**	**Low (0-1)**	**High (2+)**	**total**	**p-value**
	N=1032	**N=385**	**1417**		**N=803**	**N = 614**	**N=1417**	
Did not forego care due to cost	882 (85%)	329 (85%)	1211 (85%)	0.996	693 (86%)	518 (84%)	1211 (85%)	0.305
Poverty Status								
In poverty	263 (25%)	101 (26%)	364 (26%)	0.768	**185 (23%)**	**179 (29%)**	**364 (26%)**	**0.014**
Not in poverty	645 (63%)	243 (63%)	888 (63%)		**529 (66%)**	**359 (58%)**	**888 (63%)**	
Missing poverty	124 (12%)	41 (11%)	165 (12%)		**89 (11%)**	**76 (12%)**	**165 (12%)**	
Need								
Excellent perceived health status	**230 (22%)**	**58 (15%)**	**288 (20%)**	**0.003**	172 (21%)	116 (19%)	288 (20%)	0.241
At least one chronic condition	**658 (64%)**	**287 (75%)**	**945 (67%)**	**<.001**	**502 (63%)**	**443 (72%)**	**945 (67%)**	**<.001**
Level 2. Contextual Covariates								
Healthcare Resources								
Primary care physician density (quartiles)								
Up to 170	**269 (26%)**	**73 (19%)**	**342 (24%)**	**0.038**	**215 (27%)**	**127 (21%)**	**342 (24%)**	**0.058**
171-193	**227 (22%)**	**89 (23%)**	**316 (22%)**		**177 (22%)**	**139 (23%)**	**316 (22%)**	
194-218	**284 (27%)**	**112 (29%)**	**396 (28%)**		**212 (26%)**	**184 (30%)**	**396 (28%)**	
219+	**252 (24%)**	**111 (29%)**	**363 (26%)**		**199 (25%)**	**164 (27%)**	**363 (26%)**	
1 or more Federal/Rural Health Clinic	595 (58%)	233 (61%)	828 (58%)	0.330	463 (58%)	365 (59%)	828 (58%)	0.499
Community Characteristics								
% Persons in Poverty (quartiles)								
Up to 8.6%	**279 (27%)**	**109 (28%)**	**388 (27%)**	**0.068**	213 (27%)	175 (28%)	388 (27%)	0.168

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	Preventive Screening and Vaccination Services				Preventive Counseling Services			
	Low (0-3)	**High (4+)**	**total**	**p-value**	**Low (0-1)**	**High (2+)**	**total**	**p-value**
	N=1032	**N=385**	**1417**		**N=803**	**N = 614**	**N=1417**	
8.7 – 10.4%	**292 (28%)**	**130 (34%)**	**422 (30%)**		226 (28%)	196 (32%)	422 (30%)	
10.5% - 13.4%	**206 (20%)**	**73 (19%)**	**279 (20%)**		170 (21%)	109 (18%)	279 (20%)	
13.5% +	**255 (25%)**	**73 (19%)**	**328 (23%)**		194 (24%)	134 (22%)	328 (23%)	
% without Health Insurance								
Q1. Up to 8.8%	270 (26%)	103 (27%)	373 (26%)	0.465	207 (26%)	166 (27%)	373 (26%)	0.384
Q2. 8.9% - 9.9%	265 (26%)	89 (23%)	354 (25%)		209 (26%)	145 (24%)	354 (25%)	
Q3. 10.0% - 11.0%	265 (26%)	113 (29%)	378 (27%)		203 (25%)	175 (29%)	378 (27%)	
Q4. 11.1%+	232 (22%)	80 (21%)	312 (22%)		184 (23%)	128 (21%)	312 (22%)	
Rural Urban Continuum (County)								
Metropolitan county	**614 (60%)**	**261 (68%)**	**875 (62%)**	**0.013**	**466 (58%)**	**409 (67%)**	**875 (62%)**	**0.004**
Nonmetro, Urban	**384 (37%)**	**111 (29%)**	**495 (35%)**		**308 (38%)**	**187 (30%)**	**495 (35%)**	
Nonmetro, Rural	**34 (3%)**	**13 (3%)**	**47 (3%)**		**29 (4%)**	**18 (3%)**	**47 (3%)**	

