Published in final edited form as:

J Rural Health. 2014 ; 30(1): 40–49. doi:10.1111/jrh.12035.

The Relationship Between Perceived Burden of Chronic Conditions and Colorectal Cancer Screening Among Appalachian Residents

Yelena N. Tarasenko, DrPH¹, Steven T. Fleming, PhD², and Nancy E. Schoenberg, PhD³

¹Jiann-Ping Hsu College of Public Health, Georgia Southern University, Statesboro, Georgia

²Department of Epidemiology, College of Public Health, University of Kentucky, Lexington, Kentucky

³Department of Behavioral Sciences, University of Kentucky, Lexington, Kentucky

Abstract

Purpose—As the population living with several concurrent chronic conditions or multiple morbidity (MM) increases, understanding how to effectively fit prevention efforts into disease management becomes more important, particularly among rural, underserved populations. Compared to their urban counterparts, rural residents suffer higher rates of disease, receive fewer preventive services, and often live in environments limiting access to optimal medical care. This study describes rural residents' perceived burdens of disease management and explores the relationship between these burdens, as proxies of individuals' competing demands, and colorectal cancer screening (CRCS).

Methods—We conducted a cross-sectional study, based on telephone survey data from 1,012 Appalachian residents, ages 50-75, with 1 or more chronic conditions. Measures of perceived MM burdens were developed based on 85 pilot interviews previously undertaken with providers and patients with MM residing in Appalachian Kentucky.

Results—Many participants (81%) agreed with 1 or more statements indicating perceived burdens of disease management effects on receiving CRCS. A higher percentage of rural (vs nonrural) Appalachians perceived burdens related to physician's recommendation, preparation to colonoscopy, and time management and affordability of both current diseases and screening. These differences did not modify the overall association between perceiving MM as burdensome and forgoing CRCS. The negative effect on CRCS of perceived burdens related to interaction with physician and time management were lower for participants with multiple rather than single morbidity.

Conclusion—Future research designed to address perceived burdens of MM and improved interaction with health care providers may enhance critical prevention efforts among vulnerable populations.

Keywords

chronic conditions; colorectal cancer screening; multiple morbidity; perceptions; rural population

More than 1 in 5, or 72 million people, will be age 65 or older in the US by the year 2030.¹ The unprecedented growth of the older population portends huge increases in the simultaneous occurrence of concurrent chronic health conditions, or multiple morbidity (MM),² forcing providers and patients to face increasingly complex clinical and lifestyle decisions. These decisions include how to fit effective prevention efforts into disease management activities.³ Since those with MM are more likely than in years past to experience long life expectancy, there is utility in understanding the relationship between MM management and disease prevention. Insights on these relationships are particularly needed among traditionally underserved populations that face the highest rates of diseases and the lowest level of preventive care.⁴⁻⁶ This paper contributes to the emerging body of research by examining rural residents' perceptions of their MM and the burdens of disease management in relation to colorectal cancer screening (CRCS).

In general, rural residents tend to be older, poorer, less educated, are more likely to be uninsured, and suffer higher rates of disease and disability than their urban counterparts.⁴⁻⁶ Those who reside in rural Appalachia are particularly disadvantaged. Residents of Appalachian Kentucky (54 of 120 counties) are characterized by socioeconomic status indicators that are among the lowest in the United States.⁷⁻¹⁰ For example, in 2009, the per capita personal income in Appalachian Kentucky was \$26,157 (compared to \$39,635 nationally and \$32,426 in the Appalachian region).^{7,8} The percentage of Appalachian Kentucky residents below poverty level was nearly double the national and Appalachian region averages (24% vs 14% and 16%, respectively),⁹ and 63% had graduated from high school compared to 82% in the US and 77% in the Appalachian region overall.¹⁰ There are fewer health care professionals, particularly specialists, in rural areas—yet many challenges exist, including transportation barriers, in rural locations.^{11,12} Consequently, Appalachian and rural residents often experience a more pernicious version of the nation's health problems, including a higher MM incidence and colorectal cancer incidence and mortality.¹²⁻¹⁴ Based on the 2005 analyses of cancer registries of Kentucky, Pennsylvania, and West Virginia, the incidence of colon and rectal cancers in the Appalachian region was 44.1 and 17.6 per 100,000 population. The estimated local-stage colorectal cancer rate was low in comparison to the elevated colorectal cancer mortality rate in the region, suggesting modest utilization of CRCS among vulnerable rural and Appalachian residents.¹⁵ Thus, research efforts focused on this disadvantaged population are warranted given the combination of higher disease rates and fewer resources (on both individual and community levels) to manage existing conditions and prevent future disease.

