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The Relationship between Material Circumstances and Primary Care Utilization after Enrollment in Virginia's Medicaid Expansion

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

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Disclaimers: Any conclusions in this dissertation are the opinion of the authors alone. They do not reflect the opinions of the Virginia Department of Medical Assistance Services.

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LIST OF ABREVIATIONS

Affordable Care Act	(ACA)
Chronic Obstructive Pulmonary Disorder	(COPD)
Department of Medical Assistance Services	(DMAS)
Emergency Department	(ED)
Federal Poverty Level	(FPL)
Federally Qualified Health Centers	(FQHCs)
Governor Access Plan	(GAP)
Managed Care Organization	(MCO)
MCO Member Health Screening	(MMHS)
National Plan and Provider Enumeration System	(NPES)
National Provider Identity	(NPI)
Nurse Practitioners	(NPs)
Percentage Points	(PP)
Physician Assistants	(PAs)
Primary Care Providers	(PCPs)
Rural Health Clinics	(RHCs)
Supplemental Nutrition Assistance Program	(SNAP)
World Health Organization	(WHO)
Zip Code	(ZC)
Zip Code Tabulation Area	(ZCTA)

ABSTRACT

Health and health equity encompass not only healthcare but individual level material circumstances like food and housing, neighborhood level conditions like local consequences of residential segregation, and state and federal policies like Medicaid expansion. However, we are just beginning to understand how state level health insurance policy changes operate in the relationship between material circumstances, healthcare use, and health outcomes. This work focuses on newly enrolled Virginia Medicaid expansion members by using both claims data and survey data collected at the point individuals enrolled in Medicaid expansion and a year after Medicaid coverage.

Paper 1 asks if newly enrolled Medicaid expansion members who experience food or housing insecurity at the time of enrollment use primary care less frequently in the subsequent 12 months of Medicaid coverage compared to newly enrolled individuals who are not experiencing food or housing insecurity at the time of enrollment. Food and housing insecurity increase the prevalence of chronic conditions which may increase the demand for primary care and subsequent utilization, particularly in this sample of Medicaid expansion members who have no co-pays or premiums. However, individuals experiencing food and housing insecurity may have decreased primary care utilization because of increased barriers to care. Using data from the Virginia Department of Medical Assistance Services, we find that experiencing food insecurity at the time of enrollment in Medicaid expansion is associated with significantly decreased primary care utilization during the first year of coverage. Importantly, this association is significant among individuals living in disproportionately low-income neighborhoods, urban, and suburban neighborhoods. These findings suggest that other barriers, besides the monetary cost of primary care, exist for individuals experiencing food insecurity and the efficacy of interventions to address these barriers need to consider the local context.

Paper 2 investigates the following question: how does Medicaid expansion improve material circumstances? We offer three potential pathways in which Medicaid could reduce worry about affording food or paying for housing: 1) an increase in primary care utilization and subsequent improvements in health and functional job limitations, 2) reductions in economic constraints through decreased medical bills and healthcare expenditures, and 3) a decrease in worry about paying for catastrophic healthcare costs. To answer this question, individuals were surveyed within the first several months of Virginia Medicaid expansion (January – May 2019) and asked about their experiences in the year prior to their enrollment. Individuals who remained enrolled in Medicaid for 12 months were resurveyed about a year later (July 2020- June 2021) and were asked about their experiences during their first year of Medicaid coverage. We find that Medicaid expansion is associated with improvements across all three pathways. Critically, improvements in mental health, reductions in medical bills, and reductions in anticipated healthcare costs are associated with reductions in worry about paying for food or housing costs after a year of coverage. These findings suggest that Medicaid expansion operates through several different pathways to improve material circumstances, worry about affording food and paying for housing costs, that impact health.

INTRODUCTION

Optimal health is shaped by a multitude of factors, including those at the individual level, like an individual's material circumstances and health care use, and those at the neighborhood, state, or federal level. Healthcare use contributes about 20% to both quality of life and life expectancy, while health behaviors, social and economic factors, and physical factors account for the remaining 80%.[1] Importantly, individual socioeconomic factors like food and housing insecurity, or what will be referred to as "material circumstances," are key drivers of health.[2,3] However, these drivers of health are not distributed equally, but rather are distributed by social hierarchies.

Social hierarchies are shaped by social and public policies, also referred to as the socioeconomic and political contexts. Social hierarchies can alter an individual's exposure to health-harming conditions, reduce vulnerabilities to poor health, or result in differential financial consequences of poor health.[4] One recent public policy is the Affordable Care Act (ACA) that passed in 2010 and allowed over 21 million individuals to enroll in Medicaid expansion across 40 states and territories.[5] In Virginia, Medicaid expansion was passed in January 2019 and as of November 2023 covers over 700,000 Virginians.[6] More specifically to this work, Medicaid expansion offers a unique opportunity to examine the relationship between healthcare utilization and material circumstances at the intersection of social and public policies and social hierarchies.

This dissertation uses a sample of newly enrolled Virginia Medicaid expansion members to answer several policy questions across two chapters. Chapter 1 addresses whether newly enrolled Virginia Medicaid expansion members experiencing food or housing insecurity at the time of enrollment use primary care during the first year of coverage differently than individuals not experiencing food and housing insecurity. Further, Chapter 1 assesses whether the

relationship between material circumstances and primary care utilization is moderated by other aspects of the socioeconomic and political context, including residential segregation, rurality, and the social construct of race. Chapter 2, examines the other direction by which material circumstances and primary care use relate, by answering whether primary care utilization after enrollment in Virginia Medicaid expansion reduces worry about affording food or paying for housing. Additionally, Chapter 2 asks if there are other mechanisms that lead to reductions in these material circumstances among a sample of individuals enrolled in the first several months of Virginia Medicaid expansion.

We approach these questions using the Social Determinants of Health Framework by the World Health Organization (Figure 1 below).[4] This dissertation first walks through this conceptual framework and then introduces each element and key relationship within it in turn. Ultimately, this conceptual model is the foundation of this dissertation that seeks to better understand the relationship between material circumstances and primary care utilization in the context of Medicaid expansion, and how these relationships differ across socioeconomic and political contexts.

Conceptual Framework Overview

A modified version of the Commission on Social Determinants of Health's conceptual framework from the World Health Organization (WHO) is pictured below (Figure 1). In this model, the white boxes denote concepts examined in this dissertation while the grey boxes denote concepts in the model that are not addressed in this dissertation. Additionally, the relationships shown with green arrows will be the focus of paper 1 while the relationship depicted with an orange arrow is the focus of paper 2. Last, the relationships depicted with broken arrows are important, but fall outside the scope of this dissertation. Before applying these

concepts to the dissertation specifically, the conceptual model is defined generally, beginning on the top left (socioeconomic and political context) and following the relationships in the diagram to the bottom center (maximizing health and well-being equitably).

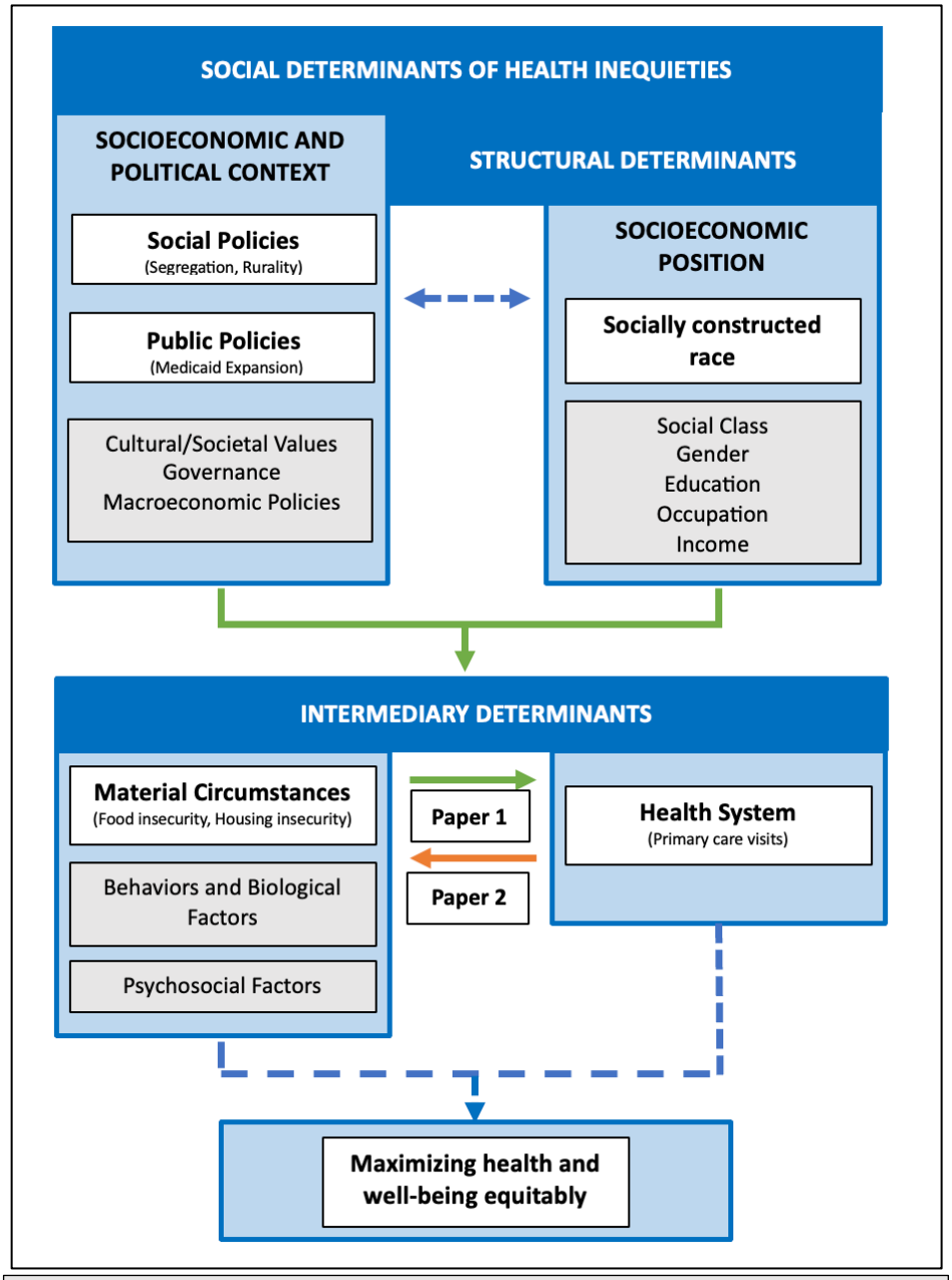


Figure 1: WHO Conceptual framework of structural determinants, social determinants of health inequities, and intermediary determinants

Socioeconomic and political context. This consists of the numerous social and public policies that shape and maintain the systems of social stratification that inform how intermediary determinants and health opportunities at the individual level are distributed. It includes the concept of welfare in which the state can protect the well-being of its citizens, in part through social insurance, including public policies to provide insurance coverage for health services. Notably, this includes Medicaid coverage and policy efforts over the last 10 years to expand eligibility as allowed under the ACA. Additionally, social policies that are relevant to this dissertation include residential segregation and rurality, both of which shape the socioeconomic position of an individual and, at the individual level, the corresponding material circumstances and ultimately health outcomes. In particular, both public and social policies can create social hierarchy that lead to inequities through differential exposures to health-damaging factors, unequal vulnerabilities to these health exposures, and differential consequences of illnesses. For example, prior evidence suggests that Medicaid expansion reduces the financial consequences of illnesses for low-income individuals by providing coverage with no premiums or co-pays.[7,8]

Socioeconomic position. Moving from left to right along the top of Figure 1, socioeconomic position corresponds to the differential positions in social hierarchies that are created by the socioeconomic and political context. An individual's position in a social hierarchy creates differential experiences of discrimination and access to power, prestige, and resources that results in inequities in intermediary determinants and ultimately health outcomes. The focus of this dissertation is on the social construct of race because the socioeconomic and political context of structural racism has created inequities in power, prestige, access to resources, and experiences of discrimination due to the race an individual is categorized as.

Taken together, the socioeconomic and political context that creates a social hierarchy in which socioeconomic position is based, is referred to as the social determinants of health inequity. Classically, the term social determinant has focused on social factors at the individual level that influence health but ignore how the unequal distribution of these resources lead to inequities. This conceptual framework intentionally calls the underlying system that perpetuates advantages and disadvantages at the individual level the "social determinants of health inequities" and calls the consequences of this hierarchy at the individual level the "intermediary determinants of health."

Intermediary determinants of health. These are the down-stream, tangible factors of the social determinants of health inequities that are experienced at the individual level. We focus on two intermediary determinants - material circumstances (food and housing insecurity) and healthcare use (primary care utilization). The conceptual model notes that there is a bidirectional relationship between material circumstances and healthcare utilization. We examine both directions of this relationship.

Maximizing health and well-being equitably. Health is not just the absence of disease but it is the physical, behavioral, spiritual, and socioeconomic wellbeing as defined by individuals, families, and communities.[9] Additionally, the goal is not to achieve health in isolation but it is to optimize health for individuals in every part of the social hierarchy, which would be to achieve health equity.

Evidence Supporting Relationships among Key Concepts in the Conceptual Model

Having briefly introduced the overarching conceptual model above, we will now provide background evidence for each area of focus throughout the following sections, beginning with public policy (Medicaid expansion), followed by social policy (residential segregation and rurality), socioeconomic position (social construct of race), material circumstances (food and housing insecurity), and finally the health system (primary care use).

Social Determinants of Health Inequities

Public policy: Medicaid expansion. The ACA increased Medicaid eligibility for adults up to 138% of the federal poverty level (FPL) in states that expanded, with Virginia expanding in 2019.[5] Medicaid expansion coverage requires no premium and little to no cost-sharing for the individual.[10] Prior evidence suggests that Medicaid expansion improves health outcomes, including self-rated health and may reduce health disparities, although findings on disparities in health outcomes are mixed.[11–15] Medicaid expansion may improve health outcomes at the individual level because Medicaid expansion coverage is associated with: 1) decreased vulnerability to health harms because of increased healthcare utilization,[16,17] 2) decreased exposure to health harms from improved medically and non-medically related financial security,[18,19] and 3) protection from the consequences of illnesses from reductions in catastrophic healthcare costs.[20–22]

First, the majority of evidence focused on Medicaid expansion finds that individuals use more primary care after enrollment, in part because of the increased affordability of healthcare. The majority of difference-in-difference studies comparing healthcare utilization in expansion states compared to non-expansion states suggest that Medicaid expansion results in a higher probability of individuals having a routine visit, an outpatient visit, or a primary care visit.[16,17,23–

[25] Additionally, Medicaid expansion is associated with gains in having a personal doctor and having a routine check-up.[26,27] More specifically, adults below 138% of the FPL in Medicaid expansion states experienced a 9.1 percentage point increase in primary care physician visits compared to similar adults in non-expanded states after expansion occured.[28] Further, nonelderly adults in expansion states experienced reductions in avoidable hospitalizations and in annual ambulatory-care sensitive discharges compared to nonelderly adults in nonexpanded states, both indicators of increased primary care use.[29,30] Last, evidence suggests that individuals relied on the emergency department less as their primary source of care after Medicaid expansion, suggesting increased access to primary care.[31] However, some studies found no change in having a primary care visits, routine check-ups, or avoidable hospitalizations.[32–35] Ultimately the majority of evidence suggests that individuals use more care after gaining Medicaid expansion coverage.[28]

In addition to improvements in utilization, Medicaid expansion is associated with improvements in material circumstances at the individual level as seen in reductions in evictions, food insecurity, and payday borrowing.[36,36,37] In Virginia, individuals enrolled in Medicaid expansion experienced reductions in concern about paying for monthly bills, food, housing, and healthcare costs after a year of coverage compared to the year prior to enrollment.[18] Last, Medicaid expansion is associated with increased protection from catastrophic healthcare costs. For example, among US adults with a traumatic injury, individuals had a 39% lower odds of a catastrophic health expenditure, defined as out-of-pocket plus premium spending exceeding 19.5% of a family's income, in the time after Medicaid implementation compared to the time before.[38]

These improvements in material circumstances and healthcare use individuals experience have positive consequences on health and health equity. For example, Medicaid expansion may improve health outcomes because the policy reduces exposures to stress from financial concerns. Further, Medicaid expansion may improve health equity because it reduces the exposure of low-income individuals, in particular, to financial stress. Additionally, increased use of primary care may help address and improve health behaviors protecting individuals from vulnerabilities that harm health, particularly for behaviors that are more common among low-income individuals like smoking.[39,40] Importantly, after healthcare use, Medicaid expansion can reduce the consequences of illnesses for low-income individuals because of the coverage's low-cost sharing.

Social policy: Segregation. Within the socioeconomic and political context, systemic racism, defined as a societal mechanism that preserves systems of White privilege by perpetuating racism across multiple domains, is a shameful and long-standing part of public and social policy in the United States.[41] We focus on the social policy of residential segregation, defined as the historic, intentional physical separation of races by enforced residence in certain areas,[42] as it is a significant mechanism through which social hierarchies are organized and results in different health opportunities along racist lines. While segregation is not limited to Black and White residents, segregation between these groups is the focus of this dissertation as this pattern of segregation is enduring[43] and most Virginia Medicaid members are Black or White individuals.[18]

Residential segregation remains today in housing markets, echoes of multiple codified policies like the creation of prohibitory racial covenants, the Infrastructure Act that led to highway construction through Black neighborhoods, unwillingness of banks to finance

mortgages if developments planned to sell to Black individuals, and the Home Owner's Loan Corporation creation of "residential security" maps that redlined predominately Black neighborhoods.[44] These policies effectively resulted in the consolidation of Black individuals into urban neighborhoods and White individuals into suburban neighborhoods.[45] While segregation was outlawed with the Fair Housing Act in 1968, the Act did nothing to undue the unjust consequences of previous decades of segregation or prevent continued discrimination through geographic steering, police power used to enforce racial boundaries, and sub-prime lending to Black individuals.[45,46]

Williams and Collins (2001) suggest that residential segregation is associated with concentrated poverty and limited opportunities for upward social mobility because of years of disinvestments in predominately Black neighborhoods that weaken individuals' opportunities for schooling and employment.[42,43,47] The lack of schooling and employment leads to unequal socioeconomic positions and accompanying inequities in power, prestige, and control of material resources based on an individual's neighborhood. However, the effects of segregation are not limited to the socioeconomic position of an individual, like individual income or educational attainment. Rather, segregation has led to the concentration of harmful features in the built environment such as increased fast food establishments, tobacco retailers, and proximity to environmental hazards in predominately Black neighborhoods.[48–50] While there are many ways segregation harms health, including experiences of discrimination, we focus on two intermediary determinants: primary care utilization and material circumstances. We posit that residential segregation harms health through its' effects on primary care utilization and material circumstances because it 1) creates a social hierarchy that results in unequal access to these intermediary determinants, 2) increases health-harming exposures in predominately Black

communities, and 3) creates unique vulnerabilities among residents of predominately Black communities.

At the individual level, segregation creates inequities by neighborhood in access to material circumstances, food and housing insecurity, that harm health. For example, in Virginia, 60% of majority Black neighborhoods have eviction rates greater than 10%, four times the national average.[51] This trend persists at smaller geographic levels as well. For example, studies in Richmond, VA and a study in a county of Houston, Tx found that neighborhoods with a larger proportion of Black individuals experienced a higher rate of rent exploitation or evictions in comparison to neighborhoods with fewer Black residents.[52,53] Additionally, as a consequence of segregation, predominately Black neighborhoods have more food deserts, worse transportation options, an inadequate number of high paying jobs, and higher food prices for healthy foods,[54–58] all of which can increase food insecurity in predominately Black neighborhoods. Inequities in these material resources because of segregation may lead to poor health outcomes from increases in exposure to health harms, like stress from evictions or inability to purchase healthy nutritious foods, by neighborhood.

Segregation may also harm health because of the inequities in access to primary care and subsequent inequities in primary care utilization across neighborhoods. Decreased access to high-quality primary care may increase the vulnerability of individuals to poor health because individuals do not have access to providers that can address behaviors or exposures that harm health. Prior work suggests that healthcare resources may not be physically present in predominately Black neighborhoods because of continued disinvestment and isolation as a part of segregation. For example, neighborhoods with a higher percent of Black or other minority adult residents had a greater likelihood of having the lowest supply of clinicians,[59] of

experiencing a hospital closure in rural neighborhoods,[60] of having gained fewer Rural Health Clinics (RHC) or Federally Qualified Health Centers (FQHC) over a ten year period in rural neighborhoods,[61] and of having either no primary care physician (PCP) or less than 1 PCPs per 3,500 residents.[62] Additionally, areas with high Black resident clustering, a measure of segregation, had fewer physician's offices and auxiliary health providers like dentists.[63,64] Taken together, the evidence suggests that segregation leads to in inequities in physical access to PCPs across neighborhoods.

The availability and accessibility of physicians have direct consequences on primary care utilization, care that could address differential vulnerabilities to health harms. In general, primary care density influences the probability of having a primary care physician, which is associated with increased preventive care utilization.[65] However, the evidence is mixed on the relationship between segregation, density, and utilization. For example, work on diabetes found no association between lower access to care, as measured by having an outpatient visit by a PCP, and neighborhood segregation using several different measures of segregation.[66] Conversely, in a national sample, Black individuals in Black zip codes had fewer office based physician visits or outpatient department physician visit compared to White individuals in White zip codes, suggesting a relationship between segregation and utilization.[67] Other work found a negative association of segregation with the density of outpatient physicians but no association between that density of physicians and having a personal physician.[63] The majority of evidence suggests that segregation leads to inequities in physical access to healthcare, though the effects of segregation on primary care utilization are mixed. More work needs to be conducted on understanding the relationship between primary care utilization and segregation as primary care utilization can address vulnerabilities of individuals to inequities in health harms.

In addition to the physical location of healthcare resources, there is a relationship between residential segregation and the type of care available within a neighborhood. For example, predominately Black neighborhoods often function as training grounds for medical schools which can result in substandard care and reinforce the American medical caste system.[68] Further, in a national sample of physicians, physicians were less likely to participate in Medicaid if the neighborhood consisted of non-White poor individuals and if the non-white individuals were segregated, although this was prior to expansion.[69] Specifically in Virginia, prior work indicates that the number of geographically accessible PCPs accepting Medicaid was lower in census block groups with a higher percentage of Black residents, although this was also before Medicaid expansion in Virginia.[70] This work suggests Medicaid members may face more difficulty in finding PCPs that accept their insurance when the members live in a neighborhood with a higher percentage of Black residents. More positively, Black PCPs tend to work in neighborhoods that are health professional shortage areas or are medically underserved areas, features associated with neighborhoods with a higher proportion of Black residents.[71,72] Having more Black physicians in predominately Black neighborhoods may improve health outcomes as racial concordance between a patient and their provider is shown to improve patient satisfaction and outcomes.[73,74] In addition to the race of providers in neighborhoods, segregated Black neighborhoods, as measured by non-White dissimilarity index and a high percentage of minorities, have a greater number of FQHCs.[75] FQHCs are required to provide care coordination services and services that could improve whole health.[76] In totality, the evidence suggests that segregation leads to individual's having differential types of care based on their neighborhood.

Differences in the location of care and the type of care available may lead to differences in the type of care individuals use. For example, in mental health treatment, individuals residing

in neighborhoods where >50% of residents were Black residents were more likely to see a general physician or non-psychiatrist instead of a psychiatrist compared to individuals residing in neighborhoods with fewer Black residents.[77] More generally, individuals living in neighborhoods with high Black clustering, a measure of segregation, more frequently chose an outpatient hospital department or clinic instead of an outpatient doctor's office compared to individuals living in neighborhoods with lower Black clustering.[78] Segregation leads to individuals seeking differential types of care which could impact how vulnerabilities to health harming exposures are addressed.

Beyond the physical location of physicians and the type of care available, segregation may create inequity in travel costs and opportunity costs of care by neighborhood. First, because of concentrated disinvestments in predominately Black neighborhoods, individuals may not access transit easily or work in jobs with paid sick leave, making the costs of care seeking higher compared to individuals living in predominately White neighborhoods.[79–82] In addition to the cost of care, care among providers in predominately Black neighborhoods was associated with poorer quality of care, potentially making the value of care lower for individuals in segregated areas.[68] For example in a sample of patients receiving dialysis, dialysis facilities in neighborhoods with 75% or more Black residents had higher mortality rates and were less likely to meet performance target goals compared to facilities located in neighborhoods with fewer than 10% Black residents.[83] Segregation may lead to inequities in opportunity and travel costs of healthcare while leading to differential benefits to primary care.

Beyond the physical environment, segregation can also affect the sociocultural environment, although there are mixed ideas on segregation's effect.[84,85] Some posit that segregation harms the formal mechanisms of social cohesion due to disinvestments in

community resources, such as the depletion of social service providers in predominately Black neighborhoods.[64] Further, segregation may harm social cohesion through less formal mechanisms such as decreased collective knowledge about health care resources.[85,86] Additionally, mistrust of medical institutions may be higher among Black individuals which could contribute to norms that decrease care seeking in predominately Black neighborhoods.[67] On the other hand, the ethnic density hypothesis suggests that the concentration of individuals from the same ethnic background in a neighborhood may foster stronger social networks that increase trustworthiness, sense of belonging, and safety that are protective against mortality.[87–89] And, empowerment, political participation, and neighborhood organizational participation in segregated communities may protect residents' health against harmful effects of segregation.[90,91] Further, specific to primary care use, strong collective efficacy within a neighborhood may increase trust in healthcare institutions or in the belief in taking care of one's health.[92] It is unclear how segregation interacts with aspects of the sociocultural environment that could encourage or discourage primary care utilization.

Ultimately segregation may result in inequities in material circumstances and healthcare access that harm health. Additionally, segregation results in increased health-harming exposures to inadequate material resources, neighborhood disinvestments, and discrimination. Last, segregation may increase vulnerabilities to these exposures as access to care is limited. Next, rurality will be explored as a mechanism by which social policies continue to harm health.

Social policy: Rurality. Individuals in rural neighborhoods experience worse health outcomes in heart disease, cancer, unintentional injuries, strokes and life expectancy compared to their urban counterparts.[93,94] There are several features of social and public policies that contribute to the current disparities in health outcomes by rurality. First, in rural communities,

political power has generally been concentrated in small groups of individuals that are often part of the dominate industry, like natural resource extraction or seasonal agriculture, creating difficulties for the political advancement for less powerful actors.[95] Additionally, policies to build resilient and financially strong rural communities have been disjointed and often focused on farming, despite the service industry now being the primary industry of rural neighborhood.[96] Further, out-migration of young educated individuals from rural areas contribute to continued disparities between rural and urban areas on returns human capital.[95] Structural racism has also been entangled in the policy process in rural neighborhoods. For example, the Homestead Act of 1862 allowed only American citizens to obtain land, limiting Black individuals' participation.[97] Although the Southern Homestead Act of 1866 allowed and actually encouraged formerly enslaved individuals to participate, the act was limited in effect and quickly ended with the end of Reconstruction.[97] Racism within rural policy continued in the New Deal era with the creation of the Tennessee Valley Project that excluded Black individuals and in the Fair Labor Standards Act of 1938, which excluded farmworkers and domestic labor in the minimum wage requirement, in part to exclude non-White workers.[95,98] These policies have led to rural disparities in intermediary determinants and health outcomes nationally, but also have led to particularly high rates of disease and poverty in rural Black communities and southern rural communities.[99,100]

These rural social policies consist of continued disinvestments in rural neighborhoods leading to limited economic and employment opportunities for individuals. For example, the current poverty rate among non-metro individuals is 15.4% compared to a poverty rate of 11.9% for metro individuals.[101] Further, men in urban neighborhoods had about a 20 percentage point higher college completion rate compared to men in rural neighborhoods.[102] Residents of rural

neighborhoods often experience poor transportation infrastructure including an increase reliance on personal vehicles, poor road infrastructure, and decreased public transportation options, potentially causing limitations on employment.[103] Last, broadband access continues to vary by rurality, limiting the ability of rural residents to use technology to work a high-skilled job if the job is not physically located in the neighborhood.[102] Collectively, rural disinvestments have led to decreased access to material circumstances and primary care which in turn leads to health-harming exposures and increased vulnerabilities for rural residents.

Inequities in socioeconomic position, including employment and education, result in differences in intermediary determinants of health by rurality. More specifically, individuals in rural neighborhoods experience higher rates of food insecurity than urban individuals.[104] Additionally, the travel costs of shopping for food may be higher for rural residents because of limited transportation infrastructure or difficulties in stocking healthy foods in areas with sparse populations spread out across large geographic areas.[105] Conversely, recent research finds that rural residents do not experience greater material hardship compared to urban residents after controlling for financial characteristics of individuals such as liquid assets and home ownership.[106] Taken together, investing in rural neighborhoods to improve housing affordability or increase housing supply could reduce rural disparities in housing insecurity. Disparities in access to material circumstances, like food or housing, may increase rural residents' health harming exposures and impact health equity.

In addition to material circumstances, individuals in rural neighborhoods experience difficulties in access to and utilization of primary care compared to urban residents. The number of PCPs has been limited in rural areas with 80% of rural counties having a shortage of primary care providers and 9% having no PCPs in the county.[107] About 77% of rural counties nationally

are designated as Primary Care Health Professional Shortage Areas, areas defined as having less than 1 provider for 3,500 residents in a community.[108] Unfortunately, the dearth of providers may not improve as 25% of PCPs in rural areas were 60 years or older compared to 18% of PCPs in urban areas in a recent study.[109] Compounding the aging workforce, prior work found that less than 8% of physicians and surgeons practicing across the U.S. in 2010 chose to practice in rural settings.[100] In addition to individual providers, over 60% of rural hospitals have closed between 2005 and 2012.[107] These shortages lead to consequences for patients, including longer travel times to care. For example, recent work found that less than 50% of rural women were able to access perinatal services within a thirty mile drive.[110] Beyond differences in physical access to care, rural residents are also less likely to have insurance coverage compared to non-rural or urban residents, potentially limiting access to care due to the cost of care.[111]

Difficulties in accessing healthcare extend beyond the physical proximity to care and insurance coverage for rural residents. First, broadband access is limited in many rural areas with urban areas being three times more likely to have access to Next Generation broadband compared to rural areas as of 2014.[112] Additionally, as of 2013, out of the 19 million Americans without broadband available where they live, 14.5 million of these individuals lived in rural areas.[112] This can limit not only access to telemedicine visits, but also the ability to interface with the care team through electronic medical systems, a growing aspect of medical care. Living in rural areas and not having broadband access were both associated with never accessing an electronic health portal across three different health systems.[113] A second barrier to healthcare utilization among rural communities is decreased care seeking due to social stigma, privacy concerns, or decreased perceived need for care. First, individuals may anticipate social stigma for certain types of treatment, like mental health treatment.[114] Second, rural residents express

privacy concerns about their healthcare, often because rural residents have a personal relationship with members of their healthcare team.[114] Last, rural residents tend to experience less need for primary care. For example, among parents of children with a special health care need, parents in rural communities reported less need for their child's routine or specialist care compared to nonrural parents.[115] In an adult population, individuals living in rural communities reported less need for mental health counseling and dental care compared to nonrural adults.[116] Collectively, rurality creates unique barriers to healthcare utilization like limited internet access and particular care seeking norms.

Rurality creates barriers to primary care utilization and may also be associated with the type of care available to individuals by neighborhoods. Recent evidence suggests that primary care clinician participation in Medicaid was highest in the most rural states.[117] Beyond individual providers, FQHCs and rural health clinics can be critical in improving access to care in rural communities, in part because of the high acceptance of Medicaid coverage. For example, when individuals called clinicians to schedule an appointment paid by Medicaid insurance, 80% of the callers could receive an appointment in rural areas compared to 60% in nonrural areas. This was, in part, due to a high rate, 95%, of Medicaid acceptance in RHCs .[118] While particular types of care in rural areas may decrease barriers to care, rurality may be associated with poor quality of care. For example, rural areas had more providers with a lower educational level compared to urban areas such as higher number of licensed practical or licensed vocational nurses compared to registered nurses in the total nursing workforce.[119] Additionally, PCPs in rural areas noted more difficulty in finding providers to refer patients to than PCPs in urban areas.[120] Rurality may be associated with the quality and type of care available to individuals.

Decreased access to care among rural individuals has consequences on healthcare utilization and outcomes. For example rural individuals were more likely to be hospitalized for an ambulatory sensitive condition than their non-rural counterparts, which indicates that rural individuals have inadequate primary care access.[121] More specific to ambulatory care, rural women were less likely to have any visits with a physician compared to urban counter-parts.[122] Among all adults, rural individuals in one large healthcare system had lower rates of primary care visits and worse health than non-rural individuals.[123] Rural residents subjectively endorsed higher rates of a usual source of care which may indicate lower expectations for care given prior work finding decreased utilization of primary care by rural individuals.[122,124] Importantly, adequate use of primary care could be particularly important for rural residents to address poor health behaviors. Residents of rural neighborhoods experience increased vulnerability to behaviors that harm health such as increased smoking rates, higher than normal body weight, and insufficient aerobic activity.[125,126] Ultimately, the conditions of rural environments, that have resulted from social policies within a larger socioeconomic and political context, lead to worse health status for individuals in rural communities accompanied by decreased access to primary care to ameliorate these harms. The next section moves from socioeconomic and political context to socioeconomic position.

Socioeconomic position: **Race**. Race is a structural determinant and a social determinant of health inequities, meaning that socioeconomic and political policies, including those described above, result in a social hierarchy that leads to differential power, prestige, and material circumstances by socially constructed race. Race is a social construct that was created to justify the horrific practice of slavery.[127] Health disparities by the current categorization of race are a reflection of racism rather than biological differences between individuals.[127] While we

recognize that race is a social construct we will use Black individuals to describe individuals categorized as Black and White individuals to describe individuals categorized as White throughout this dissertation. Currently, Black individuals have a lower life expectancy and worse health compared to White individuals in the United States.[128] A significant contributor to poor health is experiences of racial discrimination that Black individuals experience in everyday life. Racial discrimination can harm health due to increased stress and allostatic load.[129] While the harm of discrimination to health cannot be overstated, it is not the mechanism this dissertation focuses on in the relationship between structural racism and health outcomes. We instead focus on how structural racism harm Black individuals because it leads to socioeconomic positions that decrease access to intermediary determinants. These intermediary determinants, access to material circumstances like food and housing insecurity as well as healthcare utilization, can cause health harms and or exacerbate vulnerabilities by race.

Today, Black households are more likely to experience food insecurity than White households.[130] Alarmingly, the homeownership gap between White and Black households was the same in 2020 as it was in 1970, two years after the Fair Housing Act was passed.[131] Further, during the pandemic Black individuals experienced a higher rate of concern about facing evictions and a lower rate of confidence in one's ability to pay for the next months rent compared to the White individuals.[132] Material circumstances continue to be distributed by socioeconomic position that is informed by structural racism.

Although healthcare access may be critical in protecting individuals from vulnerabilities associated with health harms due to structural racism like discrimination or inadequate access to material circumstances, disparities continue to exist by the social construct of race. Among a national sample of noninstitutionalized individuals, Black individuals had 3.2 fewer ambulatory

visits than their White counterparts in 2014-2019, despite a higher disease burden.[133] Further, in a sample of Medicaid expansion members across three states, Black individuals had fewer primary care visits than White individuals.[134] Despite the potential for primary care to ameliorate health harms like racial discrimination, there are several explanations to the continued inequities in healthcare utilization by race.

First, across the US, 18.8% of Black individuals were uninsured compared to 5.7% of White individuals in 2021.[135] This is in part due to southern states not expanding Medicaid where a large portion of individuals who would gain Medicaid coverage are Black individuals.[136] However, inequity in the insurance rate between Black and White individuals is greatest among individuals with a Bachelor's degree or higher, suggesting that the differences in insurance is not due to differences in education, income or Medicaid policy alone. Instead, Black individuals may not have the same employment opportunities that offer insurance due to structural racism that results in differences in power, prestige and experiences of racial discrimination.[137]

Along with inequities in insurance, current personal experiences with discrimination, historical mistreatment by medical institutions, and undertreatment for pain create distrust between Black individuals and the medical system that subsequently deters use.[138,139] Prior evidence suggests that discrimination within healthcare systems continues to be a common experience for Black patients which can deter care seeking.[140,141] Further, in one study, about half of White providers were found to hold negative, false beliefs about Black individuals that translated into less accurate treatment recommendations for Black patients in medical scenarios.[142] Next, about 5% of physicians identify as Black as of 2019, despite evidence that suggests racially concordant physician-patient relationship can improve care.[143,144] Last, prior evidence suggests that Black individuals received less guideline appropriate care and received

cheaper or older treatments which could perpetuate distrust in the health system.[143] Inequities in resources, like health insurance, and distrust in the medical system may decrease timely and appropriate healthcare use among Black individuals, differentially increasing vulnerabilities to health harms that are left untreated and ultimately unjustly harming Black individuals' health. The following section moves beyond structural determinants of health inequities to intermediary determinants.

Intermediary Determinants

Intermediary determinants are the downstream factors that consist of the living and working conditions of an individual. Two intermediary determinants will be examined in this dissertation: material circumstances and primary care utilization.

Material circumstances. For this dissertation, we focus on food and housing insecurity as they are common, particularly in low-income populations,[132,145] and have clear consequences on health.[128,146,147] Food insecurity is defined as having limited or an uncertain availability of nutritionally adequate and safe foods.[148] Housing insecurity is variably defined and includes homelessness, frequent moves, paying more than 50% of one's income on housing, overcrowded conditions, or doubling up.[149] Food insecurity is common in low-income households with 36.7% of households below the FPL experiencing food insecurity in 2022 and less than 15% of families above the FPL experiencing food insecurity.[150] Additionally, falling behind on housing payments is more common in households with an income below $25,000 than in households with an income above $75,000.[151]

While inadequate material circumstances are common, they have consequences on health. Individuals who worry about paying for food, compared to individuals who do not worry, are more likely to use compensatory mechanisms like shopping at dollar stores or convenience

stores, often choosing low-cost, high calorie, nutritionally deficient foods and reducing the variety of their food intake.[128,147] These compensatory mechanisms can lead to weight gain and an increase in diet-related diseases such as diabetes and obesity.[2,152] Additionally, food insecurity is associated with psychological distress and depressive symptoms.[153,154] Housing insecurity has similar deleterious effects on health, including increased mortality risk, worsening of chronic health conditions, and exposure to communicable diseases.[155,156] Further, worry about paying for housing is associated with poor health.[157,158]

Primary Care. In addition to food and housing insecurity, primary care utilization is another intermediary determinant that can improve health. Primary care is thought of as a comprehensive, longitudinal, coordination focused, patient-centered, and community-oriented practice of medicine.[159] Primary care serves as the cornerstone for building a health system that achieves positive health outcomes and, importantly, health equity.[39] Primary care improves health because 1) providers can screen for and treat diseases, 2) providers can counsel on health behaviors, and 3) providers can address material circumstances. For example, higher primary care supply in Florida was associated with decreased colon cancer incidence and mortality, a disease recognized and treated by preventative screening.[160] Second, primary care provides counseling on health behaviors, either preventing chronic illnesses like diabetes or reducing the disease burden for an individual once they have the disease.[39] Last, primary care is beginning to address more material circumstances that harm health, like food or housing insecurity, by involving interprofessional teams in primary care practice. These teams lean on the expertise of social workers and community health workers to ensure whole health for patients, or health that encompasses "physical, behavioral, spiritual, and socioeconomic wellbeing as defined by

individuals, families, and communities".[9] In total, increased access to primary care improves health, making primary care an important intermediary determinant of health.

