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The effect of health insurance coverage on medical care utilization and health outcomes: Evidence from Medicaid adult vision benefits☆

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Abstract

Increasing the proportion of adults that have regular, comprehensive eye exams and reducing visual impairment due to uncorrected refractive error and other common eye health problems are federal health objectives. We examine the effect of vision insurance on eye care utilization and vision health outcomes by taking advantage of quasi-experimental variation in Medicaid coverage of adult vision care. Using a difference-in-difference-in-difference approach, we find that Medicaid beneficiaries with vision coverage are 4.4 percentage points ($p < 0.01$) more likely to have seen an eye doctor in the past year, 5.3 percentage points ($p < 0.01$) less likely to report needing but not purchasing eyeglasses or contacts due to cost, 2.0 percentage points ($p < 0.05$) less likely to report difficulty seeing with usual vision correction, and 1.2 percentage points ($p < 0.01$) less likely to have a functional limitation due to vision.

JEL classification: I11

I13; I18; I38

Keywords

Health insurance; Medicaid expansions; Vision care

1. Introduction

Medicaid and the Children's Health Insurance Program (CHIP) cover nearly 60 million Americans (Centers for Medicare and Medicaid Services (CMS), 2015a). Though non-elderly, non-disabled adults represented only 23% of total enrollment in 2013[1], this population has grown considerably in the 30 states that had opted to implement the

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[1]*Source:* Authors' calculation using enrollment data for December 2013 available from the Kaiser Family Foundation.

Affordable Care Act (ACA) Medicaid expansion to adults with incomes of up to 138% of the federal poverty threshold as of June 2015 (Kaiser Family Foundation, 2015). Preliminary estimates from the Centers for Medicare and Medicaid Services suggest that enrollment in Medicaid and CHIP increased by 10.5 million individuals between September 2013 and April 2015 in these expansion states (Centers for Medicare and Medicaid Services (CMS), 2015b). Though states must cover certain mandatory services for adult Medicaid beneficiaries (e.g., inpatient and outpatient hospital services), other services are optional. For example, states may choose whether or not to provide coverage of prescription drugs, physical and occupational therapy, dental services, optometry services, and eyeglasses, among other services. Further, states may offer different benefit packages to the traditional and expansion Medicaid populations. Knowledge of the magnitude of the effects of specific types of coverage may be useful in determining Medicaid program scope and cost-sharing structure.

A substantial body of literature analyzes the effects of Medicaid eligibility on the use of services (e.g., Busch and Duchovny, 2005; Choi et al., 2011; Currie et al., 2008; Currie and Gruber, 1996a, 1996b; Gresenz et al., 2012; Lo Sasso and Buchmueller, 2004), and a growing literature has examined the effects of generosity of provider payment on provider participation in Medicaid and access to care (e.g., Polsky et al., 2015; Decker, 2015). However, considerably less research has examined the effects of state decisions to cover optional services, even though spending on these services constitutes over 40% of total Medicaid expenditures (Kaiser Commission for Medicaid and the Uninsured, 2005). Recent work focusing on Medicaid adult dental insurance has found sizeable and significant effects of dental coverage on use of dental services (Choi, 2011; Nasseh and Vujicic, 2013) and dentists' participation in Medicaid (Buchmueller et al., 2014). However, most other optional preventive care services have received little or no attention in the literature.

This article focuses on the effects of Medicaid adult vision coverage on use of vision care and vision health outcomes. To our knowledge, no published research has examined the causal effects of Medicaid vision coverage. Even when considering the effects of vision insurance in general, the most recent rigorous evidence is based on the RAND Health Insurance Experiment (HIE), a randomized study of the effects of cost sharing conducted more than 30 years ago[2]. This leaves a significant gap in the literature, especially since the results of the RAND HIE suggest that visual acuity is one of the few health outcomes demonstrably affected by the generosity of insurance coverage (Manning et al., 1987). Improvements in visual acuity may also have health effects beyond vision: research suggests that poor visual acuity is associated with an increased risk of fall-related injuries and worse overall health (McKean-Cowdin et al., 2007; Patino et al., 2010; Varma et al., 2006).

More generally, with the exception of the Oregon Health Experiment, a limited expansion of Oregon's Medicaid program in 2008, little evidence of the impact of Medicaid coverage on health outcomes among adults exists. Though the findings of the Oregon Experiment suggest that Medicaid coverage is associated with improved self-reported health, the results do not

[2]Numerous studies show a positive correlation between vision insurance and use of vision care (see for example Galor et al., 2015; Lee et al., 2009; Zhang et al., 2008), however the results of these studies cannot be interpreted as causal.

support effects on other health outcomes such as hypertension or hypercholesterolemia (Baicker et al., 2013). The fact that some of the health outcomes considered may not respond to insurance coverage in the short term may explain these null findings. A significant and near-term effect of Medicaid vision coverage on vision health outcomes is plausible since clinical exam data indicate that nearly three-quarters of those with measured visual impairment could achieve better vision with an up-to-date prescription for corrective lenses (Chou et al., 2013; Vitale et al., 2006b). Low-income adults are least likely to visit an eye doctor regularly (Zhang et al., 2012) making adults enrolled in Medicaid a relevant population for study.

Though most state Medicaid programs cover emergency eye care and treatment of medical eye problems, some states do not provide preventive eye care services such as routine exams and eyeglasses for correction of refractive error to adult Medicaid beneficiaries. For example, 35 states (including the District of Columbia) provided coverage of routine eye exams and 28 states provided coverage of eyeglasses for correction of refractive error in 2012 (Kaiser Family Foundation, 2014c)[3]. All 16 states that did not provide coverage of preventive exams covered emergency and/or medically necessary treatments (e.g., post cataract surgery services). Of the 23 states that did not cover eyeglasses for correction of refractive error, 14 states covered eyeglasses when considered medically necessary, but 9 states did not provide coverage under any circumstances.

Providing a Medicaid adult vision benefit may increase the use of eye care services by reducing the out-of-pocket cost paid by the beneficiary. The fact that the cost of eye care may be non-trivial for low-income adults suggests that having vision insurance may increase use of care substantially. For example, one study found that the median cost of refraction (including an eye exam and eyeglasses) was $226.48 in 2000 dollars, with the cost of eyeglasses accounting for approximately 80% of the total (Vitale et al., 2006a). The results of the RAND HIE also suggest a potentially considerable response: the likelihood of an annual eye exam was about 32% higher for low-income HIE participants with free eye care compared to those subject to cost-sharing, making eye care one of the more price-elastic services studied (Lurie et al., 1989). However, there are other reasons to suspect that Medicaid vision coverage may have a moderate or insubstantial effect on outcomes. For example, Medicaid beneficiaries may not be aware of these benefits. Further, although we are not aware of any research specific to optometrists, prior research has found that nearly one-fifth of ophthalmologists do not accept Medicaid as a source of insurance, possibly dampening the effects of vision coverage on access to care (Decker, 2013).

Our preferred approach identifies the effects of vision coverage for adult Medicaid beneficiaries on the use of related health care services and outcomes using a difference-in-difference-in-difference (DDD) strategy. This method compares outcomes for adults on Medicaid and a control group of low-income adults not on Medicaid (first difference) and measures this difference for (1) adults in states that did and did not offer adult vision benefits at any given time (second difference), and (2) adults in states that changed vision coverage policies before and after the policy change (third difference). We use 2002–2013

[3]Coverage policies can differ for disabled and pregnant Medicaid beneficiaries.

data from the National Health Interview Survey (NHIS), which contains information on eye care visits and vision outcomes. Our main measures of eye care utilization are at least one eye doctor visit in the past year and needing but not purchasing eyeglasses or contacts due to cost in the past year. We also examine the likelihood of having difficulty seeing when wearing usual vision correction and having a functional limitation due to vision.

Our main findings imply that vision coverage is associated with a 4.4 percentage point ($p < 0.01$) increase in the likelihood of a visit with an eye doctor in the past year for Medicaid beneficiaries relative to the control group. Since about 26% of Medicaid beneficiaries residing in a state without vision coverage had an eye care visit in the past year, our estimated effect represents a 17% increase. We also find that Medicaid beneficiaries with vision coverage are5.3 percentage points ($p < 0.01$) less likely to report needing but not purchasing eyeglasses or contacts due to cost (28% decrease), 2.0 percentage points ($p < 0.05$) less likely to report difficulty seeing with usual vision correction (11% decrease), and 1.2 percentage points ($p < 0.01$) less likely to have a functional limitation due to vision (35% decrease) compared with the control group.

The paper proceeds as follows. Section 2 describes our data sources, sample and statistical approach. Section 3 presents our main results and several robustness checks. Section 4 concludes.