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Table 3

Multi-level analysis, adjusted odds of receiving preventive screening and vaccination services[a], Central Pennsylvania Women's Health Study (n = 1407)

	aOR[b]	95% CI[c]	p-value
Level 1. Individual Level Covariates			
Predisposing			
Higher self-esteem vs. lower	**1.27**	**(1.03,1.57)**	**0.024**
Lower Psychosocial Stress vs. higher	1.04	(0.85,1.29)	0.681
Some college vs. high school education	**1.28**	**(1.04,1.58)**	**0.022**
White, non-Hispanic vs. other	0.68	(0.46,1.02)	0.061
Depression risk vs. none	1.17	(0.89,1.53)	0.258
No intimate partner violence vs. IPV	0.87	(0.55,1.38)	0.562
Enabling			
High social support-tangible vs. low	0.99	(0.79,1.24)	0.955
High social support-emotional vs. low	1.14	(0.90,1.43)	0.271
Sees any obstetrician-gynecologist vs. does not (1+ vs. 0 services)[c]	**4.89**	**(2.72,8.79)**	**<0.001**
Sees any obstetrician-gynecologist vs. does not (2+ vs. 0-1 services)[c]	**4.72**	**(3.20,6.95)**	**<0.001**
Sees any obstetrician-gynecologist vs. does not (3+ vs. 0-2 services)[c]	**1.57**	**(1.22,2.02)**	**<0.001**
Sees any obstetrician-gynecologist vs. does not (4+ vs. 0-3 services) [c]	1.26	(0.95,1.67)	0.108
Sees any obstetrician-gynecologist vs. does not (5 vs. 0-4 services) [c]	1.03	(0.59,1.80)	0.911
Usual source of care vs. none	1.34	(0.96,1.87)	0.087
Continuous insurance vs. insurance coverage gap	**1.40**	**(1.05,1.88)**	**0.023**
Does not forego care due to cost vs. forgoes care	0.89	(0.65,1.20)	0.435
Poverty Status (1+ vs. 0 services) [c]			
In poverty	0.68	(0.38, 1.22)	0.263

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	aOR[b]	95% CI[c]	p-value
Missing poverty	0.83	(0.60, 1.14)	
Not in poverty	Ref.	Ref.	
Poverty Status (2+ vs. 0-1 services)[c]			
In poverty	**0.61**	**(0.41,0.91)**	0.014
Missing poverty	0.83	(0.60,1.14)	
Not in poverty	Ref.	Ref.	
Poverty Status (3+ vs. 0-2 services) [c]			
In poverty	0.77	(0.58,1.02)	0.136
Missing poverty	0.83	(0.60,1.14)	
Not in poverty	Ref.	Ref.	
Poverty Status (4+ vs. 0-3 services) [c]			
In poverty	1.13	(0.84,1.51)	0.299
Missing poverty	0.83	(0.60,1.14)	
Not in poverty	Ref.	Ref.	
Poverty Status (5 vs. 0-4 services)[c]			
In poverty	**1.73**	**(1.02,2.93)**	0.049
Missing poverty	0.83	(0.60,1.14)	
Not in poverty	Ref.	Ref.	
Need			
Lower vs. higher self-report health status	**1.34**	**(1.05,1.72)**	**0.020**
At least one chronic condition vs. none	**1.68**	**(1.35,2.08)**	**<0.001**
Level 2. Contextual Covariates			
Healthcare Resources			
Primary care physician density (quartiles)			
Q1. Up to 170	**Ref.**		**0.012**
Q2. 171-193	**1.85**	**(1.26,2.71)**	
Q3. 194-218	1.69	(0.89,3.21)	
Q4. 219+	1.59	(0.99,2.57)	
1 or more Federal/Rural Health Clinic vs. none	0.94	(0.74,1.19)	0.611
Community Characteristics			
% Persons in Poverty **(quartiles)**			

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	aOR[b]	95% CI[c]	p-value
Q1. Up to 8.6%	1.38	(0.95,2.00)	0.111
Q2. 8.7 – 10.4%	1.49	(1.00,2.23)	
Q3. 10.5% - 13.4%	1.40	(0.99,1.98)	
Q4. 13.5% +	Ref.		
% without Health Insurance **(quartiles)**			
Q1. Up to 8.8%	0.97	(0.63,1.52)	0.217
Q2. 8.9% - 9.9%	0.85	(0.56,1.28)	
Q3. 10.0% - 11.0%	1.27	(0.84,1.91)	
Q4. 11.1%+	Ref.		
Rural Urban Continuum (County)			
Metropolitan county	0.59	(0.29,1.21)	0.325
Nonmetro, Urban	0.63	(0.34,1.17)	
Nonmetro, Rural	Ref.		