Bidirectional relationship between material circumstances and primary care utilization. As depicted in the framework, there is a bidirectional relationship between material circumstances and primary care use. How food and housing insecurity could impact primary care utilization is explored in Chapter 1. Then, Chapter 2 focuses on why primary care could reduce food and housing insecurity. Each of these pathways is discussed next.

Chapter 1 argues that food and housing insecurity could increase the demand for primary care for two reasons: 1) material circumstances can worsen health leading to an increased need for primary care[128,146,147] and 2) elements of primary care can directly address material circumstances. As discussed previously, food and housing insecurity can increase the risk of developing chronic conditions like diabetes and hypertension which could increase the demand for health care.[128,152]Although patients can use specialist or hospitalist to treat chronic conditions, appropriate management for these illnesses include primary care.[161,162] In fact, 84% of individuals with diabetes and 81% of individuals with hypertension saw a PCP, suggesting that individuals with chronic conditions do seek primary care.[163]

Alternatively, food and housing insecurity could decrease primary care utilization because individuals with fewer material resources may have to make economic trade-offs between competing needs. For example, low-income households headed by adults 65 or older that are severely burdened with housing costs spent less than $200 on healthcare costs compared to households not burdened with housing costs who spent over $300 per month.[151] Households experiencing inadequate material circumstances may experience worse health but face barriers to using healthcare, including paying for competing needs like food and housing. Further,

households experiencing food insecurity were more likely to skip medications, take less medications, or delay taking medications than non-food insecure households.[164] Last, food and housing insecurity is associated with a reduction in the use of preventive or routine health care,[158,165,166] delaying doctor's visits,[158,165] forgoing routine check-ups, and lacking a usual source of care.[166] Although the majority of evidence suggests individuals experiencing food or housing insecurity use less primary care, some studies found no association between outpatient visits and experiencing food insecurity.[167–169] Our work will help address how individuals make the trade-off between competing needs.

Chapter 2 examines if primary care could reduce food and housing insecurity. We hypothesize that primary care could 1) improve health and productivity and 2) address social needs within the practice. Primary care may also improve health such that individuals are more able to work or have to spend less resources to maintain their health. Second, medical institutions, including primary care, have begun to address social needs as a part of healthcare which may encourage individuals with social needs to seek primary care.[170] However, such programs are still emerging and future work needs to focus explicitly on how integrating services for social needs into primary care can increase the demand for care. Ultimately, primary care may be a pathway in which individuals can improve their material circumstances. Chapter 2 also explores alternative pathways in which Medicaid expansion enrollment could lead to improvements in material circumstances, like changes in economic constraints and changes in worry about healthcare costs after gaining coverage.

Social Policies and Socioeconomic Position as Moderators of Relationships between Material Circumstances and Primary Care Utilization

As previously discussed, segregation, rurality, and socially constructed race, are social determinants of health inequities that lead to disparities in health outcomes. This dissertation posits that segregation, rurality, and race could modify how food and housing insecurity affect primary care utilization. Segregation, rurality, and race may alter the tradeoffs individuals make between intermediary determinants of health. For example, because of segregation, individuals living in predominately Black neighborhoods may have to travel further to a primary care physician because of the absence of primary care clinicians in the neighborhood. Because the costs of care seeking are higher, individuals living in predominately Black neighborhoods who are experiencing food insecurity may be less likely to visit primary care compared to food insecure individuals living in predominately White neighborhoods or other individuals in predominately Black neighborhoods.

This dissertation uses a sample of newly Virginia Medicaid expansion members to better understand if food and housing insecurity is negatively associated with primary care utilization, keeping in mind the larger social and public policy context. Further, it aims to understand how Medicaid expansion leads to reductions in food and housing insecurity. It will do so by answering the following questions in the course of the next two chapters:

Chapter 1: Do individual's experiencing food or housing insecurity when enrolling in Medicaid expansion use more or less primary care in the twelve months after enrollment compared to individuals not experiencing food or housing insecurity at enrollment? And, is this difference modified by residential segregation, rurality, or race?

Chapter 2 asks: Does using primary care in the 12 months following enrollment in Medicaid expansion reduce food and housing insecurity? Are there other pathways, like changes

in budgetary constraints or changes in worry about healthcare costs, in which Medicaid expansion could lead to improvements in material circumstances?

Chapter 1: MATERIAL CIRCUMSTANCES AND PMARY CARE UTILIZATION IN THE FIRST TWELVE MONTHS OF MEDICAID EXPANSION ENROLLMENT

Introduction

The introduction chapter argues that the socioeconomic and political context determines a social hierarchy that then leads to inequities in the distribution of intermediary determinants, namely material circumstances and health care use, that ultimately impact health and health equity. This chapter examines if food and housing insecurity at the time of Medicaid expansion enrollment leads to differential primary care use during the first 12 months of coverage among a sample of new members. It then examines if the relationship between the intermediary determinants of material circumstances and health care use is moderated by segregation, rurality, and race.

The Relationship Between Material Circumstances and Primary Care Use

This dissertation is unique in focusing on the tradeoff between paying for food or housing and primary care utilization in a sample of individuals with public coverage that have zero co-pays or premiums. In theory, if there were no opportunity or healthcare seeking costs, we would expect higher utilization of primary care among individuals experiencing food or housing insecurity because primary care could address these material circumstances and individuals experiencing inadequate material circumstances have higher rates of chronic conditions, potentially leading to an increased demand for care.[128]

Although individuals experiencing food or housing insecurity may have greater demand for care and may potentially have a greater benefit of primary care, there are costs to utilizing care. For example, all Medicaid members may experience nontrivial opportunity costs and healthcare seeking costs, such as taking time off work or the cost of transportation when using

primary care. However, the opportunity costs or care seeking costs might be higher for individuals experiencing food or housing insecurity and so these individuals may seek less primary care than individuals that do not experience food or housing insecurity. Ultimately, we hypothesize that individuals experiencing food and housing insecurity at the time of Medicaid expansion enrollment will use more primary care in the first year of enrollment (Hypothesis 1) because they have a greater need for care and the perceived benefits of care will outweigh the opportunity or healthcare seeking costs of obtaining care.

Moderation of the Relationship Between Material Circumstances and Primary Care Use

As discussed in the introductory chapter's preliminary framework, the distribution of intermediary determinants, including material circumstances and health care use, is shaped by social and public policies including segregation, rurality, and the social construct of race. By extension, the tradeoffs between material circumstances and health care use are also shaped by these aspects of the socioeconomic and political context.

As discussed in the introductory chapter, residential segregation is associated with decreased access to primary care. Therefore, this may make care seeking costs for primary care utilization much greater than the perceived benefits for individuals in a predominately Black neighborhood. Moreover, individuals who are experiencing food or housing insecurity in a predominately Black neighborhood may experience additional barriers to care compared to individuals who also live in predominately Black neighborhoods but are not experiencing food insecurity or individuals who live in predominately White neighborhoods. This may be due to barriers like finding a job with paid time off that could be particularly burdensome for individuals living in predominately Black neighborhoods and for individuals experiencing food insecurity. Consequently, at that intersection, the difference in primary care utilization between

individuals experiencing food or housing insecurity and individuals not experiencing food or housing insecurity may be larger for residents in predominately Black neighborhoods than individuals in predominately White neighborhoods, meaning that individuals experiencing food or housing insecurity in Black communities are the least likely to have a primary care visit.

Alternatively, the exposures that harm health may be greater for all individuals in a predominately Black neighborhood. Subsequently, the perceived benefits of care may be greater for both individuals experiencing food insecurity or not experiencing food insecurity in a predominately Black neighborhood than for individuals living in a predominately White neighborhood. For example, if the collective efficacy is higher in a predominately Black neighborhood, all individuals in that neighborhood may seek more primary care compared to individuals living in a predominately White neighborhood. If this is the case, the difference in primary care utilization between individuals who are food insecure and individuals who are not would be less for individuals in a predominately Black neighborhood compared to individuals in a predominately White neighborhood.

Last, individuals experiencing food insecurity in a predominately Black neighborhood may perceive a higher benefit to care than other individuals in a predominately Black neighborhood. This may occur if individuals experiencing food insecurity in a predominately Black neighborhood know of a healthcare provider that is particularly helpful for addressing food or housing insecurity. In that case the difference in individuals experiencing food insecurity and individuals who are not that live in a predominately Black neighborhood will be greater than the difference among individuals who live in a predominately White neighborhood. In this scenario, individuals living in a Black neighborhood experiencing food insecurity will have the

highest primary care utilization. These same scenarios also apply to rural and non-rural communities as well as Black and White individuals. Ultimately, we hypothesize the following:

1) The likelihood of having a primary care visit for individuals who experience food or housing insecurity compared to individuals who do not experience food or hosing insecurity will be larger for individuals living in Black segregated communities compared to White communities (Hypothesis 1A).
2) The likelihood of having a primary care visit for individuals who experience food or housing insecurity compared to individuals who do not experience food or hosing insecurity will be larger for individuals living in rural communities compared to urban communities (Hypothesis 1B).
3) And finally, the likelihood of having a primary care visit for individuals who experience food or housing insecurity compared to individuals who do not experience food or hosing insecurity will be larger for Black individuals compared to White individuals (Hypothesis 1C).

Methods

Setting and Population

Data were from the Department of Medical Assistance Services (DMAS) database that included enrollment data, demographic information, and claims for all Medicaid members. Individuals who enrolled in Medicaid expansion between January 1, 2019 to June 30, 2019, the first 6 months of Medicaid expansion in Virginia, were identified from these data. We further restricted the sample to include only individuals who were living in Virginia, were between the ages 19 to 64 at the time of enrollment, and were enrolled in full-benefit, non-dual coverage for at least 12 months. Dual-eligible individuals were excluded because all claims that were paid by

Medicare were not present within the DMAS data. Individuals that had coverage under limited eligibility were excluded because Medicaid did not cover all health care service for these individuals, meaning we could not identify all primary care visits for that individual. We did not restrict the sample to Medicaid expansion eligibility for the full year after initial enrollment in Medicaid expansion but rather individuals remained in the sample if they maintained any full benefit non-dual Medicaid eligibility. For example, if an individual initially enrolled in under Medicaid expansion eligibility but was switched to adult blind and disabled eligibility at some point in the 12 months, they were including in the sample. We restricted the age group to 19-64 because these individuals were less likely to have secondary forms of insurance like Medicare.

Outcome: Primary Care Use

Our primary outcome was primary care utilization. We operationalized primary care utilization through the following process. First, all health care encounters for each individual in the sample were identified from the time of enrollment to twelve months after the member's enrollment date from DMAS claims data. We used the Access to Preventive/Ambulatory Health Services HEDIS definition to guide our selection of CPT codes to identify outpatient visits.[171] We included all CPT codes except those for consulting services, telephone visits, online visits, and any group counseling visits. All codes used are listed in the Appendix Table A1. We used the National Plan and Provider and Registry System (NPPES) restricted to providers registered in Virginia to identify the taxonomy of the billing provider for each claim. We considered the following as primary care providers (PCPS) based on previous methods and Virginia Medicaid contract language: family medicine physicians, internal medicine physicians, obstetrician/gynecologists physicians, or pediatric physicians (Taxonomy codes in Table A1).[172] Additionally, we considered family medicine nurse practitioners, FQHCs, and RHCs, as PCPs

since those providers are important parts of primary care (Taxonomy codes in Table A1).[173] The contracts between DMAS and the MCOs specified the following providers as primary care providers: pediatricians, family and general practitioners, internists, obstetrician/gynecologists, and specialists who perform primary care functions such as surgeons, clinics including, but not limited to health departments, Federally Qualified Health Centers (FQHCs), Rural Health Clinics (RHCs), etc.[174] Although we could not identify surgeons or other specialist performing "primary care functions" we did include all other categories of providers. If the visit was billed by a PCP as described above and was an outpatient visit, then it was considered a primary care visit. We then made a binary indicator for each individual in the sample for primary care utilization (at least one primary care visit in the 12 months of coverage vs no primary care visits in the 12 months of coverage).

Independent Variables: Material Circumstances

Virginia DMAS required Managed Care Organizations (MCO), which cover about 90% of all Medicaid members, to screen new members within 90 days of enrollment for medical complexity and social needs.[175] However, screening did not occur or was not complete for all individuals. Correspondingly, we indicated several different final dispositions of the MCO Member Health Screening (MMHS): 1) no MMHS attempt recorded, 2) MCO tried to conduct the MMHS but was unable to reach the individual, 3) MCO tried to conduct the MMHS but the member declined to answer any of the MMHS questions, and 4) the MMHS was successfully completed.

In the MMHS, members were asked "in the past 3 months, did you worry whether your food would run out before you had money to buy more?" with the response options of "yes" "no". Members who answered with neither response were considered missing for that specific

question. Additionally, members were asked "what is your housing situation today? With the response options of "I have housing", "I am worried about losing my housing", "staying with others", "living in a hotel", "living in a shelter", "living outside", or "I chose not to answer". Individuals who answer "I chose not to answer" or had none of the answers checked were considered missing for that question. Individuals who only selected "I have housing" were considered housing secure while individuals who chose any other response excluding the "I chose not to answer" option were considered housing insecure. We created a binary indicator for food insecurity (experiencing food insecurity vs not experiencing food insecurity). Similarly, we created a binary indicator for housing insecurity (experiencing housing insecurity vs not experiencing housing insecurity).

Moderators: Segregation, Rurality, and Race

We considered three primary moderators: 1) residential segregation, 2) rurality, and 3) social construct of race. Proprietary software used by DMAS identified the 2010 census tract corresponding to the respondent's address at the time of enrollment. We identified the zip code of the individual if the census tract is missing.

Residential segregation was explored in three different ways 1) Index of Concentration at the Extremes for race alone (ICE_{Race}), 2) Index of Concentration at the Extremes for income alone (ICE_{Income}), and 3) Index of Concentration at the Extremes for race and income simultaneously ($ICE_{Race/Income}$).[176–178] These indices were preferred over other measures of segregation like the dissimilarity index or clustering because they could be used at smaller geographies and captured both extremes of socioeconomic deprivation and privelege.[176] Using census tract level measures instead of measures at larger spatial units like counties could better

approximate the daily experiences of individuals in their communities and were less likely to underestimate the impact of segregation.[176,179]

To calculate all ICE indexes, we used the 2019 American Community Survey (ACS) five-year estimates. For both ICE measures that include race (ICE_{Race} and $ICE_{Race/Income}$), non-Hispanic White households and non-Hispanic Black households were used because both past and present racist policies in housing has created an enduring pattern of housing segregation between these two specific groups and our sample includes primarily non-Hispanic Black and non-Hispanic White individuals (76.3% of the total sample).[180] We referred to non-Hispanic Black households as Black households and non-Hispanic White households as White households for convivence. For both ICE measures that included economic segregation we used the 80th income percentiles (making $100,000 or more) for high income households and the 20th income percentiles (making $25,000 or less) for the low-income households. ICE indices were not calculated for any census tracts that had less than 100 people (37 census tracts).[181] To calculate the ICE_{Race}, we subtracted the number of Black households from the number of White households and divided by the total number of households in each census tract as done in previous work.[176] To calculate the ICE_{Income} we subtracted the number of low-income households from the number of high-income households and divided by the total number of households.[176] Last, to calculate the $ICE_{Race/Income}$ we subtracted the number of low-income Black households from the number of high-income White households and divided by the number of households.[176]

All of the ICE measure could range from -1 to 1. For the $ICE_{Race/Income}$ measure, a value of -1 meant that all households in that census tract were low-income Black households while a value of 1 meant that all households in that census tract were high-income White households.

Similarly, for the ICE_{Race} measure, a value of -1 meant that census tract contained 100% Black households and a value of 1 meant the census tract contains 100% White households.

Finally, for each ICE index, neighborhoods were divided into terciles as done in prior work based on all of the census tracts in Virginia and not just the census tracts in which someone from our sample lived.[176] Neighborhoods in the first tercile of ICE_{Race} were those with the largest negative percentage point difference between the proportion of White households and the proportion of Black households in the census tract. For example, the maximum value of ICE_{Race} was 0.451 for this tercile and that census tract consisted of 69% White households and 24% Black households. The minimum value of ICE_{Race} for terciles in the third tercile was 0.755. The census tract with this ICE_{Race} value consisted of 83% White households and 7% Black households. We called neighborhoods in the third tercile disproportionately White neighborhoods. We repeated the process for each of the indices using similar terminology for each measure. We then assigned neighborhood terciles for each ICE index to each individual based on their census tract identified by DMAS.

To assess rurality, we used the category obtained from the American Housing Survey neighborhood description conducted by the U.S. Department of Housing and Urban Development at the census tract level. This system was advantageous because it had a suburban designation which provides more granularity than other classifications like Rural-Urban Commuting Codes that are limited to either urban or rural designations.[182,183] Rurality was also assigned to each individual based on their census tract identified by DMAS.

The socially constructed race of an individual was identified by DMAS administrative data. DMAS administrative data identified if an individual was non-Hispanic or Hispanic and in a separate variable, what race an individual was categorized as. Although the DMAS

administrative data included more racial groups, due to sample size limitations we categorized race as non-Hispanic White, non-Hispanic Black, and other race. Other race includes Hispanic individuals as well as individuals from other races (White, Black, Asian, Native American, or Asian/Pacific Islander, Other Race). For convenience we used White individuals for non-Hispanic White individuals and Black members for non-Hispanic Black members. However, again we recognize that race is a social construct and not a biological feature of an individual.

Other Covariates

Other covariates included individual, health plan, and neighborhood level factors obtained from DMAS data. Demographic data provided the sex of each individual (male vs. female) and the birthday of the individual. Age at the time of enrollment was calculated by subtracting the date of enrollment from the date of birth. Age was further categorized into a categorical variable (18-29, 30-39, 40-49, 50-59, 60-64).

To identify medical conditions, we used diagnosis codes from all claims through the 12-month period, including all ED visits, hospitalizations, specialty care, or any other types of healthcare claims. We used diagnosis codes from all claims through the 12-month period for diabetes, liver disease, cardiac disease, and COPD. We included these specific diseases as they are chronic in nature, are common, and are managed in the primary care setting.[184] Codes to identify each disease diagnosis are listed in Table A1. Medical complexity was a designation made by each MCO if an individual had any complex social or health needs.[185] If an individual was designated as medically complex by an MCO at any point during the year of enrollment they were considered medically complex for our analysis.

Health plan information included the time of enrollment, the MCO that the member was first enrolled in, and the MCO that conducted the MMHS screening. These data were obtained

from the enrollment file. Community level factors all linked to the individual based on the census tract that the individual lived in at the time they enrolled in Medicaid expansion. These included ICE_{Race}, ICE_{Income}, $ICE_{Race/Income}$, rurality, and provider accessibility. To determine the PCP accessibility measure we first used a previously collected list of PCPs in Virginia (family medicine and OBGYN, pediatricians and internal medicine physicians with at least one wellness visits).[186] We then identified the number of providers per resident in the census tract by using the two-stage floating catchment method which accounts for the total number of providers and residents within a 30 minute drive from the center of that census tract.[187] If the census tract had less than 80% of residents covered by a physician the census tract was considered to have insufficient access.

Analysis

We used complete case analysis instead of imputing data as any one covariate was missing for less than 13% of individuals and 83% of the sample had complete information (Table 1). We weighted our complete cases to better represent the total population enrolled in Medicaid expansion between January 1, 2019 and June 30, 2019 as a significant proportion of the total population do not have a complete MMHS (92%). We weighted cases using propensity scoring methods. To create this weight, we used a logistic regression to regress the probability of having a complete MMHS on gender, age, gender and age interacted, race, medical complexity, MCO, diabetes diagnosis, liver disease diagnosis, cardiac disease diagnosis, COPD diagnosis, and the county that the individual lived in. We then predicted the probability of completing the survey and divide 1 by that value.[188]

To visualize segregation and rurality across Virginia we created maps depicting census tracts by tercile of each segregation index and by rurality in four different maps. All maps were completed using R studio 4.3.1 and the tidycensus package.[189,190]

At the individual level, we first described characteristics of the sample. We then compared this sample to the total sampling frame which contained all individuals enrolled in Medicaid expansion during our time frame of interest. We then used chi-squared tests to test univariate associations between primary care utilization and each characteristic of our complete sample. Next, we used linear probability models to identify the relationships between food insecurity and housing insecurity at the time of enrollment and the probability of having a primary care visit in the following 12 months of coverage adjusting for observed covariates among the total sample with standard errors clustered at the county level and with models including a county-level intercept. To better understand the relationship between material circumstances and primary care use as sets of covariates were introduced, we used a stacked model approach. We first introduced individual level covariates (sex, race, age), individual level covariates with health variables (diabetes diagnosis, liver disease diagnosis, cardiac disease diagnosis, COPD diagnosis, medical complexity). Then we added plan level factors (time of enrollment, MCO plan that conducted the MMHS) to the first model. Last, we added neighborhood level factors to the prior model (rurality, $ICE_{Race/Income}$, PCP availability). While we calculated three different ICE measures, we only include $ICE_{Race/Income}$ in our final model. We use $ICE_{Race/Income}$ instead of ICE_{Race} or ICE_{Income} alone because it better encapsulated the experience of segregation which is both racial and economic in nature.[176,179]

We considered using several different types of models. First, we considered using census tract intercepts instead of county-level intercepts but found that some census tracts had only one

individual in the sample and the maximum number of individuals in any census tract was 38. Additionally, when performing an unweighted multilevel model at the census tract level, the ICC was low (model not shown). In comparison, the fewest number of individuals in any county was 6 but the maximum number of individuals is 900. Together, this suggests that the dependence between individuals in the census tract was relatively small, so we used county-level intercepts. We do not use multilevel models for our final models as have been used in other studies because the propensity scoring weights were created at the individual level and therefore applying them at the higher level in multilevel models biased the results.[191(pp2013–2017),192] We used linear probability models instead of logistic regression models, despite our binary outcome, due to the ease of interpretation of these models.[193]

After arriving at the final model, we then stratified the regression by tercile of ICE_{Race} which allowed for interactions between race and all covariates. For these models, county level intercepts were not included as the sample size was smaller. We repeated this approach for ICE_{Income}, $ICE_{Race/Income}$, rurality, and socially constructed race separately. Last, when analyzing these data, we unexpectedly found differences in primary care utilization by MCOs. Because this is a potential policy lever, we stratified the main model by MCO. All analyses were conducted with STATA SE 7.

Sensitivity analysis

Regression models. In addition to linear probability models with clustering at the county level and county level intercepts, linear probability models were also fit with clustering at the MCO level instead. Further, because our outcome was binary, we also included logistic regression models and the corresponding marginal effects.

Primary care definition. We created alternative primary care visit definitions. The first alternative did not include outpatient visits with NPs/PAs, FQHCs, or RHCs. The second alternative included outpatient visits conducted by PCPs excluding internal medicine physicians. The third alternative included outpatient visits conducted by PCPs excluding OBGYNs. The fourth alternative only included outpatient visits conducted by the list of providers that the research team had previously identified as PCPs in prior work.[186] The fifth alternative included all visits with CPT codes in the Preventive/Ambulatory Health Services by PCPs (internal medicine, family medicine, obstetrics/gynecology, pediatricians, FQHCs, family NPs/Pas, FQHCs, RHCs) used in the main model.

Food and housing insecurity. To assess if there is a dose dependent association between material circumstance and primary care use, we created a combined social needs indicator with three levels (not experiencing food or housing insecurity vs. experiencing either food or housing insecurity vs. experiencing both food and housing insecurity). We also conducted models that only assessed the relationship between food insecurity and primary care utilization without including housing insecurity. Alternatively, we conducted models that only assessed the relationship between housing insecurity and primary care utilization without including food insecurity.

Weights. In addition to the propensity scoring weights, we also created weights using the calibration raking-ratio method.[194] This procedure took the base weight of the sample that had a complete MMHS and then adjusted that weight so the sample matched the total population of the sampling frame on based on MCO, gender, race, and age.

Imputed data. Although 12% of members were missing the census tracts in which they lived at the time of enrollment, many of those individuals had a zip code identified. For

individuals with only zip codes, we imputed the census tract by selecting the census tract that was most common among individuals in the sample that lived in that zip code. We then assigned the neighborhood level information, the segregation indices, rurality, and PCP accessibility, of the census tract that was imputed for that individual.

COVID-19. Our sample included individuals who enrolled in Medicaid up to the end of June 2019, meaning that the year of observation for some individuals included several months of the pandemic (March 2020 - June 2020). This could have impacted our results as prior evidence suggests that individuals reduced primary care utilization during the pandemic and experienced changes in material circumstances.[195,196] To examine the effect of the pandemic on our sample, we restricted a subsample to individuals who enrolled prior to March 2019 and compared these estimates to the sample who enrolled after March 2019.

Primary care and emergency room use. Many individuals use the emergency department as their source of primary care.[197] To better understand this relationship, we restricted the sample to individuals who did not use the emergency room and reran our models. We then restricted the sample to individuals who had at least one ED visit and examined the outcome of having any primary care visits. Last, we restricted the sample to individuals without any primary care utilization and then examined the relationship between food and housing insecurity and ED visits as these individuals were likely using emergency department as their primary care. For this, ED visits were identified by CPT and revenue codes as specified by DMAS (codes listed in Table A1). Similar to primary care, we created a binary indicator for ED utilization (at least one ED visit in the 12 months after enrollment in Medicaid vs. no ED visits in the 12 months after enrollment).

Results

Describing Neighborhood Level Characteristics

Figure 2 demonstrated the neighborhood level characteristics across Virginia. Figure 2A explored racial residential segregation in Virginia and found that Tercile 1 ICE_{Race} neighborhoods, disproportionately Black neighborhoods, were concentrated largely in the southeastern and eastern parts of Virginia. Tercile 3 ICE_{Race} neighborhoods, or disproportionately White neighborhoods, were concentrated along the western border of Virginia. Similarly, figure 2B explored the distribution of economic segregation across Virginia. We found that the southwestern and central southern parts of Virginia consisted of primarily Tercile 1 ICE_{Income} census tracts or disproportionately low-income neighborhoods. The Tercile 3 ICE_{Income} census tracts, disproportionately high-income neighborhoods, were mostly clustered in Northern Virginia, parts of Norfolk/Virginia Beach, and the western part of Richmond city. Last, the geographic pattern of the $ICE_{Race/Income}$ was more difficult to discern. However, Northern Virginia, the western part of Richmond, City and parts of Norfolk/Virginia Beach had neighborhoods in the Tercile 3 $ICE_{Race/Income}$, disproportionately high-income White neighborhoods (Figure 2C). Figure 2D displayed the rural, suburban, and urban neighborhoods in Virginia. Expectedly urban and suburban areas were in Richmond, northern Virginia, and the Norfolk/Virginia Beach area. Out of all the census tracts in Virginia, 23% were urban, 51% were suburban, and 26% were rural.

Describing the Newly Enrolled Medicaid Expansion Sample

In total, we found that 347,168 individuals enrolled in Medicaid expansion during our time frame of interest. From these individuals, 14% (49,372 members) did not remain enrolled for 12 continuous months as seen in Figure 3. The final sampling frame consisted of 234,296

individuals that remained enrolled in full benefit plans for 12 continuous months, that lived in Virginia, and were between the ages of 19 and 64 at the time of enrollment.

The majority of the individuals in the sampling frame (75.1%) did not have a MMHS recorded by an MCO within 90 days of enrollment. Among the 58,395 individuals with an MMHS or MMHS attempt recorded, 68.7% were not able to be contacted, 0.7% refused to complete the MMHS, and 30.6% (7.6% of the total sample) completed an MMHS (Table A2). Compared to all members, individuals who completed the MMHS were more likely to be female (62.9% vs. 59.6%), White (56.0% vs. 51.1%) and between 60-64 (9.5% vs. 6.1%; Table 1). Individuals who completed the MMHS were sicker than individuals who did not: were medically complex (41.4% vs. 13.7%), had a diagnosis of diabetes (17.3% vs. 10.7%), had a diagnosis of liver disease (8.5% vs 5.5%), had a diagnosis of cardiac disease (8.7% vs. 5.2%), and had a diagnosis of COPD (21.4% vs. 14.4%). Additionally, the MCO in which an individual was first enrolled in differed between samples (e.g. for Plan A 6.7% for individuals with an MMHS vs. 16.7% for the entire sample). Importantly, more members with a completed MMHS than the total sample had at least one primary care visit (74.1% vs. 57.5%).

Univariate Association between Primary Care Utilization and Characteristics in the Sample

We then examined univariate differences in individuals with a primary care visit and without a primary care visit in the weighted sample of individuals who completed an MMHS (Table 1). First, 17.2% (95% confidence interval (CI): 15.9, 18.5) of individuals experienced food insecurity while 20.5% (95% CI: 19.3, 21.8) experienced housing insecurity at the time of enrollment. Having at least one primary care visit was not associated with either food insecurity or housing insecurity. Conversely, being female, being a White individual, and being older were positively associated with having a primary care visit. Having a primary care visit also

significantly differed by the MCO in which an individual was first enrolled in. Unsurprisingly, all of the chronic diseases were significantly positively associated with having a primary care visit. Last, primary care utilization did not differ by rurality, ICE_{Race}, ICE_{Income}, $ICE_{Race/Income}$, or PCP availability.

Association between Primary Care Utilization and Material Circumstances

We then examined the relationship between food and housing insecurity with primary care utilization (Hypothesis 1). In unadjusted regressions, there was no association between food or housing insecurity and primary care utilization (1.6 percentage points (PP); 95% CI: -0.6, 3.9 and -0.6 PP; 95% CI: -3.4, 2.3 respectively; Table 2). When controlling for individual level demographic characteristics alone, there was no significant relationship between food insecurity and having a primary care visit in the subsequent 12 months of coverage (-0.4 PP; 95% CI: -2.5, 1.6; Model B). However, when controlling for individual level factors, including health conditions, individuals experiencing food insecurity at the time of enrollment were 2.1 PP (95% CI: -4.1, -0.1; Model C) less likely to have a primary care visit in the subsequent 12 months of coverage compared to individuals not experiencing food insecurity at the time of enrollment. This association slightly increased in magnitude and remained significant when controlling for plan level factors (-2.9 PP; 95% CI: -4.9, -0.8; Model D) as well as when controlling for plan level and neighborhood level factors (-2.8 PP; 95% CI: -4.9, -0.8 Model E). The association between housing insecurity and primary care use was not significant in any models.

Moderation of the Association between Primary Care Utilization and Material Circumstances

Residential segregation. To answer the next hypothesis (1A), we examined each tercile of segregation for the ICE indices separately. First, we focused on the three subgroups of

ICE_{Race}. We found that there was a significant negative relationship between experiencing food insecurity at the time of enrollment and primary care utilization in the subsequent year of coverage for individuals living in neither disproportionately Black or White neighborhoods (-7.9 PP; 95% CI: -14.1, -1.7) but not for individuals living in disproportionately Black or disproportionately White neighborhoods (-2.9 PP; 95% CI: -6.0, 0.2 and 1.1 PP; 95% CI: -3.5, 5.8 respectively). We found that there was a significant negative association between food insecurity and primary care use for individuals living in disproportionately low-income neighborhoods or neighborhoods that were neither disproportionately high- or low-income neighborhoods (-3.2 PP; 95% CI: -6.1, -0.4 and -4.4 PP; 95% CI: -8.2, -0.6 respectively). We found no significant relationship for individuals living in disproportionately high-income neighborhoods. However, there was no significant relationship between experiencing food insecurity and primary care utilization in the subsequent year of coverage for individuals of any subgroup stratified by tercile of $ICE_{Race/Income}$.

Rurality. We found similar results for hypothesis 1B. Among individuals living in urban neighborhoods, individuals experiencing food insecurity were 4.1 PP (95% CI: -7.9, -0.3; Table 4) less likely to have a primary care visit during the first year of coverage than individuals not experiencing food insecurity at enrollment. Similarly, among individuals living in suburban neighborhoods, there was a significant negative association between experiencing food insecurity and primary care use for individuals (-4.2 PP; 95% CI: -7.3, -1.1). However, there was no relationship between food insecurity and primary care use among individuals living in rural neighborhoods. There was no significant relationship between housing insecurity and primary care utilization in any individuals living in urban, suburban, or rural neighborhoods.

Social construction of race and MCO. Last, we examined the moderating effect of socially constructed race and MCO. When the sample was stratified by socially constructed race, Black members experiencing food insecurity at enrollment were not significantly less likely to visit primary care during the first year of coverage compared to Black members not experiencing food insecurity at the time of enrollment (-3.0 PP; 95% CI: -7.0, 10.2; Table 5). Similarly, we found no significant association between experiencing food insecurity or housing insecurity at the time of enrollment and primary care utilization among White members. However, among individuals identified as a Hispanic ethnicity or a race other than White or Black, individuals experiencing food insecurity were significantly less likely to visit primary care during the year of coverage than individuals not experiencing food insecurity at the time of enrollment (-10.1 PP; 95% CI: -17.4, -2.9). However no significant relationship between experiencing housing insecurity at the time of enrollment and primary care utilization in the subsequent year of coverage was identified for Black individuals, White individuals, or individuals categorized as other race. When stratifying the main model by the MCO that conducted the MMHS screening, two particular MCOs stood out. Among members screened by Plan A and D, which included 40% of the complete cases collectively, individuals experiencing food insecurity were both 7.3 PP less likely to visit primary care (95% CI: -14.4, -0.2 and -11.4, -3.2 respectively). In comparison, among individuals in Plan B, which covered about 18% of complete cases, there was no significant relationship between experiencing food insecurity and primary care utilization (1.2 PP; 95% CI: -3.6, 6.0).

Robustness of Results

Sensitivity testing largely agreed with the results reported here. First, we assessed the sensitivity of our results to the model specification used and how primary care was defined. We

found that the magnitude of effect of food insecurity on primary care utilization was slightly larger when using definitions of primary care that did not include NPs/PAs, FQHCs, or RHCs (Table A6). The association between experiencing food insecurity and primary care utilization was not significant if primary care did not include internal medicine physicians and if it did not include OBGYNs (Table A6). The association between experiencing food insecurity and primary care utilization was slightly larger when only including visits conducted with PCPs using the previously identified list of PCPs (Table A6). The relationship between food insecurity and primary care was of similar magnitude when including the measure using all HEDIS codes (Table A6). The effect size for models using clustering at the MCO level were largely similar to our main model, although these models more commonly identified nonsignificant associations. Among the models using unweighted data, the associations tend to be slightly smaller in magnitude but in the same direction and level of significance, except for those clustering by the MCO that conducted the MMHS screening.

The alternative weighting method and models using imputed data at the zip code level produced similar results to those shared in the main model (Table A7 and A8 respectively). Last, the models that only included individuals that had a year follow-up before COVID began were similar in magnitude but the relationship between primary care use and food insecurity was not significant. When examining the relationship between ED visits and primary care utilization we found that the association between food insecurity and primary care was larger in magnitude for individuals who had at least one ED visit compared to individuals without an ED visit (Table A10). Further, there was a significant positive relationship between food insecurity and ED utilization among individuals who did not use any primary care (Table A10).

Because of the significant relationship between food insecurity and primary care utilization among individuals who identified as other race and Hispanic ethnicity, we then stratified the sample by ethnicity to try and understand the separate effects of race and ethnicity. We found that among all individuals categorized as non-Hispanic ethnicity, experiencing food insecurity was significantly negatively associated with primary care utilization after a year of coverage (-3.1 PP; 95% CI: -5.3, -0.9; Table A11). Importantly, this association was much larger in magnitude among non-Hispanic individuals who were not categorized as White or Black enrollees (-10 PP; 95% CI: -17.7, -2.3). Among Hispanic or Latino individuals of any race, experiencing food insecurity was not significantly associated with primary care utilization (-5.9 PP; 95% CI: -20.2, 2.4). When examining only Hispanic or Latino White individuals the association between food insecurity and primary care remained nonsignificant but the magnitude was positive (2.1 PP; 95% CI: -15.0, 19.0). We did not conduct multi-level regression for non-White Hispanic or Latino individuals as there was only 48 individuals.

Discussion

We used a sample of newly enrolled Virginia Medicaid expansion members to assess the relationship between material circumstances at the time of enrollment and primary care utilization in the subsequent year of coverage. We found that individuals experiencing food insecurity at the time of enrollment were significantly less likely to use primary care in the first year of coverage. We did not find any significant difference in primary care utilization by housing insecurity. Additionally, we found a significant negative relationship between experiencing food insecurity at the time of enrollment and primary care utilization for individuals living in disproportionately low-income neighborhoods but not for individuals in disproportionately high-income neighborhoods. Further, we found a significant relationship

between food insecurity at the time of enrollment and primary care utilization during the subsequent year of coverage among individuals living in urban and suburban neighborhoods but not rural neighborhoods. We did not find a significant relationship between primary care utilization and food insecurity for White or Black members but found a significant relationship for members categorized as a race other than White or Black. Last, the relationship between primary care utilization and food insecurity was only significant among individuals enrolled in specific MCOs.

We found that decreased primary care utilization was significantly associated with food insecurity but that there was no association between housing insecurity and primary care use. This is contrary to our hypothesis that primary care utilization would be higher for individuals experiencing food or housing insecurity. We believed that the perceived benefit of primary care would outweigh any associated costs with getting care in this sample as Medicaid insured individuals have low or no cost sharing requirements. However, our findings were in line with prior work focused on individuals with different types of health insurance that found individuals experiencing food insecurity used less primary care due to competing demands between healthcare costs and other goods.[158,165] Our findings suggest that individuals experiencing food insecurity face more substantial opportunity or travel costs to using health care compared to individuals not experiencing food insecurity. For example, individuals who are experiencing financial insecurity may be employed in jobs that offer less flexibility for office visits during normal business hours or may not have transportation to a doctor's office, increasing the barriers to utilization.[198] Alternatively, our findings suggest that individuals experiencing food insecurity may perceive fewer benefits to medical care compared to individuals not experiencing food insecurity, thus seeking less primary care than individuals not experiencing food insecurity. For

example, there is some evidence that individuals with inadequate material circumstances do not experience the same quality of care due to decreased "mental bandwidth" to take on additional burdens when already facing increased financial stress.[128] Additionally, Medicaid may not cover some services, like over the counter prescriptions or additional physical therapy, that a physician may order. If an individual cannot afford those costs, going to the doctor may not be helpful. Last, it may be that primary care is not adequately addressing social needs, making the perceived benefit of healthcare limited from the patient's perspective. This work suggests that additional policies are needed to ensure that individuals experiencing food insecurity can use primary care and that this care addresses all components of whole health.

Understanding Moderation in the Relationship between Food Insecurity and Primary Care Utilization

Our next hypotheses focused on the moderating role of social policies and socioeconomic position including residential segregation, rurality, and race. We found that there was a significant relationship between food insecurity and primary care utilization for individuals living in disproportionately low-income neighborhoods. Food insecurity may be a particular barrier for individuals in disproportionately low-income or mixed income neighborhoods because of chronic disinvestments in community infrastructure that facilitates access to primary care such as transportation or jobs with paid sick leave. Interestingly, there was only a marginally significant association between food insecurity and primary care utilization among individuals living in disproportionately Black neighborhoods which may because there are particular community strengths in predominately Black neighborhoods. For example, Federally Qualified Health Centers (FQHCs) are more likely to be in neighborhoods with a higher percentage of minorities and these centers may be particularly helpful for individuals

experiencing food or housing insecurity as addressing HRSN is part of an FQHC's mission.[75] It also suggests that social cohesion and community building that are often assets in predominately Black communities may help overcome barriers of material circumstances for Medicaid members.[87,61]

Similarly, we hypothesized that differences in primary care utilization between individuals experiencing food or housing insecurity and individuals who are not would be greater in rural communities compared to non-rural communities. However, our results do not suggest this is the case. As mentioned previously, prior evidence suggests that providers are more willing to accept Medicaid in rural areas, which may reduce the mental bandwidth required to get care, a barrier particularly important for individuals experiencing food or housing insecurity. However, it may also indicate that individuals in rural communities generally, including individuals experiencing food insecurity, are underutilizing primary care leading to no observed differences between these two groups.[116] However, our results do not indicate that individuals living in rural communities use less primary care.

