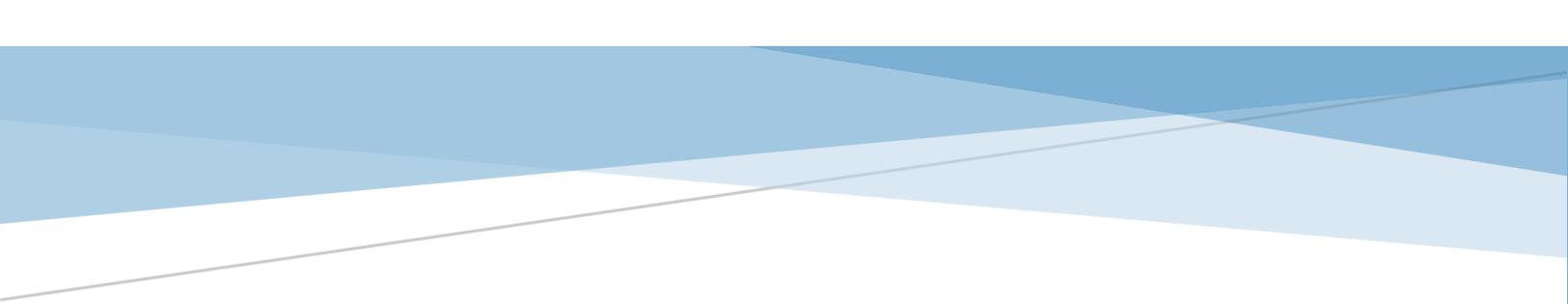

Understanding the Role of Adolescent Housing Residence on Adverse Childhood Experiences and Outcomes of Chronic Disease Risk

Interim Report



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Understanding the Role of Adolescent Housing Residence on Adverse Childhood Experiences and Outcomes of Chronic Disease Risk

Revised Interim Report

Revised March 2021

Prepared by:
Atticus Jaramillo
Michael D. Webb, Principal Investigator
Jon Hussey, Principal Investigator
Delia Wegner
Danelle Doney



Foreword

Evidence suggests that exposure to adversity throughout childhood and adolescence can have detrimental outcomes that are carried into adulthood. Children from low-income families face more stressors and adverse childhood events (ACEs) than those living in advantaged circumstances. ACEs can include physical, sexual, and emotional abuse; physical and emotional neglect; exposure to violence and substance abuse; and disruptions in household stability such as parental divorce or incarceration. Although substantial research has investigated poverty, exposure to ACEs, and programs that offset the negative impact of ACEs, relatively little is known about HUD-assisted children.

There has been little research into whether HUD-assisted children are exposed to ACEs at similar rates as other disadvantaged children, higher rates because they are concentrated among recipients, or lower rates because assistance shields children from the effects of poverty and other ACEs on developmental outcomes. This research seeks to determine whether HUD-assisted children face differential exposure to ACEs and how that affects their trajectories and outcomes compared to similarly disadvantaged, low-income children who do not receive assistance.

With the advent of improvements in data analytics and continued efforts to use administrative data to understand the impact of HUD assistance, this research linked two longitudinal databases: HUD's tenant administrative database and the University of North Carolina's (UNC's) National Longitudinal Study of Adolescent to Adult Health (Add Health). Add Health is a prospective cohort study that has followed a nationally representative sample of U.S. adolescents into adulthood. The study began in 1994–95 with adolescents in grades 7 through 12 and has followed these respondents through adolescence and the transition to adulthood with four completed waves. The original goal of the survey was to explain the causes of adolescent health and health behavior with a particular emphasis on the multiple contexts of adolescent life, including school, family, peer groups, and neighborhood. Linking this database with HUD administrative records provides HUD and other researchers with data to understand the impact of residence in HUD-assisted housing on adolescent health and adult outcomes.

The interim report presents a summary of research activities to date and initial findings. This report relies solely on descriptive frequencies and lacks a weighted comparison group. With that caveat, some interesting findings include:

- Fewer HUD residents reported that they “felt safe” in their neighborhood relative to the “A” comparison group of low-income adolescents from the Add Health study who did not reside in HUD-assisted housing at any point between 1995–2017, the “Add Health comparison group,” or the Add Health overall sample.
- There were notable disparities in perceptions of neighborhood safety and school quality between HUD residents and the low-income comparison group.
- HUD residents were somewhat more likely to report experiencing physical or verbal abuse as a child.
- There were no significant differences in health outcomes between the HUD residents and the Add Health comparison group.