Note: Variance of random error term estimated at 0.

Overall Likelihood Ratio Test p <0.001. McFadden Pseudo R^2 = 0.047.

[a] dependent variable is ordinal.

[b] aOR, adjusted odds ratio.

[c] CI, confidence interval.

[d] Sees any obstetrician-gynecologist and poverty status variables did not satisfy proportional odds assumptions, thus data are presented across the full range of possible outcomes.

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Table 4

Multi-Level Analysis, adjusted odds of receiving preventive counseling servicesa, Central Pennsylvani[a] Women's Health Study (n = 1407)

	aOR[b]	95% CI[c]	p-value
Level 1. Individual Level Covariates			
Predisposing			
Higher self-esteem vs. lower	0.82	(0.67,1.01)	0.058
Lower Psychosocial Stress vs. higher	**0.69**	**(0.57,0.85)**	**<0.001**
Some college vs. high school education	**1.26**	**(1.02,1.55)**	**0.028**
White, non-Hispanic vs. other	0.89	(0.61,1.32)	0.567
Depression risk vs. none	**1.31**	**(1.01,1.69)**	**0.045**
No intimate partner violence vs. IPV	0.74	(0.46,1.19)	0.219
Enabling			
High social support-tangible vs. low	1.20	(0.97,1.49)	0.095
High social support-emotional vs. low	**1.25**	**(1.00,1.56)**	**0.049**
Sees any obstetrician-gynecologist vs. does not	**1.51**	**(1.22,1.88)**	**<0.001**
Usual source of care vs. None	0.95	(0.67,1.34)	0.765
Continuous insurance vs. insurance coverage gap	0.95	(0.72,1.27)	0.736
Does not forego care due to cost vs. forgoes care	0.95	(0.71,1.28)	0.755
Poverty Status			
In poverty	1.17	(0.92,1.49)	0.416
Missing poverty	1.08	(0.80,1.47)	
Not in poverty	Ref.		
Need			
Lower self-reported health status vs. Excellent	1.15	(0.89,1.47)	0.283
Any chronic condition vs. none	**1.52**	**(1.22,1.88)**	**<0.001**
Level 2. Contextual Covariates			

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	aOR[b]	95% CI[c]	p-value
Healthcare Resources			
Primary care physician density**(quartiles)**			
Q1. Up to 170	Ref.		0.430
Q2. 171-193	1.34	(0.92,1.95)	
Q3. 194-218	1.53	(0.81,2.88)	
Q4. 219+	1.26	(0.79,2.01)	
1 or more Federal/Rural Health Clinic vs. none	0.95	(0.75,1.20)	0.667
Community Characteristics			
% Persons in Poverty **(quartiles)**			
Q1. Up to 8.6%	1.01	(0.70,1.46)	0.996
Q2. 8.7 – 10.4%	0.99	(0.66,1.49)	
Q3. 10.5% - 13.4%	1.00	(0.71,1.41)	
Q4. 13.5% +	Ref.		
% without Health Insurance **(quartiles)**			
Q1. Up to 8.8%	0.91	(0.59,1.42)	0.620
Q2. 8.9% - 9.9%	1.11	(0.74,1.68)	
Q3. 10.0% - 11.0%	1.24	(0.82,1.88)	
Q4. 11.1%+	Ref.		
Rural Urban Continuum (County)			
Metropolitan county	0.81	(0.39,1.68)	0.142
Nonmetro, Urban	0.64	(0.34,1.21)	
Nonmetro, Rural	Ref.		

Note: Variance of random error term estimated at 0. Overall Likelihood Ratio test , $p < 0.001$; McFadden Pseudo $R^2 = 0.022$.

[a] dependent variable is ordinal.

[b] aOR, adjusted odds ratio.

[c] CI, confidence interval.