Third, we hypothesized that the difference in food insecurity and primary care visits would be greater among Black members as compared to White members. We do not find evidence to support that hypothesis. We hypothesized that this relationship may be due to larger barriers to seeking care when experiencing food insecurity for Black individuals compared to White individuals. For example, the lack of trust in medical institutions among Black individuals due to a past and present history of racism within these institutions may make the benefits of primary care less salient.[140] However, this does not seem to translate to differences in utilization of care by Black individuals experiencing food insecurity compared to Black individuals not experiencing food insecurity. However, Black members use less primary care than White

individuals in our sample, which may lead to no observable difference between Black members experiencing food insecurity compared to not experiencing food insecurity. Interestingly, we find a significant difference in individuals categorized as Hispanic ethnicity or as race other than White or Black. Our results suggest that racial groups other than White or Black enrollees experience food insecurity as a particular barrier to primary care utilization. Food insecurity may be an even greater barrier for individuals who are categorized as non-White Hispanic. However our sample size is limited for non-White Hispanic individuals and it may be difficult to draw conclusions about this heterogenous group. Ultimately, more work is needed to address different barriers to primary care use among this group.

Importantly, we found that MCOs moderate the relationship between food insecurity and primary care visits. This may be because of particular services offered by different MCOs.[174] For example, MCOs offer care coordination but the connection and success of care coordinators varies by MCO.[199] Further, care coordination is not required for every Medicaid enrollee, but is given to individuals at the discretion of the MCO, creating some variability in who MCOs connect with a care coordinator.[185] These variances may lead to differences in both resolving food and housing insecurity as well as connecting individuals to primary care. Further, the adequacy of providers may also vary by MCO as the development and maintenance of an adequate network is the responsibility of the MCO.[174] Taken together, these findings suggest that MCO contracts and requirements may be a salient policy lever state Medicaid agencies can use to decrease barriers to care by replicating the practices in well-performing MCOs and mandating improvements in poor performing MCOs.

Understanding the Robustness of our Results

Our sensitivity analysis reveals that particular features of primary care utilization are sensitive to alternative specifications. First, the negative association between food insecurity and primary care use was slightly larger when using definitions of primary care that did not include NPs/PAs, FQHCs, or RHCs. This may indicate that these providers reduce barriers to care seeking, particularly for individuals experiencing food or housing insecurity. This is unsurprising as health centers are required to provide care coordination services and services that facilitate access to care to qualify for the Health Center Program.[76] Second, we found that the association between food insecurity and primary care was not significant in the cohort of individuals enrolled in Medicaid expansion prior to March 2019 but was larger and significant for individuals enrolled after March 1, 2019. This may suggest that COVID increased barriers to primary care utilization particularly among individuals who were also experiencing food insecurity at the time of enrollment. Third, when examining subsamples of individuals who did not use any emergency department care, we found no significant association between food insecurity and primary care use, though the coefficient was similar in magnitude to the full sample. The association was larger and significant among individuals with at least one ED visit. This may be because individuals are sicker and therefore have a greater demand for ED visits but experience high burdens to accessing primary care if they are experiencing food insecurity as well. Among individuals with no primary care visits, food insecurity was positively associated with ED visits, a finding common in the literature.[168]

Limitations

While our study is novel in many aspects, it does face several limitations. First, the sample of individuals who have complete data is much smaller and different than the number of individuals who enrolled in Medicaid at the time of interest, what we consider our sampling

frame. While we attempt to correct the potential non-response bias by weighting, the overall primary care utilization rate is still higher in the complete cases than the overall sampling frame. Although we are concerned about bias, the associations found in our unweighted models are similar to the associations found in our weighted models, which may suggest that our results are representative of results we would have found with complete data. Additionally, we would have preferred to use a multilevel model but that was complicated by the desire to weight the sample and the limited number of individuals in each census tract or county. However, we did perform several different specifications of our preferred model, and our estimates remained of very similar magnitude and always in the same direction. Further, our timing for the data was constrained as Virginia Medicaid expanded in 2019 and then COVID-19 occurred in early 2020. The first several months of expansion may not be representative of all Medicaid expansion individuals but in later months, COVID may have hampered primary care utilization or altered material circumstances. Reassuringly, our estimates were in the same direction when constraining the sample to individuals without any observation time during the pandemic. Another weakness is using claims data to identify diagnosis of individuals as individuals have to engage with the healthcare system to obtain a diagnosis. This may increase the probability that individuals with a diagnosis also have a primary care visit because we cannot observe the diagnosis of individuals who do not use any healthcare. Last, we initially planned to assess moderation of both race and segregation simultaneously. However, only 259 Black individuals lived in a disproportionately White neighborhood, making it difficult to be powered to detect differences in these regressions, which ultimately led to our decision to not stratify the sample in that manner.

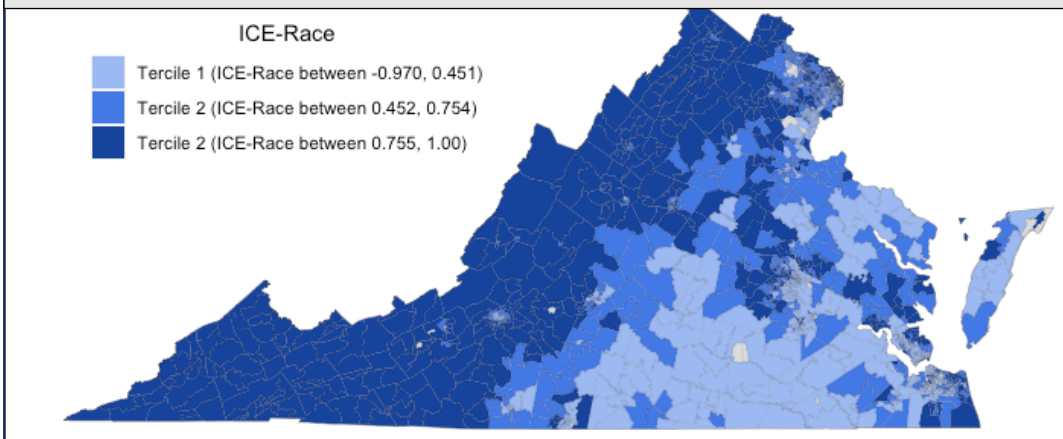
Conclusion

In summary, this study advances the field by examining the relationship between material circumstances and primary care use in a low-income sample of individuals with public insurance. This work suggests that food insecurity continues to be a barrier to primary care utilization and that public insurance alone is insufficient to enable individuals experiencing food security to use primary care. State policy makers must consider interventions that could address other barriers to primary care utilization for individuals experiencing food insecurity at the time of enrollment. State policy makers may be able to identify some helpful policies by examining MCOs that had no association or positive associations between material circumstances and primary care utilization. Further, this association between primary care and experiencing food insecurity varied by residential segregation and rurality. Segregation continues to harm residents of predominately Black neighborhoods as individuals experiencing inadequate material circumstances, conditions that harm health, use less primary care compared to other individuals in predominately Black neighborhoods. State policy makers must consider interventions to overcome barriers to primary care within the neighborhood context.

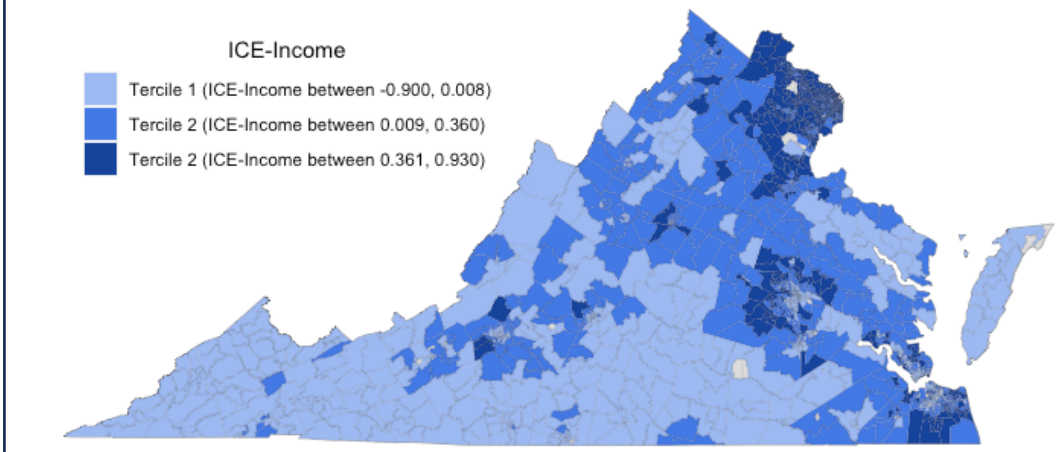
Figures and Tables

Figure 2: Spatial depictions of key variables in Virginia

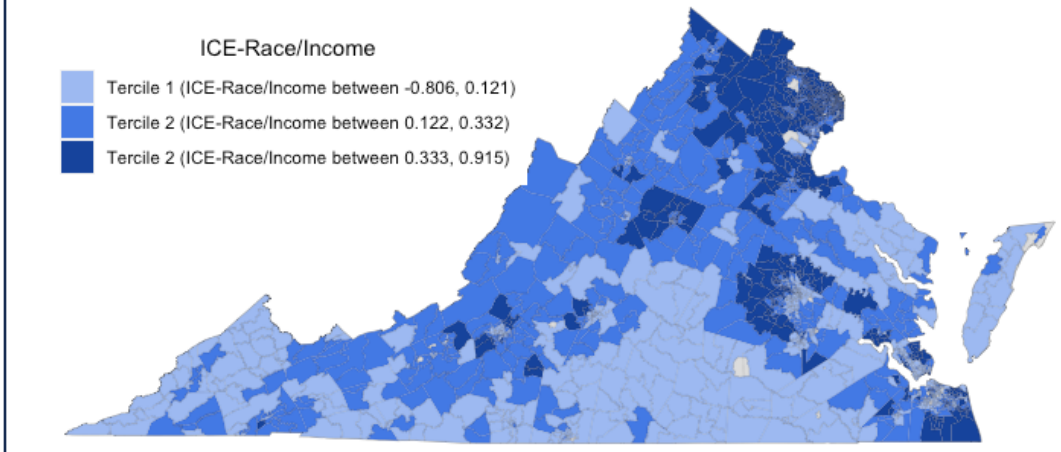
A. Census tracts by racial residential segregation (ICE_{Race}) in Virginia[b]



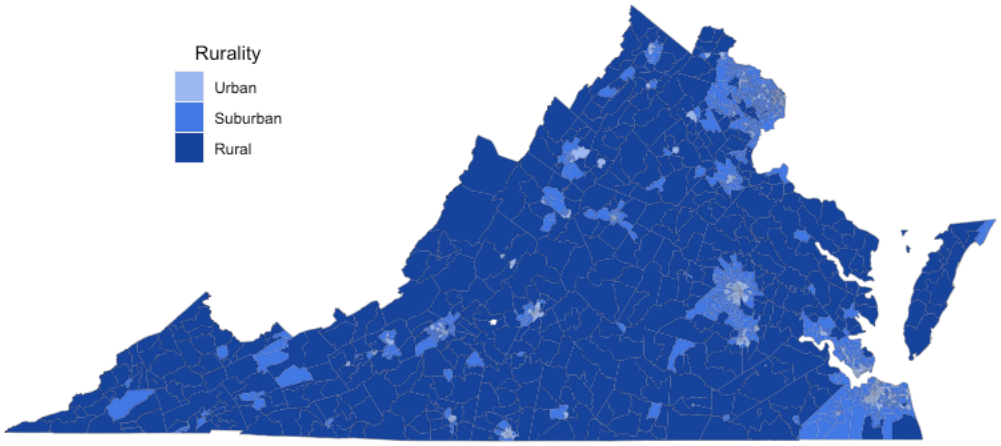
B. Census tracts by economic residential segregation (ICE_{Income}) in Virginia[b]



C. Census tracts by combined racial and economic residential segregation ($ICE_{Race/Income}$) in Virginia[b]



D. Census tracts by rurality in Virginia[a]



[a]Data obtained from the U.S. Department of Housing and Urban Development. [b]Data obtained from the 2019 American Community Survey 5-year estimates. An ICE_{Race} measure of 0.451 means that the percentage point (PP) difference between White households and Black households is 45 PP or less. In Virginia, one census tract with an ICE_{Race} score of 0.451 has 69% White households and 24% Black households. A census tract with a score of 0.746 in Virginia has 80% White households and 6.2% Black households. For ICE_{Income}, the score represents the percentage point difference in high-income households compared to low-income households in a census tract. In Virginia, one census tract with an ICE-Income score of 0.009 has 18% high-income households and 8% low-income households. The same principle applies to the $ICE_{Race/Income}$ measure.

Figure 3: Creation of sample of continuously enrolled Medicaid expansion members between 19-64 who enrolled between January 2019 and June 2019

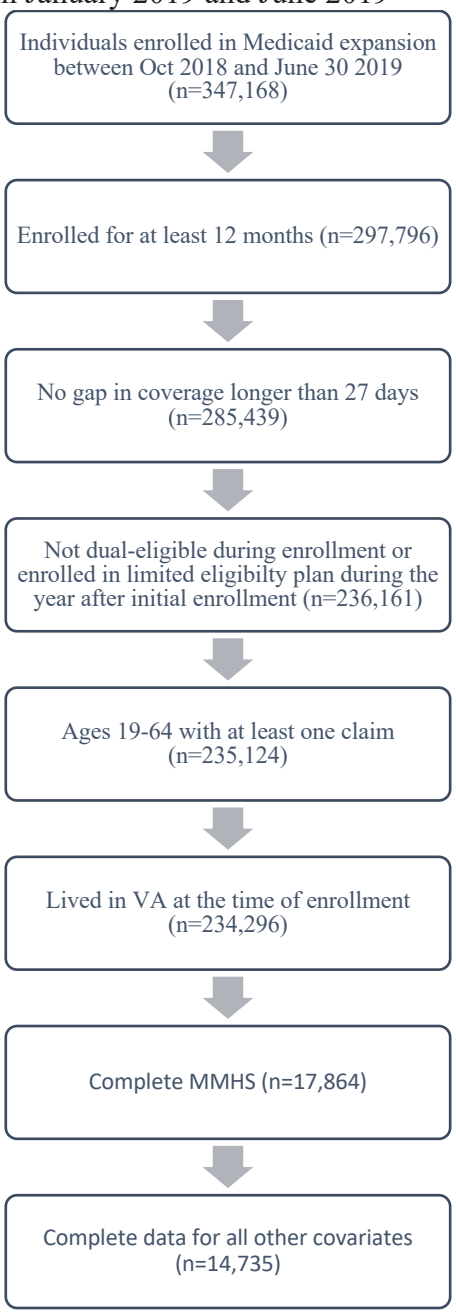


Table 1: Weighted characteristics of Virginia Medicaid expansion members enrolled between January 2019 and June 2019

	All Medicaid expansion members (n=234,296) Number (%)	Total unweighted sample (n=17,864) Number (%)	Complete Cases		
			Total weighted complete sample (n=14,735) % (95% CI)	No primary care visit (n=3,853) % (95% CI)	At least one primary care visit (n=10,882) % (95% CI)
Individual level factors					
At least one PCP visit	134,813 (57.5%)	13,231 (74.1%)	70.8 (69.5, 72.2)	---	---
Food insecure					
No	---	14,015 (78.5%)	82.8 (81.5, 84.1)	83.5 (81.3, 85.4)	82.6 (81.4, 83.7)
Yes	---	3,637 (20.4%)	17.2 (15.9, 18.5)	16.5 (14.6, 18.7)	17.4 (16.3, 18.6)
Missing		212 (1.2%)	---	---	---
Housing insecure					
No	---	13,127 (73.5%)	79.5 (78.2, 80.7)	79.4 (77.0, 81.5)	79.5 (78.1, 80.8)
Yes	---	4,157 (23.3%)	20.5 (19.3, 21.8)	20.6 (18.5, 23.0)	20.5 (19.2, 21.9)
Missing		580 (3.3%)	---	---	---
At least one ED visit***					
No	132,655 (56.6%)	9,660 (54.1%)	59.6 (56.3, 62.9)	70.8 (66.7, 74.6)	54.0 (50.6, 57.3)
Yes	101,641 (43.4%)	8,204 (45.9%)	40.4 (37.1, 43.7)	29.2 (25.4, 33.3)	46.0 (42.7, 49.4)
Sex***					
Male	94,694 (40.4%)	6,629 (37.1%)	38.0 (36.0, 40.0)	48.9 (46.0, 51.8)	33.5 (31.6, 35.5)
Female	139,602 (59.6%)	11,235 (62.9%)	62.0 (60.0, 64.0)	51.1 (48.2, 54.0)	66.5 (64.5, 68.4)
Socially-constructed race**					
White members	119,699 (51.1%)	9,996 (56.0%)	50.5 (44.8, 56.1)	46.9 (41.1, 52.8)	51.9 (46.2, 57.6)
Black member	77,979 (33.3%)	5,282 (29.6%)	33.8 (27.7, 40.6)	36.1 (29.8, 43.0)	32.9 (26.7, 39.7)
Other[a]	36,618 (15.6%)	2,586 (14.5%)	15.7 (12.7, 19.2)	17.0 (13.5, 21.0)	15.2 (12.2, 18.8)
Age***					
18-29	74,781 (31.9%)	3,605 (20.2%)	30.6 (29.3, 31.9)	40.4 (37.6, 43.2)	26.6 (25.4, 27.8)
30-39	56,391 (24.1%)	3,826 (21.4%)	24.7 (22.8, 26.7)	25.6 (22.8, 28.8)	24.3 (22.4, 26.3)
40-49	44,453 (19.0%)	4,000 (22.4%)	19.2 (18.1, 20.4)	15.1 (13.8, 16.6)	20.9 (19.5, 22.3)
50-59	44,307 (18.9%)	4,736 (26.5%)	18.8 (17.7, 20.1)	13.8 (12.1, 15.6)	20.9 (19.7, 22.2)
60-64	14,364 (6.1%)	1,697 (9.5%)	6.7 (6.1, 7.3)	5.0 (4.2, 6.1)	7.3 (6.6, 8.1)
Diabetes***					
No diagnosis	209,147 (89.3%)	14,782 (82.8%)	88.5 (87.7, 89.2)	96.7 (95.8, 97.4)	85.1 (84.1, 86.1)
Diagnosis	25,149 (10.7%)	3,082 (17.3%)	11.5 (10.8, 12.3)	3.3 (2.6, 4.2)	14.9 (13.9, 15.9)
Liver disease***					
No diagnosis	221,459 (94.5%)	16,345 (91.5%)	94.2 (93.8, 94.7)	97.8 (97.0, 98.4)	92.8 (92.2, 93.3)
Diagnosis	12,837 (5.5%)	1,519 (8.5%)	5.8 (5.3, 6.2)	2.2 (1.6, 3.0)	7.2 (6.7, 7.8)
Cardiac disease***					
No diagnosis	222,053 (94.8%)	16,312 (91.3%)	94.7 (94.2, 95.1)	98.0 (97.4, 98.5)	93.3 (92.7, 93.8)
Diagnosis	12,243 (5.2%)	1,552 (8.7%)	5.3 (4.9, 5.8)	2.0 (1.5, 2.6)	6.7 (6.2, 7.3)
COPD***					
No diagnosis	200,529 (85.6%)	14,040 (78.6%)	85.2 (83.6, 86.7)	94.4 (93.1, 95.4)	81.4 (79.6, 83.1)
Diagnosis	33,767 (14.4%)	3,824 (21.4%)	14.8 (13.3, 16.4)	5.6 (4.6, 6.9)	18.6 (16.9, 20.4)
Medically complex***[b]					
No	202,181 (86.3%)	10,468 (58.6%)	83.5 (81.5, 85.3)	87.6 (85.8, 89.1)	81.8 (79.6, 83.8)
Yes	32,115 (13.7%)	7,396 (41.4%)	16.5 (14.7, 18.5)	12.4 (10.9, 14.2)	18.2 (16.2, 20.4)
Plan level factors					
Month of enrollment					

Jan '19	162,848 (69.5%)	12,600 (85.5%)	81.8 (80.6, 82.9)	81.7 (79.4, 83.8)	81.8 (80.3, 83.2)
Feb '19	15,016 (6.4%)	462 (3.1%)	3.7 (3.2, 4.1)	3.5 (2.8, 4.5)	3.7 (3.2, 4.3)
March '19	15,453 (6.6%)	421 (2.9%)	3.4 (3.0, 4.0)	2.9 (2.1, 3.9)	3.7 (3.1, 4.4)
April '19	14,269 (6.1%)	438 (3.0%)	3.4 (3.1, 3.9)	3.7 (2.9, 4.7)	3.4 (2.9, 3.9)
May '19	14,007 (6.0%)	429 (2.9%)	4.2 (3.6, 4.7)	4.3 (3.3, 5.5)	4.1 (3.6, 4.8)
June '19	12,703 (5.4%)	385 (2.6%)	3.5 (2.9, 4.3)	3.9 (3.1, 4.8)	3.4 (2.6, 4.4)
MCO***[c]					
A	39,236 (16.7%)	1,193 (6.7%)	15.9 (13.5,18.7)	14.5 (11.3, 18.4)	16.5 (14.2, 19.2)
B	54,182 (23.1%)	3,360 (18.8%)	25.5 (22.1, 29.4)	21.9 (18.0, 26.4)	27.0 (23.5, 30.9)
C	24,745 (10.6%)	571 (3.2%)	7.7 (6.4, 9.4)	7.2 (5.1, 10.1)	8.0 (6.7, 9.4)
D	43,073 (18.4%)	6,400 (35.8%)	20.8 (17.4, 24.7)	26.4 (22.2, 31.0)	18.5 (15.3, 22.2)
E	27,811 (11.9%)	1,077 (6.0%)	8.3 (7.1, 9.7)	7.8 (6.4, 9.6)	8.6 (7.2, 10.1)
F	45,020 (19.2%)	5,262 (29.5%)	21.6 (18.8, 24.7)	22.2 (18.9, 25.9)	21.4 (18.6, 24.5)
G	229 (0.1%)	1 (0.01%)	0 (0.0, 0.0)	0 (0.0, 0.0)	0 (0.0, 0.0)
Neighborhood level factors					
Rurality					
Urban	58,546 (25.0%)	4,184 (23.4%)	27.1 (18.6, 37.7)	28.4 (19.1, 40.1)	26.5 (18.3, 36.8)
Suburban	88,465 (37.8%)	6,294 (35.2%)	44.9 (35.1, 55.0)	45.1 (34.1, 56.6)	44.8 (35.5, 54.4)
Rural	58,606 (25.0%)	5,162 (28.9%)	28.0 (19.9, 38.0)	26.4 (18.3, 36.6)	28.7 (20.5, 38.6)
Missing	28,679 (12.2%)	2,224 (12.5%)	---	---	---
ICE-Race					
Tercile 1 (disproportionately Black neighborhood)	95,370 (40.7%)	6,974 (39.0%)	47.1 (38.7, 55.7)	48.4 (40.0, 57.0)	46.5 (38.0, 55.3)
Tercile 2	54,890 (23.4%)	3,844 (21.5%)	27.1 (21.3, 33.9)	27.0 (21.3, 33.6)	27.2 (21.2, 34.1)
Tercile 3 (disproportionately White neighborhood)	55,078 (23.5%)	4,791 (26.8%)	25.8 (19.1, 33.8)	24.6 (18.3, 32.1)	26.3 (19.4, 34.6)
Missing	28,958 (12.4%)	2,255 (12.6%)	---	---	---
ICE-Income					
Tercile 1 (disproportionately low-income neighborhood)	102,224 (43.5%)	8,411 (47.1%)	48.2 (36.5, 60.1)	47.6 (35.4, 60.1)	48.5 (36.9, 60.3)
Tercile 2	68,313 (29.2%)	5,196 (29.1%)	34.6 (28.9, 40.8)	35.0 (28.8, 41.9)	34.4 (28.8, 40.5)
Tercile 3 (disproportionately high-income neighborhood)	34,801 (14.9%)	2,002 (11.2%)	17.2 (0.9, 29.3)	17.4 (9.6, 29.3)	17.1 (9.3, 29.3)
Missing	28,958 (12.4%)	2,255 (12.6%)	---	---	---
ICE-Race/Income					
Tercile 1 (disproportionately low-income Black neighborhood)	102,214 (43.6%)	8,131 (45.5%)	48.4 (38.2, 58.7)	49.7 (39.2, 60.3)	47.8 (37.7, 58.2)
Tercile 2	69,601 (29.7%)	5,364 (30.0%)	35.2 (29.5, 41.2)	33.6 (27.8, 40.0)	35.8 (30.1, 41.9)
Tercile 3 (disproportionately high-income White neighborhood)	33,523 (14.3%)	2,114 (11.8%)	16.5 (10.4, 25.1)	16.7 (10.1, 26.4)	16.4 (10.4, 24.8)
Missing	28,958 (12.4%)	2,255 (12.6%)	---	---	---
PCP availability					
Insufficient	89,943 (38.4%)	7,427 (41.6%)	44.1 (35.2, 53.5)	42.1 (32.5, 52.4)	45.0 (36.2, 54.1)
Sufficient	115,401 (49.3%)	8,182 (45.8%)	55.9 (46.5, 64.8)	57.9 (47.6, 67.5)	55.0 (45.9, 63.8)
Missing	28,952 (12.4%)	2,255 (12.6%)	---	---	---

[a]Includes race other than White or Black as well as Hispanic members. [b]Designation made by each MCO that included any complex medical or social condition. Exact criteria to be considered medical or social condition varied by MCO. [c]Represents the first MCO that individual was enrolled in. MCO G was assigned for anyone who was not enrolled in an MCO during the full year of their enrollment in Medicaid and remained in fee for service.* $p<0.05$, ** $p<0.01$, *** $p<0.001$ in chi2 test between the complete cases with at least one PC visit and complete cases without a PC visit

Table 2: The relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019

	Model A (unadjusted) PP (95% CI)	Model B (Individual level factors) PP (95% CI)	Model C (Model B + health conditions) PP (95% CI)	Model D (Model C + plan level factors) PP (95% CI)	Model E (Model D + neighborhood factors) PP (95% CI)
Individual level factors					
Food insecure					
No	Ref	Ref	Ref	Ref	Ref
Yes	1.6	-0.4	-2.1*	-2.9**	-2.8**
	(-0.6, 3.9)	(-2.5, 1.6)	(-4.1, -0.1)	(-4.9, -0.8)	(-4.9, -0.8)
Housing insecure					
No	Ref	Ref	Ref	Ref	Ref
Yes	-0.6	1.0	0.3	-0.1	-0.1
	(-3.4, 2.3)	(-1.6, 3.6)	(-2.4, 2.9)	(-2.7, 2.4)	(-2.7, 2.5)
Sex					
Male		Ref	Ref	Ref	Ref
Female		13.9***	13.7 ***	13.6 ***	13.6 ***
		(11.4, 16.2)	(11.3, 16.1)	(11.2, 16.0)	(11.2, 16.0)
Socially-constructed race					
White member		Ref	Ref	Ref	Ref
Black member		-2.5*	-2.3	-2.3	-2.4
		(-5.0, -0.00)	(-4.9, 0.3)	(-4.9, 0.3)	(-5.0, 0.2)
Other[a]		-2.6	-1.2	-1.1	-1.1
		(-6.9, 1.6)	(-5.4, 3.0)	(-5.3, 3.2)	(-5.4, 3.2)
Age					
18-29		Ref	Ref	Ref	Ref
30-39		7.5***	6.2**	6.2**	6.1**
		(3.4, 11.4)	(2.2, 10.2)	(2.2, 10.1)	(2.1, 10.1)
40-49		15.2***	11.0***	11.0***	10.9***
		(12.2, 18.2)	(8.1, 13.8)	(8.1, 13.8)	(8.0, 13.8)
50-59		17.7***	10.9***	10.9***	10.9***
		(14.4, 21.0)	(7.8, 14.1)	(7.8, 14.1)	(7.7, 14.1)
60-64		17.5***	11.4***	11.1***	11.1***
		(13.6, 21.3)	(7.5, 15.3)	(7.1, 15.1)	(7.1, 15.0)
Diabetes					
No diagnosis			Ref	Ref	Ref
Diagnosis			16.2***	16.4***	16.3***
			(13.8, 18.6)	(14.0, 18.8)	(13.9, 18.7)
Liver disease					
No diagnosis			Ref	Ref	Ref
Diagnosis			10.6***	10.4***	10.4***
			(6.7, 14.5)	(6.5, 14.2)	(6.7, 14.2)
Cardiac disease					
No diagnosis			Ref	Ref	Ref

Diagnosis		7.4*** (4.3, 10.4)	7.4*** (4.3, 10.6)	7.4*** (4.3, 10.5)
COPD				
No diagnosis		Ref	Ref	Ref
Diagnosis		14.9*** (13.0, 16.8)	15.0*** (13.1, 17.0)	15.0*** (13.1, 17.0)
Medically complex[b]				
No		Ref	Ref	Ref
Yes		4.5*** (2.7, 6.3)	3.9*** (1.8, 6.0)	3.9*** (1.8, 6.0)
Plan level factors				
Month of enrollment				
Jan '19			Ref	Ref
Feb '19			0.6 (-5.1, 6.3)	0.6 (-5.0, 6.3)
March '19			4.7 (-1.9, 11.3)	4.7 (-1.9, 11.3)
April '19			-0.4 (-7.1, 6.2)	-0.4 (-7.0, 6.3)
May '19			2.4 (-4.4, 9.1)	2.2 (-4.4, 8.8)
June '19			0.5 (-7.0, 8.0)	0.6 (-6.9, 8.0)
MCO Plan[c]				
A			Ref	Ref
B			3.2 (-1.5, 7.8)	3.1 (-1.6, 7.7)
C			-0.1 (-8.5, 6.6)	-0.8 (-8.3, 6.7)
D			-8.2*** (-12.5, -3.9)	-8.1*** (-12.5, -3.8)
E			-1.2 (-7.2, 4.7)	-1.2 (-7.2, 4.7)
F			-3.0 (-6.7, 0.6)	-3.1 (-6.7, 0.6)
Neighborhood level factors				
Rurality				
Suburban				Ref
Urban				-1.0 (-3.3,3.8)
Rural				-5.0 (-3.6, 3.5)
$ICE_{Race/Income}$				
Tercile 1 (disproportionately low-income Black neighborhood)				Ref
Tercile 2				0.2

					(-3.3, 3.8)
Tercile 3 (disproportionately high-income White neighborhood)					-0.1
					(-3.6, 3.5)
PCC availability					
Insufficient					Ref
Sufficient					-2.1
					(-4.8, 0.7)
Unweighted observations	14735	14735	14735	14735	14735
Weighted observations	205361	205361	205361	205361	205361

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval. All regressions included an intercept for counties and clustering at the county level. All regressions weighted to represent all new Medicaid expansion members enrolled between January 1, 2019-June 30, 2019 using propensity score weighting.

Table 3: The relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 by residential segregation

	Stratified by Tercile of ICE_{Race}[a]			Stratified by Tercile of ICE_{Income}[b]			Stratified by Tercile of $ICE_{Race/Income}$[c]		
Tercile	1	2	3	1	2	3	1	2	3
Description of tercile	Disproportionately Black neighborhood PP (95% CI)	PP (95% CI)	Disproportionately White neighborhood PP (95% CI)	Disproportionately low-income neighborhood PP (95% CI)	PP (95% CI)	Disproportionately high-income neighborhood PP (95% CI)	Disproportionately low-income Black neighborhood PP (95% CI)	PP (95% CI)	Disproportionately high-income White PP (95% CI)
Unweighted observations	6,565	3,609	4,561	7,967	4,894	1,874	7,685	5,071	1,979
Weighted observations	82,922	47,778	45,405	84,941	60,890	30,274	85,187	61,909	29,009
Food insecure									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	-2.9	-7.9*	1.1	-3.2*	-4.4*	0.3	-2.3	-3.0	-4.7
	(-6.0, 0.2)	(-14.1, -1.7)	(-3.5, 5.8)	(-6.1, -0.4)	(-8.2, -0.6)	(-6.5, 7.0)	(-5.4, 0.7)	(-0.07, 0.01)	(-11.2, 1.8)
Housing insecure									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	-0.7	3.6	-1.7	1.9	-2.6	1.6	0.9	0.4	-1.3
	(-4.0, 2.5)	(-1.0, 8.3)	(-6.7, 3.4)	(-1.5, 5.3)	(-6.5, 1.4)	(-5.4, 8.6)	(-2.5, 4.3)	(-3.6, 4.5)	(-8.9, 6.2)

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval. All models use clustered standard errors at county level but do not include an intercept for counties. All regressions weighted to represent all new Medicaid expansion members enrolled between January 1, 2019- June 30, 2019 using propensity score weighting. [a]Regressions adjust for sex, socially-constructed race, age category, diabetes diagnosis, liver disease diagnosis, COPD diagnosis, cardiac disease diagnosis, medical complexity, month of enrollment, MCO enrolled in at the time of the screening, rurality of the census tract that the member lived in, and the PCP sufficiency of the census tract that the member lived in. ICE_{Income} and $ICE_{Race/Income}$ were NOT included. [b]Regressions adjust for sex, socially-constructed race, age category, diabetes diagnosis, liver disease diagnosis, COPD diagnosis, cardiac disease diagnosis, medical complexity, month of enrollment, MCO enrolled in at the time of the screening, rurality, and PCP sufficiency. ICE_{Race} and $ICE_{Race/Income}$ were NOT included. [c]Regressions adjust for sex, socially-constructed race, age category, diabetes diagnosis, liver disease diagnosis, COPD diagnosis, cardiac disease diagnosis, medical complexity, month of enrollment, MCO enrolled in at the time of the screening, rurality and PCP availability. ICE_{Race} and ICE_{Income} were NOT included.

Table 4: The relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 by rurality

	Stratified by Rurality		
	Urban PP coefficient (95% CI)	Suburban PP coefficient (95% CI)	Rural PP coefficient (95% CI)
Unweighted observations	3,934	5,913	4,888
Weighted observations	47,726	78,994	49,386
Food insecure			
No	Ref	Ref	Ref
Yes	-4.1*	-4.2**	-0.00
	(-7.9, -0.3)	(-7.3, -1.1)	(-5.2, 5.2)
Housing insecure			
No	Ref	Ref	Ref
Yes	-1.3	0.9	-0.8
	(-5.5, 2.8)	(-3.4, 5.2)	(-5.5, 3.9)

Notes: ^p<0.1, *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. All models use clustered standard errors at county level but do not include an intercept for counties. All regressions weighted to represent all new Medicaid expansion members enrolled between January 1, 2019- June 30, 2019 using propensity score weighting. Regressions adjust for sex, socially-constructed race, age category, diabetes diagnosis, liver disease diagnosis, COPD diagnosis, cardiac disease diagnosis, medical complexity, month of enrollment, MCO enrolled in at the time of the screening, segregation in (using $ICE_{Race/Income}$), and PCP availability.

Table 5: The relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 by socially constructed race or by MCO

	Stratified by socially constructed race[a]			Stratified by MCO at time of MMHS that conducted the MMHS screening[b]					
	White members PP (95% CI)	Black members PP (95% CI)	Hispanic ethnicity or other race PP (95% CI)	A PP (95% CI)	B PP (95% CI)	C PP (95% CI)	D PP (95% CI)	E PP (95% CI)	F PP (95% CI)
Unweighted observations	8,087	4,445	2,203	901	2,668	326	5,481	863	4,496
Weighted observations	88,878	59,555	27,672	25,363	44,451	10,114	39,134	13,841	443,519
Food insecure									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	-1.4 (-5.1, 2.2)	-3.0 (-7.0, 10.2)	-10.1** (-17.4, -2.9)	-7.3* (-14.4, -0.2)	1.2 (-3.6, 6.0)	-9.3 (-21.2, 02.5)	-7.3** (-11.4, -3.2)	-7.7 (-23.3, 7.8)	-1.6 (-4.6, 1.5)
Housing insecure									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.3 (-3.0, 3.6)	0.9 (-3.7, 5.5)	-0.1 (-6.6, 6.3)	4.1 (-6.3, 14.5)	-1.9 (-5.6, 1.8)	23.6*** (14.1, 32.9)	-0.1 (-4.3, 4.0)	5.1 (-13.2, 0.23.4)	-4.2 (-8.6, 0.1)

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval. All models use clustered standard errors at county level but do not include an intercept for counties. All regressions weighted to represent all new Medicaid expansion members enrolled between January 1, 2019- June 30, 2019 using propensity score weighting. [a]Regressions adjust for sex, age category, diabetes diagnosis, liver disease diagnosis, COPD diagnosis, cardiac disease diagnosis, medical complexity, month of enrollment, MCO enrolled in at the time of the screening, rurality, segregation (using $ICE_{Race/Income}$), and PCP sufficiency. [b]Regressions adjust for sex, socially constructed race. age category, diabetes diagnosis, liver disease diagnosis, COPD diagnosis, cardiac disease diagnosis, medical complexity, month of enrollment, rurality, segregation (using $ICE_{Race/Income}$), and PCP sufficiency

Chapter 2: HOW DOES MEDICAID EXPANSION LEAD TO CHANGES IN MATERIAL CIRCUMSTANCES

Introduction

Medicaid expansion improves food and housing insecurity, material circumstances that affect health outcomes, and primary care utilization. However, the mechanism in which Medicaid expansion reduces food and housing insecurity has not been elucidated and is the subject of paper 2. Food and housing insecurity may change after Medicaid expansion enrollment because individuals can access primary care and subsequently be connected to social services or improve their health to increase their productivity and earn a higher wage. Second, individuals enrolling in Medicaid expansion may also experience a decrease in healthcare costs so money that was formerly spent on healthcare can be used on other goods. Third, individuals may experience protection from catastrophic healthcare costs which could reduce worry about paying for upcoming hospital bills. We will consider these three pathways in the context of how

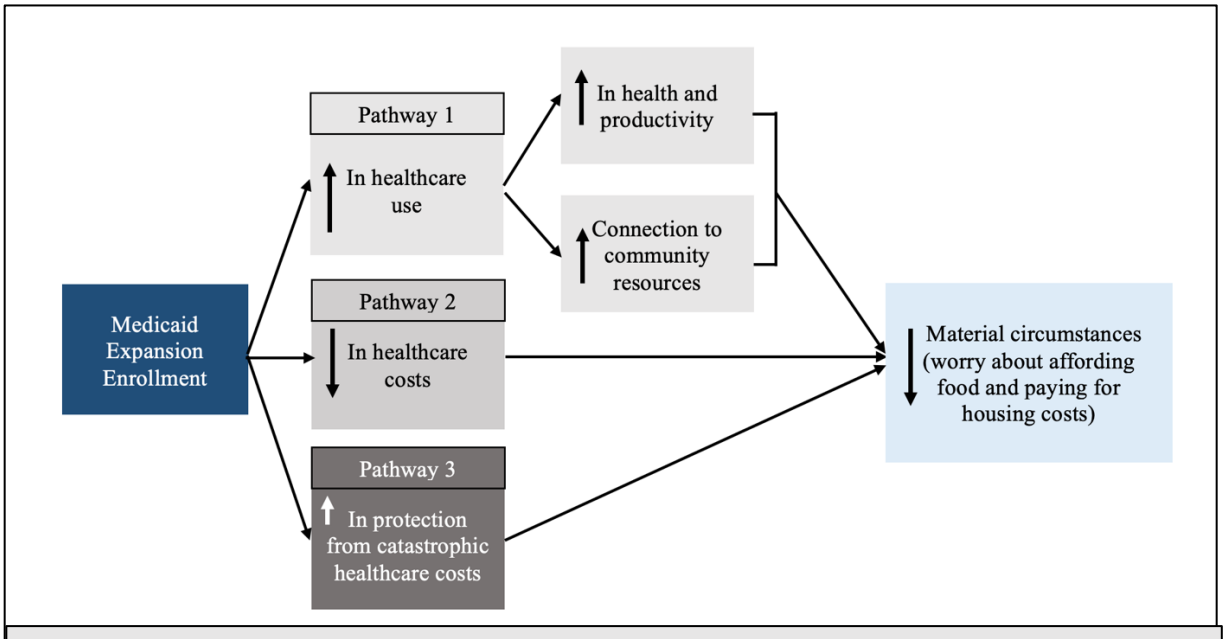


Figure 4: Mechanisms in which Medicaid Expansion may improve material circumstances
Three potential pathways are denoted that could lead to improvements in food and housing insecurity after Medicaid expansion enrollment.

families make decisions about material circumstances. Each pathway is pictured in Figure 4 and will be discussed in turn.