Research on etiology of the relationship between disease management and prevention, including CRCS, remains scant. On one hand, according to the surveillance hypothesis, individuals diagnosed with MM tend to have greater contact with the health care system and, consequently, an increased likelihood of being encouraged to receive a colorectal examination.^{16,17} Proponents of the competing demand hypothesis, on the other hand,

speculate that MM competes for the time and focus of physicians and resources of the individual, thus undermining prevention efforts like cancer screening.¹⁸⁻²⁰ Consistent with several observational studies,²¹⁻²⁷ our recent study of this vulnerable population suggests that the overall presence of MM is associated with increased rates of CRCS.²⁸ In this study, we aim to better understand the mechanisms that underlie CRCS among those with MM by examining individuals' perceived burdens of chronic conditions, as proxies of their competing demands and coping abilities. We hypothesize that: (i) individuals' perceptions are reflective of their actual MM burdens, and (ii) those who perceive their chronic conditions to constitute a burden may be less inclined to obtain screening.²⁹

METHODS

Data Source and Setting

All procedures for this study were approved by the University of Kentucky (UK) Institutional Review Board. The data were obtained from a survey administered by the UK Survey Research Center (SRC) during November 2009 – April 2010. The target population was composed of individuals aged 50-75 (the general recommended ages for starting and ending CRCS, according to the American Cancer Society [ACS]³⁰ and the US Preventive Services Task Force [USPSTF]³¹) residing in Appalachian Kentucky. Trained, experienced, and continuously monitored SRC interviewers used land-line telephones to survey households selected using a modified list-assisted Waksberg-Mitofsky random-digit dialing procedure,³² which ensured that every residential telephone line in Appalachian Kentucky had an equal probability of being selected. Up to 15 attempts were made for each number in the sample and up to 10 scheduled call backs, if timing was inconvenient.

The survey resulted in 1,230 completed interviews out of a total of 8,019 attempts, with 3,611 refusals and 3,178 ruled ineligible (many respondents' ages were outside the 50-75 bracket). The Council of American Survey Research Organization response rate includes ineligibles in both the numerator and denominator: $(1,230+3,178)/8,019 = 55\%$. Of the 1,230 interviews, 77 subjects were ruled ineligible for county residence outside Appalachian Kentucky or colorectal cancer diagnosis. This study is based on survey responses of 1,012 individuals with 1 or more chronic conditions (approximately 88% of the interviewed eligible sample): these individuals likely have the greatest number of competing demands,^{13,33-35} therefore providing a logical and salient subsample.

Measures

All measures were constructed from survey responses. The survey collected data on 4 types of CRCS modalities (eg, fecal occult blood test [FOBT], colonoscopy, flexible sigmoidoscopy [FSIG], and double-contrast barium enema [DCBE]) using the questions of whether and how long ago survey respondents had completed each of these tests. This study reports the results for guideline concordant (ie, within the last 10 years) colonoscopy screening^{30,31} only, given that it is the preferred method of screening and, according to our results, the far most common among this population. Also, the survey contained several measures of perceived burden specifically related to colonoscopy. Participants who were guideline-concordant in modalities other than colonoscopy were included as non-

colonoscopy concordant cases. As a sensitivity check, we examined perceived burdens of disease management in the context of any guideline-concordant CRCS defined as having FOBT, colonoscopy, FSIG, or DCBE within the timeline recommended for average risk asymptomatic adults by the ACS and USPSTF (ie, annually for FOBT, every 10 years for colonoscopy, and every 5 years for FSIG and DCBE).^{30,31} Any guideline-concordant CRCS was reported by 68% of the sample, of whom 92% received colonoscopies. Our results were very similar to those reported in this study (ie, on colonoscopy screening only).

The measures of perceived burden of disease management were developed based on an earlier pilot study of 85 interviews with providers and patients with MM residing in Appalachian Kentucky.¹³ In our survey following these interviews, the perceptions of how MM burden shapes CRCS decisions were assessed by asking respondents with 1 or more chronic conditions to indicate whether they agreed with specific statements such as “With all I have to worry about with my health, I can’t worry about getting screened for colorectal cancer.” Prior to reading the statements, we explained to the participants that these statements were intended to help us understand how their health condition(s) might affect their CRCS. Hence, when asked whether they agreed with the statement, for example, “The doctor told me that I do not need or should not get CRC screening,” the participants were expected to reflect on whether MM burden might have potentially influenced the physician’s opinion on whether the patients could tolerate the preparation for and procedure of CRCS. In addition to the statements, participants were asked whether any of their chronic conditions prevented them from getting screened.

Self-reported morbidities were assessed by asking respondents of the survey whether they “have ever been told by a doctor or other health professional” that they had 1 or more of 15 different chronic conditions (eg, arthritis, asthma, cancer, diabetes, and heart disease). The conditions were identified by our co-investigator, a family practice physician. These questions were supplemented by the open-ended question, “Other than these diseases, has a doctor ever told you that you have any other chronic or long-term diseases?” Responses to this question were mapped into 1 of the 15 chronic conditions or categorized as “other” morbidities. A covariate capturing the number of morbidities was created as the sum of different chronic conditions reported by each of the survey respondents. More detailed information on chronic conditions and their assessment was reported elsewhere.²⁸

Additional sample characteristics included age, sex, race, ethnicity, marital status, educational and income levels, and perceived income adequacy (or self-rated financial status). The covariate of self-rated financial status rather than actual income levels was included in the multivariable analyses. Many respondents were more reluctant to reveal actual income than self-rated financial status.