The final report, expected fall 2021, will use rigorous quantitative methods to provide a clear understanding of the relationship between residence in HUD-assisted housing as an adolescent and adult health outcomes.

A handwritten signature in black ink, appearing to read "Todd M. Richardson". The signature is fluid and cursive, with a prominent horizontal stroke at the beginning.

Todd Richardson
General Deputy Assistant Secretary for Policy Development and Research
U.S. Department of Housing and Urban Development

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Executive Summary

This Interim Report presents a summary of research activities to date and initial findings for the grant, “Understanding the Role of Adolescent Housing Residence on Adverse Childhood Experiences and Trajectories of Chronic Disease Risk.” This project has two key research activities. First, the U.S. Department of Housing and Urban Development (HUD) administrative records from 1995–2017 were linked to participants in the National Longitudinal Study of Adolescent to Adult Health (“Add Health”) to create a novel dataset. This activity is summarized in a companion report (Jaramillo et al., 2020).

The second key research activity is quantitatively analyzing this linked dataset to understand how residing in HUD-assisted housing as an adolescent is related to (1) incidence and severity of adverse childhood experiences (ACEs) and (2) health trajectories and chronic health risks later in life. This report provides descriptive statistics to that end, comparing outcomes across three groups:

- Add Health respondents who resided in HUD-assisted housing as an adolescent (referred to throughout as “linked HUD adolescent residents” or “HUD residents” for brevity).
- A comparison group of low-income adolescents from the Add Health study who did not reside in HUD-assisted housing at any point between 1995–2017 (“Add Health comparison group”).
- The entire Add Health sample.

Following the submission of this report, the research team will undertake important next steps. These include identifying and analyzing respondents’ adolescent neighborhood characteristics, developing a matched comparison group, and conducting rigorous statistical modeling of the inter-relationships among residence in HUD-assisted housing as an adolescent, exposure to adverse childhood experiences, and health trajectories later in life.

Key findings presented in this report include:

- Demographics
 - Across Wave I, III, and IV Add Health interviews, the number of linked HUD adolescent respondents fluctuates from 489, to 379, to 393, respectively. Despite the changes in size, the demographic composition of HUD residents does not differ substantially across waves.
 - Across these three waves, most HUD residents identify as female (~62 percent) and non-Hispanic Black (~53 percent). Relatively smaller numbers identify as non-Hispanic White (~24 percent), Hispanic or Latino of any race (~15 percent), or another race (~8 percent).¹
 - Relative to the low-income comparison group, a higher proportion of HUD residents identify as female and Black, and a lower proportion identify as White or Hispanic/Latino.
 - A plurality of HUD residents (~45 percent) participated in the Housing Choice Voucher (HCV) program as an adolescent. Smaller numbers participated in multiple HUD-assisted

¹ All numbers approximate here due to small variations across each wave of data collection—i.e., if a linked sample member did not respond to the Wave III Add Health interview, they are omitted from the demographic calculation.

- programs (e.g., both public housing and HCVs) as an adolescent (~25 percent), the Project-based Section 8 program (~13 percent), or the public housing program (~12 percent). Very few participated in other multifamily programs as an adolescent (<5 percent).
- Abuse and Maltreatment
 - Across multiple Wave I measures—collected when respondents were in grades 7–12—there were notable disparities in perceptions of neighborhood safety and school quality between the HUD residents and the low-income comparison group. A smaller proportion of HUD residents reported that they “felt safe” in their neighborhood (74 percent vs. 81 percent). Correspondingly, a higher proportion of HUD residents’ parents believed that litter (68 percent vs. 54 percent) and drug dealing (63 percent vs. 52 percent) were “somewhat of a problem” or a “big problem” in their neighborhood relative to parents of the comparison group.
 - HUD residents were slightly more likely to report neglect and physical abuse during childhood than the comparison group. Specifically, a higher proportion of HUD residents reported that they were left home unattended before the sixth grade (49 percent vs. 45 percent), that their parents had failed to meet their basic needs during childhood (20 percent vs. 17 percent), and that they were subjected to physical abuse in childhood (38 percent vs. 31 percent).
 - Trajectories of disease risk
 - Across all waves, we find no major differences in health outcomes between the HUD residents and the Add Health comparison group concerning (1) diabetes prevalence, (2) blood pressure/hypertension, (3) body mass index (BMI), and (4) depressive symptomatology.
 - Likewise, we find minimal differences in reports of negative health behaviors between the HUD residents and the Add Health comparison group concerning cigarette, alcohol, and marijuana usage.