In the general literature about material circumstances, there are three key elements in how households make decisions in purchasing food, housing, healthcare and other necessary goods: 1) constraints in economic resources, 2) competing needs, and 3) ability to cope with one's financial circumstances.[200] For example, among a group of individuals with incomes below the federal poverty line, a family that has higher healthcare costs, a competing need, may be more at risk of experiencing food insecurity than a family that has lower healthcare costs, despite the same income amount. Ultimately we will consider these three elements in the pathway between Medicaid expansion enrollment and changes in food and housing insecurity.

Pathway 1: Changes in Healthcare Utilization and Subsequent Changes in Health

First, as previously discussed in the introductory chapter, Medicaid expansion is largely thought to be associated with increased healthcare access and primary care utilization. Our own work focused on a population of Virginia Medicaid expansion members suggests individuals use more primary care after enrollment in Medicaid expansion with 51.6% of individuals having at least one visit to primary care prior to enrollment and 72.1% of individuals having a visit in the year after enrollment.[201] This increase in primary care utilization may lead to reductions in food or housing insecurity because 1) primary care teams can address social needs, which improves the ability to cope with financial circumstances and 2) primary care can improve health status, which could in turn reduce economic constraints and reduce competing needs.

As previously mentioned, primary care is beginning to address social needs more robustly with programs that provide social workers or community health workers that can link patients to community resources. A randomized control trial is being conducted to test the

efficacy of having a patient navigator check in with primary care patients every one or two weeks about a health goal that could include issues like housing or food insecurity.[202] In a similar project, that included both hospital and primary care sites, individuals who had more contact with patient navigators had more success with resolving social needs, suggesting that interventions of these types can help individuals.[203] On a larger scale, the Healthy Opportunities Pilot program in North Carolina is a Medicaid demonstration project that provides a funding mechanism for healthcare providers to pay for treatments to address food and housing insecurity directly.[204] Additional, in Accountable Health Communities, a Centers for Medicare and Medicaid Services (CMS) demonstration project that paired care navigators in the clinical setting with patients to address social needs, over half of the patients who worked with a community health worker or equivalent volunteer had their needs resolved.[170] Last, interventions in health clinics and pediatric clinics have focused on helping individuals who screen positive for food insecurity to enroll in SNAP.[205,206] Primary care is finding inventive ways to address food and housing insecurity in clinic practice. These connections to community resources and assistance with material circumstances may improve the ability of individuals to cope with limited economic resources. These services may also reduce competing needs if an individual enrolls in programs like WIC or utilizes community food banks as these programs provide food or funding for food which reduces a family's need to pay for food. In addition to directly addressing material circumstances, primary care may also be improving material circumstances by improving the health status of individuals.

While there is a hypothesized connection between primary care use and improvements in health status, there is a dearth of studies examining the relationship between the utilization of healthcare following a change in insurance status and subsequent changes in health status.

Instead, research focuses on the relationship between Medicaid expansion enrollment and changes in health status, regardless of healthcare utilization. The findings are mixed- with some studies finding no changes in subjective health status and others finding improvements after enrollment in Medicaid expansion.[26,27,207,208] The improvements in health status found in difference-in-difference analyses have been identified across different populations, including childless adults, women of reproductive age, and individuals with chronic conditions.[207–209] Our prior work focused on newly enrolled Virginia Medicaid expansion members identified a decrease in days that poor health kept individuals from doing their usual activities after a year of Medicaid coverage compared to the year before enrollment.[201] In theory, individuals who experience an improvement in functioning could be able to work more, improving their material circumstances. This could lead to a decrease in economic constraints due to increased wages.

Last, labor force participation could improve economic constraints as individuals earn a larger income. While there is a potential link between improved health status and workforce participation, this link has not been studied robustly within the context of Medicaid expansion. The limited work on this matter did not find a significant association between improved health status following enrollment and being employed.[210] The link between health status and workforce participation in the context of Medicaid expansion may be particularly unique as there could be incentives to work more or, conversely, work less in this context. First, individuals enrolling in Medicaid expansion may be incentivized to not work or work fewer hours because of income limits on eligibility to qualify for Medicaid expansion. However, Medicaid expansion was accompanied with the development of ACA Marketplaces that provide subsidies to individuals at incomes outside of the Medicaid eligibility limit. Therefore, the marketplaces may decrease the differences in out-of-pocket costs between an income of 137% of the FPL, which

would allow an individual to qualify for Medicaid expansion, and an income of 139% of the FPL which would allow an individual to qualify for a subsidy on the marketplace but not for Medicaid expansion coverage. Current understandings of Medicaid expansion do not support a large disincentive to work among the general Medicaid expansion population.[211]

Alternatively, Medicaid expansion may improve workforce participation for two reasons. First, Medicaid expansion may improve health status which could increase labor force participation or improve performance at a job an individual already has. For example, two thirds of Michigan Medicaid expansion members felt like their coverage helped them perform better at their job.[210] Further, our work focused on newly enrolled Virginia Medicaid expansion members found that fewer individuals could not take or keep a job because of physical or mental health problems after a year of coverage compared to the year prior to Medicaid expansion enrollment.[201] Second, prior to Medicaid expansion, individuals without a child could qualify for Medicaid if they were deemed to have a disability that did not allow the individual to work and qualified them for Supplemental Security Income (SSI). With Medicaid expansion, individuals can qualify for Medicaid based on income alone and do not need to prove that they cannot work. Unsurprisingly, difference-in-difference studies examining individuals with a disability found increased workforce participation among individuals in Medicaid expansion states compared to non-expanded states.[212] Ultimately, the majority of literature focused on employment finds that Medicaid expansion either has no effect on employment or increased rates of employment, suggesting a stronger incentive to work rather than a disincentive to work.[211,213,214] Pathway 1 suggests that Medicaid expansion is associated with increased primary care utilization, improved health status, and increased labor force participation, all mechanisms that could improve material circumstances.

Pathway 1 may improve material circumstances because individuals experience a decrease in constraints in economic resources because of improvements in health status that enable increased labor participation and higher wages. Second, with improved health status individuals could have fewer competing needs as individuals do not have to spend additional time or money to be healthy. Last, primary care could increase connections to community resources which may reduce competing needs or improve an individual's ability to cope with their financial circumstances.

Pathway 2: Changes in Healthcare Costs

Pathway 2, which focuses on changes in healthcare costs, including medical debts, could improve economic constraints as well as reduce competing needs as individuals do not have to pay for healthcare and can instead pay for other goods. However, the relationship between Medicaid expansion and changes in out-of-pocket spending on healthcare is complex. We hypothesize that individuals may experience one of the following four scenarios regarding changes in healthcare costs after enrollment: 1) no change in healthcare costs because individuals do not use care prior to expansion, 2) no change in healthcare costs because individuals used "charity care" or free sources of care prior to Medicaid enrollment, 3) no change in healthcare costs but changes in credit because individuals used care and paid for it with forms of credit prior to Medicaid enrollment, 4) decrease in healthcare costs because individuals used care and paid for it at the time the care was rendered.

There is evidence for each of these scenarios in our own prior work as well as in the overall literature. For the first scenario, there is mixed findings on pent-up healthcare demand- several studies identified a pent-up demand for healthcare when individuals obtain Medicaid expansion coverage, suggesting that individuals are forgoing necessary care due to their prior

insurance, but some did not find pent-up demand.[215,216] Medicaid expansion is also associated with reductions in delaying or avoiding care due to cost, suggesting that individuals forgo needed care before Medicaid expansion enrollment when faced with competing needs.[26,209,217,218] Our own work found that 62% of newly enrolled Virginia Medicaid expansion members experienced an unmet need for medical care prior to enrollment and 72% of those individuals cited cost as the reason for not getting care.[219] Together, this supports the first scenario in which individuals forgo care prior to enrollment and then use care after obtaining coverage but do not experience change in healthcare costs.

In support of the second scenario, Medicaid expansion is associated with reductions in uncompensated care in Virginia and in other states, suggesting many individuals that are now enrolled in Medicaid expansion were receiving uncompensated care.[220–222] Further, Community Health Centers experienced a larger increase in the number of appointments paid by Medicaid and a larger decrease in appointments without insurance in Medicaid expansion states compared to non-expansion states.[223(pp2013–2014)] Taken together, this suggests that individuals enrolling in Medicaid expansion are shifting from obtaining "charity care" to care financed by Medicaid expansion coverage. Individuals in this scenario are unlikely to experience changes in healthcare costs, as the cost of care to the individual prior to Medicaid expansion enrollment was minimal.

In regards to the third scenario, prior evidence using a difference-in-difference approach found significant reductions in medical debts and collections in Medicaid expansion states compared to non-expansion states, suggesting that when individuals face competing needs, including healthcare costs, individuals pay some of those expenses with lines of credit.[7,19,224] Importantly, the improvements in medical debt following Medicaid expansion also extend to other forms of credit than healthcare alone. For example, difference-in-difference analyses find

that individuals in Medicaid expansion states compared to non-expansion states experienced decreases in bankruptcies for any reason, decreases in nonmedical collections, better interest rates for credit cards and personal loans, and increases in credit scores after expansion.[19,225,226] Additionally, individuals in California counties that expanded Medicaid experienced reductions in payday loan usage and amounts compared to counties that did not expand Medicaid.[36] This evidence suggests that individuals who enroll in Medicaid expansion no longer have to use lines of credit to obtain healthcare when faced with competing needs, like paying for food or housing costs, versus paying for healthcare.[227]

Last, individuals may experience a reduction in economic constraints because individuals no longer have to pay for premiums, co-pays, co-insurances, or any other out-of-pocket costs. Among previously uninsured individuals using prescription drugs, obtaining Medicaid expansion coverage was associated with a $205 reduction in annual out-of-pocket spending.[228] More generally, low-income families living in Medicaid expanded states were 11% less likely to have any out-of-pocket spending and when the family did have spending, they had $754 less spending on average compared to low-income families in nonexpanded states after expansion. [229] Taken together, this suggests that some individuals use healthcare prior to enrollment and then experience a decrease in healthcare dollars spent after enrollment in Medicaid expansion.

Pathway 2 suggests that individuals experience improvements in economic constraints and reductions in competing needs when enrolling in Medicaid expansion because of reductions in healthcare costs and medical debts.

Pathway 3: Catastrophic Healthcare Costs

The third pathway through which Medicaid expansion may reduce food and housing insecurity is through reducing catastrophic healthcare spending, which could alter the way

individuals cope with their financial circumstances. Because Medicaid expansion coverage has no or very low co-pays, individuals with Medicaid expansion coverage are protected from high medical costs. Because of this, individuals may be able to think differently about budgets, as saving for a catastrophic event may not be necessary after enrolling in Medicaid. For example, in our qualitative work, Medicaid expansion members note less stress and a greater ability to do other tasks, like caregiving, after a year of Medicaid expansion compared to the year before enrollment.[20] However, there are currently mixed findings about catastrophic health care costs, as some evidence suggests Medicaid expansion affords protection against large healthcare expenditures and others find no evidence of protection.[230,231]

Hypothesis

Ultimately, we argue that Medicaid expansion may improve material circumstances after a year of coverage because of increased healthcare utilization, reduced healthcare costs, or reductions in worry about catastrophic healthcare costs. We hypothesize that each of these three pathways is associated with reductions in worry about affording food or paying for housing costs after a year of coverage among newly enrolled Medicaid expansion members.

Methods

Setting and Population

Data were obtained from a mail-based survey conducted by the Virginia Commonwealth University research team on behalf of the Department of Medical Assistance Services (DMAS). The pre-enrollment survey was sent to 7,500 individuals between the ages of 19-64 who had enrolled in Medicaid expansion by the end of April 2019, during the first four months of the policy in Virginia. The survey was mailed between January 1, 2019 and May 15, 2019 and asked

about experiences in the year prior to Medicaid expansion enrollment. Individuals who responded to the pre-enrollment survey and remained enrolled in Medicaid coverage for twelve months were resurveyed using the post-enrollment survey that was mailed between July 29, 2020, and January 11, 2021. This post-enrollment survey asked the same questions as the first survey, but the recall period was the past twelve months, during their first year of Medicaid coverage. Both surveys, the pre-enrollment and post-enrollment surveys, consist of the same individuals. Individuals enrolled in limited coverage or who lost coverage during the first 12 months after enrollment were not included in the sample. We did include individuals who switched to other forms of eligibility, like dual Medicare-Medicaid eligibility. We included these individuals, as compared to the previous analysis, as we did not have to rely on claims data for healthcare utilization, which may be missing for dual eligible individuals.

Outcomes: Material Circumstances

Our primary outcome was worry about affording food or housing costs, two measures of material circumstances. To assess worry about food and housing insecurity, we adapted questions from the National Health Interview Survey.[227] In both surveys, individuals were asked, "in the past 12 months, please indicate how worried you are about each of the following: 1) not being able to pay your rent, mortgage, or other housing costs; and 2) not having enough money to pay for food". Each question was answered separately, and the answer choices were "very worried", "somewhat worried", and "not worried". To capture worry about affording food, we categorized very worried and somewhat worried as worried about affording food, and not worried as not worried about affording food.[15] In the same way, we created a dichotomous variable for worry about paying for housing costs (very worried and somewhat worried vs. not worried).

Regressors of Interest in Pathway 1: Primary Care Utilization, Health Status, Functional Job Limitations

In each of the surveys, individuals were asked "in the past 12 months did you see a primary care provider, such as a family doctor, general practitioner, or other health care provider who treats a variety of health problems" with the answer choices being "yes" or "no." We created a dichotomous primary care utilization variable (at least one visit or no visits).

To assess health status, individuals on both surveys were asked: 1) In general, how would you rate your physical health? and 2) In general, how would you rate your mental health, including your mood and ability to think? Response options included excellent, very good, good, fair, and poor. We collapsed physical health into a three-level categorical variable (excellent/very good vs. good vs. fair/poor). We similarly categorized the mental health variable into a three-level categorical variable (excellent/very good vs. good vs. fair/poor mental health). Self-rated health variables have been categorized as binary measures (fair/poor vs good/very good/excellent) or kept as a five-point scale in prior work.[26,207,232] Prior literature found that about 40% of individuals change their rating of their health between interviews a month apart, but this dropped to only 10% when the variable was dichotomized (fair/poor vs. good/very good/excellent).[233] We created three-level physical and mental variables because we wanted to maintain the granularity of the measure but did not want to capture erroneous changes that happen more frequently in the five-level measure and because few individuals in our data were classified in the excellent physical health category (21 in the pre-enrollment survey and 30 in the post-enrollment survey) or poor categories (63 in the pre-enrollment survey and 57 in the post-enrollment survey).

After creating the mental and physical health variables, we then created a three-level categorical change variable for physical health and a three-level categorical change variable for mental health. For both, the measures had the following levels: if the individual remained in the same level of health in both the pre- and post- enrollment period they were categorized as no change, if they moved from fair/poor in the pre-enrollment period to either good or very good/excellent in the post-enrollment period they were categorized as improved health, and if they moved from good health in the pre-enrollment period to fair/poor health in the post-period or moved from very good/excellent health in the pre-enrollment period to good or fair/poor in the post-enrollment period they were categorized as worsened health.

To assess the effect of changes in productivity, we asked the following questions in both surveys: 1) In the past 12 months, was there any time when you were not able to take a job or keep a job because of physical or mental health problems? and 2) In the past 12 months, was there any time when you needed to cut back on the number of hours that you worked because of physical or mental health problems? If individuals answered yes to either of the questions, we categorized that individual as having a functional job limitation in the respective survey. We then created a three-level categorical change variable for each individual with the following values: 1) constant functional job limitations if the individual said yes in both time periods or said no in both time periods; 2) improved functional job limitations if the individual said yes in the pre-enrollment period but no in the post-enrollment period; and 3) worsened functional job limitations if the individual said no in the pre-enrollment period but yes in the post-enrollment period.

Regressors of Interest in Pathway 2 and 3: Medical Bills, Healthcare Expenses, Worry about Catastrophic Healthcare Costs

To assess the second pathway, changes in budgetary constraints, we created two different variables: 1) changes in medical bills, and 2) changes in healthcare expenses. For the first measure of medical bills, we asked two different questions on both surveys: 1) "in the past 12 months, did you have problems paying medical bills" and 2) "in the past 12 months, did you have any medical bills that were being paid off over time (please include any medical bills being paid off with a credit card, through personal loans, or bill paying arrangements with hospitals or other providers)". If individuals said yes to either of these questions in the survey, we considered the individual to have a problem paying medical bills in that respective survey. We then created a three-level categorical change variable for medical bills with the following categories: 1) constant problems with medical bills, meaning that the individual either had no problems in both time periods or problems in both time periods; 2) decreased medical bills, meaning that the individual had a problem paying medical bills in the pre-enrollment period but no problem in the post-enrollment period; and 3) increased medical bills, meaning that the individual had no problem paying medical bills in the pre-enrollment period but had problems paying medical bills in the post-enrollment period.

Next, we created a variable pertaining to healthcare costs. In the first survey, we asked individuals, "about how much did you spend out-of-pocket for your own medical care over the last 12 months?" and asked individuals who said they had any type of health insurance in the past twelve months, "about how much did you spend for your health insurance coverage over the last 12 months." If the individual stated they did not have any health insurance coverage, their health insurance costs are considered to be $0. If a range was given for either value, we took the

mean value. We combined both of these variables to create a variable for the total amount of money spent in the pre-enrollment period. Then, we created a binary variable for any healthcare spending (($0 or >$0). In the second survey, we asked, “about how much did you spend out-of-pocket for your own medical care over the last 12 months.” If a range was given, we took the mean value. Again, we created a binary variable for having any healthcare expense ($0 or >$0). Next, we created a three-level categorical change variable for healthcare costs with the following categories: 1) constant healthcare expenses, meaning that the individual had either healthcare expenses in both periods or no healthcare expenses in both periods; 2) increased healthcare expenses, meaning the individual had >$0 healthcare expenses in the pre-enrollment period but $0 expenses in the post-enrollment period; and 3) decreased healthcare expenses, meaning that the individual had $0 healthcare expenses in the pre-enrollment period but >$0 healthcare expenses in the post-enrollment period.

We operationalized the third pathway, catastrophic healthcare costs, by measuring worry about catastrophic healthcare costs. In both surveys, individuals were asked “in the past 12 months, how worried were you about not being able to pay medical costs of a serious illness or accident?” with the answers being “very worried”, “somewhat worried”, “not worried”. We created a dichotomous variable from each survey (very worried/somewhat worried vs. not worried). We then created a three-level categorical change variable for worry about catastrophic costs with the following values: 1) constant worry about catastrophic costs, meaning that individuals were worried about catastrophic costs in both time periods or not worried in both time periods; 2) decreased worry about catastrophic costs, meaning that an individual was worried about catastrophic costs in the pre-enrollment period but not in the post-enrollment period; and 3) increased worry about catastrophic costs, meaning that an individual was not

worried about catastrophic costs in the pre-enrollment period but was worried in the post-enrollment period.

Covariates

We included few covariates because of the limited sample size. All covariates are obtained from DMAS demographic data files. Sex was categorized as either male or female. We identified the age at time of enrollment by subtracting the date of birth from the date of enrollment. DMAS categorized race and ethnicity into two separate variables. The ethnicity variable was binary (either not Hispanic or Hispanic). However, we created a combined race variable with three categories (non-Hispanic White vs. non-Hispanic Black vs. all other races and Hispanic ethnicity).

Analysis

First, we compared the distributions of each variable in the pre-enrollment period and the post-enrollment period. We used unadjusted multi-level logistic regression for binary variables or Cochran-Mantel-Haenszel test for 3-level categorical variables to test for significant changes in each variable over time. We used these instead of chi-squared test because the observations consisted of the same individuals over time. We used multi-level logistic regression (individual as the second level) with robust standard errors clustered at the individual level to regress the binary outcome worry about affording food on primary care utilization, time, and the interaction time and primary care utilization. We then used margins to graph the proportions of individuals worried about affording food in each time period by individuals' use of primary care in the post-enrollment period. We then used multi-level logistic regression (individual as the second level) with robust standard errors clustered at the individual level to regress the binary worry about

affording food outcome on the three-level physical health change variable, time, the interaction of time and the three-level physical health change variable, and baseline physical health. Again, we used margins command to plot the proportions of individuals worried about affording food in each time period among individuals who remained in a constant state of health, who improved their health, and who experienced worsened health. We repeated this process for each three-level change variable, controlling for the respective baseline values. We then repeated this approach for the worry about paying for housing cost outcome and each variable.

For multivariate regressions, we used multi-level linear probability model (individual as the second level) with robust standard errors clustered at the individual to regress worry about affording food on primary care utilization, time, time interacted with primary care utilization controlling for gender, age, age squared, race, physical health in the pre-enrollment period, and mental health in the pre-enrollment period. Next, we used multi-level linear probability model (individual as the second level) with robust standard errors clustered at the individual to regress worry about affording food on the three-level physical health change variable, time, and time interacted with the three-level physical health change variable controlling for gender, age, age squared, race, physical health in the pre-enrollment period, and mental health in the pre-enrollment period. We then repeated this for each three-level change variable with their respective baseline value, controlling for gender, age, age squared, race, physical health in the pre-enrollment period, and mental health in the pre-enrollment period each time. We then repeated these regressions for the worry about paying for housing cost outcome and each variable. We used linear probability for the ease of interpretations.[193] All multivariate regressions included only individuals that had complete data for all outcomes and regressors, a common sample of 377 individuals. All analyses were conducted with STATA SE 7.

Sensitivity analysis

We assessed the sensitivity of outcomes to the statistical model used with the following: 1) we used multi-level linear probability models (individual as the second level) with robust standard errors clustered at the individual and a random slope for the individual; 2) fixed effects models; and 3) multi-level logistic regressions with robust standard errors. We also used multiple imputations to assess the sensitivity of our results to common case analyses using a multi-level linear probability model (individual as the second level) with robust standard errors clustered at the individual and fixed effect models for all individuals in the sample (n=517). We also assessed the sensitivity of our physical and mental health estimates by dichotomizing these variables, as this a common way self-rated health status variables are included in regression models.[233]

Results

Sample Characteristics

Our sample consisted of 517 individuals who answered both surveys and had complete information for our primary outcomes, worry about affording food and worry about paying for housing. Our sample was majority white (56.3%) and female (60.5%) with a median age of 52 (Table 6). In our sample, 6.6% of individuals switched Medicaid eligibility to a category other than Medicaid expansion during the post-enrollment period. Our sample had more White participants, female participants, and participants over 45, compared to the overall Medicaid expansion sampling frame (56.3% vs. 52.6%, 60.5% vs 53.2%, 72.7% vs. 39.6% respectively; the sampling frame is found in our prior work).[18] At the time of enrollment in Medicaid expansion, 65.6% of individuals were worried about affording food but only 54.2% were worried after a year of enrollment (p-value<0.001; Table 6). In the prior-enrollment period, 69.4% of

individuals were worried about paying for housing costs but only 62.9% were worried in the post-enrollment period (p-value<0.001).

There were significant differences in the sample between the pre-enrollment period and the post-enrollment period in each of the pathways of interest as seen in Table 6. Concerning pathway 1, there was a significant difference in physical health with more individuals in very good/excellent health in the post-enrollment period and fewer individuals in fair/poor health in the post-enrollment period compared to the pre-enrollment period (p-value<0.001). Additionally, functional job limitations significantly decreased from the pre-enrollment period to the post-enrollment period (49.4% vs. 43.0%; p-value<0.001; Table 6). Conversely, there was no significant difference in self-rated mental health in the pre-enrollment period compared to the post-enrollment period (p-value=0.1339).

For the pathway 2, changes in healthcare costs, and pathway 3, changes in worry about catastrophic healthcare costs, all measures were significantly different between the pre-enrollment and post-enrollment periods. Significantly fewer individuals experienced problems paying a medical bill or had any healthcare expenses in the pre-enrollment compared to the post-enrollment period (66.9% to 23.7%; p-value<0.001 and 58.3% to 31.2%; p-value<0.001 respectively). Last, worry about catastrophic healthcare costs, the measure for pathway 3, significantly decreased from the pre-enrollment to the post-enrollment period (79.3% to 52.5%; p-value<0.001).

Unadjusted Associations between Change Variables and Changes in Worry about Affording Food or Paying for Housing Costs

Next, we examined reductions in worry about affording food or paying for housing costs by primary care utilization and each of the change variables. For primary care, individuals with

at least one primary care visit in the post-enrollment period experienced a significant reduction in worry about affording food and individuals without a primary care visit experienced no significant reduction in worry about affording food between the pre- and post- enrollment periods (-10.8 PP; p-value<0.01 vs -10.0 PP; p-value=0.112 respectively; Figure 5). When examining changes in physical health, individuals who experienced improved status had a 19.1 PP (p-value<0.01) reduction in worry about affording food between the pre- and post- enrollment periods but individuals experiencing worsened or constant physical health status had only marginally significant reductions in worry about affording food between these time periods (-14.0 PP; p-value<0.1 and -6.7 PP; p-value<0.1 respectively). Individuals who experienced improvements in or constant mental health experienced significant reductions in worry about affording food (-25.7 PP; p-value<0.01 and -7.7 PP; p-value<0.05 respectively) but individuals who experienced worsened mental health had no significant reduction in affording food. Last, individuals with improved or worsened job functional status had significant reductions in worry about affording food (-16.9 PP; p-value<0.01 and -8.4 PP; p-value<0.05 respectively) while individuals who had constant functional job status had marginal reductions in worry about affording food. Further, the reductions in worry about affording food were qualitatively larger for individuals experiencing improvements in physical or mental health compared to reductions in the other subgroups (Figure 5).

For pathway 2, individuals experiencing a reduction in medical bills had a large, significant reduction in worry about affording food between the pre- and post- enrollment periods (-19.3 PP; p-value<0.001) but no significant reduction was identified in individuals with constant medical bills. Similarly, individuals experiencing reductions in healthcare costs had the largest reduction (-14.6 PP; p-value<0.01) in worry about affording food compared to individuals

with constant healthcare costs or increased healthcare costs (-7.7 PP or -12.9 PP respectively). Last, for pathway 3, individuals experiencing a decrease in worry about catastrophic healthcare costs had a significant reduction in worry about affording food between the pre- and post-enrollment periods (-36.6 PP; p-value<0.001) but individuals with constant or increased worry about catastrophic costs had no significant reduction in worry about affording food.

Worry about paying for housing costs was examined in the same way and similar results were identified. In pathway 1, individuals who had a primary care visit experienced a marginally significant decrease in worry about paying for housing costs (-5.8 PP; p-value<0.1; Figure 6). Individuals with improvements in physical health or mental health experienced significant reductions in worry about paying for housing costs between the pre- and post- enrollment periods (-16.9 PP; p-value<0.01, and -25.7; p-value<0.001 respectively). Individuals who did not have a primary care visit or experienced constant or worsened physical health or mental health had no significant reductions in worry about paying for housing costs between time periods. Individuals who experienced constant functional job limitations experienced marginally significant reductions in worry about housing costs between time periods (-6.6 PP; p-value<0.1).

For pathway two, individuals with decreased medical bills had a significant reduction in worry about housing costs (-14.0; p-value<0.001) but individuals with constant medical bills experienced similar worry about housing costs across both time periods. For pathway 3, only individuals who experienced a reduction in worry about catastrophic healthcare costs had a significant reduction in worry about paying housing costs between the pre- and post- enrollment periods (-25.2; p-value<0.001).

Adjusted Associations between Change Variables and Changes in Worry about Affording Food or Paying for Housing Costs

Next, in adjusted analysis, the magnitude of reduction in worry about affording food between the pre- and post- enrollment periods did not significantly differ between individuals with at least one primary care visit and individuals with no primary care visits in the post-enrollment period, as identified by the interaction term "YesxTime" (-8.0 PP; 95% CI: -15.0, 13.4; Table 7). However, the reductions in worry about affording food between the pre- and post-enrollment periods was significantly larger for individuals who improved their mental health status in between these time periods compared to individuals who maintained a constant mental health status (-18.0 PP; 95% CI 33.6, -2.3). There was no significant difference in the magnitude of reduction in worry about affording food after Medicaid expansion enrollment in individuals who improved their physical health or functional job limitations compared to individuals who maintained their physical health or functional job limitations between the pre- and post-enrollment periods.

For pathway 2, individuals who experienced a decrease in problems paying medical bills had a significantly larger reduction in worry about affording food between the pre- and post-enrollment periods compared to individuals that maintained the same level of medical bills between these time periods (-13.7 PP; 95% CI: -25.5, -2.0). There was no relationship between Medicaid enrollment and reductions in worry about affording food by changes in healthcare costs between time periods. Last, for pathway 3, individuals who experienced a decrease in worry about catastrophic healthcare costs experienced a significantly larger reduction in worry about affording food between the pre- and post- enrollment periods compared to individuals who

experienced constant level of worry about catastrophic healthcare costs between time periods (-39.1 PP; 95% CI: -51.5, -26.8).

Results were broadly similar when examining the outcome of worry about paying for housing costs. For pathway 1, there was no significant difference in the magnitude of reduction in worry about paying for housing costs between the pre- and post- enrollment periods for individuals who did not have any primary care visits compared to individuals who did have at least one primary care visit in the post-enrollment period (0.2 PP; 95% CI: -13.1, 13.6; Table 8). However, individuals who experienced an improvement in physical health or mental health between the pre- and post- enrollment periods had greater reductions in worry about paying for housing costs compared to individuals who experienced the same level of physical or mental health (-14.3; 95% CI: -27.8, -0.9 and -24.0 PP; CI -39.2, -8.9 respectively;). Individuals who experienced improved functional job limitations had about the same magnitude of reduction in worry about paying for housing costs between the pre- the post-enrollment period compared to individuals who had no changes in functional job limitations between the time periods (-1.9 PP; 95% CI: -17.0, 13.2).

For pathway 2, changes in healthcare costs, individuals who experienced a decrease in medical bills experienced larger reductions in worry about paying housing costs between the pre- and post-enrollment period compared to individuals with no changes in medical bills from the pre- to the post-enrollment survey (-13.5 PP; 95% CI: -24.8, -2.3). For pathway 3, the association between enrollment and worry about housing costs was significantly larger for individuals who experienced a decrease in worry about catastrophic healthcare costs between the pre- and post-enrollment periods compared to individuals with no changes in worry about catastrophic healthcare costs between time periods (-28.6; 95% CI: -41.1, -16.1).

Sensitivity Analyses

The robustness of the results differed by the variable of interest and can be found in the Appendix. First, the non-significant relationship between primary care utilization in the post-enrollment period and the magnitude of reductions in either worry about affording food or paying for housing costs after enrollment was robust to all model specifications (Table A16 and A17). This association was not significant (the interaction term between time and primary care utilization) when using the mixed effect model with a random slope for time, fixed effects, and logistic regression as well as when using the sample of individuals with complete data (n=499) or the sample with multiple imputation (n=517). The relationship between changes in physical health and the differences in magnitude of reduction in worry about affording food by enrollment period differed by how physical health was defined. If physical health was first dichotomized into fair/poor and good/very good/excellent, individuals with improved self-rated physical health experienced a significantly larger reduction in worry about paying for food between the pre- and post- enrollment periods compared to individuals with no change in all model specifications using complete cases, the common sample (n=377), and multiple imputation sample (n=517; Table A21). Similarly, the results for self-rated mental health differed by the way mental health was defined. If mental health was dichotomized into fair/poor and good/very good/excellent first, there was no significant difference in the magnitude of reduction in worry about affording food between the pre- and post- enrollment periods among individuals with improved health and individuals with no change when using the complete case sample (n=500) or multiple imputation sample (n=517; Table A25). For functional job limitations, there was a significantly larger effect size of enrollment for individuals with improved functional job limitations compared to

individuals with no change in the sample using multiple imputation and mixed effects with random intercepts (Table A28).

Specific to worry about paying for housing costs, the significant relationship between improvements in physical health and significantly larger reductions in worry about paying for housing costs between the pre- and post- enrollment periods was robust to all model specifications and how the variable was defined (two vs. three level variable; Table A20 and A22). Individuals who experienced improvements in mental health had a significantly larger reduction in worry about paying for housing costs in all models using the three-level variable. However, improvement in mental health was associated with significantly larger reductions in worry about housing costs with the two-level only in the models using the common cases (Table A26). For functional job limitations, there was no significant association between improvements in functional job limitations and the magnitude of reduction in worry about housing costs with any type of sample or model specification (Table A27).

Findings for differences in bills, care expenses, and worry about catastrophic costs were robust to any sample used and any model specification for both worry about affording food and worry about paying for housing costs (Tables A29-34).

Discussion

This chapter aimed to understand how Medicaid expansion improved material circumstances, worry about affording food or paying for housing costs. We proposed these three different pathways through which Medicaid expansion could reduce worry about affording food or paying for housing costs: 1) increased primary care utilization and its subsequent consequences on health and productivity, 2) reduction in healthcare expenses, and 3) decreased worry about catastrophic healthcare costs. Our findings, using newly enrolled Virginia Medicaid

expansion members, suggest that several of these pathways are associated with reductions in either worry about affording food or worry about paying for housing costs, material circumstances that can worsen health and increase acute healthcare use. More specifically, for pathway 1, improved mental health was associated with larger reductions in worry about affording food and paying for housing costs, while primary care utilization and changes in functional job limitations were not associated with reductions in worry about food after enrollment. In pathway 2, improvements in problems paying medical bills were associated with a larger decrease in worry about affording food or paying for housing costs compared to no change in paying medical bills. Last, in pathway 3, a reduction in worry about paying for catastrophic costs was associated with a larger decrease in worry about affording food or paying for housing costs compared to no change in worry about catastrophic costs.

First, our results concerning changes in health, healthcare expenses, and anticipated healthcare costs following enrollment in Medicaid expansion are broadly similar to prior work. While many studies focused on similar topics use a difference-in-difference design, the Oregon Health Insurance Experiment provides a good comparator to our results as it followed a random cohort of individuals who enrolled in public coverage. Both our analysis and Oregon's study found improvements in subjective ratings of physical health after enrollment in public coverage, which the authors in the Oregon Health Insurance Experiment suggested were due to increases in healthcare utilization, access, and an overall improved sense of well-being.[230] Further, the Oregon Health Insurance Experiment found improvements in the number of poor physical or mental health days that did not impair usual activity an individual had after enrollment, similar to our functional job limitation finding. Further, both our work and the Oregon Health Insurance

Experiment identified decreases in out-of-pocket medical expenses and owing money for medical expenses after obtaining public coverage.

Exploring each Pathway and its Association with Improvements in Material Circumstances

Our analysis extends prior work, including the Oregon Health Insurance Experiment, because it examined the relationship between these improvements and changes in material circumstances. As previously mentioned, prior work suggests that families make decisions about material circumstances by examining constraints in economic resources, attending to competing needs, and adjusting the family's ability to cope with financial circumstances.[200] For example, individuals with disabilities may have constrained economic resources due to difficulty obtaining work, competing needs due to expensive healthcare costs, and inability to cope due to barriers like preparing food or obtaining groceries.[200] We continue to use these three elements to interpret our findings.

Pathway 1. As previously described, we hypothesized that pathway 1 could improve material circumstances because healthcare utilization would lead to improved health status, which could, in turn, reduce economic constraints and competing needs. Healthcare utilization could also improve an individual's ability to cope with financial circumstances because of primary care's connection to community resources, as previously discussed. However, we did not find any relationship between primary care utilization and greater improvements in material circumstances. This suggests that primary care may not have the resources to address material circumstances adequately. Currently, North Carolina, is one of the only states that has explicit Medicaid reimbursements for care related to inadequate material circumstances.[234] Evidence suggests that PCPs experience less burnout when they can adequately address material

circumstances, but that having a dedicated individual to do so, which is not currently the standard of care, is an important element of being able to treat material circumstances so as a primary care team.[235] Collectively, competing medical needs within a primary care visit may take priority if dedicated resources are not present to address material circumstances. Our results suggest that more research is needed to understand how to better support primary care in actually being able to address material circumstances effectively.

Second, independent of primary care utilization, improvements in mental and physical health could improve individuals' material circumstances because of increases in productivity that reduce economic constraints, reduce competing needs as individuals no longer have to devote resources to improving their health, and increase an individual's ability to cope as individuals have the bandwidth or energy to address material circumstances. It is hypothesized that poor mental or physical health may lead to decreased earnings, constraining economic resources. [236,237] However, we do not find robust evidence that changes in functional job limitations are associated with improvements in material circumstances in our sample, suggesting that improved health may not be improving material circumstances through increased in ability to work. Second, poor mental and physical health may decrease the ability of an individual to cope with their financial circumstances. For example, maternal depressive symptoms have been linked to a decreased ability to apply for welfare benefits or adhere to requirements, limiting the ability to cope with an individual's current financial circumstances.[238] In our previously published qualitative work focused on Virginia Medicaid expansion members, individuals noted reductions in stress and their ability to actually attend to their health needs.[201] Improved health may improve individuals' ability to cope with current financial circumstances, leading to decreases in food or housing insecurity.

As stated, we did not find evidence that an increased ability to work led to improvements in material circumstances. Prior work focused on the relationship between disabilities causing impairment in employment and inadequate material circumstances found that households headed by people with disabilities were more likely to experience food insecurity than households without a disability. Additionally, work focused on improvements in disability found that improving disability status was not symmetric to facing a new disability, meaning that the decrease in the probability of experiencing a material hardship when a person with a disability moves out of a household was less than the increase in the probability of hardship when a person with a disability moves into a household.[236] Our work bolsters this finding, as improvements in functional job limitations did not lead to significantly greater improvements in food or housing insecurity compared to individuals who maintained the same job function status. This may be because individuals who improve their job function limitations are met with different competing needs. For example, if someone works more hours, they may not be able to spend time preparing food or seek cheaper grocery options. It may also be that even with improvements in functional job limitations, economic constraints are insufficiently reduced and inadequate material circumstances are not ameliorated. Ultimately, our work suggests that Medicaid expansion enrollment leads to changes in health status that are associated with improvements in worry about food and housing insecurity, which may be due to an improved ability to cope with an individual's current financial circumstances rather than improved job function.

Pathway 2. Next, for pathway 2, changes in healthcare costs may reduce economic constraints and competing needs in the context of material circumstances. Prior work on material circumstances finds that individuals divert resources needed for food or housing toward healthcare expenses.[239,240] For example, medical debt was associated with increased odds of

becoming food insecure and losing the ability to pay rent or the mortgage.[133] Similarly, reductions in medical bills in this sample were associated with reductions in worry about paying for both food and housing. Taken together, this suggests that individuals no longer have to acquire medical debt after enrolling in Medicaid and are able to divert those funds to food and housing costs.