Statistical Analysis

We calculated descriptive statistics to characterize our survey participants and describe their perceived burdens of disease management in the context of guideline-concordant colonoscopy examination. Using the chi-square test of independence, we assessed differences in percentages of participants who had colonoscopy by the presence of MM, as well as differences in percentages of participants who expressed perceived burdens by the

presence of MM. Since 62% of our sample reported guideline-concordant CRCS, we assessed the relationships between this non-rare primary outcome of interest and each of the perceived burdens, respectively, using crude prevalence ratios (PR). More traditional with regard to binary outcome odds ratios are less appropriate measures of associations for non-rare (ie, 10%) outcomes. We explored whether the relationships between CRCS and each of the perceived burdens, respectively, differed with regard to the presence of MM by estimating stratum-specific (ie, 1 morbidity vs 2 and more morbidities) PR and examining their uniformity (or lack thereof) using the Mantel-Haenszel (M-H) chi-square test for homogeneity. We then assessed whether the relationships between colonoscopy examination and each of the perceived burdens, respectively, differed given sociodemographic characteristics of the participants, by calculating adjusted prevalence ratios using Poisson regressions with robust variance.³⁶

Finally, we conducted 2 sensitivity analyses. First, even though Appalachian Kentucky is primarily considered rural, we assessed differences between sociodemographic and health-related characteristics of rural vs non-rural Appalachian respondents using the chi-square test of independence and Fisher's exact test. We used Federal Information Processing Standard and 2003 Rural-Urban Continuum codes (frequently reported as Beale codes) to dichotomize counties into rural (Beale codes 6 to 9) and nonrural (Beale codes 1 to 5).³⁷ Second, the reported results of adjusted analyses are based on observations without missing values. We re-fitted multivariable models including observations with missing values (ie, adding an indicator of missing for education or financial status). We found no appreciable differences from the reported results.

All analyses were conducted using Intercooled Stata version 10.1 for Windows (StataCorp LP, College Station, Texas). An alpha level of .05 was used to identify statistically significant results, and all tests were 2-sided.

RESULTS

Consistent with the demographics of the Appalachian Kentucky region, most of the 1,012 respondents described their ethnicity as non-Hispanic (98%) and identified themselves as white/Caucasian (97%). The average respondent's age was 62 years (SD 7). Most respondents were married or partnered (63%) and female (71%). Over one-third of respondents (36%) reported having a high school diploma or its equivalent as their highest level of educational attainment; however, 22% did not complete high school. The remaining 42% reported having more than a high school education. Slightly fewer than half of respondents (45%) reported having just enough to get by, and one-fifth of respondents (19%) reported having more than needed to live well. More than one-third (36%) reported struggling to make ends meet. The colonoscopy screening test was the most widely used screening modality (62%) (Table 1). Fewer participants reported guideline-concordant FOBT (13%), FSIG (12%), or DCBE (11%) (results not shown).

Perceived Burden of MM and CRCS in Appalachia

Many participants (81%) agreed with 1 or more statements indicating perceived burden of MM effects on CRCS (average 3, SD 2). A majority of participants (59%) felt that doctors

focused more on participants' existing chronic health conditions than disease prevention. Slightly less than one-third (32%) affirmed that they could not afford to take care of all their health conditions as well as getting CRCS. Approximately the same percentage felt that doctors did not discuss both health conditions and disease prevention, like CRCS. Few (13%) felt that they did not have sufficient time to take care of current health conditions as well as getting CRCS. Additional descriptive statistics on the perceptions of disease management burdens in the context of colonoscopy screening are reported in Figure 1. When asked specifically whether any of their health conditions prevented them from getting screened, only 2% of participants responded affirmatively (result not shown).

There were 163 (16%) participants with 1 morbidity and 849 (84%) participants with MM. A higher percentage of participants with MM reported guideline-concordant colonoscopy screening compared to their counterparts with 1 morbidity (64% vs 53%). At the same time, a higher percentage of participants with MM (vs those with 1 morbidity) were concerned with not having enough time during their doctor visits for a discussion of prevention or screening (26% vs 18%). Similarly a higher percentage of participants with MM perceived preparation to or colonoscopy itself as burdensome (29%) compared to their counterparts with 1 morbidity (20%). More participants with MM were worried about being put to sleep before colonoscopy (24%) or were not physically up for CRCS (16%) compared to participants with 1 morbidity (11% and 9%, respectively). Participants with MM also perceived other burdens more frequently; however, associations between each of them and the presence of MM were not statistically significant. More detailed results are displayed in Figure 1.