Chapter 1: Project Background and Relevant Literature

Housing policymakers and scholars are increasingly interested in understanding how living in subsidized housing impacts health outcomes. In general, public housing residents tend to have very poor health compared with the general population, likely due to public housing being a “safety net” for extremely-low-income individuals who are more likely to suffer from health maladies (Ruel et al., 2010). However, research has suggested that subsidized housing may exert independent effects on health outcomes by influencing household finances and living environments. Although past cross-sectional studies provide some evidence consistent with this hypothesis, existing research is plagued by the lack of longitudinal data on health, reliance on self-reported—rather than biometric—measures of health, and the lack of comparison groups.

This first stage of this project addressed this research need by linking HUD administrative records to the National Longitudinal Study of Adolescent to Adult Health (“Add Health”)—a nationally representative cohort study of U.S. adolescents (now adults). The linked dataset will allow researchers to explore important topics lying at the nexus of housing and health and is described more fully in the next chapter.

The second stage of this project addresses this research need by analyzing whether teen residence in HUD-assisted housing is related to exposure to adverse childhood experiences (ACEs) and chronic disease later in life. Chronic diseases are the leading cause of death in the United States and major contributors to racial/ethnic and socioeconomic disparities in adult morbidity and mortality (Miniño, Heron, and Smith, 2006; WHO, 2011). Efforts to prevent or delay chronic disease onset have traditionally focused on proximate lifestyle behaviors. However, mounting evidence traces the origins of chronic disease to factors earlier in the life course (Schulze and Hu, 2005). Adolescence and the transition to adulthood are critical periods concerning the emergence of adult chronic disease risks (Doom et al., 2017). However, researchers and policymakers know little about the links between teen risk factors to adult health outcomes.

Past research suggests that teen residence in HUD-assisted housing may positively and negatively affect lifelong health outcomes (Slopen et al., 2018). Because HUD-assisted housing can increase housing stability, children residing in it may have lower levels of household stress, be more resilient to ACEs, and have improved health trajectories (Fertig and Reingold, 2007). However, HUD-assisted housing has often been developed in neighborhoods with high levels of poverty and crime, and the physical quality of HUD-assisted housing varies greatly (Northridge et al., 2010). Thus, teen HUD-assisted housing residence may also be associated with higher stress levels, greater exposure to ACEs, and negative health trajectories.

The specific policy-relevant research questions addressed in this project include:

- Did teens who lived in HUD-assisted housing experience a differential number of ACEs and physical health problems compared to a matched set of teens who did not reside in HUD-assisted housing?
- Did teens who lived in HUD-assisted housing have a different trajectory of obesity, hypertension, diabetes, depression, and substance abuse later in life compared with a matched set of teens who did not reside in assisted housing?
- Do additional contextual factors—such as neighborhood crime, poverty rates, type of HUD assistance received, and access to opportunities—in the areas in which teens lived moderately the relationships among ACEs, who lived in HUD-assisted housing, and chronic disease later in life?

This report provides descriptive statistics for the 489 Add Health participants who resided in HUD-assisted housing as an adolescent.² Key measures presented here include ACE incidence and severity, abuse and maltreatment, and substance abuse incidence and frequency, in addition to chronic health risks. This report is a companion to a recently submitted documentation report on the procedure used to create the linked dataset (Jaramillo et al., 2020).

The purpose of this report is to present descriptive statistics on the linked HUD-Add Health cohort and contrast these statistics to a comparison group of low-income Add Health respondents who did *not* reside in HUD-assisted housing at any point between 1995–2017 and the overall Add Health sample. Future project activities will include identifying and analyzing respondents’ adolescent neighborhood characteristics, developing a matched comparison group, and conducting rigorous statistical modeling of the inter-relationships between residence in HUD-assisted housing as an adolescent, exposure to ACEs, and health trajectories later in life.