2. Data and methods

2.1. The National Health Interview Survey

We analyzed the effect of Medicaid coverage of vision services for adults using data from the 2002–2013 NHIS, a continuous cross-sectional survey of the civilian, non-institutionalized population of the United States conducted by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS). We used the restricted-use version of the survey data files, which includes respondent state of residence. The NHIS uses a multistage area probability design to select a nationally representative sample of households. Trained field representatives collect information on a wide variety of health topics for each household member through in-person interviews, with one adult member of each family selected to complete a more in-depth survey. Unweighted response rates for 2002–2013 sample adults range from 61% to 74%, depending on the survey year. The survey instrument and other information about NHIS are available from NCHS (National Center for Health Statistics, 2014).

Outcomes of interest included eye care utilization as well as vision health outcomes. We constructed binary measures of eye care use from the questions "During the past 12 months, have you seen or talked to…an optometrist, ophthalmologist, or eye doctor (someone who prescribes eyeglasses)?" and "During the past 12 months, was there any time when you needed any of the following, but didn't get it because you couldn't afford it?…Eyeglasses?" Although eye exams are recommended for asymptomatic individuals without risk factors for eye disease every two years (American Optometric Association, 2014), an increase in the proportion of individuals with a bi-yearly eye exam should translate into a (smaller) increase in the likelihood of an eye care visit in the past year. To gauge presenting visual acuity, we created a binary variable using the question "Do you have trouble seeing, even when wearing glasses or contact lenses?" Finally, we examined whether a respondent had a functional limitation due to vision by combining survey questions about whether the respondent had any functional limitation and the whether the limitation was due to vision[4].

2.2. State coverage policies

Our main source of data on Medicaid adult vision coverage policies for the period 2002–2013 is the Kaiser Family Foundation (KFF). KFF reports state policies for coverage of vision exams and eyeglasses for select years on their website (Kaiser Family Foundation, 2014c). In addition, KFF publishes an annual report based on a 50-state survey which describes state changes to Medicaid benefits, eligibility, and copayments among other program attributes (Kaiser Family Foundation, 2014b). Since the 50-state survey asks states about policy changes during the previous year and those planned for the coming year, the KFF reports provide two observations of changes to benefit policies per fiscal year, once at the beginning and once at the end of each year. We used exact dates of changes to coverage policy whenever possible. When the date was unavailable, we assumed that the policy change occurred at the beginning of the fiscal year unless this change was observed in the KFF report corresponding to the end but not the beginning of that fiscal year, in which case we assumed the change occurred in the middle of the fiscal year. Though most state fiscal years begin on July 1st, there are some exceptions (the start of the state fiscal year ranges from April 1st to October 1st). When the date of policy change is imputed, the imputed date is aligned with the fiscal year specific to each state. To resolve uncertainties, we searched state Medicaid websites, conducted an internet search of news articles, and contacted state health departments.

We used data on vision coverage policies for non-disabled, non-pregnant, and non-elderly adult Medicaid beneficiaries to define a binary coverage variable equal to one for individuals residing in states that offered coverage for at least six months of the year prior to their interview date and equal to zero otherwise[5]. Except for states with no Medicaid fee-for-service (FFS) component (e.g., Tennessee), our data on vision coverage policies are based on FFS coverage[6]. The coverage variable reflects coverage status during the past year because some NHIS outcomes are retrospective (e.g., at least one eye care visit in the past year). Our vision health outcomes are not retrospective, however it is unlikely that vision coverage (or the absence of coverage) would have an immediate effect on presenting visual acuity as changes in acuity often develop over time making past coverage relevant.

[4]Respondents were asked a series of questions to determine the presence of any functional limitation such as the level of difficulty experienced during normal social activities, when walking, sitting, standing, etc.

[5]While we limit our sample to non-elderly and non-pregnant adults who are not enrolled in Medicare, it is not possible to determine if individuals are eligible for Medicaid because of a disability using NHIS data. Medicaid coverage of optional benefits may differ by eligibility category, though vision coverage policies for different eligibility groups are often aligned in practice. Further, the authors' calculations based on 2009 data using the Medicaid Statistical Information System (MSIS) data mart suggest that among those aged 21–64 eligible for Medicaid and not Medicare, approximately 81% were not eligible due to a disability. MSIS data are available from the Centers for Medicare and Medicaid Services and can be accessed here: http://www.cms.gov/Research-Statistics-Data-and-Systems/Computer-Data-and-Systems/MedicaidDataSourcesGenInfo/MSIS-Mart-Home.html.

[6]Managed care plans may choose to provide additional benefits such as eye exams and eyeglasses even when fee-for-service beneficiaries do not receive these benefits. Therefore, if MCO vision benefits differ from FFS benefits in a state with a high MCO penetration rate, our coverage indicator may be inaccurate for the majority of beneficiaries in that state. However, results stratified by state managed care penetration rate do not indicate substantial differences in the effect of Medicaid vision coverage among states with higher and lower MCO penetration rates. Results are available from the authors upon request.

Since most states that provide coverage of exams also cover eyeglasses, only a small percentage of Medicaid beneficiaries have coverage of exams only (no states offered coverage of eyeglasses but not exams during our period of analysis). Because eyeglasses comprise the majority of the costs of refraction (Vitale et al., 2006a), and refractive error is more prevalent compared with other eye conditions (Vitale et al., 2008), our main analysis uses a coverage variable that is equal to one for states that provide coverage of both exams and eyeglasses and zero for states that provide coverage of exams only or do not provide coverage[7].

Our coverage variable does not distinguish more from less generous coverage, mainly because of the difficulty of making this distinction with the available data and the complexity introduced by multidimensional policies. Our estimates of the effect of vision coverage on outcomes therefore represent the average effect of vision coverage policies that vary in some specifics. The KFF website provides the frequency with which beneficiaries in states with coverage can visit an eye doctor and replace their eyeglasses, but this information is not provided for all states with coverage (or for all years). The available data demonstrate that the majority of states with an adult vision benefit cover exams and eyeglasses replacement every one or two years. For example, 24 states covered eyeglasses replacement every one (six states) or two years (18 states) compared with four states that covered eyeglasses replacement every three to five years in 2012 (Kaiser Family Foundation, 2014d). Other factors that are not captured in our coverage variable include the requirement of a specific minimum diopter correction for eyeglasses replacement and copayments for eye exams and eyeglasses. Minimum diopter correction requirements are common with most states that cover eyeglasses having a requirement. Many states that offer coverage charge a copayment for receipt of an eye exam, and some states also charge a copayment or dispensing fee for eyeglasses. For example, 19 of 35 states that covered eye exams and 10 of 28 states that covered eyeglasses charged a copayment or dispensing fee in 2012, though most of these fees did not exceed $3 (Kaiser Family Foundation, 2014d). Though copayments may discourage use (Helms et al., 1978), coverage of eyeglasses even including fees reduces the beneficiaries' out of pocket cost substantially.

Fig. 1 illustrates state vision coverage policies during FY 2013. The majority of states offered some preventive vision benefits with all but 15 states covering either routine exams or exams and eyeglasses. Of the states that offered some coverage, eight offered coverage of exams only and the remaining 28 states offered coverage of both exams and eyeglasses. The states that offered coverage of exams only tended to be smaller than average in terms of Medicaid population. According to our calculations from NHIS, approximately 71% of adult Medicaid beneficiaries resided in states that offered coverage of both exams and eyeglasses and only about 10% resided in states that offered coverage of exams only in 2013. Over the full period 2002–2013, 68% of Medicaid beneficiaries resided in states that offered coverage of both exams and eyeglasses and 11% resided in states that covered exams only.

[7]The results of an alternative specification which compares coverage of exams only and coverage of both exams and eyeglasses with coverage of neither are available upon request from the authors.

According to our definition, between 28 and 34 states provided Medicaid adult vision benefits during 2002–2013 (depending on the year). States often add or drop optional benefits such as adult vision services based on budgetary considerations. Fifteen states changed vision coverage policy during our study period. Some states both added and dropped vision coverage and others dropped coverage during this period, as shown in Fig. 2. Some coverage changes were brief (e.g., Nevada eliminated coverage of eyeglasses for one year only during FY 2008), while others were longer lasting (e.g., Massachusetts eliminated coverage of eyeglasses for four years between July 1, 2002 and July 1, 2006; Delaware provided vision coverage between 2004 and 2011).