Affirmative responses to almost all perceived burden items were negatively and significantly associated with adherence to colonoscopy screening guidelines. The inclination of participants to forgo CRCS when a doctor might have told them there was no need to get screening (crude PR = 0.86, 95% CI: 0.69 – 1.08) or when participants' many health conditions might have made the preparation the day before a colonoscopy too risky or uncomfortable (crude PR = 0.90, 95% CI: 0.81 – 1.01) could be due to random chance alone. Adjusting for potential confounders (ie, presence of MM or sociodemographic characteristics and rural/nonrural Appalachian residence) did not significantly change the magnitude and strength of these associations. Crude and adjusted PRs and corresponding statistics are reported in Table 2.

Examining whether the presence of MM modified the crude associations between perceived burdens and colonoscopy screening, we found 2 statistically significant results (Table 3). Participants with 1 morbidity whose doctor did not discuss either their health conditions or disease prevention were 63% (95% CI: 0.22 – 0.61) less likely to undergo colonoscopy screening than those who felt otherwise. In comparison, participants with MM who expressed the same concern were 35% less likely to undergo screening (95% CI: 0.57 – 0.75). Additionally, participants with 1 morbidity, who reported that they did not have the time to take care of their health conditions and undergo CRCS, were 75% (95% CI: 0.09 – 0.72) less likely to undergo colonoscopy compared to 29% (95% CI: 0.58 – 0.88) for participants with MM (Table 3).

Rural vs Nonrural Appalachia

The vast majority (80%) of our respondents resided in rural Appalachian counties. Rural residents were more likely to report lower levels of educational attainment and financial status than their nonrural counterparts. There were no other statistically significant differences between sociodemographic and health-related (ie, prevalence of CRCS and MM) characteristics of rural vs nonrural Appalachian respondents. In terms of perceived burdens, a higher percentage of rural Appalachian Kentuckians reported being told by a doctor that they did not need or should not get CRCS (8% vs 3%) or felt they could not afford “to take care of all their health conditions plus get CRCS” (34% vs 24%) or did not have time for both management of current diseases and CRCS (14% vs 8%). Similarly, a higher percentage of rural residents expressed concerns that their “many health conditions make the preparation the day before a colonoscopy too risky or uncomfortable” (30% vs 19%) or worries about being put to sleep before a colonoscopy (23% vs 14%) (results not shown). Given these statistically significant differences we controlled for the rural/nonrural Appalachian residence in addition to other sample characteristics in the estimation of aforementioned adjusted prevalence ratios (Table 2).

DISCUSSION

This research was driven largely by earlier findings²⁸ which showed that CRCS rates were higher in Appalachian residents with MM compared to those with one or no chronic conditions. Researchers have speculated on 2 pathways—one exerting a positive (via the surveillance)^{16,17} effect and the other a negative (via the competing demand)¹⁸⁻²⁰ effect on screening—underlying the role that MM plays on the likelihood of cancer screening. In this study, we examined individuals’ perceived burdens of disease management in shaping their uptake of CRCS. Despite the greater likelihood that this vulnerable rural population will fail to obtain cancer screening and, ultimately, suffer a greater incidence and mortality from cancer, to our knowledge, prior studies have not explored these relationships.

Health-related perceptions, including burdens attributed to disease management, reveal the underpinnings of behavior and may direct researchers to productive intervention opportunities. Such perceptions can also serve as proxy measures for the perceived symptom burden of chronic conditions.^{38,39} Since some studies have suggested that individuals tend to seek formal medical services when they feel unhealthy (or perceive subjective as opposed to objective need), self-perceptions may also be predictive of the future burden on the health care delivery system.⁴⁰⁻⁴²

With regard to colonoscopy screening, individuals’ perceptions were reflective of their actual MM burden. A higher percentage of participants with several (compared to 1) chronic conditions responded affirmatively to 9 out of 11 perceived burden items (Figure 1). Our findings also suggest that the way Appalachian individuals with 1 or more chronic conditions perceived their morbidities had burdened their health mattered: between 14% and 42% fewer of them (based on the crude PRs in Table 2) reported guideline-concordant colonoscopy screening compared to those who did not perceive disease management burdensome. In the bivariate sensitivity analyses, we found differences in percentages of rural vs nonrural Appalachian residents with regard to 5 (out of 11) perceived burdens that

were related to interaction with or recommendation of a physician, preparation for colonoscopy, and time management and affordability of both current diseases and screening. These differences, however, did not modify the overall negative association between perceived burdens and forgoing CRCS among the Appalachian population in Kentucky.