The remainder of this report proceeds as follows. Chapter 2 provides background information on the HUD and Add Health data sources utilized in this study and summarizes the linkage procedures. Chapter 3 specifies the analysis methods used in this report. Chapter 4 compares the sociodemographic characteristics of the linked HUD residents with the Add Health comparison group and overall sample. Chapter 5 compares the ACEs of HUD residents and the other two analytic cohorts. Chapter 6 reports on longitudinal health and chronic disease risks across the three groups. Finally, Chapter 7 summarizes the overall findings and discusses future research plans.

² Defined as before their 19th birthday. As explained later in this report, however, a key limitation of the linked dataset is that we are unable to ascertain whether an individual resided in HUD-assisted housing prior to 1995. Thus, it is likely that some non-linked records did reside in HUD-assisted housing prior to 1995.

Chapter 2: Data Sources and Linkage Method

The dataset used in this study was created by linking HUD administrative records (1995–2017) with National Longitudinal Study of Adolescent to Adult Health (Add Health) data, which were collected via five waves of surveys administered between 1995 and 2018.

Data Sources

Add Health

Add Health is a prospective cohort study that has followed a nationally representative sample of U.S. adolescents into adulthood. The study began in 1994–1995 with adolescents in grades 7–12 and has followed these respondents through adolescence and the transition to adulthood with five completed waves (see exhibit 1 for the Add Health study design). The original goal of the survey was to explain the causes of adolescent health and health behavior with a special emphasis on adolescent life contexts, including school, peer groups, neighborhood, and family. As the cohort has aged, study objectives have expanded to include a focus on how adolescent and early adulthood experiences, behaviors, and social contexts influence well-being in early- and mid-adulthood using an integrative approach that combines the social, behavioral, and biomedical sciences.

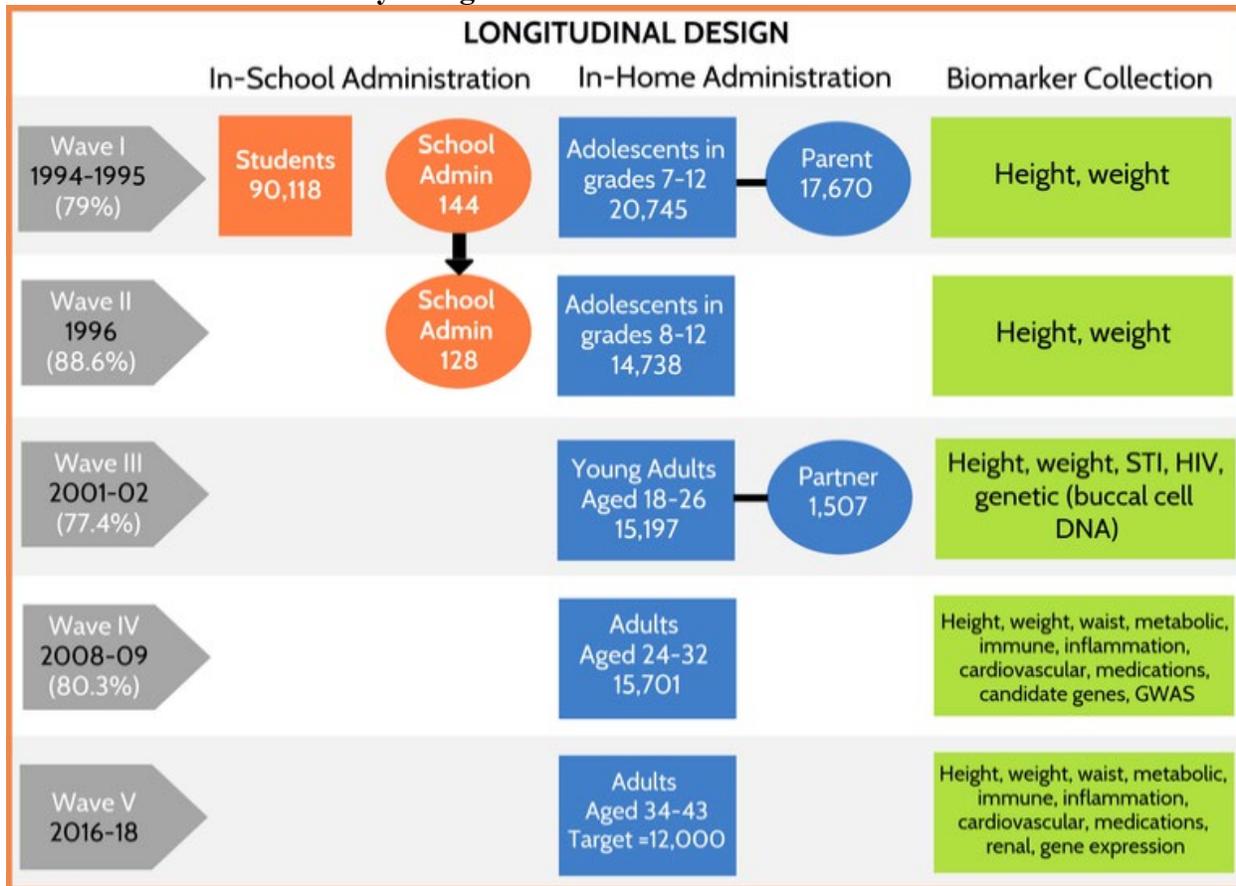
Add Health is based on a multi-stage, stratified, school-based cluster sampling design. A stratified sample of 80 high schools was selected, with probability proportional to size, from a comprehensive list of U.S. high schools. Schools were first stratified by size, type (public, parochial, private), region (Northeast, Midwest, South, West), urbanization (urban, suburban, rural), and ethnic mix (Thalji et al., 1997). For each high school, one feeder school (typically a middle school) was selected with probability proportional to its student contribution to the high school. Because some schools spanned grades 7–12, the sample contains 132 schools located in 80 communities. School sizes varied from fewer than 100 students to more than 3,000 students. All 7th–12th-grade students in these 132 schools were eligible for the in-school questionnaire completed by 90,118 students between September 1994 and April 1995.