2.3. Statistical methodology

We use two standard approaches that take advantage of within state variation in vision coverage over time to estimate the effect of vision coverage on outcomes. First, we estimate a difference-in-difference (DD) model, which compares outcomes for Medicaid beneficiaries in states with compared to without adult vision coverage (first difference) and before and after a change in vision coverage in states that changed their policies (second difference). Our analysis is restricted to adult Medicaid beneficiaries, who are directly affected by the policies we examine. Our DD specification is of the following form:

$$Y_{\text{ist}} = \beta_1 \text{FullVision}_{\text{st}} + \beta_2 \text{X}_{\text{ist}} + \tau_t + \gamma_{0s} + \gamma_{1s} t + \gamma_{1s} t^2 + \varepsilon_{\text{ist}} \quad (1)$$

where Y_{ist} represents the vision care utilization or health outcome of interest for individual i in state s at time t, $\text{FullVision}_{\text{st}}$ is a binary variable equal to one if state s offers coverage of both exams and eyeglasses at time t and zero otherwise, X_{ist} is a vector of individual-level and county-level controls, $\boldsymbol{\tau}_t$ is a vector of year fixed effects, $\gamma_{0\text{s}}$ is a vector of state fixed effects, and $\gamma_{1\text{s}} t$ and $\gamma_{1\text{s}} t^2$ represent linear and quadratic state-specific annual time trends, respectively. Individual-level demographic controls include age, age squared, race/ethnicity, sex, education, marital status, general health status, ratio of family income to the federal poverty threshold, and an urban area indicator[8]. County-level controls include the supply of optometrists per 1000 population, available from the Area Resource File[9], and the annual average unemployment rate, available from the Bureau of Labor Statistics (Bureau of Labor Statistics, 2014). The estimated coefficient $\widehat{\beta_1}$ represents the difference-in-difference effect of coverage of exams and eyeglasses compared with coverage of exams only or neither.

Including state fixed effects accounts for unobservable state-level characteristics that are not time-varying. For example, states with relatively generous Medicaid programs in general may be most likely to adopt Medicaid adult vision coverage. To the extent that differences in state Medicaid generosity are long-standing, state fixed effects should absorb these differences. Year effects provide flexible control for national trends in outcomes over time

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[8]General health status controls are excluded from regressions analyzing the vision health outcomes since general health status could be endogenous to vision health (i.e., those with vision problems may be more likely to report poor general health). However, results were similar when general health status was included as a control.

[9]The supply of optometrists was missing for 2002–2007 and 2013. Values were imputed for 2002–2007 using linear imputation by county between 2000 and 2008. The 2012 value was used for 2013.

while state-specific time trends allow trends in outcomes to vary at the state level. The error term, represented by ε_{ist}, is clustered at the state level. Sampling weights are used in all analyses to produce nationally representative estimates.

Our second and preferred approach is a difference-in-difference-in-difference (DDD) model, which compares outcomes for adults on Medicaid and a control group of low-income adults not on Medicaid (first difference) and measures this difference for (1) adults in states that did and did not offer Medicaid adult vision benefits at any given time (second difference), and (2) adults in states that changed vision coverage policies before and after the policy change (third difference). Our DDD specification is of the following form:

$$Y_{\text{ist}} = \beta_1 \text{FullVision}_{\text{st}} + \beta_2 \text{ Medicaid }_{\text{ist}} + \beta_3 \text{ FullVision}_{\text{st}} \times \text{Medicaid }_{\text{ist}} + \beta_4 X_{\text{ist}} + \tau_t + \gamma_{0s} + \gamma_{1s} t + \gamma_{1s} t^2 + \varepsilon_{\text{ist}} \quad (2)$$

where Medicaid_{ist} is a binary variable equal to one if individual *i* is enrolled in Medicaid in state *s* at time *t*, $\text{FullVision}_{st} \times \text{Medicaid}_{ist}$ is the interaction between vision coverage status and Medicaid enrollment status, and all other terms are as defined in specification (1). The estimated coefficient $\widehat{\beta_1}$ now represents the effect of coverage of exams and eyeglasses compared with coverage of exams only or neither for control group individuals, $\widehat{\beta_2}$ represents the baseline difference in the outcome between Medicaid beneficiaries and control group individuals, and $\widehat{\beta_3}$ is the DDD estimate of the effect of coverage of exams and eyeglasses compared with coverage of exams only or neither for Medicaid beneficiaries relative to the control group.

Use of a within-state control group can account for state-level factors that may affect both coverage policies and outcomes simultaneously, which is a potential advantage of specification (2) compared to specification (1). For example, the supply of eye care services available through Community Health Centers (CHCs) and Medicaid provision of vision benefits are likely correlated with general state resources. However, all low income adults within a state would likely be affected by an increase in vision services available through CHCs, and therefore our use of a control group reduces the likelihood of falsely attributing changes in outcomes to Medicaid adult vision benefits as opposed to concurrent changes in other state resources.

We investigate whether low-income adults not enrolled in Medicaid are an appropriate control group in two ways. First, we regress each covariate on coverage status, Medicaid status, the interaction between coverage status and Medicaid status, state and year fixed effects, and state-specific linear and quadratic yearly trends to determine whether Medicaid beneficiary and control group characteristics are balanced with respect to the treatment variable (i.e., vision coverage). A significant coefficient on the interaction term between vision coverage and Medicaid status would indicate an imbalance. Second, we analyze trends in outcomes for Medicaid beneficiaries compared to the control group in states that did not change vision coverage and prior to vision coverage changes in states that did change coverage. Significant differences in outcome trends prior to vision policy changes would cast doubt on the ability of our control group to account for within-state trends in outcomes unrelated to Medicaid vision coverage policy. Since states change policies at different times, we restrict our analysis period to 2002–2008 in order to include the largest number of states that changed vision coverage policy before any change to coverage and estimate the following regression:

$$Y_{ist} = \beta_1 \text{ Medicaid }_{ist} + \beta_2 \text{ Medicaid } + \beta_3 \text{ Medicaid }_{ist}q^2 + \beta_4 X_{ist} + \tau_q + \gamma_{0s} + \gamma_{1s}q + \gamma_{1s}q^2 + \varepsilon_{ist} \quad (3)$$

where Medicaid $_{ist}q$ and Medicaid$_{ist}q^2$ represent the interaction between Medicaid enrollment status and linear and quadratic quarterly trends, respectively, and all other terms are as defined above. The estimates $\widehat{\beta_2}$ and $\widehat{\beta_3}$ indicate whether trends in the outcome of interest differ for Medicaid beneficiaries relative to the control group. Given the shorter time period, we replaced the year fixed effects and state specific yearly trends used in our main models with quarter fixed effects (τ_q)and state specific quarterly trends ($\gamma_{1s}q, \gamma_{1s}q^2$).

A potential concern associated with use of Medicaid enrollment to define the treatment group is that participation in Medicaid among eligible adults could be endogenous. Specifically, if participation in Medicaid is more likely in states that offer vision coverage, the results of both specifications (1) and (2) could be biased. We assess this possible threat to the validity of our results by estimating the association between a state's provision of adult vision benefits and participation in Medicaid among all low income adults. As an additional check, we present results that compare the effects of vision coverage for individuals more likely to be eligible for Medicaid (i.e., those with less than a high school education) and those less likely to be eligible (i.e., those with some college education or more) rather than comparing Medicaid beneficiaries to adults not enrolled in Medicaid. These analyses are discussed further in the robustness section of the paper.

2.4. Final sample

To select our final sample of non-elderly adult Medicaid beneficiaries, we apply several exclusions. First, we limit our sample to individuals aged 22–64 that report Medicaid enrollment. Medicaid beneficiaries up to age 21 are eligible for vision coverage through the Early and Periodic Screening, Diagnostic, and Treatment (EPSDT) benefit. Individuals aged 21 are excluded because they may have received vision services covered by EPSDT within the past year. Individuals aged 65 and over are excluded because the majority of these individuals are eligible for Medicare, which may affect use of health care. Though traditional Medicare does not provide preventive vision benefits, coverage is available through Medicare Advantage. (We exclude all individuals that report Medicare coverage even if they are aged 22–64.)

Second, we include only individuals with family income less than two times the federal poverty threshold. (Family income is imputed when missing in NHIS.) Since most state income eligibility limits for adults were far below this level during our period of study and Medicaid status reported in NHIS is a point-in-time measure, individuals with family income above two times the federal poverty threshold are unlikely to have been enrolled in Medicaid for the full year. For example, only the District of Columbia and Minnesota had income eligibility limits higher than two times the federal poverty threshold for low income parents as of January 2013 (Kaiser Family Foundation, 2014a).