We also hypothesized that reductions in the dollars spent on healthcare costs would be associated with improvements in material circumstances. While we did find that there was a significant reduction in dollars spent on healthcare costs, this was not associated with improvements in material circumstances. Prior evidence on changes in individuals' healthcare expenditures is mixed with some evidence suggesting that changes in out-of-pocket expenses have no association with food insecurity but some finding that out-of-pocket expenditures are negatively associated with the probability of being able to meet a family's food needs.[239,241] However, changes in out-of-pocket costs are hypothesized to have an effect primarily through poor health, as increased healthcare costs tend to reflect poor health.[239,241] Because we controlled for health status, we may not have seen any effect of healthcare expenditures. Further, our binary measure of changes in healthcare costs may not be granular enough to capture an association between dollars spent on healthcare costs and improvements in material circumstances.

Pathway 3. Last, we found that improvements in concern about catastrophic healthcare costs following Medicaid expansion were associated with improvements in material circumstances. There is a paucity of literature examining how changes in catastrophic healthcare costs relate to material circumstances. However, we suspect that the financial protection afforded by health insurance changes the way individuals are able to cope with their financial circumstances. Behaviors such as saving or working to further one's education may be possible

with the protection of insurance not tied to employment. These behaviors may then buffer the effects of changes in economic resources like job loss or cutting hours that would have otherwise driven a household to worry about affording food or housing. More work is needed to better elucidate this potential mechanism.

Limitations

While our work advances the literature on material circumstances and public insurance, it is not without limitations. First, we had a small sample that is not necessarily representative of the larger Medicaid expansion population. Second, we cannot draw causal conclusions because the changes in outcome and variables on each pathway were happening simultaneously. This also means we cannot rule out bidirectional relationships. For example, prior work identified a bidirectional relationship between mental health and food and housing insecurity, suggesting that mental health can worsen material circumstances, but material circumstances can also worsen mental health.[240] Our work was conducted over one year, and changes in health, healthcare use, and healthcare expenses may take longer than a year to change material circumstances. Last, the outcome of interest, material circumstances, was measured by the level of worry about affording food or housing costs. One independent variable of interest in pathway 1, changes in mental health, may be closely related to our outcome as it also included feelings of worry and stress. In fact, there was a significant association between worry about affording food and paying for housing costs and mental health status at baseline (Table A16). Therefore, the significant association between the independent variable, mental health status, and the outcomes, worry about affording food and paying for housing, we identified may be because of the overlap in the way these two constructs were measured.

Conclusion

Ultimately, we confirm previous research that Medicaid expansion is associated with improvements in health and healthcare expenses– both current and anticipated. Additionally, we demonstrate that these improvements are associated with improvements in material circumstances, which in turn can improve health. Understanding how Medicaid operates as a social program beyond providing healthcare is critical to comprehensively estimating the benefits recipients of Medicaid expansion experience. Ensuring adequate food and housing is essential to health. Medicaid expansion is pivotal in achieving food and housing insecurity for all individuals. This analysis provides additional evidence that public insurance advances health because it improves health status directly and indirectly by improving material circumstances.

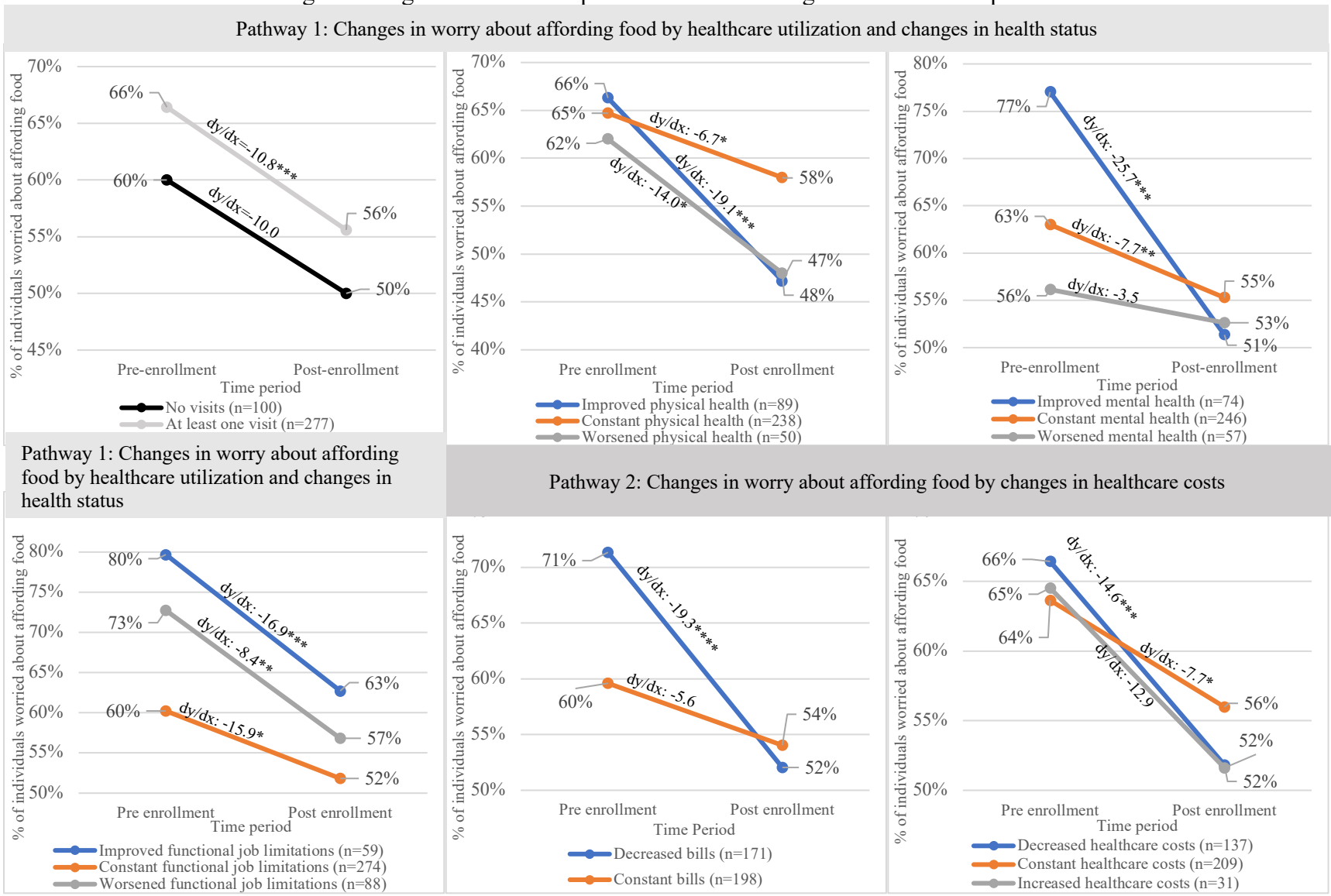
Figures and Tables

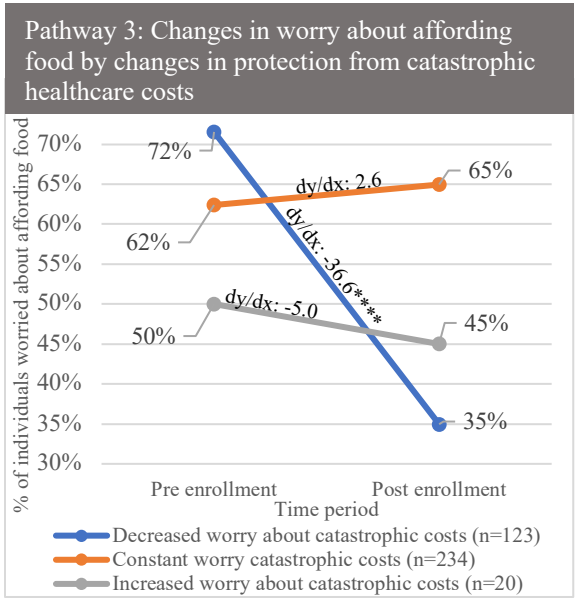
Table 6: Virginia Medicaid Expansion members in pre-enrollment period (2019) compared to the post-enrollment period (2020-2021)

Characteristic	Total sample (%)	Pre-enrollment (%)	Post-enrollment (%)	p-value
Socially constructed race (n=517)				
White	56.3%	---	---	---
Black	31.0%	---	---	---
Other	12.8%	---	---	---
Age (median, IQR)	52 (41,58)	---	---	---
Sex (n=517)				
Male	39.5%	---	---	---
Female	60.5%	---	---	---
Any other type of Medicaid coverage during the post-enrollment period[a]	6.6%			
Outcomes				
Worried about affording food[b] (n=517)	59.9%	65.6%	54.2%	<0.001
Worried about paying for housing costs[b] (n=517)	66.2%	69.4%	62.9%	<0.001
Pathway 1- Health and Healthcare Use				
Primary care utilization (n=506)				
No visits	26.1%	---	---	---
At least one visit	73.9%	---	---	---
Number of primary care visits after enrollment (n=468; median, IQR)	2 (0, 4)	---	---	---
Physical health[c]				<0.001
Fair/Poor	40.0%	42.8%	37.2%	
Good	38.9%	39.2%	38.6%	
Very good/Excellent	21.2%	13.0%	24.3%	
Mental health[c]				0.1339
Fair/Poor	29.0%	31.6%	27.0%	
Good	32.0%	29.8%	34.1%	
Very good/Excellent	38.7%	38.6%	38.9%	
Functional job limitations[b]				0.008
None		50.6%	57.0%	
1 or 2		49.4%	43.0%	
Pathway 2- Healthcare Costs				
Medical bills[b]				<0.001
None	54.6%	33.1%	76.3%	
1 or 2	45.4%	66.9%	23.7%	
Healthcare expenses[b]				<0.001
$0	55.4%	41.7%	68.8%	
> $0	45.6%	58.3%	31.2%	
Pathway 3- Protection from catastrophic healthcare costs				
Worry about catastrophic healthcare costs[b]				<0.001
Not worried	34.0%	20.7%	47.5%	
Worried	66.0%	79.3%	52.5%	

[a]Coverage includes any other Medicaid coverage as well as dual eligibility with Medicare. [b]Variable regressed on time using a logistic regression random effects model. [b]Cochran-Mantel-Haenszel used to account for paired observations

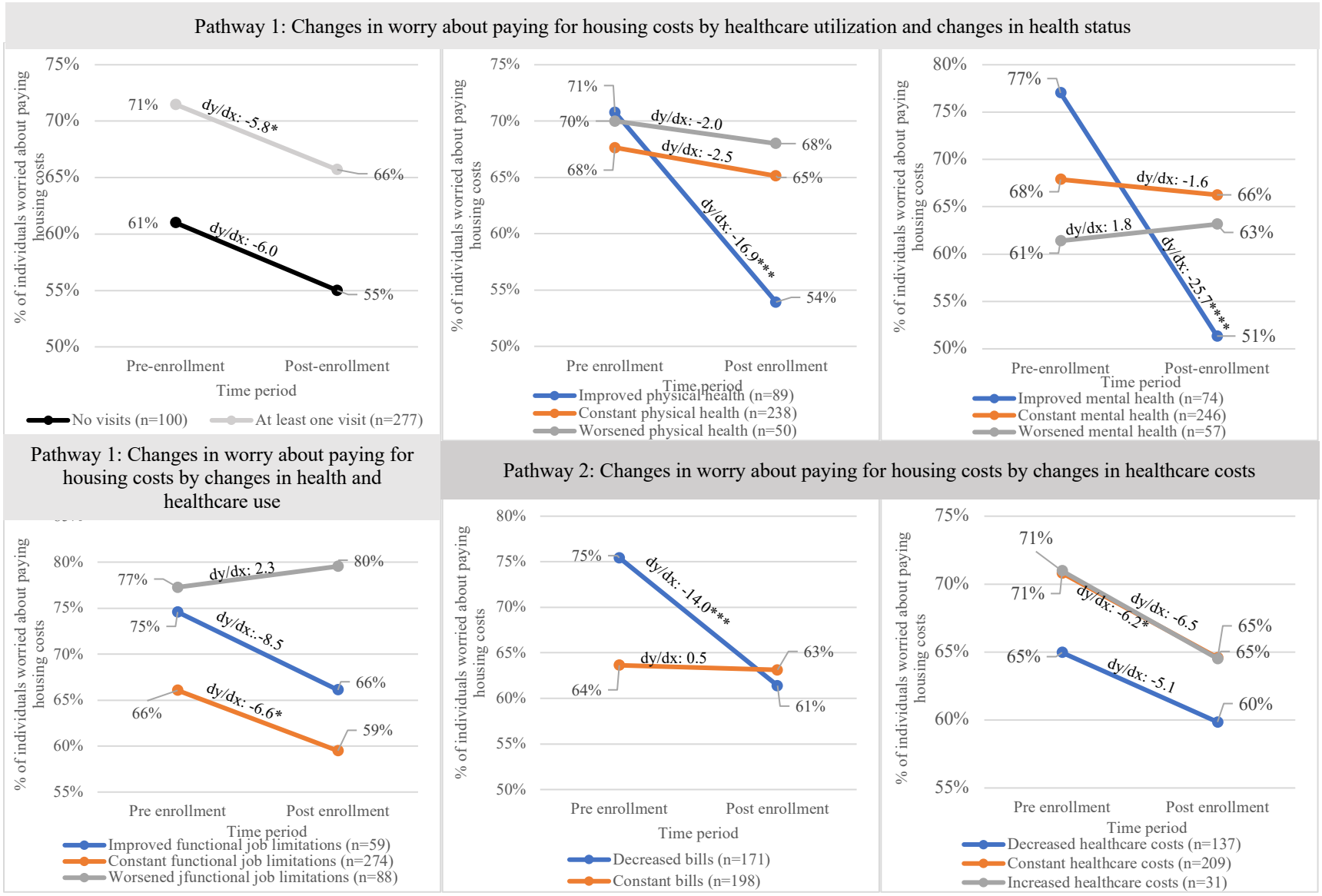
Figure 5: Unadjusted changes in worry about affording food in the pre-enrollment period compared to the post-enrollment period by each variable of interest among new Virginia Medicaid expansion members using the common sample

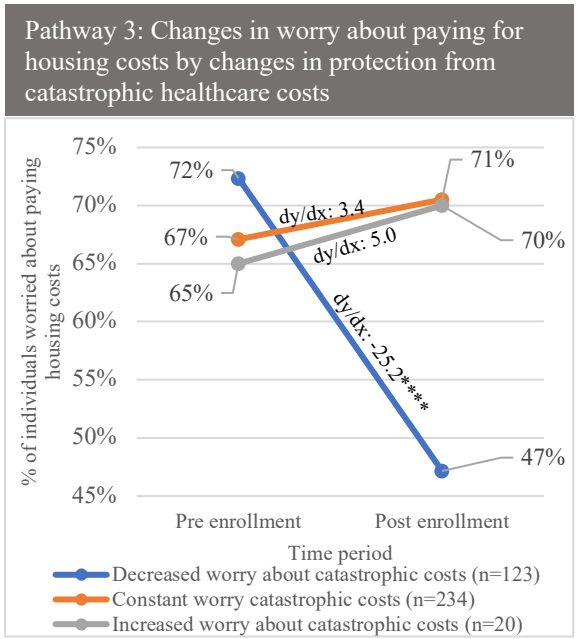




Notes: *p-value<0.10, **p-value<0.05, ***p-value<0.01, p-value<0.001. All regressions besides the first (primary care utilization) adjusts for the baseline variable. Example, for the figure depicting change in worry about affording food by change in physical health adjusts for baseline rating of physical health. Worsened bills subgroup is not included because there are too few individuals to estimate effect sizes (n=17).

Figure 6: Unadjusted changes in worry about paying for housing costs in the pre-enrollment period compared to the post-enrollment period by each variable of interest among new Virginia Medicaid expansion members using the common sample





Notes: *p-value<0.10, **p-value<0.05, ***p-value<0.01, p-value<0.001. All regressions besides the first (primary care utilization) adjusts for the baseline variable. Example, for the figure depicting change in worry about affording food by change in physical health adjusts for baseline rating of physical health. Worsened bills subgroup is not included because there are too few individuals to estimate effect sizes (n=17).

Table 7: The relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and each variable of interest among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about affording food								
	Pathway 1: Healthcare utilization and health		Pathway 1: Healthcare utilization and health			Pathway 2: Healthcare costs		Pathway 3: Protection from catastrophic healthcare costs
	PCP visits PP (95% CI)		Physical health PP (95% CI)	Mental health PP (95% CI)	Functional job limitations PP (95% CI)	Medical bills PP (95% CI)	Any healthcare expense PP (95% CI)	Worry about catastrophic healthcare costs PP (95% CI)
Period		Period						
Pre	Ref	Pre	Ref	Ref	Ref	Ref	Ref	Ref
Post	-10.0	Post	-6.7*	-7.7**	-8.4**	-5.6	-7.7*	2.6
	(-22.6, 2.6)		(-14.0, 0.5)	(-14.7, -0.8)	(-15.5, -1.3)	(-13.6, 2.5)	(-15.3, 0.0)	(-4.4, 9.6)
PCP visit								
No	Ref							
Yes	3.3							
	(-7.6, 14.3)							
		Change Variable						
		Constant	Ref	Ref	Ref	Ref	Ref	Ref
		Improved	-0.2	2.4	4.4	-6.2	-6.9	-2.6
			(-11.6, 11.3)	(-9.5, 14.4)	(-8.2, 17.0)	(-16.3, 3.9)	(-18.2, 4.3)	(-12.3, 7.1)
		Worsened	6.9	-3.3	21.0***	-0.6	0.07	24.3**
			(-7.2, 21.1)	(-17.7, 11.2)	(6.2, 35.8)	(-38.2, 37.0)	(-11.2, 25.3)	(0.4, 48.3)
PCP visitxTime								
NoxTime	Ref							
YesxTime	-0.8							
	(-15.0, 13.4)							
		Change Variable x Time						
		Constant x Time	Ref	Ref	Ref	Ref	Ref	Ref
		ImprovedxTime	-12.4	-18.0**	-8.6	-13.7**	-6.9	-39.1****
			(-27.4, 2.7)	(-33.6, -2.3)	(-23.0, 5.9)	(-25.5, -2.0)	(-19.4, 5.5)	(-51.5, -26.8)
		WorsenedxTime	-7.3	4.2	-7.5	55.6***	-5.2	-7.6
			(-23.7, 9.1)	(-13.3, 21.8)	(-26.6, 11.6)	(19.9, 91.2)	(-29.7, 19.2)	(-30.5, 15.4)

Notes: *p-value<0.10, **p-value<0.05, ***p-value<0.01, p-value<0.001. PP is percentage point. CI is confidence interval. Common cases used for all regressions (n=377). Each individual has two observations so the total observations in the regression are 754. multi-level logistic regression (individual as the second level) with robust standard errors clustered at the individual level used. All regressions besides the first (primary care use) adjusts for the baseline variable, gender, age, race, baseline physical health (three-level), baseline mental health (three-level variable). For example, the model examining differences in job limitation functions controls for baseline job limitation functions, gender, age, race, baseline physical health, and baseline mental health

Table 8: The relationship between worry about paying for housing costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and each variable of interest among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about paying for housing cost								
	Pathway 1: Healthcare utilization and health		Pathway 1: Healthcare utilization and health			Pathway 2: Healthcare costs		Pathway 3: Protection from catastrophic healthcare costs
	PCP visits PP (95% CI)		Physical health PP (95% CI)	Mental Health PP (95% CI)	Functional job limitations PP (95% CI)	Medical bills PP (95% CI)	Any healthcare expense PP (95% CI)	Worry about catastrophic healthcare costs PP (95% CI)
Period		Period						
Pre	Ref	Pre	Ref	Ref	Ref	Ref	Ref	Ref
Post	-6.0	Post	-2.5	-1.6	-6.6*	-0.5	-6.2*	3.4
	(-17.7, 5.7)		(-9.8, 4.8)	(-8.5, 5.2)	(-13.3, 0.2)	(-8.2, 7.2)	(-13.4, 0.9)	(-3.0, 9.8)
PCP visit								
No	Ref							
Yes	9.0							
	(-2.0, 19.9)							
		Change Variable						
		Constant	Ref	Ref	Ref	Ref	Ref	Ref
		Improved	1.4	0.2	-7.1	-3.4	-18.2***	-5.8
			(-9.7, 12.5)	(-12.0, 12.4)	(-20.2, 6.1)	(-13.8, 7.0)	(-29.1-7.2)	(-15.6, 3.9)
		Worsened	9.3	-4.0	0.216***	-0.109	9.0	32.3***
			(-5.1, 23.8)	(-17.9, 9.9)	(0.068 - 0.365)	(-0.484 - 0.266)	(-9.0, 27.0)	(8.4, 56.1)
PCP visitxTime								
NoxTime	Ref							
YesxTime	0.2							
	(-13.1, 13.6)							
		Change Variable x Time						
		Constant x Time	Ref	Ref	Ref	Ref	Ref	Ref
		ImprovedxTime	-14.3**	-24.0***	-1.9	-13.5**	1.1	-28.6****
			(-27.8, -0.9)	(-39.2, -8.9)	(-17.0, 13.2)	(-24.8, -2.3)	(-10.5, 12.7)	(-41.1, -16.1)
		WorsenedxTime	0.5	3.4	8.8	38.0**	-0.2	1.6
			(-14.4, 15.4)	(-10.8, 17.6)	(-7.4, 25.1)	(3.5, 72.5)	(-27.9, 27.5)	(-25.1, 28.2)

Notes: *p-value<0.10, **p-value<0.05, ***p-value<0.01, p-value<0.001. PP is percentage point. CI is confidence interval. Common cases used for all regressions (n=377). Each individual has two observations so the total observations in the regression are 754. multi-level logistic regression (individual as the second level) with robust standard errors clustered at the individual level used. All regressions besides the first (primary care use) adjusts for the baseline variable, gender, age, race, baseline physical health (three-level), baseline mental health (three-level variable). For example, the model examining differences in job limitation functions controls for baseline job limitation functions, gender, age, race, baseline physical health, and baseline mental health

CONCLUSION

The health of an individual encompasses more than just physical or mental illness; it also includes their material circumstances and neighborhood. Health is the physical, behavioral, spiritual, and socioeconomic wellbeing as defined by individuals, families, and communities.[9] Food and housing insecurity have been associated with higher rates of increased acute care use, chronic disease, and mortality.[2,3] Further, the opportunity to be healthy depends on the socioeconomic and political context as well as the socioeconomic position of an individual.[1] This study aimed to understand the relationship between material circumstances and healthcare use, two intermediary determinants of health, in response to a policy change in Virginia: Medicaid expansion. Although Medicaid expansion coverage has no co-pays and no premiums, it may be insufficient to reduce barriers to needed primary care, particularly among individuals who experience food or housing insecurity that often have higher rates of chronic disease. We found that experiencing food insecurity, led to decreases in primary care use, despite this potentially higher health burden among individuals experiencing food and housing insecurity. Additionally, associations between food insecurity and primary care use differed by the neighborhood context of the individual.

This work also aimed to understand how Medicaid expansion led to improvements in material circumstances, food or housing insecurity. We found that Medicaid expansion enrollment was associated with improvements in mental health, reductions in paying medical bills, and improvements in worry about catastrophic healthcare costs. Improvements in these elements were associated with larger decreases in food and housing insecurity compared to individuals who had no change in mental health, paying medical bills or worry about catastrophic healthcare costs after enrollment.

There is growing recognition that material circumstances are a critical element of health and are necessary to address within the healthcare space to achieve better population health. For example, the Biden-Harris Administration recently released their Playbook to Address Social Determinants of Health, which articulated the ways in which federal agencies are working to connect social and healthcare services.[241] In conjunction, the Department of Health and Human Services released a call to action in late 2023 that reiterated the importance of partnerships across sectors of social services and health care to address the social needs of individuals and improve "the health and well-being of every American."[242] This call to action is complemented by the Center for Medicare and Medicaid's support for 1115 Demonstrations that address material circumstances.[243] Most recently, New York has obtained a 1115 waiver that calls for an investment in social determinants of health networks that consist of a network of community-based organizations that can address social needs.[244] All of these policy interventions recognize the importance of material circumstances.

This study suggests that individuals experiencing food insecurity may be facing additional barriers to accessing primary care. The federal work around social determinants recognizes the critical interplay between social and medical needs. Greater connectedness between these types of services may reduce the barriers that individuals experiencing food insecurity face when trying to seek care. However, limiting programs that address food to the primary care setting may miss individuals who cannot get to the primary care office. Instead, outreach may be required like providing primary care at a food bank, which could provide an additional opportunity to access health services for individuals experiencing food insecurity. However, as our data suggests, aspects of an individual's neighborhood like rurality and

segregation may moderate the effect of housing insecurity on primary care. Policy interventions must consider not only the individual involved, but their surroundings.

While increasing the interconnectedness between healthcare and social systems is critical to improving health and reducing health disparities, this study highlights that providing public insurance itself can improve material circumstances by reducing food and housing insecurity. This is particularly important as ten states in have not yet expanded Medicaid and all states have disenrolled individuals following the end of the COVID Maintenance of Effort.[242,243] These states and individuals disenrolled from Medicaid expansion are unable to experience these improvements in material circumstances and in health outcomes. However, our work demonstrates the individual level benefits of public insurance coverage extend beyond obtaining healthcare alone and can improve health for populations.

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APPENDIX

Table A1: CPT codes and taxonomy codes used to identify primary care utilization and chronic health conditions

CPT Codes	
Outpatient visits used in outcome for main model	'99201','99202','99203','99204','99205','99211', '99212','99213','99214','99215', '99341','99342','99343','99344', '99345', '99347','99348','99349','99350','99381','99382', '99383','99384','99385', '99386', '99387', '99391', '99392', '99393', '99394', '99395', '99396', '99397', '99401', '99402', '99403', '99404', '99429', '99483'
Taxonomy codes	
All PCPS	'207Q00000X', '207QA0000X', '207QA0505X', '207QG0300X', '207R00000X', '207RA0000X', '207RG0300X', '208D00000X', '207QS0010X', '207QS1201X', '207QH0002X', '207QB0002X', '207RB0002X','207RS0010X', '2080S0010X', '2083S0010X', '208000000X', '2080A0000X', '207V00000X', '207VG0400X', '207VX0000X', '363LF0000X', '261QF0400X', '261QR1300X'
PCPS excluding NPs/PAs, FQHCs, RHC	'207Q00000X', '207QA0000X', '207QA0505X', '207QG0300X', '207R00000X', '207RA0000X', '207RG0300X', '208D00000X', '207QS0010X', '207QS1201X', '207QH0002X', '207QB0002X', '207RB0002X','207RS0010X', '2080S0010X', '2083S0010X', '208000000X', '2080A0000X', '207V00000X', '207VG0400X', '207VX0000X'
Diagnosis	
Diabetes (ICD10)	'E100' , 'E101', 'E106', 'E108', 'E109', 'E110', 'E111', 'E116', 'E118', 'E119', 'E120', 'E121', 'E126', 'E128', 'E129', 'E130', 'E131', 'E136', 'E138', 'E139', 'E140', 'E141', 'E146', 'E148', 'E149', 'E102', 'E103', 'E104', 'E105', 'E107', 'E112', 'E117', 'E113', 'E114' , 'E115', 'E122', 'E123', 'E124', 'E125', 'E127', 'E132', 'E133', 'E134', 'E135', 'E137', 'E142', 'E143', 'E144', 'E145', 'E147'
Cardiac disease	'I099', 'I110', 'I130', 'I132', 'I1255', 'I1420', 'I1425', 'I1426', 'I1427', 'I1428', 'I1429', 'I143', 'I50', 'P290', 'I121', 'I122', 'I1252', 'I70', 'I71', 'I731', 'I738', 'I739', 'I771', 'I790', 'I792', 'K551', 'K558', 'K559', 'Z958', 'Z959', 'G45', 'G46', 'H340', 'I60', 'I61', 'I62', 'I63', 'I64' , 'I65', 'I66', 'I67', 'I68', 'I69'
Liver disease	'I850', 'I859', 'I864', 'I982', 'K704,' 'K71.1', 'K721', 'K729', 'K765', 'K766', 'K767', 'B18', 'K700', 'K701',

	'K702', 'K703', 'K709', 'K713', 'K714', 'K715', 'K717', 'K73', 'K74', 'K760', 'K762', 'K763', 'K764', 'K768', 'K769', 'Z944’
COPD (ICD10)	‘J40', 'J41', 'J42' , 'J43', 'J44', ‘J45', ‘J46' , 'J47', 'J60' 'J61', 'J62', 'J63', 'J64', 'J65', 'J66', 'J67', 'J684' 'J701', 'J703'

Table A2: Characteristics of Virginia Medicaid expansion members enrolled between January 2019 and June 2019 by MMHS completion disposition

	Total in sampling frame # (%)	MMHS Status			
		No MMHS attempt recorded # (%)	MMHS attempt recorded		
			No contact made # (%)	Refused # (%)	Completed # (%)
Number of observations	234,296	175,900	40,107	425	17,864
Individual level factors					
Primary care visits					
No visits	99,483 (42.5%)	76,040 (43.2%)	18,654 (46.5%)	156 (36.7%)	4,633 (25.9%)
At least one visit	134,813 (57.5%)	99,860 (56.8%)	21,453 (53.5%)	269 (63.3%)	13,231 (74.1%)
Emergency Department visits					
No visits	132,655 (56.6%)	98,747 (56.1%)	23,985 (59.8%)	263 (61.9%)	9,660 (54.1%)
At least one visit	101,641 (43.4%)	77,153 (43.9%)	16,122 (40.2%)	162 (38.1%)	8,204 (45.9%)
Sex					
Male	94,694 (40.4%)	71,975 (40.9%)	15,943 (39.8%)	147 (34.6%)	6,629 (37.1%)
Female	139,602 (59.6%)	103,925 (59.1%)	24,164 (60.2%)	278 (65.4%)	11,235 (62.9%)
Socially-constructed race					
White members	119,699 (51.1%)	88,606 (50.4%)	20,850 (52.0%)	247 (58.1%)	9,996 (56.0%)
Black members	77,979 (33.3%)	59,803 (34.0%)	12,785 (31.9%)	109 (25.6%)	5,282 (29.6%)
Other[a]	36,618 (15.6%)	27,491 (15.6%)	6,472 (16.1%)	69 (16.2%)	2,586 (14.5%)
Age					
18-29	74,781 (31.9%)	57,665 (32.8%)	13,402 (33.4%)	109 (25.6%)	3,605 (20.2%)
30-39	56,391 (24.1%)	42,225 (24.0%)	10,236 (25.5%)	104 (24.5%)	3,826 (21.4%)
40-49	44,453 (19.0%)	32,934 (18.7%)	7,431 (18.5%)	88 (20.7%)	4,000 (22.4%)
50-59	44,307 (18.9%)	32,589 (18.5%)	6,887 (17.2%)	95 (22.4%)	4,736 (26.5%)
60-64	14,364 (6.1%)	10,487 (6.0%)	2,151 (5.4%)	29 (6.8%)	1,697 (9.5%)
Diabetes					
No diagnosis	209,147 (89.3%)	157,535 (89.6%)	36,468 (90.9%)	362 (85.2%)	14,782 (82.7%)
Diagnosis	25,149 (10.7%)	18,365 (10.4%)	3,639 (9.1%)	63 (14.8%)	3,082 (17.3%)
Liver disease					
No diagnosis	221,459 (94.5%)	166,549 (94.7%)	38,173 (95.2%)	392 (92.2%)	16,345 (91.5%)
Diagnosis	12,837 (5.5%)	9,351 (5.3%)	1,934 (4.8%)	33 (7.8%)	1,519 (8.5%)
Cardiac disease					
No diagnosis	222,053 (94.8%)	166,802 (94.8%)	38,539 (96.1%)	400 (94.1%)	16,312 (91.3%)
Diagnosis	12,243 (5.2%)	9,098 (5.2%)	1,568 (3.9%)	25 (5.9%)	1,552 (8.7%)
COPD					
No diagnosis	200,529 (85.6%)	151,368 (86.1%)	34,766 (86.7%)	355 (83.5%)	14,040 (78.6%)
Diagnosis	33,767 (14.4%)	24,532 (13.9%)	5,341 (13.3%)	70 (16.5%)	3,824 (21.4%)
Medically complex[b]					
No	202,181 (86.3%)	156,031 (88.7%)	35,370 (88.2%)	312 (73.4%)	10,468 (58.6%)
Yes	32,115 (13.7%)	19,869 (11.3%)	4,737 (11.8%)	113 (26.6%)	7,396 (41.4%)

Plan level factors					
Month of enrollment					
Jan '19	162,848 (69.5%)	118,230 (67.2%)	29,258 (72.9%)	355 (83.5%)	15,005 (84.0%)
Feb '19	15,016 (6.4%)	12,615 (7.2%)	1,803 (4.5%)	12 (2.8%)	586 (3.3%)
March '19	15,453 (6.6%)	12,501 (7.1%)	2,350 (5.9%)	15 (3.5%)	587 (3.3%)
April '19	14,269 (6.1%)	11,432 (6.5%)	2,254 (5.6%)	14 (3.3%)	569 (3.2%)
May '19	14,007 (6.0%)	11,110 (6.3%)	2,286 (5.7%)	15 (3.5%)	596 (3.3%)
June '19	12,703 (5.4%)	10,012 (5.7%)	2,156 (5.4%)	14 (3.3%)	521 (2.9%)
MCO[c]					
A	39,236 (16.7%)	32,748 (18.6%)	5,206 (13.0%)	89 (20.9%)	1,193 (6.7%)
B	54,182 (23.1%)	50,320 (28.6%)	474 (1.2%)	28 (6.6%)	3,360 (18.8%)
C	24,745 (10.6%)	9,743 (5.5%)	14,415 (35.9%)	16 (3.8%)	571 (3.2%)
D	43,073 (18.4%)	34,270 (19.5%)	2,296 (5.7%)	107 (25.2%)	6,400 (35.8%)
E	27,811 (11.9%)	26,083 (14.8%)	635 (1.6%)	16 (3.8%)	1,077 (6.0%)
F	45,020 (19.2%)	22,510 (12.8%)	17,079 (42.6%)	169 (39.8%)	5,262 (29.5%)
G	229 (0.1%)	226 (0.1%)	2 (0.0%)	0 (0.0%)	1 (0.0%)
Neighborhood level factors					
Rurality					
Urban	58,546 (25.0%)	44,474 (25.3%)	9,795 (24.4%)	93 (21.9%)	4,184 (23.4%)
Suburban	88,465 (37.8%)	67,765 (38.5%)	14,243 (35.5%)	163 (38.4%)	6,294 (35.2%)
Rural	58,606 (25.0%)	42,312 (24.1%)	11,014 (27.5%)	118 (27.8%)	5,162 (28.9%)
Missing	28,679 (12.2%)	21,349 (12.1%)	5,055 (12.6%)	51 (12.0%)	2,224 (12.4%)
ICE_{Race}[e]					
1	95,370 (40.7%)	72,946 (41.5%)	15,305 (38.2%)	145 (34.1%)	6,974 (39.0%)
2	54,890 (23.4%)	41,792 (23.8%)	9,147 (22.8%)	107 (25.2%)	3,844 (21.5%)
3	55,078 (23.5%)	39,624 (22.5%)	10,542 (26.3%)	121 (28.5%)	4,791 (26.8%)
Missing	28,958 (12.4%)	21,538 (12.2%)	5,113 (12.7%)	52 (12.2%)	2,255 (12.6%)
ICE_{Income}[e]					
1	102,224 (43.6%)	75,033 (42.7%)	18,611 (46.4%)	169 (39.8%)	8,411 (47.1%)
2	68,313 (29.2%)	51,711 (29.4%)	11,270 (28.1%)	136 (32.0%)	5,196 (29.1%)
3	34,801 (14.9%)	27,618 (15.7%)	5,113 (12.7%)	68 (16.0%)	2,002 (11.2%)
Missing	28,958 (12.4%)	21,538 (12.2%)	5,113 (12.7%)	52 (12.2%)	2,255 (12.6%)
$ICE_{Race/Income}$[e]					
1	102,214 (43.6%)	76,151 (43.3%)	17,777 (44.3%)	155 (36.5%)	8,131 (45.5%)
2	69,601 (29.7%)	52,053 (29.6%)	12,032 (30.0%)	152 (35.8%)	5,364 (30.0%)
3	33,523 (14.3%)	26,158 (14.9%)	5,185 (12.9%)	66 (15.5%)	2,114 (11.8%)
Missing	28,958 (12.4%)	21,538 (12.2%)	5,113 (12.7%)	52 (12.2%)	2,255 (12.6%)
PCC availability[e]					
Insufficient	89,943 (38.4%)	67,134 (38.2%)	15,217 (37.9%)	165 (38.8%)	7,427 (41.6%)
Sufficient	115,401 (49.3%)	87,232 (49.6%)	19,779 (49.3%)	208 (48.9%)	8,182 (45.8%)
Missing	28,952 (12.4%)	21,534 (12.2%)	5,111 (12.7%)	52 (12.2%)	2,255 (12.6%)

[a]Includes race other than White or Black as well as Hispanic members. [b]Designation made by MCO that includes any complex medical or social condition. [c]Represents the first MCO that individual was enrolled in. MCO G was assigned for anyone who was not enrolled in an MCO during the full year of their enrollment in Medicaid.