Wave I of Add Health also included an in-home interview. The sampling frame for the in-home interview had students listed on their school enrollment roster and students not on the roster but who completed the in-school questionnaire. From this list, a probability sample of students was selected, including oversamples of (1) Cuban, Puerto Rican, and Chinese adolescents, (2) Black adolescents with a college graduate parent, and (3) adolescents with disabilities. In addition, there was a genetic relatedness oversample of twins, full siblings, half-siblings, and unrelated adolescents living in the same household. Wave I in-home interviews were completed between April through December 1995 with 79 percent of sampled respondents for a total sample size of 20,745 adolescents aged 12–19 years. An in-home interview also was completed with a parent, usually the resident mother.

The Wave I in-home sample of adolescents is the basis for all longitudinal followup interviews. Four followup waves have been completed to date. Wave II was fielded in 1996, approximately 1 year

after the baseline. Interviews were completed with 88 percent of sampled respondents, consisting primarily of Wave I respondents in grades 7 through 11, for a total Wave II sample size of 14,738. In 2001–2002, Wave III interviews were completed with 15,170 respondents, who at the time were 18 to 26 years of age, from the original probability sample for a response rate of 77 percent. At Wave IV (2007–2008), interviews were completed with 15,701 respondents, ranging in age from 24–32 years (80 percent response rate). At Wave V (2016–2018), data collection was completed with 12,300 respondents, ages 31–42. Survey data from this most recent wave were released to contractual users in December 2019.

Exhibit 1. Add Health Study Design



GWAS = genome-wide association. HIV = human immunodeficiency virus. STI =sexually transmitted infection.

Notes: This figure was created while Wave V surveys were being collected. Thus, the sample size for Wave V listed in this figure was based on the sample size at that point in time; the actual Wave V sample is 12,300.

Source: National Study of Adolescent to Adult Health Presentation on Research Design

Written parental/guardian consent and adolescent assent were obtained before the Wave I and II interviews. At Waves III, IV, and V, written consent was obtained from all respondents (now adults). A complete description of the Add Health study design and the sample is available elsewhere (Harris et al., 2019). All Add Health procedures and the present study were approved by the Public Health Institutional Review Board at the University of North Carolina-Chapel Hill.