Third, we exclude women who were pregnant at the time of the survey and those residing with a child under one year of age. Medicaid coverage policies often differ for pregnant women or women with children under one. Further, pregnancy may affect health and use of medical services. Fourth, we exclude all individuals with missing demographic information. Finally, we exclude individuals that report having Medicaid coverage and a second source of insurance (i.e., private insurance). After applying these criteria, our final sample consists of 14,775 Medicaid beneficiaries.

To select our main control group of low income individuals not enrolled in Medicaid, we apply the first four exclusion criteria described above and also require that Medicaid coverage is not reported. Although these exclusions are motivated by features of the Medicaid program, we apply these criteria to the control group for consistency and to increase the similarities between the treatment and control groups. Our final control group consists of 61,350 low income adults not enrolled in Medicaid.

2.5. Comparison of Medicaid beneficiaries and the low-income control group

Table 1 presents mean characteristics for Medicaid beneficiaries and low income adults not enrolled in Medicaid included in our analysis sample, which are weighted using sampling weights available from NCHS. A simple comparison of mean characteristics suggests that there are statistically and economically significant differences between Medicaid beneficiaries and the control group. For example, approximately 33% of Medicaid beneficiaries in our sample are married compared with 48% of low income adults not enrolled in Medicaid, and this difference is significant at the 1% level. Medicaid beneficiaries are also significantly less likely to be male, more likely to live in an urban area, have lower family income, are less educated, in worse health and have a different racial composition when compared with the control group. However, these differences will not bias our estimates if characteristics are balanced with respect to the treatment variable (i.e., vision coverage).

Table 2 presents our covariate balance test results, suggesting that most covariates are balanced with respect to vision coverage. Marital status is an exception, with the difference in marital status among Medicaid beneficiaries with and without vision coverage significantly larger than the analogous difference among control group individuals with and without vision coverage. The coefficient on the interaction between vision coverage status and Medicaid status is about 4.5 percentage points and significant at the 5% level. Though we control for marital status in our regression models, if our model of the association between demographic characteristics and vision outcomes is misspecified, then our DDD estimates of the effect of vision coverage could be biased. However, because past studies have found that marital status is not significantly associated with eye care utilization (Caban-Martinez et al., 2012; Galor et al., 2015), this imbalance is unlikely to introduce substantial bias.

Our analysis of outcome trends also lends support to our use of low-income adults not enrolled in Medicaid as a control group. Table 3 presents the results of an analysis of each outcome for sample individuals with an interview date between January 2002 and June 2008 residing in one of the 20 states that always provided vision coverage during our period of study (AK, AL, AR, CT, DC, HI, IL, IN, IA, MN, MS, NE, NH, NJ, NY, ND, OH, RI, SD, and WI), the 16 states that never provided coverage (AZ, CO, GA, KY, LA, MD, ME, MT, OK, PA, SC, TN, VT, VA, WV, and WY), and the eight states that changed vision coverage policy after July 2008 (CA, ID, MI, NV, NM, NC, OR, and WA) as described in the methodology section. The first column of Table 3 shows the coefficient estimate for the interaction between Medicaid and the linear quarterly trend, the second the coefficient estimate for the interaction between Medicaid and the quadratic quarterly trend, and the third provides the p-value for a test of the joint significance of these two interactions. The interactions between Medicaid and the time trend variables are not individually or jointly significant at conventional levels for any of the outcomes.

3. Results

3.1. Difference-in-difference results

Table 4 presents the results of our DD analysis estimating the effects of vision coverage on outcomes as in specification (1). The first three columns of Table 4 display the mean of the outcome variables for Medicaid beneficiaries residing in states with and without vision coverage and their difference, respectively. The fourth column presents the estimated difference-in-difference effect of vision coverage on each outcome. On average, Medicaid beneficiaries with compared to without vision coverage are more likely to have seen an eye doctor in the past year (30.0 vs. 26.1%), though the difference in the mean percentage with an annual eye care visit is not significant at conventional levels ($p = 0.12$). Medicaid beneficiaries with vision coverage are about 8.6, 4.3, and 1.5 percentage points less likely to report needing but not purchasing eyeglasses due to cost, having difficulty seeing with usual vision correction, and having a functional limitation due to vision, respectively. Each of these differences is significant at the 5% or better level.

Difference-in-difference regression estimates are consistent with these simple comparisons when considering use of vision care. Our results suggest that vision coverage is associated with a significant 3.9 percentage point increase ($p < 0.05$) in the likelihood of an annual eye care visit, an effect size that is very similar to the simple mean difference in the percentage of Medicaid beneficiaries with a visit in states with compared to without vision coverage. Compared to the percentage of Medicaid beneficiaries residing in a state without vision coverage with an eye care visit (26.1%), this increase represents a 15% effect. We also find that vision coverage is associated with a significant reduction of 4.2 percentage points ($p < 0.05$) in the likelihood of needing but not purchasing eyeglasses or contacts due to cost, which represents a 22% reduction relative to Medicaid beneficiaries without vision coverage.

The estimated effects of vision coverage on the likelihood of difficulty seeing with usual vision correction and having a functional limitation due to vision are positive and insignificant at conventional levels. While it is possible that vision coverage does not have an effect on these outcomes, our estimates may not identify effects for several reasons. First, these outcomes are indirectly affected by vision coverage through increased used of care and therefore changes may occur with a lag compared to changes in use of care. Second, these outcomes are relatively uncommon and precise estimation may require more power than identifying an effect on use of services. Having a functional limitation due to vision is particularly rare, affecting only 3.6% of Medicaid beneficiaries without vision coverage. Since our sample comprises a small number of Medicaid beneficiaries with a functional limitation due to vision in some states, identification using only within state variation is challenging. (Estimates based purely on cross sectional differences, i.e., from models that do not include state fixed effects but do control for all demographic characteristics, show statistically significant and negative effects, as expected, on both of the final outcomes in Table 4.) Finally, self-report of vision problems may be less accurate than reported use of care, which may bias estimates.

3.2. Difference-in-difference-in-difference results

The results of our DDD regression analysis (specification (2)) are similar to those of specification (1) when considering use of vision care, however in contrast to our DD estimates, our DDD results suggest that adult vision coverage is associated with a statistically significant reduction in poor vision health. Table 5 summarizes the results of analyses using specification (2). The first two columns of Table 5 report the difference in mean outcomes in states with compared to without vision coverage for Medicaid beneficiaries and low income adults not on Medicaid, respectively, and the third column reports the difference in these two quantities. The fourth column presents the DDD regression estimate of the effect of vision coverage for Medicaid beneficiaries relative to the control group.

We find that mean outcomes for low income adults not on Medicaid are similar in states with and without Medicaid adult vision coverage. For example, low income adults not on Medicaid residing in a state with compared to without vision coverage are about 0.4 percentage points more likely to have seen an eye doctor in the past year, 1.1 percentage points less likely to report needing but not purchasing eyeglasses or contacts due to cost in the past year, 1.1 percentage points less likely to report difficulty seeing with usual vision correction, and less than 0.1 percentage points less likely to have a functional limitation due to vision (Table 5). These differences are small in magnitude compared to the difference in mean outcomes for Medicaid beneficiaries residing in states with compared to without vision coverage and none are significant at conventional levels. The unadjusted differences in outcomes for Medicaid beneficiaries relative to control group individuals in states with compared to without adult vision coverage are highly significant and of the expected signs, as shown in column 3. These simple comparisons suggest that Medicaid beneficiaries in states with compared to without vision coverage are 4.2 percentage points more likely to have seen an eye doctor in the past year, 7.7 percentage points less likely to report needing but not purchasing eyeglasses/contacts due to cost, 3.5 percentage points less likely to report difficulty seeing with usual vision correction, and 1.5 percentage points less likely to have a functional limitation due to vision relative to the control group.

Our DDD regression estimates are similar to these simple comparisons, though some regression estimates are smaller in magnitude compared with the unadjusted results. Using specification (2), we estimate that vision coverage is associated with a 4.4 percentage point increase ($p < 0.01$) in the likelihood of an eye care visit in the past year, which represents a 17% change relative to the mean among Medicaid beneficiaries in states without vision coverage. Since eye care visits for asymptomatic individuals without risk factors for eye disease are recommended once every two years, and many states that cover preventive exams cover bi-yearly rather than annual exams, the reported effect may underestimate the effect of vision coverage on the likelihood of receiving recommended care. Further, we find that vision coverage is associated with a 5.3 percentage point reduction ($p < 0.01$) in the likelihood of needing but not purchasing eyeglasses or contacts due to cost, which represents a 28% change relative to the mean among Medicaid beneficiaries in states without vision coverage. These estimates are qualitatively and quantitatively similar to the DD effects estimated using specification (1) and shown in Table 4, where we estimated that vision coverage was associated with an increase in the likelihood of an annual eye care visit of 3.9 percentage points (compared to the DDD estimate of 4.4 percentage points) and a reduction in the likelihood of needing but not purchasing eyeglasses/contacts due to cost of 4.2 percentage points (compared to the DDD estimate of 5.3 percentage points).