Table A3: Full models exploring the relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 by residential segregation

Description of tercile	Stratified by ICE_{Race}			Stratified by ICE_{Income}			Stratified by $ICE_{Race/Income}$		
	1	2	3	1	2	3	1	2	3
	Disproportionately Black neighborhood PP (95% CI)	PP (95% CI)	Disproportionately White neighborhood PP (95% CI)	Disproportionately low-income neighborhood PP (95% CI)	PP (95% CI)	Disproportionately high-income neighborhood PP (95% CI)	Disproportionately low-income Black neighborhood PP (95% CI)	PP (95% CI)	Disproportionately high-income White neighborhood PP (95% CI)
Individual level factors									
Food insecure									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	-2.9	-7.9*	1.1	-3.3*	-4.4*	0.3	-2.3	-3.0	-4.7
	[-6.0, 0.2]	[-14.1, -1.7]	[-3.5, 5.8]	[-6.1, -0.4]	[-8.2, -0.6]	[-6.5, 7.0]	[-5.4, 0.7]	[-7.2, 1.2]	[11.2, 1.8]
Housing insecure									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	-0.7	0.036	-1.7	1.9	-2.6	1.6	0.9	0.4	-1.3
	[-4.0, 2.5]	[-1.0, 8.3]	[-6.8, 3.4]	[-1.5, 5.3]	[-6.5, 1.4]	[-5.4, 8.6]	[-2.5, 4.3]	[-3.6, 4.5]	[-8.9, 6.2]
Sex									
Male	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Female	15.4***	13.3***	11.9***	15.3***	12.4***	13.7***	15.8***	12.1***	13.4***
	[12.2, 18.5]	[9.0, 17.5]	[7.6, 16.3]	[11.9, 18.6]	[9.2, 15.5]	[7.9, 19.5]	[12.7, 18.8]	[8.3, 15.9]	[8.2, 18.6]
Socially constructed race									
White members	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Black members	-3.9	-1.9	-2.4	-2.5	-5.7*	-0.4	-1.7	-4.7*	-3.0
	[-8.3, 0.4]	[-7.2, 3.3]	[10.6, 5.8]	[-6.1, 1.0]	[-10.3, -1.1]	[-6.2, 5.4]	[-5.4, 2.1]	[-9.3, -0.1]	[-12.5, 6.6]
Other[a]	-0.3	-3.2	-2.1	1.1	-0.2	-6.2	5.1*	-6.7*	-2.9
	[-7.1, 6.5]	[-8.6, 2.1]	[-9.8, 5.6]	[-3.8, 5.9]	[-6.2, 5.9]	[14.8, 2.3]	[0.4, 9.7]	[-12.6, -0.8]	[11.8, 6.1]
Age									
18-29	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
30-39	6.1	6.7**	5.7*	9.8**	0.7	8.7*	7.0*	5.0	5.0
	[-0.3, 12.4]	[2.0, 11.4]	[0.0, 11.3]	[3.7, 15.8]	[-3.6, 4.9]	[1.2, 16.2]	[0.7, 13.3]	[-0.8, 10.7]	[-4.4, 14.4]
40-49	9.1***	16.1***	10.0***	10.9***	7.6**	17.9***	9.7***	9.8**	16.5***
	[4.4, 13.8]	[10.9, 21.4]	[4.4, 15.6]	[6.6, 15.2]	[2.0, 13.2]	[11.5, 24.3]	[5.2, 14.2]	[3.9, 15.6]	[7.9, 25.1]

50-59	11.7*** [6.9, 16.5]	14.6*** [10.3, 19.0]	7.2* [0.6, 13.8]	11.7*** [6.9, 16.6]	10.8*** [5.9, 15.8]	7.9* [0.3, 15.5]	11.2*** [6.2, 16.1]	11.5*** [6.7, 16.3]	7.5 [-0.4, 15.4]
60-64	13.4*** [7.4, 19.3]	12.6** [5.0, 20.2]	7.1* [0.4, 3.9]	10.6** [3.7, 17.4]	10.6** [3.6, 17.6]	14.3*** [7.4, 21.1]	11.0** [4.3, 17.7]	10.2** [3.7, 16.7]	12.0* [2.3, 21.7]
Diabetes									
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	16.8*** [13.2, 20.4]	14.8*** [9.6, 19.9]	15.1*** [12.0, 18.1]	17.2*** [14.0, 20.3]	15.4*** [11.6, 19.2]	14.8*** [9.9, 19.7]	17.3*** [13.9, 20.7]	14.8*** [10.9, 18.6]	16.4*** [11.1, 21.7]
Liver disease									
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	8.5** [2.3, 14.6]	8.0* [0.7, 15.3]	15.3*** [11.4, 19.2]	11.6*** [8.3, 14.8]	7.3 [-0.5, 15.1]	11.3*** [4.7, 17.8]	10.0*** [5.9, 14.2]	8.0* [1.3, 14.6]	15.4*** [8.6, 22.1]
Cardiac disease									
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	10.6*** [6.6, 14.6]	3.5 [-4.0, 10.9]	6.0** [1.6, 10.3]	8.6*** [5.1, 12.0]	8.6** [2.4, 14.7]	3.4 [-2.4, 9.3]	8.8*** [4.9, 12.8]	7.2* [1.0, 13.4]	4.2 [-1.8, 10.1]
COPD									
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	15.7*** [12.4, 19.0]	17.6*** [14.1, 21.1]	12.4*** [9.3, 15.5]	14.3*** [11.5, 17.1]	14.7*** [11.9, 17.6]	19.8*** [15.2, 24.3]	14.1*** [11.3, 16.8]	15.5*** [12.4, 18.6]	18.9*** [14.4, 23.4]
Medically complex[b]									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	3.4** [1.0, 5.9]	3.0 [-1.4, 7.4]	5.4* [1.3, 9.5]	4.4** [1.4, 7.4]	5.3** [1.4, 9.2]	-1.6 [-5.9, 2.7]	6.0*** [3.1, 8.8]	3.0 [-0.6, 6.7]	-0.7 [-6.8, 5.4]
Plan level factors									
Month of enrollment									
Jan '19	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Feb '19	2.6 [-7.6, 12.8]	0.4 [-11.3, 12.0]	-0.8 [-11.8, 10.3]	-0.6 [-9.5, 8.4]	4.0 [-4.7, 12.7]	-2.2 [-13.6, 9.1]	-1.6 [-11.9, 8.8]	3.3 [-5.7, 12.3]	1.8 [-9.7, 13.4]
March '19	6.4 [-0.7, 13.6]	2.8 [-10.4, 16.0]	3.3 [-7.2, 13.7]	0.2 [-6.2, 6.7]	6.0 [-1.5, 13.5]	0.113 [-7.5, 30.1]	3.7 [-3.0, 10.3]	5.5 [-3.0, 14.0]	6.9 [17.4, 31.1]
April '19	0.4	-4.8	-2.2	-7.9	2.6	7.6	-6.4	0.7	4.3

	[-6.5, 7.3]	[21.4, 11.7]	[13.3, 8.8]	[17.9, 2.0]	[-8.9, 14.2]	[-6.6, 21.8]	[-16.0, 3.2]	[-9.2, 10.6]	[-7.9, 16.5]
May '19	3.9	4.7	-4.9	0.8	2.1	7.3	0.6	1.4	7.7
	[-2.9, 10.8]	[-9.3, 18.6]	[-18.0, 8.2]	[-5.9, 7.6]	[-6.2, 10.5]	[-14.6, 29.1]	[-6.9, 8.2]	[-9.3, 12.2]	[-13.5, 29.0]
June '19	4.1	0.1	-7.5	1.4	-2.2	6.9	5.2	-7.0	6.2
	[-4.7, 12.9]	[-9.4, 9.6]	[-21.9, 7.0]	[-7.4, 10.2]	[-15.1, 10.7]	[-1.3, 15.1]	[-3.6, 14.0]	[-18.7, 4.6]	[-3.9, 16.4]
MCO Plan[c]									
A	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
B	3.8	10.6	-5.2	-0.6	8.1	5.7	3.0	1.5	8.2
	[-2.6, 10.1]	[-1.2, 22.3]	[-14.3, 3.8]	[-7.1, 6.0]	[-1.8, 17.9]	[-9.3, 20.7]	[-3.3, 9.3]	[-7.3, 10.3]	[-5.7, 22.1]
C	4.0	-1.4	-4.6	-1.6	2.0	2.3	1.0	-2.2	2.4
	[-6.4, 14.4]	[18.2, 15.3]	[-15.9, 6.6]	[-12.6, 9.4]	[-9.4, 13.4]	[-15.2, 19.9]	[-10.4, 12.3]	[-12.6, 8.2]	[-12.5, 17.3]
D	-7.9*	0.8	-16.2***	-12.1***	-2.4	-5.7	-7.5**	-8.6*	-7.0
	[-14.0, -1.8]	[-8.9, 10.5]	[-24.3, -8.1]	[-17.8,-6.4]	[-10.1, 5.2]	[-21.2, 9.8]	[-13.2, -1.9]	[-15.8, -1.4]	[-19.7, 5.7]
E	-2.5	12.8*	-13.9*	-8.2*	3.2	6.3	-3.0	-2.9	7.3
	[10.1, 5.1]	[1.8, 23.9]	[-24.8, -3.0]	[-15.0, -1.4]	[-8.0, 14.5]	[-6.1, 18.7]	[-9.2, 3.2]	[-14.1, 8.4]	[-5.2, 19.8]
F	-3.0	3.7	-5.7	-6.2*	2.4	3.4	-3.4	-3.1	7.6
	[-8.1, 2.1]	[-4.4, 11.8]	[-14.1, 2.8]	[-11.5, -0.8]	[-4.9, 9.8]	[-9.6, 16.4]	[-8.7, 1.9]	[-9.5, 3.3]	[-4.8, 20.1]
Neighborhood level factors									
Rurality									
Suburban	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Urban	-1.0	1.0	3.8	3.2	-1.7	-0.1	-0.2	-1.8	3.6
	[-6.0, 4.0]	[-3.4, 5.5]	[-6.8, 14.5]	[-0.8, 7.3]	[-7.3, 3.9]	[-9.3, 9.2]	[-4.6, 4.3]	[-9.3, 5.6]	[-2.9, 10.0]
Rural	3.8	0.1	2.3	3.1	-0.8	-0.005	2.7	-3.1	4.8
	[-1.7, 9.4]	[-6.0, 6.3]	[-7.2, 11.8]	[-1.3, 7.5]	[-6.4, 4.7]	[-14.5, 13.6]	[-2.0, 7.3]	[-11.8, 5.6]	[-2.7, 12.3]
$ICE_{Race/Income}$									
1	---	---	---	---	---	---	---	---	---
2	---	---	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---	---	---
PCP availability									
Insufficient	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Sufficient	-2.2	-0.0	-0.9	0.2	-0.9	-3.9	-1.5	0.0	-4.0

	[-5.1, 0.7]	[-5.0, 5.0]	[-6.1, 4.3]	[-3.1, 3.5]	[-4.6, 2.9]	[-9.5, 1.7]	[-4.8, 1.8]	[-4.2, 4.5]	[-9.2, 1.3]
Unweighted observations	6,565	3,609	4,561	7,967	4,894	1,874	7,685	5,071	1,979
Weighted observations	82,922	47,778	45,405	84,941	60,890	30,274	85,187	61,909	29,009

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval. All regressions cluster standard errors at the county level but do not include an intercept for county level. All regressions weighted to represent all new Medicaid expansion members between January 1, 2019- June 30, 2019 using propensity score weighting.

Table A4: Full models exploring the relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 by rurality

	Urban PP (95% CI)	Suburban PP (95% CI)	Rural PP (95% CI)
Individual level factors			
Food insecure			
No	Ref	Ref	Ref
Yes	-4.1* [-7.9, -0.3]	-4.2** [-7.3, -1.1]	-0.0 [-5.2, 5.2]
Housing insecure			
No	Ref	Ref	Ref
Yes	-1.3 [-5.5, 2.8]	0.9 [-3.4, 5.2]	-0.8 [-5.5, 3.9]
Sex			
Male	Ref	Ref	Ref
Female	13.0*** [8.2, 17.9]	15.2*** [12.2, 18.3]	12.9*** [8.8, 17.0]
Socially constructed race			
White members	Ref	Ref	Ref
Black members	-1.2 [-5.1, 2.6]	-6.4*** [-9.9, -3.0]	1.3 [-4.1, 6.6]
Other[a]	1.6 [-3.6, 6.9]	-4.7 [-11.3, 1.8]	3.3 [-2.5, 9.1]
Age			
18-29	Ref	Ref	Ref
30-39	9.4 [-1.0, 19.7]	5.8* [1.4, 10.3]	3.3 [-2.3, 8.8]
40-49	9.5** [2.9, 16.2]	13.0*** [8.8, 17.1]	9.1*** [3.9, 14.4]
50-59	12.5** [4.9, 20.0]	12.2*** [7.5, 16.8]	7.6** [2.2, 13.1]
60-64	13.3*** [5.6, 21.0]	14.3*** [9.8, 18.8]	3.7 [-3.6, 11.0]

Diabetes			
No diagnosis	Ref	Ref	Ref
Diagnosis	18.7***	14.4***	16.7***
	[14.6, 22.9]	[10.6, 18.3]	[12.7, 20.7]
Liver disease			
No diagnosis	Ref	Ref	Ref
Diagnosis	11.1**	11.1***	0.08.5
	[4.2, 18.1]	[8.1, 14.2]	[-0.1, 17.1]
Cardiac disease			
No diagnosis	Ref	Ref	Ref
Diagnosis	7.0**	9.1***	5.2
	[2.5, 11.5]	[0.053,0.129]	[-2.8, 13.2]
COPD			
No diagnosis	Ref	Ref	Ref
Diagnosis	16.4***	16.5***	12.2***
	[12.2, 20.6]	[13.4, 19.7]	[8.4, 16.0]
Medically complex[b]			
No	Ref	Ref	Ref
Yes	1.4	2.7	7.9***
	[-2.9, 5.6]	[-0.6, 5.9]	[3.7, 12.1]
Plan level factors			
Month of enrollment			
Jan '19	Ref	Ref	Ref
Feb '19	3.4	0.6	-1.6
	[-7.5, 14.3]	[-8.3, 9.4]	[-12.4, 9.2]
March '19	-1.4	7.6	7.3
	[-11.5, 8.6]	[-3.3, 18.5]	[-2.7, 17.2]
April '19	-2.3	4.7	-6.4
	[-12.3, 7.6]	[-3.2, 12.7]	[-18.2, 5.3]
May '19	0.4	7.5	-3.0
	[-11.7, 12.5]	[-3.7, 18.7]	[-14.4, 8.5]
June '19	6.4	-1.0	1.1
	[-2.7, 15.6]	[-12.0, 10.0]	[-12.7, 14.9]

MCO Plan[c]			
A	Ref	Ref	Ref
B	1.5	7.2	-1.9
	[-7.1, 10.1]	[-0.4, 14.9]	[-10.5, 6.6]
C	16.4*	-4.2	-8.7
	[2.9, 29.9]	[-14.3, 5.8]	[-21.9, 4.5]
D	-9.9*	-3.3	-12.7***
	[-18.4,-1.5]	[-9.9, 3.4]	[-19.9, -5.5]
E	-1.9	5.4	-11.1*
	[-12.5, 8.8]	[-1.5, 12.4]	[-21.3, -1.0]
F	-4.2	1.8	-4.8
	[-11.6, 3.1]	[-3.4, 7.0]	[-11.9, 2.2]
Neighborhood level factors			
Rurality			
Suburban	---	---	---
Urban	---	---	---
Rural	---	---	---
$ICE_{Race/Income}$			
1	Ref	Ref	Ref
2	3.8	1.5	-0.8
	[-3.9, 11.5]	[-2.2, 5.1]	[-5.2, 3.7]
3	-2.6	0.6	1.4
	[-9.3, 4.1]	[-3.2, 4.5]	[-5.3, 8.0]
PCC availability			
Insufficient	Ref	Ref	Ref
Sufficient	-3.3	0.9	-3.5
	[-8.9, 2.3]	[-2.5, 4.3]	[-8.0, 1.0]
Unweighted observations	3,934	5,913	4,888
Weighted observations	47,726	78,994	49,386

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval. All regressions cluster standard errors at the county level but do not include an intercept for county level. All regressions weighted to represent all new Medicaid expansion members between January 1, 2019- June 30, 2019 using propensity score weighting.

Table A5: Full models exploring the relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 by socially constructed race or by MCO

	Stratified by socially-constructed race			Stratified by MCO at time of MMHS screen					
	White members PP (95% CI)	Black members PP (95% CI)	Other race or Hispanic ethnicity members PP (95% CI)	A PP (95% CI)	B PP (95% CI)	C PP (95% CI)	D PP (95% CI)	E PP (95% CI)	F PP (95% CI)
Individual level factors									
Food insecure									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	-1.4 [-5.1, 2.2]	-3.0 [-7.0, 1.0]	-10.1** [-17.4, -2.9]	-7.3* [-14.4, -0.2]	1.2 [-3.6, 6.0]	-9.3 [-21.2, 2.5]	-7.3*** [-11.4, -3.2]	-7.7 [-23.3, 7.8]	-1.6 [-4.7, 1.5]
Housing insecure									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.3 [-3.0, 3.6]	0.9 [-3.7, 5.5]	-0.1 [-6.6, 6.3]	4.1 [-6.3, 14.5]	-1.9 [-5.6, 1.8]	23.5*** [14.1, 32.9]	-0.1 [-4.3, 4.0]	5.1 [-13.2, 23.4]	-4.2 [-8.6, 0.1]
Sex									
Male	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Female	10.8*** [7.3, 14.3]	19.4*** [15.0, 23.8]	13.7*** [9.5, 17.9]	14.8*** [7.6, 22.1]	9.5*** [5.4, 13.6]	19.5** [7.1, 32.0]	17.9*** [14.9, 20.9]	6.5 [-1.1, 14.0]	15.1*** [11.6, 18.7]
Socially constructed race									
White members	---	---	---	Ref	Ref	Ref	Ref	Ref	Ref
Black members	---	---	---	-0.09* [-0.16,-0.02]	-0.01 [-0.07,0.06]	-0.14* [-0.27,-0.01]	0.01 [-0.03,0.04]	-0.04 [-0.13,0.05]	-0.05* [-0.09,-0.00]
Other[a]	---	---	---	-0.03 [-0.16,0.11]	-0.02 [-0.07,0.04]	-0.08 [-0.31,0.16]	0.01 [-0.03,0.06]	-0.04 [-0.17,0.10]	-0.03 [-0.08,0.02]
Age									
18-29	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
30-39	5.2* [0.7, 9.7]	6.3 [-1.2, 13.9]	7.8* [0.1, 15.6]	4.7 [-7.3, 16.6]	9.6* [1.0, 18.2]	26.4** [10.2, 42.5]	2.5 [-2.9, 8.0]	-1.0 [-12.1, 10.0]	4.2 [-1.1, 9.5]
40-49	8.8***	11.6***	17.0***	7.5	13.9***	18.5*	11.4***	10.3	7.0**

	[4.0, 13.5]	[5.3, 17.9]	[10.7, 23.4]	[-2.7, 17.8]	[7.2, 20.7]	[3.7, 33.4]	[7.0, 15.7]	[-2.8, 23.3]	[2.2, 11.9]
50-59	8.5***	12.0***	15.1***	10.0*	14.9***	27.1***	10.0***	-2.2	7.3**
	[3.9, 13.1]	[6.5, 17.4]	[7.4, 22.7]	[0.8, 19.2]	[7.7, 22.1]	[11.4, 42.7]	[5.0, 14.9]	[-14.8, 10.3]	[2.8, 11.8]
60-64	7.2*	13.1**	16.4***	14.6	10.3**	28.9**	13.6**	-1.7	9.0***
	[0.3, 14.1]	[4.9, 21.4]	[9.1, 23.7]	[-2.3, 31.6]	[2.9, 17.7]	[7.2, 50.6]	[4.6, 22.5]	[-18.7, 15.3]	[4.1, 13.9]
Diabetes									
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	14.5***	18.1***	16.5***	19.5***	11.6***	21.4**	19.1***	13.5**	18.1***
	[11.9, 17.2]	[14.4, 21.9]	[9.3, 23.7]	[12.3, 26.8]	[7.0, 16.1]	[7.7, 35.1]	[15.3, 22.9]	[5.1, 22.0]	[14.5, 21.7]
Liver disease									
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	10.9***	9.6**	9.8	-4.5	9.4***	12.7	16.6***	14.1**	13.0***
	[6.2, 15.6]	[3.4, 15.8]	[-0.6, 20.2]	[-23.4, 14.4]	[4.1, 14.8]	[-4.2, 29.5]	[11.4, 21.8]	[5.6, 22.6]	[9.3, 16.7]
Cardiac disease									
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	7.7***	7.4*	6.9	-4.4	6.8**	-2.5	5.4*	11.1**	14.0***
	[3.9, 11.5]	[1.2, 13.6]	[-0.4, 14.2]	[-19.1, 10.3]	[1.8, 11.9]	[-21.7, 16.8]	[0.8, 9.9]	[4.5, 17.7]	[9.5, 18.4]
COPD									
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	14.0***	15.8***	18.1***	15.4***	12.4***	14.9*	19.0***	15.1***	13.5***
	[11.5, 16.6]	[12.1, 19.5]	[13.6, 22.6]	[8.9, 21.8]	[8.6, 16.2]	[0.5, 29.2]	[16.1, 22.0]	[7.2, 23.0]	[9.8, 17.1]
Medically complex[b]									
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	4.3**	4.3*	3.2	3.7	1.4	-2.6	7.8***	2.8	6.3***
	[1.7, 6.9]	[0.7, 8.0]	[-2.0, 8.3]	[-2.4, 9.9]	[-2.0, 4.8]	[-15.2, 10.1]	[5.0, 10.7]	[-8.2, 13.8]	[3.2, 9.4]
Plan level factors									
Month of enrollment									
Jan '19	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Feb '19	1.1	0.5	-0.2	-18.8	-2.9	22.4	6.3	12.9	3.6
	[-6.9, 9.1]	[-10.5, 11.6]	[-13.4, 13.0]	[-41.6, 4.1]	[-12.3, 6.4]	[-4.7, 49.5]	[-3.1, 15.7]	[-6.2, 32.0]	[-4.1, 11.3]
March '19	5.6	2.9	6.6	-0.3	10.4	19.1*	-4.3	-5.6	0.4
	[-1.3, 12.4]	[-6.3, 12.1]	[-8.7, 21.9]	[-21.9, 21.2]	[-0.8, 21.6]	[1.7, 36.6]	[-14.0, 5.4]	[-46.4, 35.2]	[-8.7, 9.5]

April '19	0.7 [-8.5, 9.9]	-2.0 [-12.0, 7.9]	-9.0 [-20.5, 2.6]	19.8*** [10.3, 29.4]	-9.4 [-23.9, 5.2]	-44.3* [-84.6, -4.0]	0.3 [-12.4, 13.0]	-0.207 [-56.6, 15.3]	3.2 [-3.0, 9.4]
May '19	-3.6 [-13.2, 6.1]	6.5 [-2.9, 15.9]	8.3 [-1.0, 17.6]	-6.7 [-32.8, 19.3]	8.0 [-5.4, 21.4]	9.9 [-18.4, 38.3]	-2.2 [-9.1, 4.8]	-2.9 [-25.1, 19.3]	5.8 [-1.2, 12.8]
June '19	-1.4 [-9.9, 7.1]	7.4 [-1.7, 16.4]	-4.9 [-31.3, 21.6]	15.7 [-10.0, 41.3]	12.2 [-0.4, 24.7]	7.5 [-7.3, 22.2]	3.0 [-3.6, 9.6]	0.124 [-10.4, 35.1]	-17.5*** [-26.9, -8.1]
MCO Plan[c]									
A	Ref	Ref	Ref	---	---	---	---	---	---
B	-0.8 [-7.5, 6.0]	7.9* [0.5, 15.2]	3.3 [-7.9, 14.5]	---	---	---	---	---	---
C	-0.7 [-11.4, 9.9]	0.8 [-12.8, 14.3]	-2.6 [-24.3, 19.0]	---	---	---	---	---	---
D	-12.1*** [-18.0,-6.2]	-3.0 [-9.2, 3.3]	-8.1 [-19.9, 3.6]	---	---	---	---	---	---
E	-4.0 [-11.2, 3.2]	0.7 [-7.7, 9.2]	-1.2 [-16.8, 14.3]	---	---	---	---	---	---
F	-3.1 [-8.5, 2.2]	-0.5 [-7.3, 6.4]	-2.8 [-15.4, 9.9]	---	---	--- ---	--- ---	--- ---	--- ---
Neighborhood level factors									
Rurality									
Suburban	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Urban	3.0 [-1.6, 7.5]	-2.5 [-8.4, 3.4]	0.2 [-7.7, 8.2]	-4.9 [-14.7, 4.9]	2.7 [-5.0, 10.4]	-25.8** [-41.3, -10.3]	4.6* [0.1, 9.1]	-1.0 [-11.1, 9.1]	1.5 [-3.3, 6.4]
Rural	0.1 [-4.3, 4.5]	3.3 [-3.4, 9.9]	4.3 [-5.8, 14.3]	5.5 [-5.8, 16.9]	1.0 [-6.5, 8.4]	-20.5* [-36.4, -4.6]	3.9 [-0.5, 8.4]	-11.0 [-22.6, 0.6]	3.6 [-1.6, 8.8]
$ICE_{Race/Income}$									
1	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
2	3.0 [-0.3, 6.3]	1.8 [-4.1, 7.7]	-6.7 [-13.9, 0.5]	1.8 [-7.3, 11.0]	0.6 [-4.8, 6.1]	-0.0 [-14.6, 14.6]	0.7 [-4.1,5.5]	-0.5 [-11.2, 10.2]	1.6 [-2.7, 5.9]
3	1.4 [-4.0, 6.9]	2.2 [-6.6, 11.1]	-4.8 [-11.4, 1.8]	-5.3 [-19.8, 9.1]	0.0 [-6.3, 6.3]	4.6 [-9.8, 18.9]	-4.6 [-10.8, 1.6]	0.3 [-11.9, 12.5]	5.8* [1.1, 10.4]
PCC availability									

Insufficient	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Sufficient	-1.5 [-4.9, 1.9]	-2.2 [-6.4, 1.9]	-1.1 [-7.6, 5.4]	1.9 [-7.4, 11.3]	-3.8 [-8.5, 1.0]	-1.6 [-13.9, 10.6]	0.0 [-2.5, 2.5]	-14.7* [-26.4, -2.9]	2.7 [-0.7, 6.0]
Unweighted observations	8,087	4,445	2,203	901	2,668	326	5,481	863	4,496
Weighted observations	88,878	59,555	27,672	25,363	44,451	10,114	39,134	13,841	443,519

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval.All regressions cluster standard errors at the county level but do not include an intercept for county level. All regressions weighted to represent all new Medicaid expansion members between January 1, 2019- June 30, 2019 using propensity score weighting.

Table A6: Exploring the sensitivity of the relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 to different model specifications and outcome specifications

Model Features			Model 1	Model 2	Model 3		Model 4	
Type	Clustering	Intercept	Food insecure coefficient PP (95% CI)	Housing insecure coefficient PP (95% CI)	Food insecure coefficient PP (95% CI)	Housing insecure coefficient PP (95% CI)	1 need coefficient PP (95% CI)	2 needs coefficient PP (95% CI)
PCP definition that includes care provided by all PCPs (outcome used in main model)								
OLS	x	MCO	-3.0* [-5.8, -0.3]	-0.5 [-3.1, 2.0]	-3.1* [-5.9, -0.2]	0.1 [-2.5, 2.7]	-1.9 [-4.4, 0.6]	-2.2 [-6.2, 1.9]
OLS	County	MCO	-3.0** [-5.2, -0.9]	-0.5 [-3.1, 2.0]	-3.1** [-5.2, -0.9]	0.1 [-2.5, 2.7]	-1.9 [-4.2, 0.3]	-2.2 [-6.1, 1.8]
OLS	MCO	MCO	-3.0 [-7.5, 1.4]	-0.5 [-5.6, 4.5]	-3.1 [-8.0, 1.9]	0.1 [-5.5, 5.7]	-1.9 [-4.9, 1.1]	-2.2 [-7.3, 3.0]
OLS	County	MCO, County	-2.8** [-4.9, -0.8]	-0.7 [-3.2, 1.9]	-2.8** [-4.9, -0.8]	-0.1 [-2.7, 2.5]	-1.9 [-4.1, 0.2]	-2.1 [-5.9, 1.7]
OLS	MCO	MCO, County	-2.8 [-7.3, 1.6]	-0.7 [-5.6, 4.2]	-2.8 [-7.3, 1.6]	-0.1 [-5.5, 5.3]	-1.9 [-4.7, 0.9]	-2.1 [-6.8, 2.6]
Logit	County	MCO, County	-3.0** [-5.2, -0.8]	-0.6 [-3.2, 2.0]	-3.0** [-5.2, -0.9]	-0.0 [-2.6, 2.6]	-1.9 [-4.1, 3.8]	-2.2 [-6.4, 2.0]
PCP definition that DOES NOT include care provided by NPs/PAs, FQHCs, or RHCs								
OLS	x	MCO	-4.0** [-6.8,-1.1]	-0.9 [-3.6, 1.7]	-3.9** [-6.8, -1.0]	-0.00 [-0.03,0.03]	-3.0* [-5.6, -0.4]	-2.5 [-6.7, 1.7]
OLS	County	MCO	-4.0** [-6.3, -1.6]	-0.9 [-3.6, 1.7]	-3.9*** [-6.2,-1.7]	-0.00 [-0.03,0.02]	-3.0* [-5.4,-0.6]	-2.5 [-7.0, 2.0]
OLS	MCO	MCO	-4.0 [-8.6, 0.7]	-0.9 [-7.0, 5.1]	-3.9 [-9.0, 1.1]	-0.00 [-0.07,0.06]	-3.0 [-7.2, 1.11]	-2.5 [-8.5, 3.5]
OLS	County	MCO, County	-3.7*** [-5.9, -1.5]	-1.2 [-3.8, 1.3]	-3.7*** [-5.9, -1.5]	-0.001 [-0.03,0.02]	-3.1** [-5.4, -0.8]	-2.7 [-7.1, 1.7]
OLS	MCO	MCO, County	-3.7 [-8.2, 8.0]	-1.2 [-7.0, 4.5]	-3.7 [-8.2,0.8]	-0.01 [-0.07,0.06]	-3.1 [-6.9, 0.8]	-2.7 [-8.4, 3.1]

Logit	MCO	MCO, County	-3.9** [-6.3, -1.5]	-1.2 [-3.8, 1.5]	-3.8** [-6.1, -1.6]	-0.5 [-3.0, 2.1]	-3.0* [-5.3, -0.6]	-2.7 [-7.5, 2.0]
PCP definition that does not include internal medicine physicians								
OLS	x	MCO	-2.0 [-5.0, 0.9]	-0.6 [-3.4, 2.1]	-2.0 [-5.0, 0.1]	-0.2 [-3.0, 2.5]	-1.5 [-4.2, 1.1]	-1.5 [-6.0, 2.9]
OLS	County	MCO	-2.0 [-4.8, 0.7]	-0.6 [-3.2, 1.9]	-2.0 [-4.6, 0.6]	-0.2 [-2.7, 2.3]	-1.5 [-3.9, 0.8]	-1.5 [-6.1, 3.1]
OLS	MCO	MCO	-2.0 [-7.6, 3.5]	-0.6 [-5.1, 3.9]	-2.0 [-8.4, 4.5]	-0.2 [-5.7, 5.2]	-1.5 [-4.2, 1.1]	-1.5 [-6.9, 3.8]
OLS	County	MCO, County	-1.6 [-4.2, 1.0]	-0.6 [-3.0, 1.9]	-1.6 [-4.1, 1.0]	-0.3 [-2.7, 2.1]	-1.4 [-3.6, 0.9]	-1.1 [-5.5, 3.3]
OLS	MCO	MCO, County	-1.6 [-6.9, 3.6]	-0.6 [-5.6, 4.5]	-1.6 [-7.7, 4.6]	-0.3 [-6.2, 5.7]	-1.4 [-4.5, 1.8]	-1.1 [-6.4, 4.1]
Logit	MCO	MCO, County	-1.7 [-4.4, 0.9]	-0.6 [-3.0, 1.9]	-1.6 [-4.3, 0.9]	-0.2 [-2.6, 2.2]	-1.3 [-3.6, 0.9]	-1.2 [5.7, 3.2]
PCP definition that does not include OBGYNs								
OLS	x	MCO	-1.9 [-4.7, 1.0]	-1.3 [-4.0, 1.4]	-1.6 [-4.5, 1.3]	-1.0 [-3.7, 1.8]	-2.4 [-5.0, 0.2]	-1.2 [-5.3, 3.0]
OLS	County	MCO	-1.9 [-4.0, 0.3]	-1.3 [-3.9, 1.3]	-1.6 [-3.9, 0.7]	-1.0 [-3.7, 1.8]	-2.4* [-4.7, -0.1]	-1.2 [-4.8, 2.5]
OLS	MCO	MCO	-1.9 [-7.0, 3.3]	-1.3 [-6.2, 3.7]	-1.6 [-7.3, 4.0]	-1.0 [-6.4, 4.4]	-2.4 [-5.1, 0.3]	-1.2 [-7.2, 4.9]
OLS	County	MCO, County	-1.6 [-3.6, 0.5]	-1.2 [-3.7, 1.3]	-1.3 [-3.5, 0.9]	-1.0 [-3.6, 1.7]	-2.2** [-4.4, -0.0]	-0.9 [-4.3, 2.6]
OLS	MCO	MCO, County	-1.6 [-6.5, 3.4]	-1.2 [-6.1, 3.6]	-1.3 [-6.7, 4.1]	-1.0 [-6.2, 4.1]	-2.2 [-4.9, 5.0]	-0.9 [-4.9, 5.0]
Logit	MCO	MCO, County	-1.7 [-3.8, 0.5]	-1.0 [-3.6, 1.5]	-1.5 [-3.7, 8.3]	-0.7 [-3.4, 1.9]	-2.2 [-4.4, 0.0]	-0.7 [-4.5, 3.1]
PCP definition that includes care provided by the previously identified list of PCPs								
OLS	x	MCO	-4.0** [-6.9, -1.1]	-0.4 [-3.1, 2.3]	-4.1** [-7.1, -1.2]	0.4 [-2.3, 3.2]	-2.8* [-5.4, -0.1]	-2.1 [-6.4, 2.2]

OLS	County	MCO	-4.0*** [-6.3,-1.8]	-0.4 [-3.4, 2.6]	-4.1*** [-6.4, -1.9]	0.4 [-2.6, 3.5]	-2.8* [-5.3, -0.2]	-2.1 [-6.0, 1.8]
OLS	MCO	MCO	-4.0* [-7.6, -0.4]	-0.4 [-5.6, 4.8]	-4.1 [-8.3,0.1]	0.4 [-5.3, 6.2]	-2.8 [-6.5, 0.9]	-2.1 [-6.7, 2.5]
OLS	County	MCO, County	-3.9** [-6.2, -1.6]	-0.6 [-3.6, 2.3]	-3.9*** [-6.2, -1.6]	0.1 [-2.8, 3.1]	-3.1* [-5.6, -0.7]	-1.8 [-6.0, 2.3]
OLS	MCO	MCO, County	-3.9* [-7.2, -0.6]	-0.6 [-5.3, 4.0]	-3.9* [-7.8, -0.1]	0.1 [-5.1, 5.4]	-3.1 [-6.6, 0.3]	-1.8 [-5.9, 2.2]
Logit	MCO	MCO, County	-4.0** [-6.4,-1.6]	-0.01 [-0.04,0.02]	-4.0** [-6.3, -1.6]	0.1 [-2.9, 3.2]	-3.1* [-5.6, -0.6]	-1.9 [-6.3, 2.5]
PCP definition that includes all CPT codes in the HEDIS Preventive/Ambulatory Care Services								
OLS	x	MCO	-3.0* [-5.8, -0.2]	-0.5 [-3.1, 2.0]	-3.0* [-5.8, -0.2]	0.1 [-2.6, 2.7]	-1.9 [-4.3, 0.6]	-2.2 [-6.3, 1.8]
OLS	County	MCO	-3.0** [-5.2, -0.9]	-0.5 [-3.1, 2.0]	-3.0** [-5.1,-0.9]	0.1 [-2.5, 2.7]	-1.9 [-4.1, 0.4]	-2.2 [-6.2, 1.8]
OLS	MCO	MCO	-3.0 [-7.7, 1.7]	-0.5 [-5.6, 4.5]	-3.0 [-8.2, 2.2]	0.1 [-5.5, 5.7]	-1.9 [-4.9, 1.2]	-2.2 [-7.4, 2.9]
OLS	County	MCO, County	-2.8** [-4.9, -0.8]	-0.7 [-3.2, 1.8]	-2.8** [-4.8, -0.8]	-0.1 [-2.7, 2.4]	-1.9 [-4.1, 0.3]	-2.2 [-6.0, 1.6]
OLS	MCO	MCO, County	-2.8 [-7.0, 1.3]	-0.7 [-5.6, 4.2]	-2.8 [-7.5, 1.9]	-0.1 [-5.5, 5.2]	-1.9 [-4.8, 1.0]	-2.2 [-7.0, 2.6]
Logit	MCO	MCO, County	-3.0** [-5.2, -0.8]	-0.6 [-3.2, 2.0]	-3.0** [-5.1, -0.1]	-0.1 [-2.7, 2.5]	-1.8 [-4.0, 0.4]	-2.3 [-6.5, 1.9]

Notes: *p<0.05, ** p<0.01, *** p<0.001. All regressions weighted to represent all new Medicaid expansion members enrolled between January 1, 2019- June 30, 2019 using propensity score weighting. Regressions adjusted for sex, socially-constructed race, age category, diabetes diagnosis, liver disease diagnosis, cardiac disease diagnosis, COPD diagnosis, medical complexity, month of enrollment, MCO that conducted the MMHS screening, rurality, segregation (using $ICE_{Race/Income}$), and PCP availability.

Table A7: Exploring the relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 in the unweighted sample and using alternative weighting methods

	Unweighted		Raking method	
	Unadjusted PP (95% CI)	Adjusted regression PP (95% CI)	Unadjusted PP (95% CI)	Adjusted regression PP (95% CI)
Individual level factors				
Food insecure				
No	Ref	Ref	Ref	Ref
Yes	2.4* (0.5, 4.2)	-2.2* [-3.9, -0.5]	2.4* (0.4, 4.3)	-2.1* [-3.8, -0.4]
Housing insecure	Ref		Ref	
No	0.6 (-1.2, 2.3)	Ref	0.6 (-0.9, 2.1)	Ref
Yes		-0.4 [-1.8, 1.0]		-0.4 [-1.8, 1.1]
Sex				
Male		Ref		Ref
Female		11.8*** [10.2, 13.3]		11.7*** [10.3, 13.2]
Socially constructed race				
White members		Ref		Ref
Black members		-1.5 [-3.3, 0.4]		-1.5 [-3.3, 0.4]
Other[a]		0.2 [-1.9, 2.3]		0.2 [-1.9, 2.3]
Age				
18-29		Ref		Ref
30-39		4.9** [1.5, 8.3]		4.9** [1.6, 8.2]
40-49		8.8*** [6.4, 11.2]		8.7*** [6.4, 11.1]

50-59	9.7*** [6.6, 12.7]	9.6*** [6.6, 12.5]
60-64	9.6*** [5.7, 13.6]	9.6*** [5.7, 13.4]
Diabetes		
No diagnosis	Ref	Ref
Diagnosis	13.2*** [11.4, 15.1]	13.2*** [11.4, 14.9]
Liver disease		
No diagnosis	Ref	Ref
Diagnosis	11.1*** [9.1, 13.0]	11.0*** [9.1, 12.9]
Cardiac disease		
No diagnosis	Ref	Ref
Diagnosis	6.3*** [4.3, 8.3]	6.3*** [4.3, 8.3]
COPD		
No diagnosis	Ref	Ref
Diagnosis	13.1*** [11.7, 14.6]	13.1*** [11.6, 14.5]
Medically complex[b]		
No	Ref	Ref
Yes	5.1*** [3.6, 6.6]	5.2*** [3.7, 6.6]
Plan level factors		
Month of enrollment		
Jan '19	Ref	Ref
Feb '19	4.1 [-0.0, 8.1]	4.1* [0.2, 8.0]
March '19	0.3 [-4.3, 4.9]	0.3 [-4.1, 4.7]

April '19	1.6 [-3.0, 6.2]	1.8 [-2.8, 6.4]
May '19	-0.6 [-4.4, 3.1]	-0.8 [-4.4, 2.9]
June '19	-3.1 [-7.7, 1.5]	-2.9 [-7.6, 1.7]
MCO Plan[c]		
A	Ref	Ref
B	2.8 [-0.7, 6.3]	2.7 [-0.7, 6.2]
C	-0.3 [-5.9, 5.3]	-0.2 [-5.8, 5.4]
D	-6.7*** [-9.9, -3.4]	-6.7*** [-9.9, -3.5]
E	-2.4 [-6.4, 1.7]	-2.5 [-6.5, 1.6]
F	-2.4 [-5.1, 0.4]	-2.3 [-5.1, 0.4]
Neighborhood level factors		
Rurality		
Suburban	Ref	Ref
Urban	1.7 [-0.6, 3.9]	1.6 [-0.8, 4.0]
Rural	-1.5 [-5.2, 2.2]	-1.5 [-5.1, 2.1]
$ICE_{Race/Income}$		
1	Ref	Ref
2	-0.3 [-2.6, 2.0]	-0.1 [-2.4, 2.2]
3	-1.6 [-4.4, 1.3]	-1.4 [-4.3, 1.4]
PCC availability		
Insufficient	Ref	Ref

Sufficient	-0.01.1 [-2.8, 0.6]	-1.1 [-2.8, 0.6]

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval. All regressions included county intercepts and clustering at the county level. Adjusted regressions control for sex, socially-constructed race, age category, diabetes diagnosis, liver disease diagnosis, cardiac disease diagnosis, COPD diagnosis, medical complexity, month of enrollment, MCO that conducted the MMHS screening, rurality, segregation (using $ICE_{Race/Income}$), and PCP availability. Outcome is PCP definition that includes care provided by all PCPs (outcome used in main model).