Respondents with either a single chronic condition or MM had lower rates of CRCS if they perceived that their physicians did not discuss both their health condition and disease prevention, or they perceived that they did not have time to care for both their health condition(s) and receive CRCS. The negative impact of these perceptions on screening rates was lower, however, for those with multiple rather than single morbidities, suggesting that the attenuation of screening rates caused by perception is moderated to some degree by the increased surveillance resulting from MM. Prior research indicates that perceptions based on actual experience influence behavior more powerfully than perceptions derived from other sources (eg, a discussion with a health care provider).²⁹ Compared to behaviors that are performed frequently or repeatedly not performed despite having multiple opportunities or behaviors that are completely new, CRCS represents an intermittent behavior—a behavior which people have (or have not) performed in the past occasionally, at considerable intervals. However, in the context of MM, CRCS may become incorporated into the MM management activities and, therefore, is conceptualized as an ongoing or repeated behavior, which entails more opportunities for patients to acquire personal experiences with the health care system and learn to better cope with competing demands using external sources (eg, social support) compared to individuals without MM.^{29,43}

The study has several limitations. Access to care and health literacy may influence individuals' perceived burdens of MM, as well as their disease management and prevention. In our preliminary analyses, we explored whether participants had a usual source of care, whether they were seeing the same health care provider when needed, and participants' insurance status as proxies for health care access. Since these variables failed to modify the relationships between each of the perceived burdens and colorectal cancer screening (compared to the reported ones), we did not include them in the final models. We did, however, include self-rated financial status because it represents the balance between actual income and insurance, among other socio-economic (SES) characteristics. Although we did not assess health literacy, we used participants' SES characteristics as its correlates. Furthermore, the focus on a relatively homogeneous sample from a specific geographic area, Appalachian and rural Kentucky, is both a weakness and strength. In our earlier work, described elsewhere in more detail,²⁸ we compared sociodemographic composition of this sample with the general residents of Appalachian Kentucky using land-line 2009 BRFSS data. While the sample characteristics were consistent with those of Appalachian Kentuckians in terms of race, ethnicity, age, and education, our sample had proportionately more respondents who were female, not married, or at the lowest income level.²⁸ Among these characteristics, the latter 2 were statistically significantly associated with having MM based on bivariate analyses. Nevertheless, what one loses in generalizability, one gains in the focus on a vulnerable population. While our study findings are not necessarily generalizable to populations outside Appalachia, they can apply to many other vulnerable rural populations with characteristics similar to those of Appalachian Kentuckians. Additionally, the study is a cross-sectional study based on self-report of morbidities, their

perceived burden, and colonoscopy; hence, we cannot assume causality and must assume some misclassification bias of both exposure (ie, morbidity and MM) and outcome (ie, CRCs). Nonetheless, this is an exploratory study rather than an explanatory one, and it provides important insights into the relationship between disease management and prevention among a vulnerable population.

In conclusion, as the prevalence of MM increases globally and in the US, understanding how to maintain or enhance quality of life for individuals living with MM becomes increasingly important. Within the integrated framework for living well with chronic illness,⁴⁴ prevention is essential for improving quality of life and compressing morbidity rather than merely counteracting (or warding off) new morbidities or prolonging life expectancy. Rural residents oftentimes are vulnerable to greater disease burdens in the context of more limited preventive service provision.⁶ Future research designed to address perceived burdens of disease management may improve critical prevention efforts. Ensuring regular access to and interaction with a trusted medical source may enable individuals to overcome their barriers of disease management in the context of prevention; nowhere is this need more critical than among underserved populations.

Acknowledgments

Support for this research was provided by the grant “Increasing Colorectal Cancer Screening for Patients with Multiple Morbidities” (National Institutes of Health/ National Cancer Institute, R21CA129881-01, PI: Schoenberg/Fleming). The project was approved by the University of Kentucky Institutional Review Board (#07-0843-P2H). We acknowledge and thank Dr. Alan E. Simon and the reviewers for their insightful feedback. We also thank our interviewers and study participants.

References

1. Wan, H.; Sengupta, M.; Velkoff, VA.; DeBarros, KA. U S Census Bureau. Current Population Reports, P23-209, 65+ in the United States: 2005. Washington, DC: U.S. Government Printing Office; 2005.
2. Valderas JM, Starfield B, Sibbald B, Salisbury C, Roland M. Defining comorbidity: implications for understanding health and health services. *Ann Fam Med*. 2009; 7(4):357–363. [PubMed: 19597174]
3. Mullen PD, Allen JD, Glanz K, et al. Measures used in studies of informed decision making about cancer screening: a systematic review. *Ann Behav Med*. 2005; 32(3):188–201. [PubMed: 17107291]
4. Rural Healthy People 2010. College Station, TX: Southwest Rural Health Research Center. Available at: <http://www.srph.tamhsc.edu/centers/rhp2010/> [November 6, 2012]
5. Bennett, KJ.; Olatosi, B.; Probst, JC. [November 6, 2012] Health Disparities: A Rural-Urban Chartbook. South Carolina Rural Health Research Center. Jun. 2008 Available at: [http://rhr.sph.sc.edu/report/\(7-3\)%20Health%20Disparities%20A%20Rural%20Urban%20Chartbook%20-%20Distribution%20Copy.pdf](http://rhr.sph.sc.edu/report/(7-3)%20Health%20Disparities%20A%20Rural%20Urban%20Chartbook%20-%20Distribution%20Copy.pdf)
6. Jones, CA.; Parker, TS.; Ahearn, M.; Mishra, AK.; Variyam, JN. United States Department of Agriculture: Economic Information Bulletin 57; Aug. 2009 Health Status and Health Care Access of Farm and Rural Populations. Available at: http://www.ers.usda.gov/media/155453/eib57_1_.pdf [December 7, 2012]
7. Appalachian Regional Commission: Regional Planning and Research Division. [November 6, 2012] Appalachian Region Income Report, 2011. Available at: <http://www.arc.gov/images/appregion/Sept2011/IncomeReportSept2011.pdf>
8. Appalachian Regional Commission. [November 6, 2012] Personal Income Rates, 2009. Available at: http://www.arc.gov/reports/custom_report.asp?REPORT_ID=43