However, unlike our DD estimates, our DDD results imply that vision coverage is associated with a significant reduction in the likelihood of poor vision health outcomes. Our DDD estimates imply that vision coverage is associated with a 2.0 percentage point reduction ($p < 0.05$) in the likelihood of difficulty seeing with usual vision correction for Medicaid beneficiaries relative to the control group, which represents an 11% reduction relative to the mean percentage of Medicaid beneficiaries in states without vision coverage. Similarly we find that vision coverage is associated with a 1.2 percentage point reduction in the likelihood of having a functional limitation due to vision, which represents a 35% reduction relative to the mean percentage of Medicaid beneficiaries in states without vision coverage.

3.3. Robustness checks

We explore several tests of the robustness of our main results. First, we estimate specification (2) using several alternative within-state control groups to determine whether the magnitude or significance of our main results is sensitive to the choice of control group. Our main DDD results used a control group of low income individuals not enrolled in Medicaid with family income below two times the federal poverty threshold. Though low income adults may be more likely than higher income adults to experience trends in health and access to health care that are similar to those of Medicaid beneficiaries, low income adults may also be more likely to have been enrolled in Medicaid in the recent past, particularly those without an alternative source of insurance (i.e., private insurance). Since

NHIS insurance status is a point-in-time measure, it is not possible to completely eliminate individuals recently enrolled in Medicaid from the control group. As alternative control groups, we consider two subsets of our main control group – privately insured low income adults and uninsured low income adults – and a higher income control group consisting of adults with family income between three and four times the federal poverty threshold. The DDD results for our main control group of low income adults and each of these alternative control groups are presented in Table 6.

For each outcome, DDD estimates are of the expected sign regardless of the control group considered and all estimates are significant at conventional levels with the exception of difficulty seeing with usual vision correction when using privately insured low income adults as a control group. Effect magnitudes are also generally similar regardless of the control group used. We find that the estimated effect of vision coverage on the likelihood of having seen an eye doctor in the past year for Medicaid beneficiaries relative to the control group ranges from 4.1 to 4.7 percentage points, depending on the control group considered. Similarly, the estimated effect ranges from −4.6 to −7.3 percentage points for the likelihood of needing but not purchasing glasses/contacts due to cost, from −2.0 to −3.2 percentage points for difficulty seeing with usual vision correction, and from −1.2 to −1.5 percentage points for having a functional limitation due to vision.

Second, since use of a control group cannot account for state-level factors that are Medicaid specific, we conducted a placebo test by estimating specification (2) for the outcomes “seen general practitioner in the past year”, “needed but did not get prescription drugs due to cost in the past year”, and “any bed days in the past year.” These are common outcomes unrelated to vision care. A significant association between vision coverage and these outcomes could suggest, for example, that vision coverage and general Medicaid generosity are correlated. Table 7 presents the results of regressions estimating the association between vision coverage and each of these general outcomes. The estimated effects are small in magnitude and insignificant.

Third, we explicitly considered the possibility that participation in Medicaid could be endogenous to a state’s provision of vision coverage by estimating the effect of vision coverage on Medicaid enrollment among our entire sample of adults with income less than two times the federal poverty threshold. Controlling for all model covariates including individual and county-level variables, state and year fixed effects, and state-specific linear and quadratic yearly time trends, we found no evidence to suggest an effect of vision coverage on Medicaid enrollment (Table 8). The coefficient estimate for the Medicaid adult vision coverage indicator is about0.4 percentage points and statistically insignificant.

Finally, rather than comparing Medicaid beneficiaries to those not on Medicaid as in our main analysis, we compared the effect of Medicaid vision coverage for adults with less than a high school education, who are more likely to participate in Medicaid, to the effect for adults with at least some college education. We present results in Table 9 for all adults, all parents (adults with children less than age 18 living in the household), and all female parents. As expected, results are smaller and more imprecisely estimated compared to results comparing Medicaid recipients and non-recipients since not all adults with less than a high school education participate in, or are eligible for, Medicaid. However, results for the outcomes of having seen an eye doctor in the past year and needing but not purchasing eyeglasses/contacts due to cost are of the expected sign and statistically significant at the 5% level. All estimates for the outcomes of having difficulty seeing with usual vision correction and having a functional limitation due to vision are negative in sign (as expected), though imprecisely estimated.

4. Conclusions

Approximately half of all adults in the United States have a clinically significant refractive error (Vitale et al., 2008) and about 8% are visually impaired, or have distance visual acuity of 20/50 or worse in the better-seeing eye when wearing usual vision correction (Willis et al., 2012). Increasing the proportion of adults that have regular, comprehensive eye exams and reducing visual impairment due to uncorrected refractive error and other common eye health problems such as diabetic retinopathy, glaucoma, cataracts, and age-related macular degeneration are federal health objectives (U.S. Department of Health and Human Services, 2014). Many of these eye health problems are preventable and treatable, but also unlikely to exhibit apparent symptoms at an early stage, underscoring the potential benefit of preventive screening.

Our findings indicate that Medicaid coverage of vision services for adults increases the likelihood of an eye care visit within the past year by about 17%, or four percentage points, and reduces the likelihood of needing but not purchasing eyeglasses/contacts due to cost by 28%, or five percentage points. Findings from our preferred specification also suggest that vision coverage reduces the likelihood of difficulty seeing with usual vision correction (11% reduction) as well as the likelihood of having a functional limitation due to vision (35% reduction). The estimated effect of Medicaid vision coverage on use of eye care services is robust to various specifications and implies that vision coverage increases the likelihood that low-income individuals, who are least likely to visit an eye doctor regularly (Zhang et al., 2012), receive recommended care.

Although very similar for use of vision care outcomes, our DDD and DD estimates differ for the vision health outcomes considered. Our DDD estimates suggest that Medicaid vision coverage significantly reduces the likelihood of vision problems while our DD estimates do not support this conclusion. Our DDD estimates may be preferable to DD estimates since the use of a within-state control group makes our DDD estimates robust to correlation between changes in Medicaid vision policy and other state-level changes that may affect outcomes for both groups. The fact that we find no significant differences in outcome trends among Medicaid beneficiaries and control group individuals in states that did not change vision policies and before changes in states that added or dropped vision coverage supports this strategy. Further, our DDD estimates have more power to identify the effects of vision coverage separate from other measured correlates of vision outcomes that are common to both the treatment and control groups. These include overall national trends in outcomes, individual and county-level covariates, and state fixed effects, since only 15 states changed vision policy during our twelve-year period of analysis.

Compared to the RAND HIE finding that the likelihood of an annual eye exam was about 32% higher for low-income individuals with free eye care, our result (17% increase) implies an effect much smaller in magnitude. There are several reasons this may be the case. First, RAND HIE coverage was more generous than coverage provided by Medicaid programs in practice. The RAND HIE covered one eye exam per year, one pair of corrective lenses each year, and one pair of frames every two years. The majority of Medicaid programs cover an eye exam and new eyeglasses once every other year and often require a minimum diopter correction for coverage of new eyeglasses. The RAND HIE also offered first-dollar coverage, whereas 19 of the 35 states that covered preventive eye exams for adult Medicaid beneficiaries in 2012 required copayments, typically between $1 and $3[10]. Also, the temporary nature of the RAND HIE may have induced an especially large increase in eye exams as individuals randomly assigned to more generous vision coverage than usual sought to purchase eyeglasses at a reduced price while they could. Finally, the experimental data from the RAND HIE are more than three decades old. Other more recent estimates of the demand for prescription drugs and mental health care also diverge significantly from the results of the RAND HIE (Gibson et al., 2005; Simon et al., 1996).

The fact that our results imply a smaller effect of vision coverage on use of vision care compared to the findings of the RAND HIE may indicate that state cost-sharing requirements and restrictions on frequency of use of care moderate the effects of vision coverage. These policies may be efficient since second-best pricing suggests that coverage of more price-elastic services should be less generous, and previous research has found that the demand for preventive care is more price-elastic than demand for other types of care. For example, findings from the RAND HIE imply that at higher coinsurance rates (25–95%), the price elasticity of demand for preventive care is −0.43 compared to 0.32 for acute care (Manning et al., 1987). However, we also find evidence that Medicaid vision coverage is associated with improvements in reported visual functioning, which may translate into enhanced productivity in workplace and/or educational settings as well as increased well-being (Crews et al., 2014; Daum et al., 2004; Lee et al., 1997). These potential benefits need to be weighed against the costs of providing vision coverage (or more generous coverage). In fact, some researchers suggest that the degree of health insurance coverage should be set to correspond to the value of health care services (e.g., Chernew et al., 2007). This article aimed to inform this discussion for a relatively understudied service.