Table A8: Exploring the sensitivity of the relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 with imputed neighborhood data

Model Features			Model 1	Model 2	Model 3		Model 4	
Type	Clustering	Intercept	Food insecure coefficient PP (95% CI)	Housing insecure coefficient PP (95% CI)	Food insecure coefficient PP (95% CI)	Housing insecure coefficient PP (95% CI)	1 need coefficient PP (95% CI)	2 needs coefficient PP (95% CI)
PCP definition that includes care provided by all PCPs (outcome used in main model)								
OLS	---	MCO	-2.4 [-4.9, 0.2]	-0.5 [-2.9, 1.9]	-2.5 [-5.2, 0.1]	0.0 [-5.2, 0.1]	-1.6 [-3.9, 0.8]	-1.9 [-5.7, 1.8]
OLS	County	MCO	-2.4* [-4.3, -0.5]	-0.5 [-2.8, 1.9]	-2.5* [-4.6, -0.5]	0.0 [-2.4, 2.4]	-1.6 [-3.7, 0.5]	-1.9 [-5.5, 1.7]
OLS	MCO	MCO	-2.4 [-6.7, -1.9]	-0.5 [-5.4, 4.4]	-2.5 [-7.1, 2.0]	0.0 [-5.3, 5.3]	-1.6 [-4.2, 1.1]	-1.9 [-7.4, 3.6]
OLS	County	MCO, County	-2.2* [-4.1, -0.3]	-0.7 [-3.0, 1.7]	-2.3* [-4.2, -0.3]	-0.2 [-2.5, 2.1]	-1.6 [-3.7, 0.5]	-1.9 [-5.3, 1.7]
OLS	MCO	MCO, county	-2.2 [-6.2, 1.8]	-0.7 [-5.3, 4.0]	-2.3 [-6.6, 2.0]	-0.2 [-5.2, 4.8]	-1.6 [-4.1, 0.8]	-1.8 [-6.8, 3.2]
Logit	MCO	MCO, County	-2.4* [-4.4, -0.3]	-0.6 [-3.0, 1.8]	-2.5* [-4.5, -0.4]	-0.1 [-2.5, 2.3]	-1.6 [-3.8, 0.5]	-1.9 [-5.7, 2.0]

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval. All regressions weighted to represent all new Medicaid expansion members enrolled between January 1, 2019- June 30, 2019 using propensity score weighting. Regressions adjust for sex, socially-constructed race, age category, diabetes diagnosis, liver disease diagnosis, cardiac disease diagnosis, COPD diagnosis, medical complexity, month of enrollment, MCO that conducted the MMHS screening, rurality, segregation (using $ICE_{Race/Income}$), and PCP availability. If census tract was missing, the census tract and county was imputed based on the respondent's zip codes.

Table A9: Exploring the sensitivity of the relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 to the amount of observation time during COVID

	Enrolled between January-February 2019 PP (95% CI)	Enrolled between March - June 2019 PP (95% CI)
Individual level factors		
Food insecure		
No	Ref	Ref
Yes	-1.4	-9.5*
	[-3.6, 0.8]	[-18.8,-0.3]
Housing insecure		
No	Ref	Ref
Yes	-0.5	-0.1
	[-3.2, 2.3]	[-6.7, 6.5]
Sex		
Male	Ref	Ref
Female	14.4***	11.3**
	[11.9, 17.0]	[4.6, 18.0]
Socially constructed race		
White members	Ref	Ref
Black members	-3.1*	-1.9
	[-5.9, -0.4]	[-10.2, 6.3]
Other[a]	-0.5	-7.3
	[-4.6, 3.6]	[-19.5, 4.9]
Age		
18-29	Ref	Ref
30-39	6.6**	3.6
	[2.5, 10.8]	[-4.4, 11.6]
40-49	11.2***	8.1

	[8.1, 14.2]	[-0.4, 16.5]
50-59	11.2***	6.7
	[7.5, 14.9]	[-2.9, 16.2]
60-64	10.5***	14.5*
	[6.1, 14.8]	[3.1, 25.9]
Diabetes		
No diagnosis	Ref	Ref
Diagnosis	16.6***	12.9***
	[14.1, 19.2]	[5.7, 20.2]
Liver disease		
No diagnosis	Ref	Ref
Diagnosis	9.7***	12.0**
	[5.4, 14.0]	[4.3, 19.7]
Cardiac disease		
No diagnosis	Ref	Ref
Diagnosis	6.6***	12.0**
	[3.0, 10.1]	[4.3, 19.7]
COPD		
No diagnosis	Ref	Ref
Diagnosis	14.6***	19.0***
	[12.5, 16.7]	[12.9, 25.0]
Medically complex[b]		
No	Ref	Ref
Yes	4.4***	0.9
	[1.9, 6.9]	[-7.0, 8.8]
Plan level factors		
MCO Plan[c]		
A	Ref	Ref
B	3.0	3.4
	[-1.8, 7.7]	[-8.0, 14.8]
C	-0.8	0.6
	[-8.2, 6.5]	[-16.8, 18.0]

D	-8.2***	-9.1
	[-12.7, -3.6]	[-22.2, 4.1]
E	-2.5	-0.9
	[-10.3, 5.3]	[-16.2, 14.3]
F	-2.4	-6.0
	[-6.2, 1.4]	[-19.5, 7.4]
Neighborhood level factors		
Rurality		
Suburban	Ref	Ref
Urban	-1.3	3.7
	[-5.9, 3.3]	[-4.0, 11.3]
Rural	-4.0	-6.6
	[-10.0, 2.0]	[-26.9, 13.7]
$ICE_{Race/Income}$		
1	Ref	Ref
2	0.6	-4.4
	[-3.3, 4.5]	[-12.5, 3.8]
3	-0.2	-1.0
	[-3.5, 3.2]	[-12.7, 10.8]
PCC availability		
Insufficient	Ref	Ref
Sufficient	-0.8	-5.7
	[-3.8, 2.1]	[-14.5, 3.1]

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval. All regressions included county intercepts and clustering at the county level. Adjusted regressions control for sex, socially-constructed race, age category, diabetes diagnosis, liver disease diagnosis, cardiac disease diagnosis, COPD diagnosis, medical complexity, month of enrollment, MCO that conducted the MMHS screening, rurality, segregation (using $ICE_{Race/Income}$), and PCP availability. Outcome is PCP definition that includes care provided by all PCPs (outcome used in main model).

Table A10: Exploring the sensitivity of the relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 by different patterns of ED utilization

Model Features			Model 1	Model 2	Model 3		Model 4	
Type	Clustering	Intercept	Food insecure coefficient PP (95% CI)	Housing insecure coefficient PP (95% CI)	Food insecure coefficient PP (95% CI)	Housing insecure coefficient PP (95% CI)	1 need coefficient PP (95% CI)	2 needs coefficient PP (95% CI)
Individuals with NO ED use; outcome is any PCP visit								
OLS	---	MCO	-2.6 [-6.9, 1.6]	-0.5 [-4.3, 3.3]	-2.6 [-6.9, 1.7]	-0.1 [-3.9, 3.8]	-1.6 [-5.1, 2.0]	-1.9 [-8.4, 2.0]
OLS	CT	MCO	-2.6 [-6.8, 1.5]	-0.5 [-4.9, 3.9]	-2.6 [-6.8, 1.6]	-0.1 [-4.5, 4.4]	-1.6 [-5.1, 2.0]	-1.9 [-9.2, 5.3]
OLS	MCO	MCO	-2.6 [-8.2, 2.9]	-0.5 [-7.4, 6.3]	-2.6 [-9.3, 4.1]	-0.1 [-7.7, 7.5]	-1.6 [-5.6, 2.5]	-1.9 [-5.6, 1.8]
OLS	CT	MCO, CT	-2.8 [-6.7, 1.0]	-0.8 [-5.1, 3.5]	-2.8 [-6.7, 1.2]	-0.3 [-4.7, 4.0]	-1.5 [-4.9, 2.0]	-2.8 [-9.4, 3.8]
OLS	MCO	MCO, CT	-2.8 [-8.4, 2.7]	-0.8 [-7.4, 5.8]	-2.8 [-9.6, 4.1]	-0.3 [-7.8, 7.2]	-1.5 [-5.1, 2.1]	-2.8 [-6.3, 0.7]
Individuals with ED use; outcome is any PCP visit								
OLS	---	MCO	-4.9** [-8.4, -1.5]	-0.9 [-4.2, 2.4]	-5.0** [-8.4, -1.5]	0.2 [-3.0, 3.5]	-2.5 [-5.6, 0.6]	-4.5 [-9.7, 0.6]
OLS	CT	MCO	-4.9** [-8.4, -1.4]	-0.9 [-4.1, 2.3]	-5.0** [-8.6, -1.3]	0.2 [-3.1, 3.5]	-2.5 [-6.1, 1.0]	-4.5 [-9.1, 0.1]
OLS	MCO	MCO	-4.9 [-10.5, 0.6]	-0.9 [-3.7, 1.8]	-5.0 [-10.8, 0.8]	0.2 [-3.1, 3.5]	-2.5 [-5.2, 0.1]	-4.5 [-10.9, 2.0]
OLS	CT	MCO, CT	-4.5** [-7.9, -1.1]	-1.0 [-4.1, 2.1]	-4.5* [-8.1,- 1.0]	0.1 [-3.2, 3.3]	-2.7 [-6.2, 0.8]	-4.0 [-8.2, 0.3]
OLS	MCO	MCO, CT	-4.5 [-10.1, 1.0]	-1.0 [-3.3, 1.3]	-4.5 [-10.2, 1.1]	0.1 [-2.3, 2.4]	-2.7* [-4.9, -0.5]	-4.0 [-10.6, 2.7]
Individuals with no PCP use; outcome is any ED visit								
OLS	---	MCO	9.1** [3.4, 14.7]	1.9 [-2.9, 6.6]	9.0** [3.4, 14.7]	0.2 [-4.4, 4.8]	1.6 [-2.7, 5.9]	12.3** [3.5, 21.1]
OLS	CT	MCO	9.1** [3.4, 14.7]	1.9 [-3.4, 7.1]	9.0** [3.1, 15.0]	0.2 [-5.2, 5.6]	1.6 [-3.1, 6.4]	12.3** [5.6, 19.0]

OLS	MCO	MCO	9.1* [0.2, 17.9]	1.9* [0.6, 3.1]	9.0* [0.0, 18.0]	0.2 [-1.0, 1.3]	1.6 [-4.0, 7.3]	12.3** [5.8, 18.8]
OLS	CT	MCO, CT	8.4** [2.8, 14.1]	1.8 [-3.5, 7.0]	8.4** [2.3, 14.4]	0.2 [-5.3, 5.8]	2.6 [-2.2, 7.4]	10.1** [4.1, 16.0]
OLS	MCO	MCO, CT	8.4 [0.1, 16.9]	1.8 [-0.9, 4.4]	8.4 [-0.3, 17.0]	0.2 [-2.8, 3.2]	2.6 [-3.0, 8.2]	10.1** [4.9, 15.3]

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval. All regressions weighted to represent all new Medicaid expansion members enrolled between January 1, 2019- June 30, 2019 using propensity score weighting. Regressions adjust for sex, socially-constructed race, age category, diabetes diagnosis, liver disease diagnosis, cardiac disease diagnosis, COPD diagnosis, medical complexity, month of enrollment, MCO that conducted the MMHS screening, rurality, segregation (using $ICE_{Race/Income}$), and PCP availability. PCP definition that includes care provided by all PCPs (outcome used in main model) used in all models with the outcome as primary care utilization.

Table A11: Exploring the sensitivity of the relationship between material circumstances and primary care utilization among new Virginia Medicaid expansion members enrolled between January 2019 and June 2019 by ethnicity

	Non-Hispanic or Latino enrollees				Hispanic or Latino enrollees	
	All	White enrollees	Black enrollees	Other race	All	White enrollees
	PP (95% CI)	PP (95% CI)	PP (95% CI)	PP (95 % CI)	PP (95 % CI)	PP (95 % CI)
Unweighted observations	14,509	8,087	4,445	1,977	226	178
Weighted observations	173,488	88,878	59,555	25,055	2,617	1,981
Individual level factors						
Food insecure						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	-3.1**	-1.4	-3.0	-10.0*	-5.9	2.1
	[-5.3, -0.9]	[-5.1, 2.2]	[-7.0, 1.0]	[-17.7, -2.3]	[-20.2, 8.4]	[-15.0, 19.2]
Housing insecure						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	-0.3	0.3	0.9	-1.4	11.3	9.0
	[-2.9, 2.2]	[-3.0, 3.6]	[-3.7, 5.5]	[-7.6, 4.8]	[-8.9, 31.6]	[-14.1, 32.0]
Sex						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	13.8***	10.8***	19.4***	12.7***	26.8**	21.3**
	[11.5, 16.2]	[7.3, 14.3]	[15.0, 23.8]	[7.7, 17.6]	[10.7, 42.9]	[6.3, 36.3]
Age						
18-29	Ref	Ref	Ref	Ref	Ref	Ref
30-39	6.3**	5.2*	6.3	8.4*	-2.1	9.1
	[2.4, 10.1]	[0.7, 9.7]	[-1.2, 13.9]	[0.1, 16.8]	[-18.8, 14.6]	[-9.9, 28.0]
40-49	11.3***	8.8***	11.6***	17.7***	7.9	0.1
	[8.4, 14.3]	[4.0, 13.5]	[5.3, 17.9]	[10.5, 24.9]	[-10.9, 26.7]	[-21.1, 21.4]
50-59	11.0***	8.5***	12.0***	15.3***	6.3	7.4
	[7.8, 14.2]	[3.9, 13.1]	[6.5, 17.4]	[7.0, 23.5]	[-10.3, 23.0]	[-9.8, 24.6]
60-64	11.1***	7.2*	13.1**	16.3***	17.2	11.0
	[7.0, 15.1]	[0.3, 14.1]	[4.9, 21.4]	[8.6, 24.0]	[-6.0, 40.5]	[-13.1, 35.1]
Diabetes						
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	16.0***	14.5***	18.1***	15.7***	17.8*	23.4*

	[13.6, 18.4]	[11.9, 17.2]	[14.4, 21.9]	[8.5, 22.9]	[0.4, 35.3]	[4.7, 42.1]
Liver disease						
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	10.4***	10.9***	9.6**	9.2	19.6	32.2**
	[6.6, 14.2]	[6.2, 15.6]	[3.4, 15.8]	[-1.8, 20.3]	[-7.0, 46.3]	[8.0, 56.4]
Cardiac disease						
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	7.6***	7.7***	7.4*	8.6**	-44.8	-40.5
	[4.6, 10.7]	[3.9, 11.5]	[1.2, 13.6]	[2.6, 14.6]	[-98.7, 9.1]	[-94.1, 13.0]
COPD						
No diagnosis	Ref	Ref	Ref	Ref	Ref	Ref
Diagnosis	15.2***	14.0***	15.8***	19.2***	16.5	23.5**
	[13.3, 17.2]	[11.5, 16.6]	[12.1, 19.5]	[14.0, 24.4]	[-0.7, 33.7]	[6.6, 40.3]
Medically complex[b]						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	4.3***	4.3**	4.3*	2.5	2.5	1.5
	[2.4, 6.2]	[1.7, 6.9]	[0.7, 8.0]	[-3.3, 8.4]	[-15.8, 20.9]	[-18.3, 21.2]
Plan level factors						
Month of enrollment						
Jan '19	Ref	Ref	Ref	Ref	Ref	Ref
Feb '19	1.6	1.1	0.5	4.5	-35.1	-0.8
	[-4.1, 7.2]	[-6.9, 9.1]	[-10.5, 11.6]	[-10.3, 19.2]	[-72.6, 2.3]	[-39.1, 37.4]
March '19	5.1	5.6	2.9	9.9	-12.6	-22.8
	[-1.7, 11.9]	[-1.3, 12.4]	[-6.3, 12.1]	[-8.7, 28.5]	[-46.4, 21.2]	[-61.5, 15.8]
April ‘19	-0.8	0.7	-2.0	-4.3	-63.9**	-86.9***
	[-7.4, 5.9]	[-8.5, 9.9]	[-12.0, 7.9]	[-14.0, 5.4]	[-105.4, -22.5]	[-121.5,-52.2]
May '19	2.1	-3.6	6.5	9.5	1.3	-0.4
	[-4.3, 8.5]	[-13.2, 6.1]	[-2.9, 15.9]	[-0.6, 19.5]	[-25.3, 27.8]	[-27.8, 27.1]
June '19	1.3	-1.4	7.4	-3.6	-15.6	2.1
	[-5.7, 8.2]	[-9.9, 7.1]	[-1.7, 16.4]	[-31.4, 24.2]	[-38.3, 7.0]	[-29.1, 33.3]
MCO Plan[c]						
A	Ref	Ref	Ref	Ref	Ref	Ref

B	3.3	-0.8	7.9*	2.1	9.8	24.7
	[-1.6, 8.3]	[-7.5, 6.0]	[0.5, 15.2]	[-10.8, 15.1]	[-17.8, 37.4]	[-9.3, 58.7]
C	-0.3	-0.7	0.8	-3.8	25.3	25.2
	[-7.7, 7.1]	[-11.4, 9.9]	[-12.8, 14.3]	[-26.7, 19.0]	[-14.5, 65.0]	[-17.3, 67.8]
D	-7.5**	-12.1***	-3.0	-7.6	-16.2	-2.8
	[-12.1, -2.9]	[-18.0, -6.2]	[-9.2, 3.3]	[-21.6, 6.3]	[-40.8, 8.4]	[-34.1, 28.5]
E	-1.2	-4.0	0.7	-1.2	14.7	9.7
	[-6.9, 4.5]	[-11.2, 3.2]	[-7.7, 9.2]	[-18.1, 15.7]	[-19.2, 48.7]	[-26.9, 46.4]
F	-1.6	-0.031	-0.5	-3.0	0.5	14.9
	[-5.4, 2.3]	[-8.5, 2.2]	[-7.3, 6.4]	[-17.1, 11.2]	[-25.7, 26.8]	[-18.7, 48.5]
Neighborhood level factors						
Rurality						
Suburban	Ref	Ref	Ref	Ref	Ref	Ref
Urban	0.9	3.0	-2.5	1.5	-12.3	-19.1*
	[-2.9, 4.7]	[-1.6, 7.5]	[-8.4, 3.4]	[-6.6, 9.7]	[-30.1, 5.5]	[-36.3,-2.0]
Rural	1.9	0.1	3.3	5.9	-18,6	-18.8
	[-1.8, 5.6]	[-4.3, 4.5]	[-3.4, 9.9]	[-4.4, 16.1]	[-48.6, 11.4]	[-53.6, 16.0]
$ICE_{Race/Income}$						
1	Ref	Ref	Ref	Ref	Ref	Ref
2	2.0	3.0	1.8	-5.7	-9.4	-10.1
	[-1.1, 5.1]	[-0.3, 6.3]	[-4.1, 7.7]	[-13.1, 1.7]	[-24.9, 6.1]	[-26.9, 6.7]
3	1.5	1.4	2.2	-4.3	-27.2*	-23.2
	[-1.5, 4.5]	[-4.0, 6.9]	[-6.6, 11.1]	[-10.5, 1.9]	[-49.6, -4.9]	[-0.518,0.054]
PCP availability						
Insufficient	Ref	Ref	Ref	Ref	Ref	Ref
Sufficient	-1.2	-1.5	-2.2	-0.0	-14.4*	-19.1*
	[-3.6, 1.3]	[-4.9, 1.9]	[-6.4, 1.9]	[-6.5, 6.4]	[-26.2, -2.5]	[-34.4, -3.8]

Notes: *p<0.05, ** p<0.01, *** p<0.001. PP is percentage point. CI is confidence interval. All regressions weighted to represent all new Medicaid expansion members enrolled between January 1, 2019- June 30, 2019 using propensity score weighting. PCP definition that includes care provided by all PCPs (outcome used in main model) used in all models with the outcome as primary care utilization.

Table A12: Full models assessing the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and each variable of interest among newly enrolled Virginia Medicaid Expansion members in pathway 1

Outcome: Worried about affording food					
	PCP visits PP (95 % CI)		Changes in physical health PP (95 % CI)	Changes in mental health PP (95 % CI)	Changes in job status PP (95 % CI)
Period		Period			
Pre	Ref	Pre	Ref	Ref	Ref
Post	-10.0	Post	-6.7*	-7.7**	-8.4**
	(-22.6, 2.6)		(-14.0, 0.5)	(-14.7, -0.8)	(-15.5, -1.3)
PCP visit					
No	Ref				
Yes	3.3				
	(-7.6, 14.3)				
		Change Variable			
		Constant	Ref	Ref	Ref
		Improved	Ref	Ref	Ref
			-0.2	2.4	4.4
		Worsened	(-11.6, 11.3)	(-9.5, 14.4)	(-8.2, 17.0)
			6.9	-3.3	21.0***
PCP visitxTime					
NoxTime			(-7.2, 21.1)	(-17.7, 11.2)	(6.2, 35.8)
YesxTime					
	Ref				
Yes	-0.8				
	(-15.0, 13.4)				
		Change VariablexTime			
		ConstantxTime	Ref	Ref	Ref
		ImprovedxTime	-12.4	-18.0**	-8.6
			(-27.4, 2.7)	(-33.6, -2.3)	(-23.0, 5.9)
		WorsenedxTime	-7.3	4.2	-7.5
			(-23.7, 9.1)	(-13.3, 21.8)	(-26.6, 11.6)
Gender		Gender			
Male	Ref		Ref	Ref	Ref
Female	2.4		2.5	2.3	3.9
	(-5.2, 10.1)		(-5.2, 10.2)	(-5.4, 9.9)	(-3.6, 11.5)
Race		Race			
White	Ref	White	Ref	Ref	Ref
Black	1.5	Black	1.3	0.019	1.6

	(-7.1, 10.2)		(-7.3, 9.8)	(-6.8, 10.7)	(-6.8, 10.1)
Other	-3.5	Other	-3.7	-3.7	-2.2
	(-13.8, 6.9)		(-14.0, 6.7)	(-14.1, 6.6)	(-12.1, 7.7)
Age	4.2***	Age	4.1***	4.3****	3.8***
	(1.7, 6.7)		(1.6, 6.6)	(1.8, 6.7)	(1.4, 6.2)
Age squared	-0.0***	Age squared	-0.0***	-0.0****	-0.0***
	(-0.1, -0.0)		(-0.1, -0.0)	(-0.1, -0.0)	(-0.1, -0.0)
Physical health at baseline		Physical health at baseline			
Fair/Poor	Ref	Fair/Poor	Ref	Ref	Ref
Good	-2.5	Good	-4.4	-2.2	2.0
	(-11.4, 6.5)		(-13.9, 5.0)	(-11.2, 6.8)	(-7.0, 11.0)
Very good/excellent	-16.0**	Very good/excellent	-20.0***	-15.7**	-9.3
	(-28.8, -3.2)		(-34.1, -5.8)	(-28.5, -3.0)	(-22.0, 3.4)
Mental health at baseline		Mental health at baseline	-4.4	-2.2	2.0
Fair/Poor	Ref	Fair/Poor	(-5.2, 10.2)	(-5.4, 9.9)	(-3.6, 11.5)
Good	-8.3	Good	-8.4	-9.2*	-4.9
	(-18.5, 2.0)		(-18.5, 1.7)	(-19.7, 1.4)	(-15.1, 5.2)
Very good/excellent	-19.4****	Very good/excellent	-18.4****	-22.0****	-12.0**
	(-30.0, -8.7)		(-29.1, -7.6)	(-34.1, -10.0)	(-22.8, -1.3)
Functional job limitations		Functional job limitations			
No	---	No	---	---	Ref
Yes	---	Yes	---	---	21.8****
					(11.6, 32.1)

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. Multi-level linear probability models with a random intercept only and robust standard errors using common cases (n=377). Each individual has two observations so the total observations in the regression are 754. Mixed linear probability model with random intercept for each individual used.

Table A13: Full models assessing the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and each variable of interest among newly enrolled Virginia Medicaid Expansion members in pathways 2 and 3

Outcome: Worried about affording food			
	Pathway 3: Protection from catastrophic healthcare costs		Pathway 3: Protection from catastrophic healthcare costs
	Change in medical bills PP (95% CI)	Change in healthcare expenses PP (95% CI)	Change in worry about catastrophic healthcare costs PP (95% CI)
Period			
Pre	Ref	Ref	Ref
Post	-5.6	-7.7*	2.6
	(-13.6, 2.5)	(-15.3, 0.0)	(-4.4, 9.6)
Change Variable			
Constant	Ref	Ref	Ref
Improved	Ref	Ref	Ref
	-6.2	-6.9	-2.6
Worsened	(-16.3, 3.9)	(-18.2, 4.3)	(-12.3, 7.1)
	-0.6	0.07	24.3**
Change Variable x Time			
Constant x Time	Ref	Ref	Ref
ImprovedxTime	Ref	Ref	Ref
	-13.7**	-6.9	-39.1****
WorsenedxTime	(-25.5, -2.0)	(-19.4, 5.5)	(-51.5, -26.8)
	55.6***	-5.2	-7.6
Gender			
Male	Ref	Ref	Ref
Female	2.1	1.7	1.4
	(-5.4, 9.6)	(-6.1, 9.6)	(-5.6, 8.4)
Race			
White	Ref	Ref	Ref
Black	-0.6	1.8	2.0
	(-9.0, 7.8)	(-6.7, 10.2)	(-5.6, 9.7)
Other	-2.7	-5.0	-5.9
	(-13.0, 7.6)	(-15.7, 5.6)	(-15.7, 3.8)
Age	3.1**	4.0***	2.7**
	(0.6, 5.5)	(1.4, 6.5)	(0.6, 4.9)
Age squared	-0.0**	-0.0**	-0.0**
	(-0.1, -0.0)	(-0.1, -0.0)	(-0.1, -0.0)
Physical health at baseline			
Fair/Poor	Ref	Ref	Ref
Good	0.3	-2.9	-1.0
	(-8.6, 9.1)	(-11.8, 6.1)	(-9.2, 7.3)

Very good/excellent	-11.7* (-24.3, 1.0)	-16.2** (-28.9, -3.4)	-10.8* (-22.3, 0.7)
Mental health at baseline			
Fair/Poor	Ref	Ref	Ref
Good	-7.8 (-17.5, 1.9)	-8.9* (-19.0, 1.2)	-6.7 (-15.9, 2.6)
Very good/excellent	-17.7**** (-28.2, -7.2)	-20.4**** (-31.0, -9.7)	-17.7**** (-27.7, -7.7)
Bills at baseline			
No	Ref	---	---
Yes	25.1**** (14.6, 35.7)	---	---
Healthcare expenses at baseline			
No	---	Ref	---
Yes	---	12.5** (2.0, 23.1)	---
Catastrophic healthcare costs at baseline			
No	---	---	Ref
Yes	---	---	42.7**** (31.5, 54.0)

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. Multi-level linear probability models with a random intercept only and robust standard errors using common cases (n=377). Each individual has two observations so the total observations in the regression are 754. Mixed linear probability model with random intercept for each individual used.

Table A14: Full models assessing the relationship between worry about paying for housing costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and each variable of interest among newly enrolled Virginia Medicaid Expansion members in pathways 1

Outcome: Worried about paying for housing cost					
	PCP visits PP (95% CI)		Changes in physical health PP (95% CI)	Changes in mental health PP (95% CI)	Changes in job status PP (95% CI)
Period		Period			
Pre	Ref	Pre	Ref	Ref	Ref
Post	-6.0	Post	-2.5	-1.6	-6.6*
	(-17.7, 5.7)		(-9.8, 4.8)	(-8.5, 5.2)	(-13.3, 0.2)
PCP visit					
No	Ref				
Yes	9.0				
	(-2.0, 19.9)				
		Change Variable			
		Constant	Ref	Ref	Ref
		Improved	1.4	0.2	-7.1
			(-9.7, 12.5)	(-12.0, 12.4)	(-20.2, 6.1)
		Worsened	9.3	-4.0	0.216***
			(-5.1, 23.8)	(-17.9, 9.9)	(0.068 - 0.365)
PCP visitxTime					
NoxTime					
YesxTime					
	Ref				
Yes	0.2				
	(-13.1, 13.6)				
		Change VariablexTime			
		ConstantxTime	Ref	Ref	Ref
		ImprovedxTime	-14.3**	-24.0***	-1.9
			(-27.8, -0.9)	(-39.2, -8.9)	(-17.0, 13.2)
		WorsenedxTime	0.5	3.4	8.8
			(-14.4, 15.4)	(-10.8, 17.6)	(-7.4, 25.1)
Gender		Gender			
Male	Ref		Ref	Ref	Ref
Female	0.5		0.7	0.2	3.0
	(-7.2, 8.2)		(-7.0, 8.4)	(-0.075 - 0.080)	(-0.045 - 0.106)
Race		Race			
White	Ref	White	Ref	Ref	Ref

Black	2.5 (-6.0, 11.0)	Black	1.6 (-6.7, 9.9)	2.8 (-5.7, 11.4)	2.6 (-5.6, 10.7)
Other	3.3 (-8.1, 14.8)	Other	3.3 (-8.3, 14.9)	2.7 (-9.1, 14.4)	5.6 (-5.2, 16.4)
Age	2.5* (-0.1, 5.2)	Age	2.8** (0.2, 5.5)	2.9** (0.2, 5.6)	2.3* (-0.2, 4.9)
Age squared	-0.0* (-0.1, 0.0)	Age squared	-0.0** (-0.1, -0.0)	-0.0** (-0.1, -0.0)	-0.0** (-0.1, -0.0)
Physical health at baseline		Physical health at baseline			
Fair/Poor	Ref	Fair/Poor	Ref	Ref	Ref
Good	2.8 (-6.1, 11.6)	Good	-0.9 (-10.2, 8.5)	3.1 (-5.8, 11.9)	7.6* (-1.1, -16.3)
Very good/excellent	-13.5** (-26.5, -0.5)	Very good/excellent	-19.3*** (-32.8, -5.8)	-13.0** (-25.9, -0.2)	-5.7 (-18.7, 7.3)
Mental health at baseline		Mental health at baseline			
Fair/Poor	Ref	Fair/Poor	Ref	Ref	Ref
Good	-2.9 (-12.8, 7.0)	Good	-3.4 (-13.3, 6.6)	-4.8 (-14.8, 5.2)	0.3 (-9.3, 9.9)
Very good/excellent	-11.6** (-22.1, -1.2)	Very good/excellent	-10.7** (-21.2, -0.3)	-16.6*** (-28.2, -5.0)	-3.9 (-14.3, 6.4)
Functional job limitations		Functional job limitations			
No	---	No	---	---	Ref
Yes	---	Yes	---	---	25.9**** (15.9, 35.8)

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. Multi-level linear probability models with a random intercept only and robust standard errors using common cases (n=377). Each individual has two observations so the total observations in the regression are 754. Mixed linear probability model with random intercept for each individual used.

Table A15: Full models assessing the relationship between worry about paying for housing costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and each variable of interest among newly enrolled Virginia Medicaid Expansion members in pathways 2 and 3

Outcome: Worried about paying for housing cost			
	Pathway 2- Healthcare expenses		Healthcare 3- Anticipated healthcare expenses
	Change in medical bills PP (95% CI)	Change in healthcare expenses PP (95% CI)	Change in worry about catastrophic healthcare costs PP (95% CI)
Period			
Pre	Ref	Ref	Ref
Post	-0.5	-6.2*	3.4
	(-8.2, 7.2)	(-13.4, 0.9)	(-3.0, 9.8)
Change Variable			
Constant	Ref	Ref	Ref
Improved	-3.4	-18.2***	-5.8
	(-13.8, 7.0)	(-29.1-7.2)	(-15.6, 3.9)
Worsened	-0.109	9.0	32.3***
	(-0.484 - 0.266)	(-9.0, 27.0)	(8.4, 56.1)
Change Variable x Time			
Constant x Time	Ref	Ref	Ref
ImprovedxTime	-13.5**	1.1	-28.6****
	(-24.8, -2.3)	(-10.5, 12.7)	(-41.1, -16.1)
WorsenedxTime	38.0**	-0.2	1.6
	(3.5, 72.5)	(-27.9, 27.5)	(-25.1, 28.2)
Gender			
Male	Ref	Ref	Ref
Female	-0.002	0.001	-0.006
	(-0.078 - 0.075)	(-0.078 - 0.079)	(-0.077 - 0.065)
Race			
White	Ref	Ref	Ref
Black	0.1	2.2	2.3
	(-8.1, 8.4)	(-6.0, 10.3)	(-5.4, 10.0)
Other	4.5	1.1	0.8
	(-7.1, 16.0)	(-10.6, 12.8)	(-10.0, 11.6)
Age	2.0	2.6*	1.4
	(-0.7, 4.6)	(-0.1, 5.2)	(-1.0, 3.8)
Age squared	0.0	0.0	0.0
	(-0.0, 0.0)	(-0.0, 0.0)	(-0.0, 0.0)
Physical health at baseline			
Fair/Poor	Ref	Ref	Ref
Good	4.6	0.02	3.3
	(-4.3, 13.6)	(-6.7, 10.8)	(-5.2, 11.7)

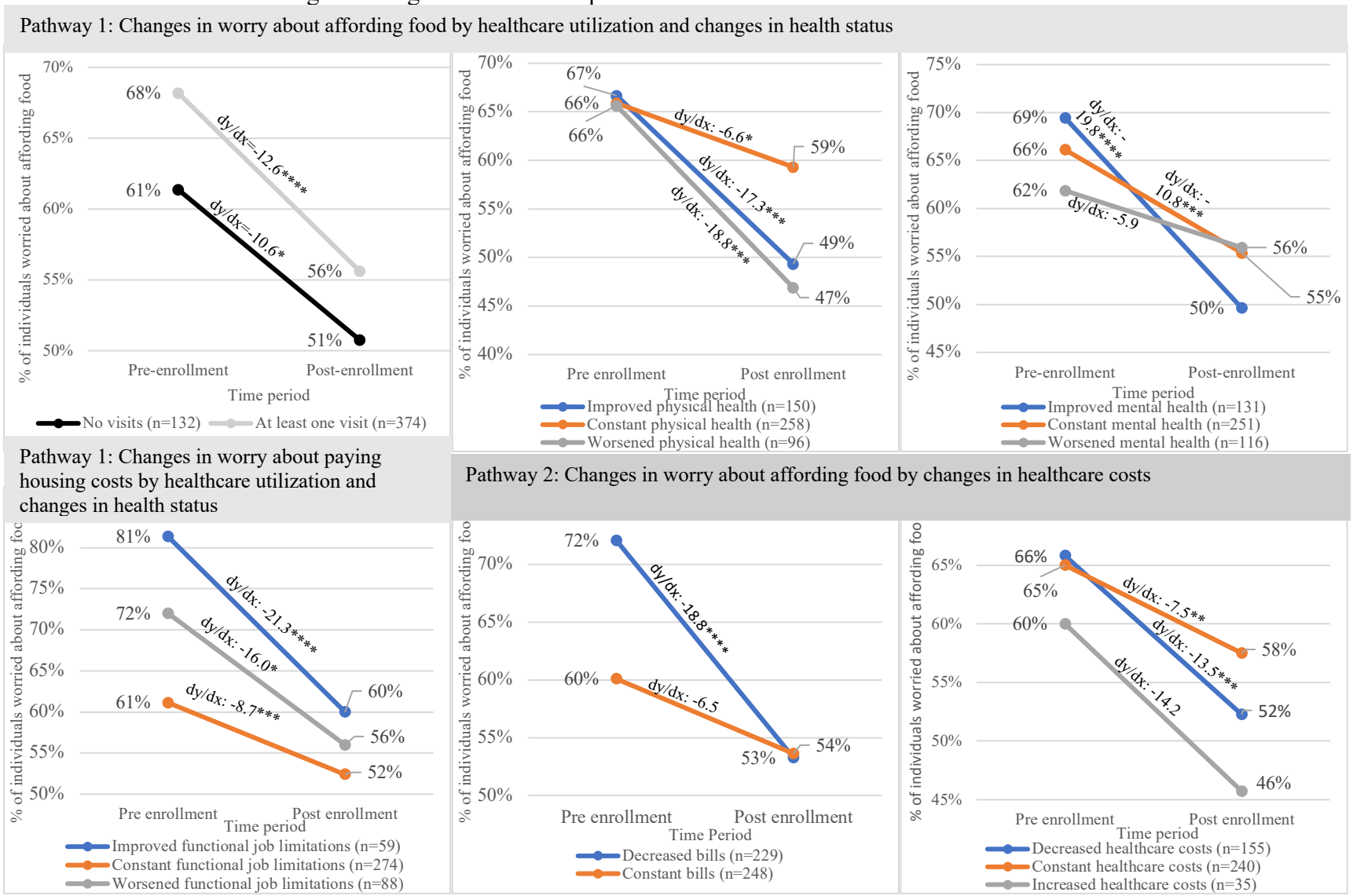
Very good/excellent	-10.4 (-23.2, 2.4)	-13.8** (-26.6, -1.0)	-9.5 (-20.9, 1.9)
Mental health at baseline			
Fair/Poor	Ref	Ref	Ref
Good	-2.9 (-12.6, 6.8)	-4.2 (-13.8, 5.4)	-2.3 (-11.8, 7.1)
Very good/excellent	-10.1* (-20.4, 0.2)	-13.6*** (-23.8, -3.4)	-10.7** (-20.4, -1.0)
Bills at baseline			
No	Ref	---	---
Yes	21.0**** (10.3, 31.8)	---	---
Healthcare expenses at baseline			
No	---	Ref	---
Yes	---	17.6**** (7.8, 27.4)	---
Catastrophic healthcare costs at baseline			
No	---	---	Ref
Yes	---	---	40.5**** (28.9, 52.0)

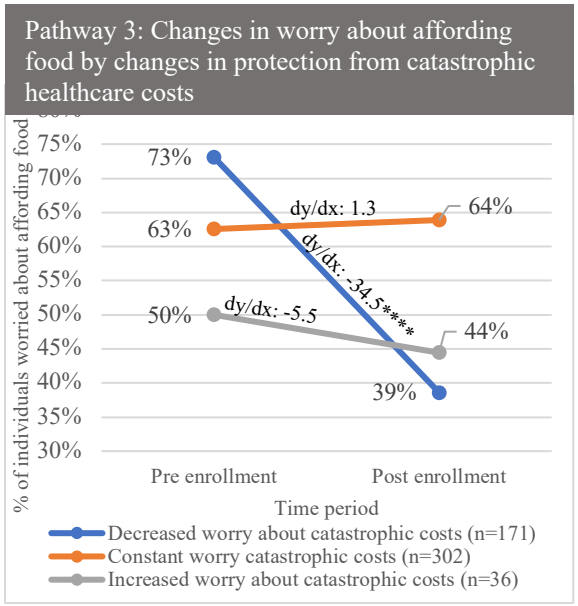
Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. Multi-level linear probability models with a random intercept only and robust standard errors using common cases (n=377). Each individual has two observations so the total observations in the regression are 754. Mixed linear probability model with random intercept for each individual used.