9. Appalachian Regional Commission. [November 6, 2012] Poverty Rates, 2006-2010. Available at: http://www.arc.gov/reports/custom_report.asp?REPORT_ID=44
10. Appalachian Regional Commission. [November 6, 2012] Education – High School and College Completion Rates, 2000. Available at: http://www.arc.gov/reports/custom_report.asp?REPORT_ID=18
11. Halverson, JA.; Harner, JE. [August 15, 2012] An analysis of disparities in health status and access to health care in the Appalachian region. Executive Summary. Sep. 2004 Available at: http://www.arc.gov/research/researchreportdetails.asp?REPORT_ID=82
12. Hartley D. Rural health disparities, population health, and rural culture. American Journal of Public Health. 2004; 94(10):1675–1678. [PubMed: 15451729]
13. Schoenberg NE, Bardach SH, Manchikanti KN, Goodenow AC. Appalachian residents' experiences with and management of multiple morbidity. Qual Health Res. 2011; 21(5):601–611. [PubMed: 21263063]
14. Behringer B, Friedell G. Appalachia: Where place matters in health. Prev Chronic Dis. 2006; 3(4):A113–118. [PubMed: 16978488]
15. Lengerich EJ, Tucker TC, Powell RK, et al. Cancer incidence in Kentucky, Pennsylvania, and West Virginia: Disparities in Appalachia. J Rural Health. 2005; 21(1):39–47. [PubMed: 15667008]
16. Lehnert T, Heider D, Leicht H, et al. Review: health care utilization and costs of elderly persons with multiple chronic conditions. Med Care Res Rev. 2011; 68(4):387–420. [PubMed: 21813576]
17. Fleming ST, Pursley HG, Newman B, Pavlov D, Chen K. Comorbidity as a predictor of stage of illness for patients with breast cancer. Med Care. 2005; 43(2):132–140. [PubMed: 15655426]
18. Vaeth PA, Satariano WA, Ragland DR. Limiting comorbid conditions and breast cancer stage at diagnosis. J Gerontol A Biol Sci Med Sci. 2000; 55:M593–600. [PubMed: 11034232]
19. Schapira MM, McAuliffe TL, Nattinger AB. Underutilization of mammography in older breast cancer survivors. Med Care. 2000; 38:281–288. [PubMed: 10718353]
20. Jaen CR, Strange KC, Nutting PA. Competing demands of primary care: a model for the delivery of clinical preventive services. J Family Practice. 1994; 38:166–171.
21. Deshpande AD, McQueen A, Coups EJ. Different effects of multiple health status indicators on breast and colorectal cancer screening in a nationally representative US sample. Cancer Epidemiol. 2012; 36(3):270–275. [PubMed: 22079763]
22. Guessous I, Dash C, Lapin P, Doroshenko M, Smith RA, Klabunde CN. Colorectal cancer screening barriers and facilitators in older persons. Prev Med. 2010; 50(1-2):3–10. [PubMed: 20006644]
23. Bazargan M, Ani C, Bazargan-Hejazi S, Baker RS, Bastani R. Colorectal cancer screening among underserved minority population: discrepancy between physicians' recommended, schedule, and completed tests. Patient Educ Couns. 2009; 76(2):240–247. [PubMed: 19150198]
24. Beydoun HA, Beydoun MA. Predictors of colorectal cancer screening behaviors among average-risk older adults in the United States. Cancer Causes & Control: CCC. 2008; 19(4):339–359. [PubMed: 18085415]
25. Klabunde CN, Schenck AP, Davis WW. Barriers to colorectal cancer screening among Medicare consumers. Am J Prev Med. 2006; 30(4):313–319. [PubMed: 16530618]
26. Sultan S, Conway J, Edelman D, Dudley T, Provenzale D. Colorectal cancer screening in young patients with poor health and severe comorbidity. Arch Intern Med. 2006; 166(20):2209–2214. [PubMed: 17101938]
27. Christman LK, Abdulla R, Jacobsen PB, et al. Colorectal cancer screening among a sample of community health center attendees. J Health Care Poor Underserved. 2004; 15(2):281–293. [PubMed: 15253379]
28. Fleming ST, Schoenberg NE, Tarasenko YN, Pearce KA. Prevalence of colorectal cancer screening among a multimorbid rural Appalachian population. South Med J. 2011; 104(12):811–818. [PubMed: 22089360]
29. Weinstein ND. Misleading tests of health behavior theories. Ann Behav Med. 2007; 33(1):1–10. [PubMed: 17291165]
30. Smith RA, Cokkinides V, Brooks D, Saslow D, Shah M, Brawley OW. Cancer screening in the United States, 2010: a review of current American Cancer Society guidelines and issues in cancer screening. CA: Cancer J Clin. 2011; 61(1):8–30. [PubMed: 21205832]