While states are not required to provide Medicaid adult vision benefits, most states have offered some level of preventive coverage over the past decade. Our analysis implies that on average, about 79% of adult Medicaid beneficiaries resided in a state that covered refractive eye exams and 68% resided in a state that covered both exams and eyeglasses for correction of refractive error over the period 2002–2013. In contrast, recent survey figures suggest that only about 26% of privately insured adults have vision coverage[11]. Since vision coverage is not considered an essential health benefit for adults under the ACA, low-income adults will not be able to obtain subsidized vision coverage through the health insurance marketplaces.

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[10] *Source:* Authors' analysis of Kaiser Family Foundation data on state vision coverage policies. More information is available here: http://kff.org/medicaid/state-indicator/optometrist-services/.

[11] Authors' estimate from the National Health Interview Survey for adults ages 22–64 and not on Medicare.

Therefore, while low-income adults in states that have opted not to expand their Medicaid programs may obtain medical insurance at a reduced rate, those in Medicaid expansion states may be more likely to have access to some services considered non-essential. This includes vision coverage since some expansion states have opted to offer adult vision benefits to their expansion population (Statereforum, 2014). Our results may serve as an indication of the likely demand response among those newly enrolled in Medicaid in these expansion states.

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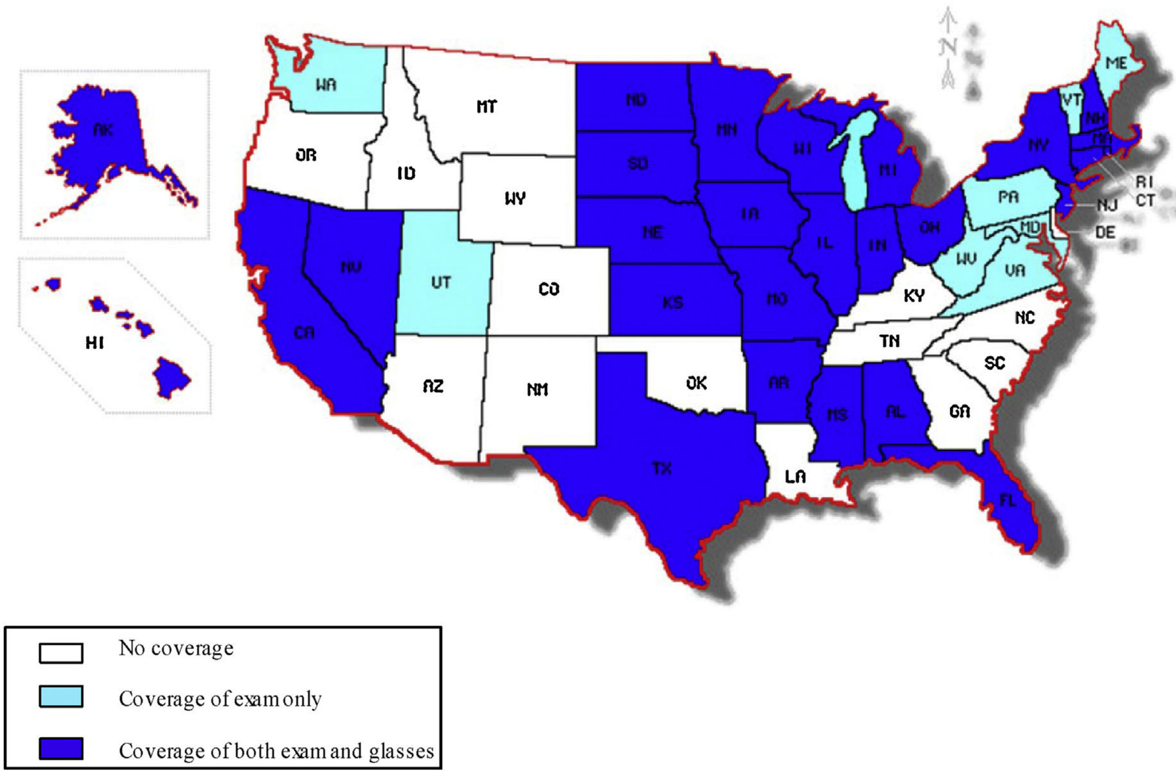

Fig. 1.
State vision coverage policies in Fiscal Year 2013.

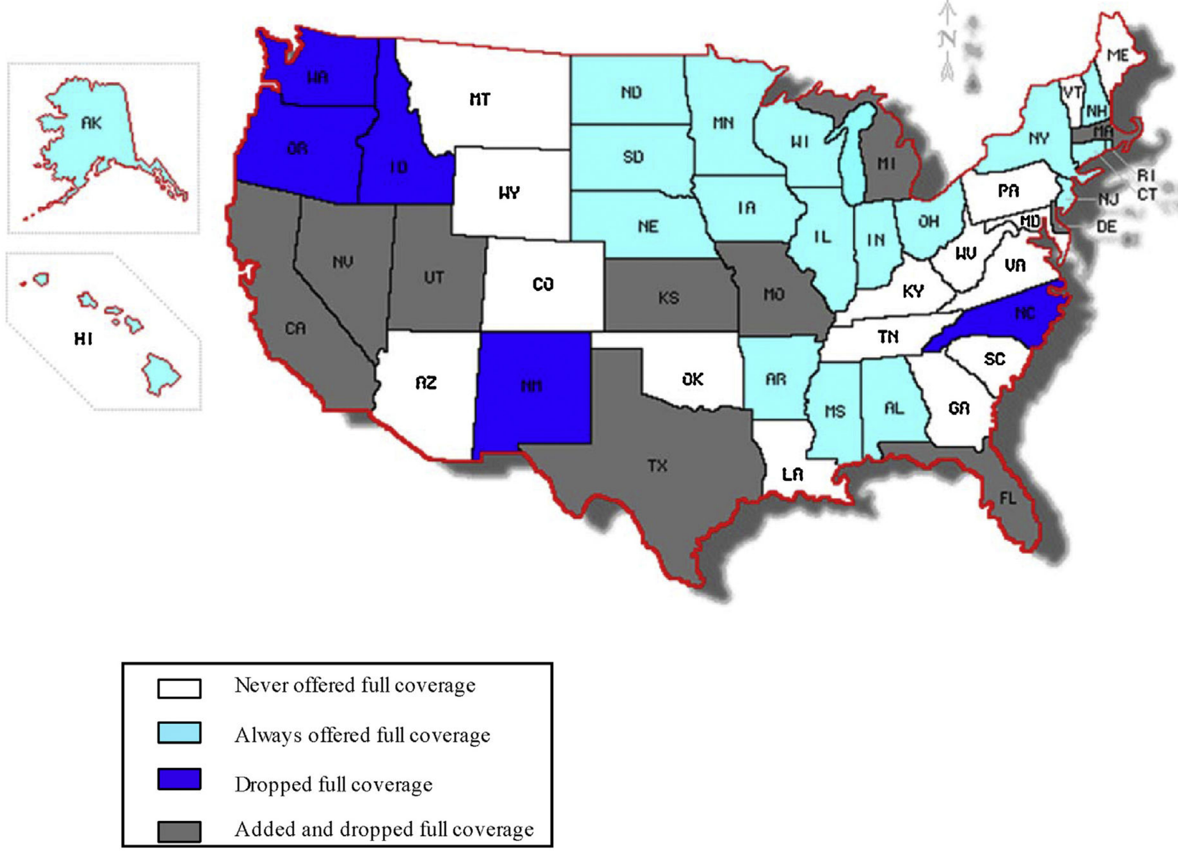

Fig. 2.

Changes in Medicaid coverage of adult vision, 2002–2013.

Table 1

Weighted mean sample characteristics, Medicaid beneficiaries and low income adults not on Medicaid, NHIS 2002–2013[a].