Table A16: Exploring the relationship between mental health status and material circumstances at baseline among newly enrolled Virginia Medicaid Expansion members

	Worried about affording food at baseline			Worried about paying housing costs at baseline		
	Not worried # (%)	Worried # (%)	p-value	Not worried # (%)	Worried # (%)	p-value
Mental health at baseline			<0.001			<0.001
Fair/Poor	22 (16.5)	92 (37.7)		28 (23.7)	86 (33.2)	
Good	36 (27.1)	72 (29.5)		32 (27.1)	76 (29.3)	
Very good/excellent	75 (56.4)	80 (32.8)		48 (49.2)	97 (37.5	

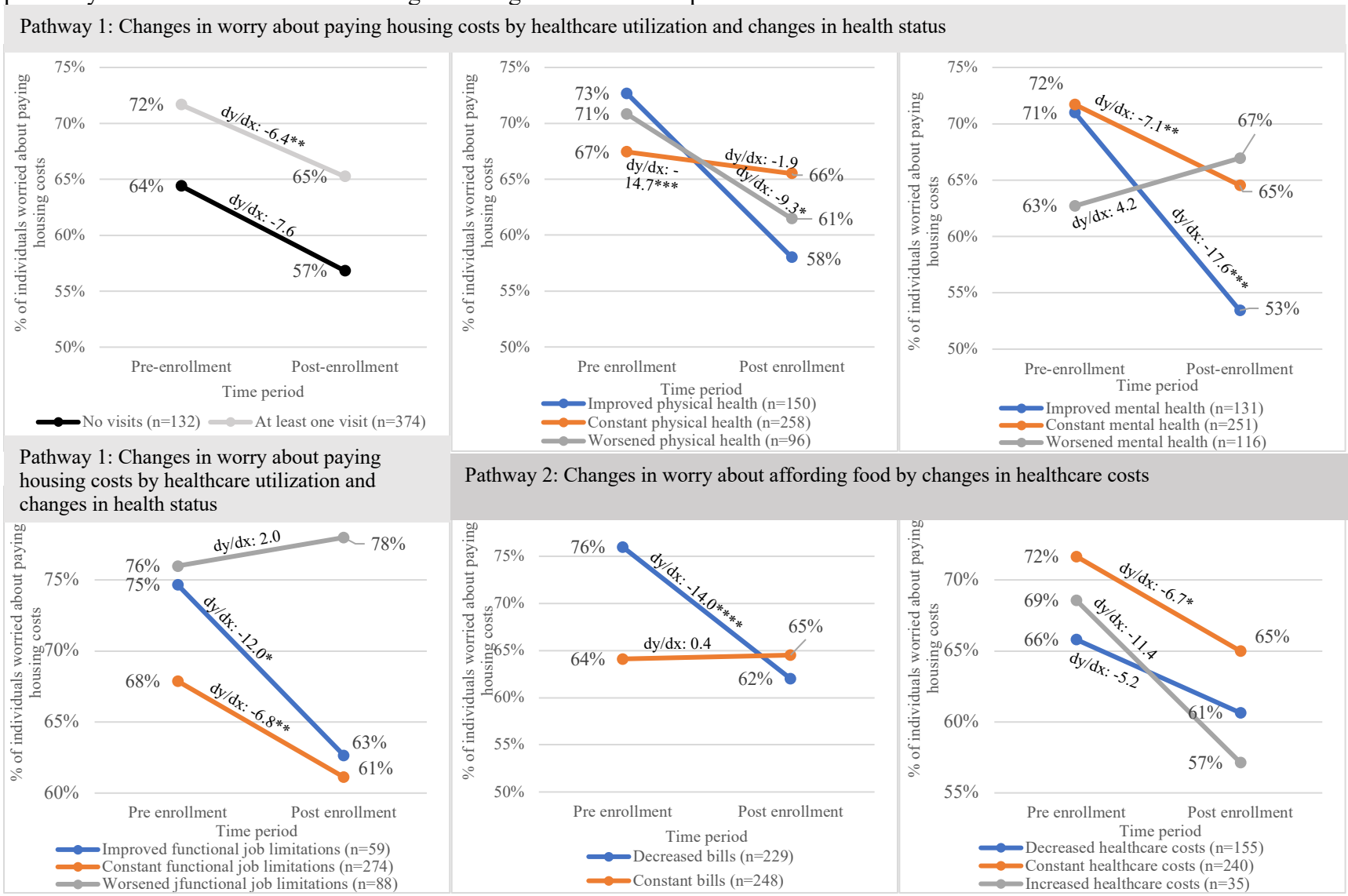
Figure A1: Unadjusted hanges in worry about affording food in the pre-enrollment period compared to the post-enrollment period by each variable of interest among new Virginia Medicaid expansion members

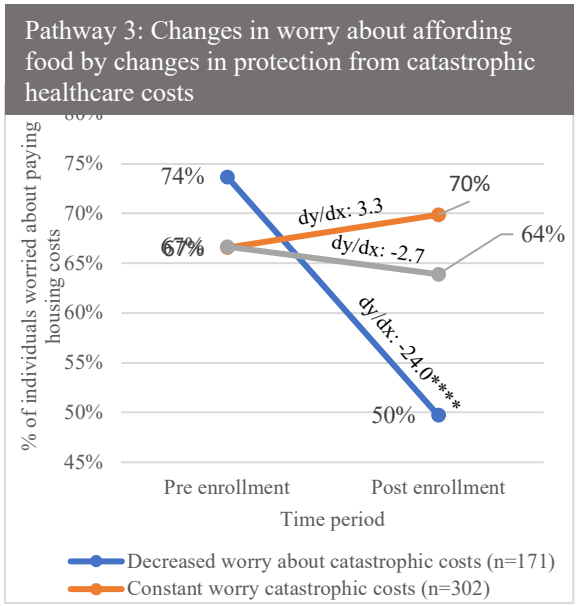




Notes: *p-value<0.10, **p-value<0.05, ***p-value<0.01, p-value<0.001. All regressions besides the first (primary care utilization) adjusted for the baseline variable. Example, for the figure depicting change in worry about affording food by change in physical health is adjusted for baseline rating of physical health. Worsened bills subgroup is not included because there are too few individuals to estimate effect sizes (n=17).

Figure A2: Unadjusted changes in worry about paying for housing costs in the pre-enrollment period compared to the post-enrollment period by each variable of interest among new Virginia Medicaid expansion members





Notes: *p-value<0.10, **p-value<0.05, ***p-value<0.01, p-value<0.001. All regressions besides the first (primary care utilization) adjusted for the baseline variable. Example, for the figure depicting change in worry about affording food by change in physical health is adjusted for baseline rating of physical health. Worsened bills subgroup is not included because there are too few individuals to estimate effect sizes (n=17).

Table A17: Exploring the sensitivity of the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and primary care utilization among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about affording food									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=499; observations in the regression=999)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-10.0	-10.0*		-10.8*	-10.8*	-10.8**		-10*	-10*
	(-22.6, 2.6)	(-21.5, 1.5)		(-21.7, 0.2)	(-21.7, 0.2)	(-20.8, -0.8)		(-21, 1)	(-20, -0)
PCP visit									
No	Ref			Ref	Ref			Ref	Ref
Yes	3.3	---		4.6	4.6	---		4	7
	(-7.6, 14.3)	---		(-4.9, 14.2)	(-5.0, 14.2)	---		(-6, 13)	(-3, 17)
PCP visitxTime									
NoxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
YesxTime	-0.8	-0.8		-1.7	-1.7	-1.7		-2	-2
	(-15.0, 13.4)	(-14.2, 12.6)		(-14.0, 10.6)	(-14.0, 10.6)	(-13.3, 9.9)		(-15, 10)	(-14, 9)
PCP visitxTime									
No x Post time			-9.6				-10.4*		
			(-21.8, 2.5)				(-21.0, 0.2)		
Yes x Post time			-11.0***				-12.6****		
			(-17.7, -4.3)				(-18.4, -6.9)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval.[a]Regressions controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level) and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous) and used robust standard errors.

Table A18: Exploring the sensitivity of the relationship between worry about paying for housing costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and primary care utilization among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about paying for housing cost									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=499; observations in the regression=998)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-6.0	-7.4		-7.7	-7.7	-7.7		-7	-8
	(-17.7, 5.7)	(-17.4, 2.5)		(-18.1, 2.7)	(-18.1, 2.7)	(-17.2, 1.9)		(-17, 3)	(-17, 2)
PCP visit									
No	Ref			Ref	Ref			Ref	Ref
Yes	9.0	---		5.9	5.9			5	0.08
	(-2.0, 19.9)	---		(-3.6, 15.5)	(-3.6, 15.5)			(-5, 14)	(-0.02, 0.17)
PCP visitxTime									
NoxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
YesxTime	0.2	1.5		0.9	0.9	0.9		1	1
	(-13.1, 13.6)	(-9.9, 13.1)		(-10.8, 12.6)	(-10.8, 12.6)	(-10.2, 12.0)		(-11, 12)	(-10, 12)
PCP visitxTime			Ref						
No x Post time			-5.9				-7.5		
			(-17.5, 5.6)				(-17.7, 2.6)		
Yes x Post time			-5.8*				-6.8**		
			(-12.2, 0.6)				(-12.3, -1.3)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Regressions controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level) and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous) and used robust standard errors.

Table A19: Exploring the sensitivity of the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in physical health among newly enrolled Virginia Medicaid Expansion members using a three-level physical health variable

Outcome: Worried about affording food									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=504; observations in the regression=1008)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-6.7*	-6.7*		-9.1***	-9.1***	-9.1***		-9*	-9***
	(-14.0, 0.5)	(-14.1, 0.7)		(-15.2, -3.1)	(-15.2, -3.1)	(-15.5, -2.8)		(-15, -3)	(-20, -0)
Physical health									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	-0.0	---		-2.2	-2.2	---		-1	---
	(-11.5, 11.4)			(-11.8, 7.5)	(-11.9, 7.5)			(-10, 0.09)	
Worsened	6.7	---		2.8	3.0	---		1	---
	(-7.4, 20.8)			(-10.1, 15.8)	(-9.9, 16.0)			(-11, 14)	
Physical healthxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-12.4	-12.4*		-10.0	-10.0	-10.0		-10	-10
	(-27.4, 2.7)	(-26.6, 1.8)		(-22.9, 2.9)	(-22.9, 2.9)	(-22.2, 2.1)		(-23, 3)	(-22, 2)
WorsenedxTime	-7.3	-7.3		-4.3	-4.2	-4.3		-3	-3
	(-23.7, 9.1)	(-25.1, 10.5)		(-19.8, 11.2)	(-19.8, 11.2)	(-19.5, 11.0)		(-19, 13)	(-19, 13)
Physical healthxTime									
ConstantxTime			-6.7*				-9.3		
			(-14.0, 0.5)				(-15.4, -3.2)		
ImprovedxTime			-18.4***				-18.7***		
			(-31.2, -5.6)				(-29.9, -7.6)		
WorsenedxTime			-13.3*				-12.3*		
			(-27.3, 0.8)				(-25.7, 0.9)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval.[a]Regressions controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level) and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous) and used robust standard errors.

Table A20: Exploring the sensitivity of the relationship between worry about paying for housing costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in physical health among newly enrolled Virginia Medicaid Expansion members using a three-level physical health variable

Outcome: Worried about paying for housing costs									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=504; observations in the regression=1008)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-2.5	-2.5		-4.7	-4.7	-4.7		-4	-4
	(-9.8, 4.8)	(-9.6, 4.6)		(-10.9, 1.4)	(-10.9, 1.4)	(-10.8, 1.3)		(-10, 2)	(-10, 2)
Physical health									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	1.4	---		1.9	1.9	---		3	---
	(-9.7, 12.5)			(-7.5, 11.3)	(-7.5, 11.2)			(-6, 13)	
Worsened	9.3			7.9	8.0	---		7	---
	(-5.2, 23.7)	---		(-4.7, 20.5)	(-4.5, 20.7)			(-5, 20)	
Physical healthxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-14.3**	-14.3**		-11.9**	-11.9**	-11.9**		-12**	-12**
	(-27.8, -0.9)	(-27.7, -0.8)		(-23.6, -0.3)	(-23.6, -0.3)	(-23.5, -0.3)		(-24, -0)	(-24, -0)
WorsenedxTime	0.5	0.5		3.2	3.2	3.2		4	4
	(-14.4, 15.4)	(-16.5, 17.5)		(-10.3, 16.8)	(-10.3, 16.8)	(-11.3, 17.8)		(-10, 18)	(-10, 19)
Physical healthxTime									
ConstantxTime			-6.8*				-4.8		
			(-14.2, 0.5)				(-10.9, 1.4)		
ImprovedxTime			-18.5***				-16.8***		
			(-31.3, -5.6)				(-26.8, -6.8)		
WorsenedxTime			-13.3*				-1.3		
			(-27.5, 0.8)				(-11.9, 9.4)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Regressions controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level) and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous) and used robust standard errors.

Table A21: Exploring the sensitivity of the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in physical health among newly enrolled Virginia Medicaid Expansion members using a two-level physical health variable

Outcome: Worried about affording food									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=504; observations in the regression=1008)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-7.5**	-7.5**		-9.6***	-9.6***	-9.6***		-9***	-9***
	(-14.1, -1.0)	(-14.2, -0.8)		(-15.1, -4.0)	(-15.1, -4.0)	(-15.3, -3.8)		(-14, -3)	(-15, -3)
Physical health									
Constant	Ref			Ref	Ref			Ref	
Improved	-2.0	---		-1.8	-2.0	---		2	---
	(-16.4, 12.5)			(-13.5, 9.9)	(-13.8, 9.7)			(-9, -13)	
Worsened	14.7*	---		5.2	5.4	---		1	---
	(-2.2, 31.7)			(-10.3, 20.7)	(-10.1, 21.0)			(-14, 16)	
Physical healthxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-17.5*	-17.5**		-16.5**	-16.5**	-16.5**		-17**	-17*
	(-36.2, 1.3)	(-34.7, -0.3)		(-31.8, -1.2)	(-31.8, -1.2)	(-30.9, -2.0)		(-32, -1)	(-31, -2)
WorsenedxTime	-7.6	-7.6		-1.8	-1.8	-1.8		1	-10
	(-27.7, 12.5)	(-28.6, 13.4)		(-20.7, 17.1)	(-20.7, 17.1)	(-19.8, 16.2)		(-21, -18)	(-20, 17)
Physical healthxTime									
ConstantxTime			-7.4**				-9.5***		
			(-13.9, -1.0)				(-15.0, -4.0)		
ImprovedxTime			-24.1***				-26.1****		
			(-41.3, -7.0)				(-40.5, -11.7)		
WorsenedxTime			-13.1				-10.0		
			(-29.8, 3.6)				(-26.0, 6.0)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Regressions controlled for race, gender, age, age squared, baseline physical health (two-level), baseline mental health (two-level) and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous) and used robust standard errors.

Table A22: Exploring the sensitivity of the relationship between worry about paying for housing costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in physical health among newly enrolled Virginia Medicaid Expansion members using a two-level physical health variable

Outcome: Worried about paying for housing costs									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=504; observations in the regression=1008)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-2.7	-2.7		-4.4	-4.4	-4.4		-4	-4
	(-9.2, 3.7)	(-9.1, 3.6)		(-9.9, 1.1)	(-9.9, 1.1)	(-9.9, 1.1)		(-9, 2)	(-9, 2)
Physical health									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	-0.6	---		0.8	0.6	---		1	---
	(-14.8, 13.5)			(-10.6, 12.3)	(-10.9, 12.1)			(-10, 12)	
Worsened	9.4	---		7.1	7.4	---		5	---
	(-7.0, 25.8)			(-7.4, 21.6)	(-7.2, 21.9)			(-10, 19)	
Physical healthxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-20.3**	-20.3**		-18.9***	-18.9***	-18.9***		-19***	-19***
	(-36.4, -4.3)	(-36.7, -3.9)		(-32.9, -4.9)	(-32.9, -4.9)	(-32.7, -5.1)		(-33, -5)	(-33, -5)
WorsenedxTime	-3.3	-3.3		-0.2	-0.2	-0.2		-1	1
	(-21.2, 14.6)	(-23.3, 16.7)		(-16.5, 16.2)	(-16.5, 16.2)	(-17.3, 17.0)		(-17, 18)	(-17, 19)
Physical healthxTime									
ConstantxTime			-2.7				-4.3		
			(-9.0, 3.6)				(-9.8, 1.1)		
ImprovedxTime			-23.8***				-24.3****		
			(-38.8, -8.7)				(-37.8, -10.9)		
WorsenedxTime			-5.5				-4.1		
			(-20.7, 9.7)				(-18.0, 9.8)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Regressions controlled for race, gender, age, age squared, baseline physical health (two-level), baseline mental health (two-level) and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous) and used robust standard errors.

Table A23: Exploring the sensitivity of the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in mental health among newly enrolled Virginia Medicaid Expansion members using a three-level mental health variable

Outcome: Worried about affording food									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=500; observations in the regression=1000)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-7.7**	-7.7**		-10.6***	-10.6***	-10.6***		-10***	-10***
	(-15.7, -0.8)	(-15.0, -0.5)		(-16.6, -4.5)	(-16.6, -4.5)	(-16.6, -4.3)		(-16, -4)	(-16, -4)
Mental health									
Constant	Ref			Ref	Ref			Ref	
Improved	2.3	---		2.0	2.0	---		4	---
	(-9.5, 14.2)			(-8.3, 12.3)	(-8.4, 12.4)			(-6, 14)	
Worsened	-3.3	---		-0.5	-0.5	---		-3	---
	(-17.7, 11.1)			(-12.8, 11.7)	(-12.7, 11.7)			(-20, 13)	
Mental healthxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-18.0**	-18.0**		-11.7*	-11.7*	-11.7*		-11	-11*
	(-33.6, -2.3)	(-33.1, -2.8)		(-24.8, 1.5)	(-24.8, 1.5)	(-24.6, 1.3)		(-25, 2)	(-25, 2)
WorsenedxTime	4.2	4.2		5.5	5.5	5.5		5	5
	(-13.3, 21.8)	(-12.5, 21.0)		(-9.3, 20.3)	(-9.3, 20.3)	(-8.6, 19.6)		(-10, 20)	(-9, 19)
Mental healthxTime									
ConstantxTime			-7.7**				-10.5***		
			(-14.7, -0.8)				(-16.6, -4.5)		
ImprovedxTime			-26.3***				-22.9****		
			(-40.7, -11.9)				(-35.0, -10.8)		
WorsenedxTime			-3.2				-4.7		
			(-18.1, 11.6)				(-17.4, 7.9)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Regressions controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level) and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous) and used robust standard errors.

Table A24: Exploring the sensitivity of the relationship between worry about paying for housing costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in mental health among newly enrolled Virginia Medicaid Expansion members using a three-level mental health variable

Outcome: Worried about paying for housing costs									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=500; observations in the regression=1000)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-1.6	-1.6		-5.6*	-5.6*	-5.6*		-5	-10*
	(-8.5, 5.2)	(-8.5, 5.3)		(-11.7, 0.5)	(-11.7, 0.5)	(-11.6, 0.4)		(-11, 1)	(-20, -0)
Mental health									
Constant	Ref			Ref	Ref			Ref	
Improved	0.2	---		-2.4	-2.5	---		-1	---
	(-12.0, 12.4)			(-13.0, 8.1)	(-13.1, 8.1)			(-11, 10)	
Worsened	-4.0	---		-3.2	-3.2	---		-4	---
	(-17.9, 9.9)			(-15.2, 8.8)	(-15.2, 8.8)			(-16, 8)	
Mental healthxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-24.0***	-24.0***		-15.6**	-15.6**	-15.6**		-15**	-15**
	(-39.2, -8.9)	(-38.4, -9.7)		(-28.5, -2.8)	(-28.5, -2.8)	(-28.0, -3.2)		(-28, -3)	(-28, -3)
WorsenedxTime	3.4	3.4		9.4	9.4	9.4		9	9
	(-10.8, 17.6)	(-12.5, 19.3)		(-3.0, 21.8)	(-3.0, 21.8)	(-4.2, 21.0)		(-3, 22)	(-4, 23)
Mental healthxTime									
ConstantxTime			-1.6				-5.5*		
			(-8.4, 5.2)				(-11.5, 4.5)		
ImprovedxTime			-26.0****				-21.6****		
			(-39.8, -12.2)				(-33.0, -10.1)		
WorsenedxTime			1.7				3.6		
			(-10.2, 13.6)				(-6.6, 13.8)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Regressions controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level) and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous) and used robust standard errors.

Table A25: Exploring the sensitivity of the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in mental health among newly enrolled Virginia Medicaid Expansion members using a two-level mental health variable

Outcome: Worried about affording food									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=500; observations in the regression=1000)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-8.5***	-8.5**		-11.8****	-11.8****	-11.8****		-11****	-11****
	(-15.0, -2.1)	(-15.1, -2.0)		(-17.3, -6.2)	(-17.3, -6.2)	(-17.4, -6.1)		(-17, -6)	(-17, -6)
Mental health									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	3.4	---		3.5	3.5			4	
	(-11.1, 17.9)			(-8.6, 15.7)	(-8.7, 15.7)			(-7, 16)	
Worsened	4.3			0.5	0.5			-3	
	(-15.8, 24.3)	---		(-15.8, 16.9)	(-15.8, 16.9)			(-20, 13)	
Mental healthxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-18.1*	-18.1*		-10.4	-10.4	-10.4		-10	-10
	(-38.1, -1.8)	(-36.4, 0.1)		(-26.9, 6.1)	(-26.9, 6.1)	(-25.7, 4.8)		(-27, 6)	(-26, 5)
WorsenedxTime	1.1	1.1		14.4	14.4	14.4		15	15
	(-20.2, 22.5)	(-21.8, 24.1)		(-3.6, 32.3)	(-3.6, 32.4)	(-4.7, 33.5)		(-3, 33)	(-5, 34)
Mental healthxTime									
ConstantxTime			-8.4***				-11.6****		
			(-14.8, -2.1)				(-17.1, -6.1)		
ImprovedxTime			-28.8***				-24.3***		
			(-49.4, -8.2)				(-41.4, -7.3)		
WorsenedxTime			-6.8				2.5		
			(-25.5, 11.9)				(-13.7, 18.6)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Regressions controlled for race, gender, age, age squared, physical health at the baseline (two-level), mental health at baseline (two-level) and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, physical health at the baseline (continuous), mental health at baseline (continuous) and used robust standard errors.

Table A26: Exploring the sensitivity of the relationship between worry about paying for housing costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in mental health among newly enrolled Virginia Medicaid Expansion members using a two-level mental health variable

Outcome: Worried about paying for housing costs									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=500; observations in the regression=1000)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-4.3	-4.3		-7.0**	-7.0**	-7.0**		-5*	-6**
	(-10.4, 1.9)	(-10.5, 2.0)		(-12.4, -1.6)	(-12.4, -1.6)	(-12.5, -1.6)		(-11, 1)	(-12, -1)
Mental health									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	-0.1	---		-2.9	-3.1			-3	
	(-15.9, 14.0)			(-15.5, 9.7)	(-15.6, 9.5)			(-16, 10)	
Worsened	-6.4			-3.8	-3.7			-6	
	(-25.3, 12.6)	---		(-19.9, 12.3)	(-19.8, 12.3)			(-23, 10)	
Mental healthxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-20.2**	-20.2**		-10.4	-10.4	-10.4		-10	-10
	(-38.8, -1.5)	(-37.6, -2.8)		(-25.7, 4.9)	(-25.7, 4.9)	(-25.2, 4.3)		(-25, 6)	(-26, 6)
WorsenedxTime	11.7	11.7		14.9*	14.9*	14.9		8	11
	(-9.6, 32.9)	(-10.2, 33.5)		(-1.3, 31.1)	(-1.3, 31.1)	(-3.5, 33.4)		(-10, 25)	(-10, 31)
Mental healthxTime									
ConstantxTime			-4.2				-6.9**		
			(-10.2, 1.8)				(-12.2, -1.6)		
ImprovedxTime			-0.26***				-18.6**		
			(-44.0, -7.1)				(-33.9, -3.4)		
WorsenedxTime			7.1				7.6		
			(-12.3, 26.5)				(-7.1, 22.2)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Regressions controlled for race, gender, age, age squared, physical health at the baseline (two-level), mental health at baseline (two-level) and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, physical health at the baseline (continuous), mental health at baseline (continuous) and used robust standard errors.

Table A27: Exploring the sensitivity of the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in functional job limitations among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about affording food									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=474; observations in the regression=948)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-8.4**	-8.4**		-8.8***	-8.8***	-8.8***		-9***	-9***
	(-15.5, -1.3)	(-15.3, -1.5)		(-15.1, -2.6)	(-15.1, -2.6)	(-15.0, -2.67		(-15, -3)	(-14, -3)
Functional job limitations									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	4.6	---		6.5	6.4	---		7	
	(-7.9, 17.1)			(-4.8, 17.9)	(-5.0, 17.8)			(4, 18)	
Worsened	21.1***			18.4**	18.3**			18**	
	(6.2, 36.0)	---		(4.4, 32.3)	(4.4, 32.3)	---		(4, 31)	
Functional job limitationsxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-8.6	-8.6		-11.4*	-11.4*	-11.4		-13**	-13*
	(-23.0, 5.9)	(-25.0, 7.9)		(-24.3, 1.4)	(-24.3, 1.4)	(-26.2, 3.3)		(-26, -0)	(-27, 1)
WorsenedxTime	-7.5	-7.5		-7.5	-7.5	-7.5		-7	-7
	(-26.6, 11.6)	(-26.1, 11.1)		(-25.9, 10.9)	(-25.9, 10.9)	(-25.1, 10.1)		(-24, 11)	(-24, 10)
Functional job limitationsxTime									
ConstantxTime			-8.4**				-8.8***		
			(-15.4, -1.3)				(-15.1, -2.5)		
ImprovedxTime			-18.5***				-22.0****		
			(-32.2, -4.9)				(-34.0, -9.9)		
WorsenedxTime			-13.2*				-13.8*		
			(-28.2, 1.8)				(-28.7, 1.0)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Regressions controlled for race, gender, age, age squared, physical health at the baseline (three-level), mental health at baseline (three-level), baseline functional job limitations, and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, physical health at the baseline (continuous), mental health at baseline (continuous), baseline functional job limitations, and used robust standard errors.

Table A28: Exploring the sensitivity of the relationship between worry about paying for housing costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in functional job limitations among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about paying for housing costs									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=474; observations in the regression=948)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-6.6*	-6.6*		-7.4**	-7.4**	-7.4**		-7**	-7**
	(-13.3, 0.2)	(-13.2, 0.1)		(-13.2, -1.6)	(-13.2, -1.6)	(-13.2, -1.6)		(-13, -1)	(-13, -1)
Functional job limitations									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	-7.1	---		-7.0	-7.2	---		-6	
	(-20.2, 6.1)			(-19.0, 5.0)	(-19.2, 4.8)			(-18, 6)	
Worsened	21.6***			16.2**	16.2**			17**	
	(6.8, 36.5)	---		(2.3, 30.1)	(2.3, 30.2)	---		(3, 31)	
Functional job limitationsxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-1.9	-1.9		-3.4	-3.4	-3.4		-2	-0
	(-17.0, 13.2)	(-17.6, 13.8)		(-17.4, 10.6)	(-17.4, 10.6)	(-17.3, 10.5)		(-15, 12)	(-14, 14)
WorsenedxTime	8.8	8.8		9.4	9.4	9.4		0.07	5
	(-7.4, 25.1)	(-9.0, 26.7)		(-6.1, 25.0)	(-6.1, 25.0)	(-7.1, 26.0)		(-8, 22)	(-11, 22)
Functional job limitationsxTime									
ConstantxTime			-6.5*				-7.3**		
			(-13.1, 0.2)				(-13.1, -1.6)		
ImprovedxTime			-9.2				-11.4*		
			(-24.0, 5.5)				(-24.9, 2.0)		
WorsenedxTime			1.7				1.6		
			(-9.1, 12.4)				(-9.5, 12.6)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Regressions controlled for race, gender, age, age squared, physical health at the baseline (three-level), mental health at baseline (three-level), baseline functional job limitations, and used robust standard errors. [b]Regressions controlled for race, gender, age, age squared, physical health at the baseline (continuous), mental health at baseline (continuous), baseline functional job limitations, and used robust standard errors.

Table A29: Exploring the sensitivity of the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in medical bills among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about affording food									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=487; observations in the regression=974)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-5.6	-5.6		-6.2*	-6.2*	-6.2*		7*	7*
	(-13.6, 2.5)	(-13.6, 2.5)		(-13.5, 1.1)	(-13.5, 1.1)	(-13.4, 1.1)		(-0.14, 0.00)	(-14, 0)
Medical bills									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	-6.2	---		-6.5	-6.5	---		-6	
	(-16.3, 3.8)			(-15.7, 2.3)	(-15.7, 2.7)			(-15, 3)	
Worsened	-0.4			1.5	1.5			2	
	(-37.9, 37.2)	---		(-22.1, 25.2)	(-22.2, 25.2)	---		(-21, 25)	
Medical billsxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-13.7**	-13.7**		-12.7**	-12.7**	-12.7**		-11**	-11**
	(-25.5, -2.0)	(-25.5, -2.0)		(-23.0, -2.3)	(-23.0, -2.3)	(-23.1, -2.3)		(-22, -1)	(-22, -1)
WorsenedxTime	55.6***	55.6***		23.8	23.8	23.8		24	24*
	(19.9, 91.2)	(14.9, 96.2)		(-6.4, 54.1)	(-6.4, 54.1)	(-4.5, 52.1)		(-5, 55)	(-4, 52)
Medical billsxTime									
ConstantxTime			-5.3				-5.8*		
			(-13.0, 2.4)				(-12.8, 1.1)		
ImprovedxTime			-18.7****				-18.4****		
			(-27.0, -10.5)				(-25.5, -11.3)		
WorsenedxTime			Not estimable				13.1		
							(-9.1, 35.3)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level), baseline medical bills and used robust standard errors. [b]Controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous), baseline medical bills, and used robust standard errors.

Table A30: Exploring the sensitivity of the relationship between worry about paying for housing costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in medical bills among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about paying for housing costs									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=487; observations in the regression=974)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-0.5	-0.5		0.0	0.0	0.0		-0	-1
	(-8.2, 7.2)	(-8.2, 7.2)		(-6.8, 6.8)	(-6.8, 6.8)	(-6.8, 6.8)		(-7, 7)	(-8, 7)
Medical bills									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	-3.4	---		-3.1	-3.1	---		-2	
	(-13.8, 7.0)			(-12.4, 6.1)	(-12.4, 6.2)			(-11, 8)	
Worsened	-10.6			-1.0	-1.1			2	
	(-48.0, 25.8)	---		(-25.3, 23.3)	(-25.5, 23.2)	---		(-22, 25)	
Medical billsxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-13.5**	-13.5**		-14.0***	-14.0***	-14.0***		-11**	-11**
	(-24.8, -2.3)	(-24.8, -2.2)		(-23.8, -4.3)	(-23.8, -4.3)	(-23.8, -4.2)		(-21, -1)	(-22, -1)
WorsenedxTime	38.0**	38.0*		11.8	11.8	11.8		16	0.15
	(3.5, 72.5)	(-1.1, 77.1)		(-16.8, 40.3)	(-16.8, 40.3)	(-14.9, 38.4)		(-13, 44)	(-16, 45)
Medical billsxTime									
ConstantxTime			-0.5				0.00		
			(-7.5, 6.6)				(-6.2, 6.2)		
ImprovedxTime			-14.6***				-14.6****		
			(-23.1, -6.1)				(-21.8, -7.4)		
WorsenedxTime			30.2*				9.3		
			(-0.2, 60.6)				(-13.0, 31.7)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (thre-level), baseline medical bills and used robust standard errors. [b]Controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous), baseline medical bills, and used robust standard errors.

Table A31: Exploring the sensitivity of the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in healthcare expenses among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about affording food									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=424; observations in the regression=848)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-7.7**	-7.7*		-7.5**	-7.6**	-7.6**		-6*	-6
	(-15.3, 0.0)	(-15.6, 0.3)		(-14.9, -0.3)	(-14.9, -0.3)	(-15.1, -0.1)		(-13, 1)	(-14, 1)
Care expenses									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	-6.8	---		-8.4	-8.6	---		-15***	
	(-18.0, -4.5)			(-19.1, 2.2)	(-19.3, 2.1)			(-26, -4)	
Worsened	6.9			0.7	0.8			6	
	(-11.3, 25.2)	---		(-16.6, 17.9)	(-16.4, 18.1)	---		(-11, 24)	
Care expensesxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	6.9	6.9		-5.6	-5.6	-5.6		2	2
	(-19.4, 5.5)	(-19.6, 5.7)		(-17.4, 6.2)	(-17.4, 6.2)	(-17.5, 6.4)		(-9, 14)	(-10, 14)
WorsenedxTime	-5.2	-5.2		-6.7	-6.7	-6.7		-0	-2
	(-29.7, 19.2)	(-27.3, 16.8)		(-29.1, 15.7)	(-29.1, 15.6)	(-27.4, 14.1)		(-27, 27)	(-23, 19)
Care expensesxTime									
ConstantxTime			-7.4*				-7.4**		
			(-15.0, 0.0)				(-14.5, -0.2)		
ImprovedxTime			-14.7***				-13.3***		
			(-24.7, -4.8)				(-22.7, -3.9)		
WorsenedxTime			-11.5				-13.3		
			(-32.3, 9.4)				(-33.3, 6.6)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level), baseline healthcare expenses and used robust standard errors. [b]Controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous), baseline healthcare expenses, and used robust standard errors.

Table A32: Exploring the sensitivity of the relationship between worry about paying for healthcare costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in healthcare expenses among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about paying for housing costs									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=424; observations in the regression=848)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	-6.2*	-6.2		-7.2**	-7.2**	-7.2**		-7*	-7*
	(-13.4, 0.9)	(-13.8, 1.4)		(-13.9, -0.5)	(-13.9, -0.5)	(-14.3, -0.1)		(-14, 1)	(-15, 1)
Care expenses									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	-18.1***	---		-17.4***	-17.5***	---		-5	
	(-29.1, 7.1)			(-28.0, -6.7)	(-28.1, -6.9)			(-16, 5)	
Worsened	9.0			4.3	4.4			1	
	(-9.0, 27.0)	---		(-12.7, 21.3)	(-12.5, 21.4)	---		(-17, 19)	
Care expensesxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	1.1	1.1		2.6	2.6	2.6		-4	-7
	(-10.5, 12.7)	(-11.0, 13.2)		(-8.4, 13.5)	(-8.4, 13.5)	(-8.8, 13.9)		(-17, 8)	(-20, 5)
WorsenedxTime	-0.2	-0.2		-4.3	-4.3	-4.3		-3	-8
	(-27.9, 27.5)	(-21.4, 20.9)		(-29.9, 21.4)	(-29.9, 21.4)	(-24.0, 15.5)		(-27, 20)	(-30, 14)
Care expensesxTime									
ConstantxTime			5.8*				6.8**		
			(-12.5, 0.1)				(-13.1, -0.5)		
ImprovedxTime			-5.2				-4.7		
			(-14.5, 4.1)				(-13.6, 4.1)		
WorsenedxTime			-4.7				-9.1		
			(-24.3, 14.9)				(-28.9, 10.8)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval [a]Controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level), baseline healthcare expenses and used robust standard errors. [b]Controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous), baseline healthcare expenses, and used robust standard errors.

Table A33: Exploring the sensitivity of the relationship between worry about affording food in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in worry about catastrophic healthcare expenses among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about affording food									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=502; observations in the regression=1004)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	2.6	2.6		1.3	1.3	1.3		2	1
	(-4.4, 9.6)	(-4.6, 9.7)		(-4.8, 7.5)	(-4.8, 7.5)	(-5.0, 7.7)		(-4, 9)	(-6, 7)
Catastrophic									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	-2.6	---		-0.3	-0.3	---		1	
	(-12.3, 7.1)			(-8.6, 8.1)	(-8.6, 8.1)			(-7, 10)	
Worsened	24.3**			25.0**	25.0**			27***	
	(0.4, 48.2)	---		(6.0, 44.0)	(6.0, 44.1)	---		(8, 47)	
CatastrophicxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-39.1****	-39.1****		-35.5****	-35.5****	-35.5****		-35****	-35****
	(-51.5, -26.8)	(-51.3, -26.9)		(-46.0, -24.9)	(-46.0, -24.9)	(-46.0, -24.9)		(-46, -24)	(-46, -23)
WorsenedxTime	-7.6	-7.6		-7.1	-7.1	-7.1		-11	-12
	(-30.5, 15.4)	(-33.0, 17.9)		(-28.8, 14.7)	(-28.8, 14.7)	(-26.7, 12.6)		(-33, 11)	(-33, 9)
CatastrophicxTime									
ConstantxTime			2.5				1.4		
			(-4.4, 9.5)				(-4.9, 7.6)		
ImprovedxTime			-33.3****				-31.1****		
			(-42.7, -23.8)				(-39.0, -23.2)		
WorsenedxTime			-2.8				-3.1		
			(-15.0, 9.4)				(-14.5, 8.3)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level), baseline catastrophic healthcare costs and used robust standard errors. [b]Controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous), baseline worry about catastrophic healthcare costs, and used robust standard errors.

Table A34: Exploring the sensitivity of the relationship between worry about paying for healthcare costs in the pre-enrollment period (2019) compared to the post-enrollment period (2020-2021) and changes in worry about catastrophic healthcare expenses among newly enrolled Virginia Medicaid Expansion members

Outcome: Worried about paying for housing costs									
	Common cases (individuals in the regression=377; observations in the regression=754)			Complete cases (individuals in the regression=502; observations in the regression=1004)				Multiple imputation (individuals in the regression=517; observations in the regression=1034)	
	Multi-level with random slope[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random slope[a] PP (95% CI)	Multi-level with random intercept[a] PP (95% CI)	Fixed Effects[a] PP (95% CI)	Logit[a] PP (95% CI)	Multi-level with random intercept[b] PP (95% CI)	Fixed Effects[b] PP (95% CI)
Period									
Pre	Ref	Ref		Ref	Ref	Ref		Ref	Ref
Post	3.4	3.4		3.0	3.0	3.0		4	2
	(-3.0, 9.8)	(-3.5, 10.4)		(-2.6, 8.7)	(-2.6, 8.7)	(-3.2, 9.2)		(-2, 9)	(-4, 9)
Catastrophic									
Constant	Ref			Ref	Ref			Ref	Ref
Improved	-5.9	---		-4.5	-4.4	---		-4	
	(-15.6, 3.9)			(-12.8, 3.9)	(-12.8, 4.0)			(-12, 5)	
Worsened	32.3***			37.5****	37.4****			39****	
	(8.5, 56.1)	---		(19.8, 55.3)	(19.7, 55.2)	---		(20, 57)	
CatastrophicxTime									
ConstantxTime	Ref	Ref		Ref	Ref	Ref		Ref	Ref
ImprovedxTime	-28.6****	-28.6****		-26.6****	-26.6****	-26.6****		-25****	-24****
	(-41.1, -16.1)	(-40.5, -16.8)		(-37.2, -16.0)	(-37.1, -16.0)	(-36.8, -16.3)		(-36, -14)	(-35, -13)
WorsenedxTime	1.6	1.6		-8.7	-8.7	-8.7		-8	-7
	(-25.1, 28.2)	(-23.2, 26.4)		(-30.4, 12.9)	(-30.4, 12.9)	(-27.8, 10.3)		(-30, 13)	(-28, 14)
CatastrophicxTime									
ConstantxTime			3.4				3.0		
			(-2.9, 9.7)				(-2.6, 8.6)		
ImprovedxTime			-23.5****				-21.8****		
			(-33.6, -13.4)				(-30.2, -13.4)		
WorsenedxTime			2.0				-2.4		
			(-8.5, 12.5)				(-11.0, 6.3)		

Notes: *p-value<0.1, **p-value<0.05,***p-value<0.01, ****p-value<0.001. PP is percentage point. CI is confidence interval. [a]Controlled for race, gender, age, age squared, baseline physical health (three-level), baseline mental health (three-level), baseline catastrophic healthcare costs and used robust standard errors. [b]Controlled for race, gender, age, age squared, baseline physical health (continuous), baseline mental health (continuous), baseline worry about catastrophic healthcare costs, and used robust standard errors.