31. U.S. Preventive Services Task Force. Screening for colorectal cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2008; 149(9):627–637. [PubMed: 18838716]
32. Waksberg J. Sampling methods for random digit dialing. *J Am Stat Assoc.* 1978; 73:40–46.
33. Kane, RL.; Preister, R.; Totten, A. Meeting the Challenge of Chronic Illness. Baltimore: Johns Hopkins University Press; 2005.
34. Lipscombe L, Hux J, Booth G. Reduced screening mammography among women with diabetes. *Arch Intern Med.* 2005; 165(18):2090–2095. [PubMed: 16216998]
35. Starfield B, Lemke K, Bernhardt T, Foldes S, Forrest C, Weiner J. Comorbidity: Implications for the importance of primary care in 'case' management. *Ann Fam Med.* 2003; 1(1):8–14. [PubMed: 15043174]
36. Barros AJ, Hirakata VN. Alternative for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol.* 2003; 3:21. [PubMed: 14567763]
37. United States Department of Agriculture. [November 29, 2012] Rural-Urban Continuum Codes. Jul 05. 2012 Available at: <http://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx>
38. Bower P, Harkness E, Macdonald W, Coventry R, Bundy C, Moss-Morris R. Illness representations in patients with multimorbid long-term conditions: Qualitative study. *Psychol Health.* 2012; 27(10):1211–1226. [PubMed: 22390140]
39. Schüz B, Wurm S, Warner LM, Ziegelmann JP. Self-efficacy and multiple illness representations in older adults: a multilevel approach. *Psychol Health.* 2012; 27(1):13–29. [PubMed: 21678174]
40. Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav.* 1997; 38:12–37.
41. Pijls LT, Feskens EJ, Kromhout D. Self-rated health, mortality, and chronic diseases in elderly men: The Zutphen study, 1985-1990. *Amer J Epidemiol.* 1993; 138(10):840–848. [PubMed: 8237972]
42. Centers for Disease Control and Prevention. Measuring Health Days: Population Assessment of Health-Related Quality of Life. Atlanta, GA: CDC; 2000.
43. Bardach SH, Tarasenko YN, Schoenberg NE. The role of social support in multiple morbidity: self-management among rural residents. *J Health Care Poor Underserved.* 2011; 22(3):756–771. [PubMed: 21841277]
44. IOM (Institute of Medicine). Washington, DC: The National Academies Press; 2012. Living Well with Chronic Illness: A Call for Public Health Action. Available at: <http://www.iom.edu/Reports/2012/Living-Well-with-Chronic-Illness.aspx> [March 27, 2012]

Figure 1. Colonoscopy screening and perceived burdens by presence of multiple morbidity

Notes: CRC – colorectal cancer. Percentages of those participants who reported guideline concordant colonoscopy screening or a perceived burden. Percentages were calculated for all participants and for those with one or multiple morbidity (MM). * $P < .05$. Statistically significant differences between colonoscopy examination and presence of MM, as well as each of the perceived burdens and presence of MM were assessed using chi-square test of independence.

Table 1

Sociodemographic and Health-Related Sample Characteristics (n = 1,012).

Sample characteristics	Frequency ^a	Percent ^b
Mean age in yrs – n (std. dev.)	62	7
Sex		
Male	297	29
Female	715	71
Race		
White	957	97
Non-white ^c	33	3
Ethnicity		
Hispanic	15	2
Non-Hispanic	970	98
Marital status		
Married/partnered	626	63
Separated/divorced/widowed/single/never married/other	361	37
Education		
< High school	219	22
= High school/GED	352	36
> High school	417	42
Income		
< \$15,000	224	28
\$15,000 - \$24,999	152	19
\$25,000 - \$34,999	113	14
\$35,000 - \$50,000	99	12
\$50,000	224	28
Perceived financial status/income adequacy		
Struggle to meet needs	353	36
Just enough to get by	434	45
More than needed to live well	182	19
Colonoscopy within the last 10 years	627	62

^aThe total number of respondents for each variable may differ due to sporadically missing data.^bPercentages may not sum to 100% due to rounding.^cNon-white includes African American, Asian, and other.

Table 2

Prevalence of Guideline-Concordant Colonoscopy Given Perceived Burdens of Disease Management (n = 1,012).