	Adults on Medicaid	Low income adults not on Medicaid
Characteristic		
Age (years)	40.27 (0.26)	39.22*** (0.18)
Male	35.38 (0.96)	50.19*** (0.50)
Married	33.26 (2.74)	47.67*** (0.95)
Urban	80.59 (3.06)	77.44* (3.04)
Family income (% federal poverty threshold)	85.50 (1.27)	117.97*** (0.64)
Education[b]		
Less than high school	38.22 (2.24)	26.20 (2.17)
High school	34.45 (1.82)	32.16 (1.47)
Some college	23.10 (0.94)	27.96 (0.69)
College/graduate school	4.22 (0.59)	13.68 (0.57)
Race/ethnicity[c]		
Non-Hispanic white	46.02 (4.83)	51.09 (4.71)
Non-Hispanic black	25.48 (3.01)	15.97 (1.96)
Hispanic	22.88 (5.85)	26.90 (5.44)
Asian/other	5.62 (0.98)	6.03 (0.81)
Health status[d]		
Excellent	14.27 (0.88)	24.63 (0.42)
Very good	18.62 (0.79)	29.27 (0.55)
Good	29.98 (0.57)	31.13 (0.68)
Fair/poor	37.12 (1.75)	14.96 (0.46)
Sample size (unweighted)	14,775	61,350

[a]All estimates are expressed as percentages, except for age which is expressed in years. Sampling weights are used to produce nationally-representative estimates. Standard errors are in parentheses below estimates and are clustered by state. t-Tests were used to test the difference in mean (dichotomous) characteristics between Medicaid beneficiaries and the control group. Significance stars indicate a significant difference compared with Medicaid beneficiaries. * $p < 0.10$, *** $p < 0.01$.

[b]Chi-square tests for linear trend were used to test for differences in education between Medicaid beneficiaries and the control group. Medicaid status was significantly associated ($p < 0.01$) with lower educational attainment.

[c]Chi-square tests were used to test for differences in race/ethnicity between Medicaid beneficiaries the control group. Race/ethnicity was significantly different at the 1% level for Medicaid beneficiaries compared to the control group.

[d]Chi-square tests for linear trend were used to test for differences in health status between Medicaid beneficiaries and the control group. Medicaid status was significantly associated ($p < 0.01$) with being in worse health.

Table 2

Covariate balance test, NHIS 2002–2013[a].

Characteristic	
Age (years)	−0.40 (0.52)
Male	−1.58 (1.71)
Married	4.49** (2.21)
Urban	−0.14 (2.55)
Family income (% federal poverty threshold)	1.12 (2.61)
Education	
Less than high school	−1.09 (2.26)
High school	0.72 (1.48)
Some college	−0.51 (1.31)
College/graduate school	0.87 (0.83)
Race/ethnicity	
Non-Hispanic white	0.94 (2.59)
Non-Hispanic black	−1.39 (2.23)
Hispanic	1.61 (2.27)
Asian/other	−1.17 (0.84)
Health status	
Excellent	1.28 (1.28)
Very good	1.54 (1.68)
Good	−0.13 (1.67)
Fair/poor	−2.69 (2.45)

[a]Using linear probability models, we regress each demographic characteristic on Medicaid status, vision coverage status, and the interaction between these two binary indicators. Estimates represent the coefficient on the interaction term and are expressed in terms of percentage point effects. Controls also include state and year fixed effects and state-specific linear and quadratic yearly trends. Estimates use sampling weights and errors are clustered by state. Standard errors are in parentheses below estimates. The sample includes 14,775 Medicaid beneficiaries and 61,350 low income adults not enrolled in Medicaid. ** $p < 0.05$.

Table 3

Regression estimates of the difference in trends in vision outcomes for Medicaid beneficiaries vs. other low-income adults not enrolled in Medicaid prior to changes in vision coverage policy, NHIS 2002–2008[a].

	Medicaid × quarter	**Medicaid × quarter squared**	***p*-Value forjoint significance**[b]
Outcome			
Seen eye doctor, past year	−0.65 (0.55)	0.02 (0.02)	0.23
Needed but did not purchase glasses/contacts due to cost	−0.15 (0.30)	0.01 (0.01)	0.62
Difficulty seeing with usual vision correction	0.04 (0.33)	0.00 (0.01)	0.59
Functional limitation due to vision	0.00 (0.31)	0.00 (0.01)	0.56

[a]Results are estimates from linear probability models and represent percentage point changes. Models regress each outcome on Medicaid status, linear and quadratic quarterly trends, and the interactions between Medicaid status and the quarterly trends. Results reported in the first and second columns represent the coefficient estimates for the interaction between Medicaid and the linear quarterly trend and the quadratic quarterly trend, respectively. Models also control for age, age squared, race/ethnicity, sex, education, marital status, ratio of family income to the poverty threshold, an urban area indicator, the county-level supply of optometrists per 1000 population, the average annual county-level unemployment rate, state and quarter fixed effects, and state-specific linear and quadratic quarterly trends. Errors are clustered at the state level and sampling weights are used to produce nationally-representative estimates. Standard errors are below estimates in parentheses.

[b]Results represent the *p*-value for the Wald test of joint significance of the interaction between Medicaid and the linear quarterly trend and the interaction between Medicaid and the quadratic quarterly trend.

Table 4

Difference-in-difference estimates of the effect of Medicaid adult vision coverage on vision care outcomes, NHIS 2002–2013[a].

	Outcome means			
	Vision coverage	**No vision coverage**	**Difference[b]**	**Difference-in-difference estimate[c]**
Outcome				
Seen eye doctor, past year	29.95 (1.62)	26.14 (1.87)	3.81 (2.39)	3.88** (1.89)
Needed but did not purchase glasses/contacts due to cost	10.74 (1.23)	19.32 (1.32)	−8.58*** (1.76)	−4.17** (1.87)
Difficulty seeing with usual vision correction	14.07 (1.52)	18.36 (1.25)	−4.30** (1.82)	0.80 (1.45)
Functional limitation due to vision	2.08 (0.26)	3.58 (0.35)	−1.50*** (0.42)	0.63 (0.92)

[a]States that covered both refractive exams and eyeglasses for adult Medicaid beneficiaries were classified as providing vision coverage. States that covered exams but not eyeglasses and those that did not cover exams or eyeglasses were classified as not providing coverage. All means are expressed as percentages. Standard errors are below mean estimates in parentheses. Means are weighted and errors are clustered at the state level. The sample includes 14,775 Medicaid beneficiaries.

[b]The difference in mean outcomes for Medicaid beneficiaries in states with and without adult vision coverage is reported. ** $p < 0.05$, *** $p < 0.01$.

[c]Results are estimates from linear probability models and represent percentage point changes. Model includes vision coverage status, age, age squared, race/ethnicity, sex, education, marital status, health status, ratio of family income to the poverty threshold, an urban area indicator, the county-level supply of optometrists per 1000 population, the average county-level annual unemployment rate, year fixed effects, state fixed effects, and state-specific linear and quadratic yearly trends. States that covered both refractive exams and eyeglasses for adult Medicaid beneficiaries were classified as providing vision coverage. States that covered exams but not eyeglasses and those that did not cover exams or eyeglasses were classified as not providing coverage. Health status is omitted from regressions analyzing ‘difficulty seeing with usual vision correction’ and ‘functional limitation due to vision’ due to potential endogeneity (e.g., those with poor vision health may be more likely to report worse overall health). The coefficient estimate for the vision coverage indicator represents the difference-in-difference effect. Errors are clustered at the state level and sampling weights are used to produce nationally-representative estimates. Standard errors are in parentheses below estimates. ** $p < 0.05$. The sample includes 14,775 Medicaid beneficiaries.

Table 5

Regression estimates of the effect of Medicaid coverage of adult vision services on vision care outcomes, Medicaid beneficiaries and low-income adults not on Medicaid, NHIS, 2002–2013[a].

	Difference in outcome means: states with vs. without vision coverage[a]			
	Medicaid beneficiaries	**Low income adults not on Medicaid**	**Difference**	**DDD estimate[b]**
Outcome				
Seen eye doctor, past year	3.81 (2.39)	−0.37(1.28)	4.18*** (1.44)	4.36*** (1.21)
Needed but did not purchase glasses/contacts due to cost	−8.76*** (1.74)	−1.11 (1.15)	−7.65*** (1.51)	−5.34*** (1.54)
Difficulty seeing with usual vision correction	−4.54** (1.69)	−1.06 (0.80)	−3.49*** (1.16)	−1.98** (0.93)
Functional limitation due to vision	−1.50*** (0.42)	−0.04(0.11)	−1.46*** (0.44)	−1.24*** (0.42)

[a]All estimates are expressed in terms of percentage points and standard errors are next to estimates in parentheses. Results represent mean differences for individuals residing in states with compared to without Medicaid adult vision benefits. The leftmost column provides this difference for Medicaid beneficiaries, the middle column provides this difference for low income adults not enrolled in Medicaid, and the rightmost column provides the difference in the first and second column quantities. All estimates are weighted using sampling weights available from NCHS and errors are clustered at the state level. ** $p < 0.05$, *** $p < 0.01$. The sample includes 14,775 Medicaid beneficiaries and 61,350 low income adults not on Medicaid.