Perceived burdens	Crude PR (95% CI)	PR adjusted by presence of MM (95% CI)	PR adjusted by SES (95% CI)
When I go to the doctor, we focus more on my health conditions than on disease prevention, like cancer screenings.	0.82 (0.74 – 0.90)	0.82 (0.74 – 0.90)	0.87 (0.79 – 0.96)
My doctor does not discuss both my health conditions and disease prevention, like CRC screening.	0.61 (0.53 – 0.70)	0.61 (0.53 – 0.70)	0.65 (0.56 – 0.75)
There doesn't seem to be enough time during my doctor visits for a discussion of prevention or screening.	0.82 (0.72 – 0.93)	0.81 (0.71 – 0.92)	0.86 (0.75 – 0.98)
The doctor told me that I do not need or should not get CRC screening.	0.86 (0.69 – 1.08)	0.86 (0.69 – 1.08)	0.89 (0.70 – 1.14)
I can't afford to take care of all my health conditions plus get a CRC screening test.	0.73 (0.64 – 0.82)	0.72 (0.64 – 0.82)	0.79 (0.69 – 0.89)
My many health conditions make the preparation the day before a colonoscopy too risky or uncomfortable.	0.90 (0.81 – 1.01)	0.89 (0.80 – 1.00)	0.94 (0.83 – 1.06)
With all of my health conditions, I worry about being put to sleep before a colonoscopy.	0.67 (0.57 – 0.78)	0.66 (0.56 – 0.77)	0.72 (0.61 – 0.84)
I am just too tired from all of the other things I have to do for my health to deal with getting a CRC screening.	0.66 (0.55 – 0.80)	0.66 (0.55 – 0.79)	0.73 (0.61 – 0.88)
With all I have to worry about with my health, I can't worry about getting screened for CRC.	0.58 (0.47 – 0.71)	0.57 (0.47 – 0.70)	0.63 (0.51 – 0.78)
With all of my health conditions, I am not physically up for CRC screening.	0.75 (0.63 – 0.89)	0.74 (0.62 – 0.88)	0.79 (0.66 – 0.94)
I don't have the time to both take care of my health conditions and get the CRC screening.	0.65 (0.52 – 0.80)	0.65 (0.53 – 0.80)	0.71 (0.57 – 0.88)

Notes: CRC – colorectal cancer. PR – prevalence ratio. CI – confidence interval. MM – multiple morbidity. SES – characteristics reflective of participants' socio-economic status (eg, age, sex, marital status, educational level, perceived financial status, and rural/nonrural Appalachian residence).

Reference group for each of the perceived burdens consists of those participants who did not express that perceived burden.

Table 3

Prevalence of Colonoscopy Screening Given Perceived Burdens of Disease Management Stratified by Presence of Multiple Morbidity (n = 1,012).

Perceived burdens	One Morbidity PR (95% CI)	MM PR (95% CI)	P value ^a
When I go to the doctor, we focus more on my health conditions than on disease prevention, like cancer screenings.	0.74 (0.55 – 0.99)	0.83 (0.75 – 0.92)	.46
My doctor does not discuss both my health conditions and disease prevention, like CRC screening.	0.37 (0.22 – 0.61)	0.65 (0.57 – 0.75)	.03
There doesn't seem to be enough time during my doctor visits for a discussion of prevention or screening.	0.48 (0.26 – 0.87)	0.85 (0.75 – 0.97)	.06
The doctor told me that I do not need or should not get CRC screening.	0.73 (0.34 – 1.57)	0.88 (0.70 – 1.11)	.63
I can't afford to take care of all my health conditions plus get a CRC screening test.	0.61 (0.41 – 0.90)	0.74 (0.66 – 0.84)	.33
My many health conditions make the preparation the day before a colonoscopy too risky or uncomfortable.	0.80 (0.52 – 1.21)	0.91 (0.81 – 1.02)	.55
With all of my health conditions, I worry about being put to sleep before a colonoscopy.	0.92 (0.56 – 1.49)	0.63 (0.54 – 0.75)	.16
I am just too tired from all of the other things I have to do for my health to deal with getting a CRC screening.	0.43 (0.20 – 0.92)	0.69 (0.57 – 0.83)	.23
With all I have to worry about with my health, I can't worry about getting screened for CRC.	0.52 (0.24 – 1.10)	0.58 (0.47 – 0.72)	.78
With all of my health conditions, I am not physically up for CRC screening.	1.11 (0.72 – 1.73)	0.70 (0.58 – 0.85)	.06
I don't have the time to both take care of my health conditions and get the CRC screening.	0.25 (0.09 – 0.72)	0.71 (0.58 – 0.88)	.046

Notes: CRC – colorectal cancer. PR – prevalence ratio. CI – confidence interval. MM – multiple morbidity. Reference group for each of the perceived burdens consists of those participants within a given stratum who did not express a perceived burden.

^aDifferences between strata-specific prevalence ratios were assessed using M-H test of homogeneity.