[b]Results are estimates from linear probability models and represent percentage point changes. All models include Medicaid status, vision coverage status, and the interaction between these two binary indicators. The coefficient estimate on this interaction term is the DDD effect, which represents the effect of vision coverage for Medicaid beneficiaries relative to the control group. States that covered both refractive exams and eyeglasses for adult Medicaid beneficiaries were classified as providing vision coverage. States that covered exams but not eyeglasses and those that did not cover exams or eyeglasses were classified as not providing coverage. Model controls include age, age squared, race/ethnicity, sex, education, marital status, health status, private insurance status, ratio of family income to the poverty threshold, an urban area indicator, the county-level supply of optometrists per 1000 population, the average county-level annual unemployment rate, state and year fixed effects and state-specific linear and quadratic yearly trends. Health status is omitted from regressions analyzing ‘difficulty seeing with usual vision correction’ and ‘functional limitation due to vision’ due to potential endogeneity (e.g., those with poor vision health may be more likely to report worse overall health). Errors are clustered at the state level and sampling weights are used to produce nationally-representative estimates. ** $p < 0.05$, *** $p < 0.01$.

Table 6

Regression estimates of the effect of Medicaid coverage of adult vision services on vision care outcomes, comparison of different control groups, NHIS 2002–2013[a].

	All low income adults	Higher income adults	Privately insured low income adults	Uninsured low income adults
Outcome				
Seen eye doctor, past year	4.36*** (1.21)	4.74*** (1.56)	4.12*** (1.37)	4.57*** (1.55)
Needed but did not purchase glasses/contacts due to cost	−5.34*** (1.54)	−7.29*** (1.59)	−6.73*** (1.47)	−4.57** (2.05)
Difficulty seeing with usual vision correction	−1.98** (0.93)	−3.19*** (1.18)	−2.12 (1.29)	−1.97** (0.92)
Functional limitation due to vision	−1.24*** (0.42)	−1.48*** (0.41)	−1.25*** (0.46)	−1.24*** (0.41)
Size of control group	61,350	31,697	24,383	32,910

[a]Results are estimates from linear probability models and represent percentage point changes. Errors are clustered at the state level and sampling weights are used to produce nationally-representative estimates. Standard errors are in parentheses below estimates. All models include Medicaid status, vision coverage status, and the interaction between these two binary indicators. The coefficient estimate on this interaction term is the DDD effect, which represents the effect of vision coverage for Medicaid beneficiaries relative to the control group. States that covered both refractive exams and eyeglasses for adult Medicaid beneficiaries were classified as providing vision coverage. States that covered exams but not eyeglasses and those that did not cover exams or eyeglasses were classified as not providing coverage. Model controls include age, age squared, race/ethnicity, sex, education, marital status, health status, ratio of family income to the federal poverty threshold, an urban area indicator, the county-level supply of optometrists per 1000 population, the average annual county-level unemployment rate, state and year fixed effects and state-specific linear and quadratic yearly time trends. Health status is omitted from regressions analyzing ‘difficulty seeing with usual vision correction’ and ‘functional limitation due to vision’ due to potential endogeneity (e.g., those with poor vision health may be more likely to report worse overall health). ** $p < 0.05$, *** $p < 0.01$.

Table 7

Regression estimates of the association between vision coverage and unrelated outcomes, NHIS 2002–2013[a].

		Percentage point difference estimates, states with vs. without full vision coverage		
	Percent of Medicaid beneficiaries[b]	**Medicaid beneficiaries**	**Low income adults not on Medicaid**	**DDD estimate**
Dependent variable				
Seen general practioner, past year	71.10 (1.59)	−1.27(1.40)	−0.25 (1.13)	−1.02 (1.29)
Needed but did not purchase prescription drugs due to cost	14.82 (1.24)	−0.00 (1.13)	−1.00 (0.63)	0.99 (1.19)
Any bed days, past year	44.14 (1.77)	−1.79 (1.07)	−0.37 (0.90)	−1.42 (1.19)

[a]Results are estimates from linear probability models with controls including age, age squared, race/ethnicity, sex, education, marital status, health status, private insurance status, ratio of family income to the poverty threshold, and an urban area indicator, and county level controls including the supply of optometrists per 1000 population and the annual unemployment rate, state fixed effects and year indicators. The model includes Medicaid status, vision coverage status, and the interaction between these two binary indicators. The coefficient on this interaction term is the DDD effect, which represents the effect of vision coverage for Medicaid beneficiaries relative to the control group. States that covered both refractive exams and eyeglasses for adult Medicaid beneficiaries were classified as providing vision coverage. States that covered exams but not eyeglasses and those that did not cover exams or eyeglasses were classified as not providing coverage. Errors are clustered at the state level and sampling weights are used to create nationally representative estimates. All estimates represent percentage point changes. Standard errors are in parentheses next to estimates. The sample includes 14,775 Medicaid beneficiaries and 61,350 low income adults not on Medicaid.

[b]Mean outcomes for Medicaid beneficiaries included in the sample. All estimates represent percentages. Errors are clustered at the state level and sampling weights are used to create nationally representative estimates. Standard errors are next to estimates in parentheses.

Table 8

Regression estimates of the association between vision coverage and participation in Medicaid, NHIS 2002–2013[a].

Explanatoryvariables	
Vision coverage	0.37 (1.24)
Age	0.94*** (0.15)
Age squared	−0.01*** (0.00)
Male	−6.68*** (0.64)
Married	−4.46*** (0.76)
Black, Non-Hispanic	5.06*** (0.58)
Hispanic	−4.86*** (1.17)
Asian/other	−0.35 (0.97)
Less than high school degree	14.29*** (1.00)
High school graduate or GED	10.20*** (0.79)
Some college or AA	6.72*** (0.72)
Excellent health status	−18.52*** (0.89)
Very good health status	−17.90*** (0.83)
Good health status	−14.98*** (0.70)
Ratio of family income to the poverty threshold	−1.17*** (0.10)
Urban area	0.89 (0.68)
Unemployment rate (annual)	1.19*** (0.31)

[a]Results are estimates from linear probability modes. Models estimate Medicaid status as a function of vision coverage status, age, age squared, race/ethnicity, sex, education, marital status, health status, ratio of family income to the poverty threshold, an urban area indicator, the county-level supply of optometrists per 1000 population, the average county-level annual unemployment rate, year fixed effects, state fixed effects, and state-specific linear and quadratic yearly trends. Errors are clustered at the state level and sampling weights are used to produce nationally-representative estimates. Standard errors are in parentheses below estimates. *** $p < 0.01$. The sample includes 14,775 Medicaid beneficiaries and 61,350 low income adults not on Medicaid. States that covered both refractive exams and eyeglasses for adult Medicaid beneficiaries were classified as providing vision coverage. States that covered exams but not eyeglasses and those that did not cover exams or eyeglasses were classified as not providing coverage.

Table 9

Regression estimates of the effect of Medicaid coverage of adult vision services on vision care outcomes, Adults with less than a high school education compared to adults with some college education or more, NHIS 2002–2013[a].

Outcome			
Seen eye doctor, past year	2.32** (0.92)	2.52** (0.96)	3.10** (1.22)
Needed but did not purchase glasses/contacts due to cost	−2.27** (0.89)	−2.32** (1.05)	−3.20** (1.33)
Difficulty seeing with usual vision correction	−1.03 (0.71)	−0.74 (0.68)	−0.26 (0.80)
Functional limitation due to vision	−0.10 (0.19)	−0.24 (0.22)	−0.36 (0.35)
Sample restrictions			
Parent	No	Yes	Yes
Female	No	No	Yes

[a]Results are estimates from linear probability models. All models include education status, vision coverage status, and the interaction between these two binary indicators. The coefficient estimate on this interaction term is the DDD effect, which represents the effect of vision coverage for adults with less than a high school education compared to adults with at least some college. States that covered both refractive exams and eyeglasses for adult Medicaid beneficiaries were classified as providing vision coverage. Model controls include age, age squared, race/ethnicity, sex, education, marital status, health status, private insurance status, ratio of family income to the poverty threshold, an urban area indicator, the county-level supply of optometrists per 1,000 population, the average county-level annual unemployment rate, state and year fixed effects and state-specific linear and quadratic yearly trends. Health status is omitted from regressions analyzing ‘difficulty seeing with usual vision correction’ and ‘functional limitation due to vision’ due to potential endogeneity (e.g., those with poor vision health may be more likely to report worse overall health). Errors are clustered at the state level and sampling weights are used to produce nationally-representative estimates. All estimates represent percentage point changes. Standard errors are in parentheses below estimates. ** $p < 0.05$.