HUD Administrative Data

HUD offers housing assistance to low-income, very low-income, and extremely low-income families through various programs.³ The largest of these program categories include Housing Choice Vouchers (HCVs),⁴ public housing, and multifamily (MF) programs. The former two are administered under HUD's Office of Public and Indian Housing through local public housing authorities (PHAs), while the latter is administered under HUD's Office of Housing. See exhibit 2 for an overview chart of HUD programs and data collection.

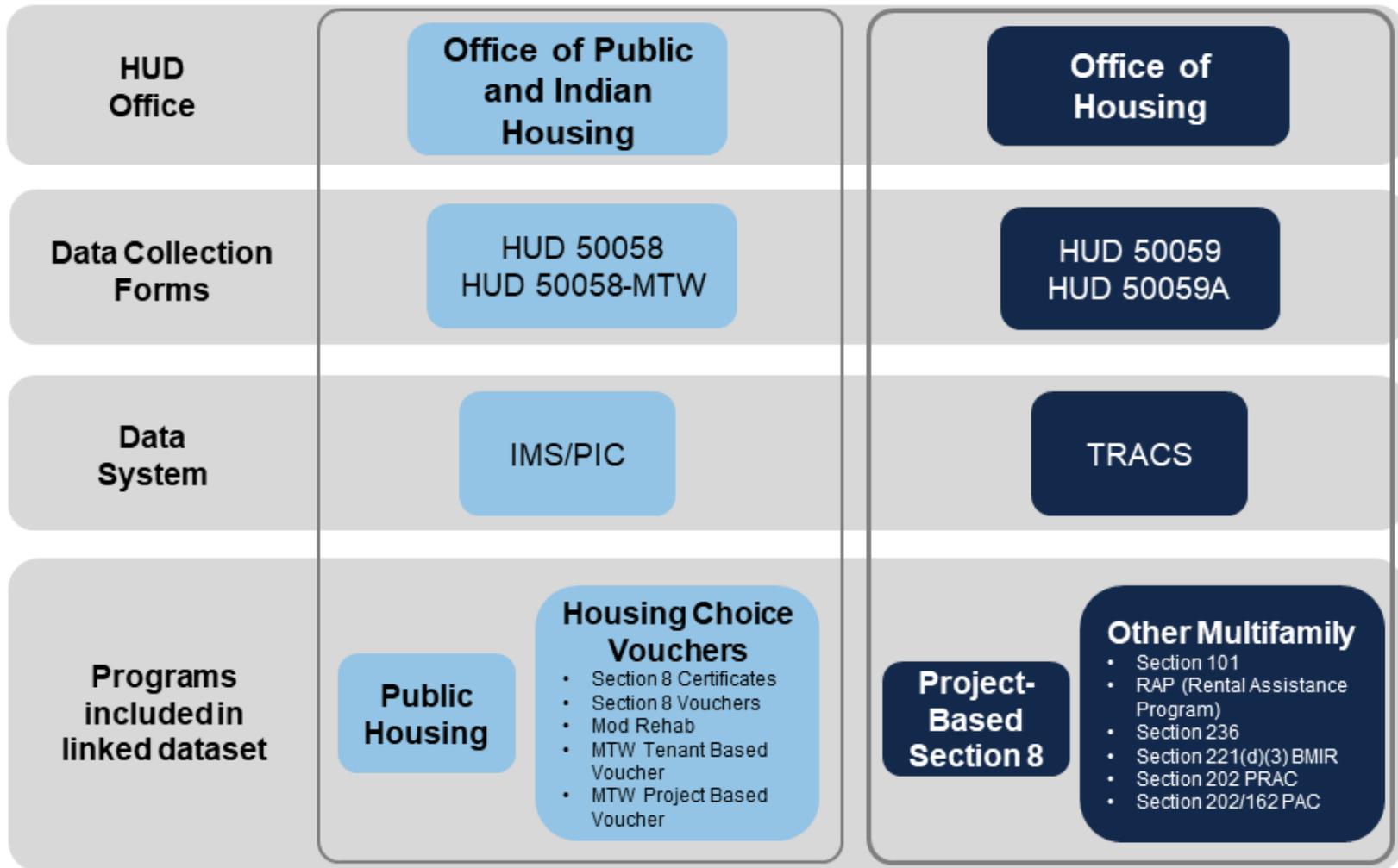
In 2019, the most recent period for which data are available, HUD provided over 5 million (5,035,000) units/vouchers of subsidized housing nationwide that collectively served 9,439,919 individuals (HUD, n.d.). The programmatic breakdown for these units is as follows:

- HCVs: 2,556,000 vouchers serving 5,249,000 individuals. As discussed in the following section, some of these vouchers are tenant-based, whereas others are project-based.
- Public housing: 987,000 units serving 1,909,000 individuals.
- MF: 1,491,000 units serving 2,282,000 individuals.
 - Of those units, 1,290,000 are Project-based Section 8; these units serve 2,063,000 individuals.
 - The remainder are in smaller MF programs such as Section 202 and Section 811(HUD, n.d.).

³ For housing assistance programs, HUD defines income limits as a percentage of area median income (AMI) for a family of four with adjustments for household size and geography. Low income means income not greater than 80 percent of AMI; very low income is not greater than 50 percent of AMI, and extremely low income is not greater than 30 percent of AMI. Most HUD-assisted households are in the latter two categories.

⁴ The tenant-based HCV program is often referred to as 'Section 8' because it was initially implemented under Section 8 of the Housing Act of 1937. It is sometimes confused with another HUD program, known as 'Project-based Section 8,' which does not rely on vouchers. The HCV program also has a project-based component (project-based vouchers), which adds to the confusion.

Exhibit 2. HUD Administrative Data Overview



BMIR = below-market interest rate. IMS/PIC = Inventory Management System/Public and Indian Housing Information Center. MTW = Moving to Work. PAC = Project Assistance Contract. PRAC = Project Rental Assistance Contract. TRACS = Tenant Rental Assistance Certification System.

Data collection for participants in HUD-assisted housing programs primarily occurs when a tenant initially moves into a unit and, at minimum, annually thereafter.⁵ For the public housing and HCV programs, PHAs also collect data at ‘interim recertifications’ due to changes in family composition or changes in income; these interim recertifications may also trigger a recalculation of rent. Failure to report these changes may result in program termination. For MF programs, data collection occurs when a family moves into the unit and annually thereafter with interim recertifications like those for public housing and HCV programs (e.g., changes in family composition or income).

The data collected by PHAs and multifamily housing providers via administrative forms (described below) include:

- Date of data collection
- Reason for data collection, e.g., program entry, income recertification, annual recertification, or end of program participation
- Geographic location of the housing unit
- Personal characteristics of everyone living in the housing units:
 - First and last name
 - Race/ethnicity
 - Sex
 - Citizenship status
 - Date of birth
 - Social security number
 - Relationship to head of household
- Information on income and assets, including income sources, in addition to an estimate for the household’s income in the next 12 months.

These data are collected and submitted to HUD on the following forms:

- HUD-50058 (the “Family Report”): used by PHAs to collect data on households who participate in the HCV and public housing programs. Available at <http://portal.hud.gov/hudportal/documents/huddoc?id=HUD50058.pdf>
- HUD-50058 Moving to Work (MTW, or the “MTW Family Report”): used by MTW PHAs to collect data on households who participate in any MTW program offered by a MTW PHA.⁶ Available at https://www.hud.gov/sites/documents/DOC_10236.pdf

⁵ An exception to this rule is for public housing and HCV participants at housing authorities participating in the MTW demonstration, which provides a limited number of public housing authorities (currently 39) with regularly flexibility. Many MTW agencies have reduced the frequency of recertification for some or all public housing and HCV clients. As a result, MTW agencies may transmit tenant data to HUD on a less frequent basis.

⁶ MTW PHAs may choose not to include all their programs within their MTW participation. In general, however, most MTW agencies include their public housing and HCV programs (except special purpose vouchers) as part of the MTW program.

- HUD-50059 (“Owners Certification of Compliance with HUD’s Tenant Eligibility and Rent Procedures”): used by MF housing providers to collect data on households participating in MF programs. Available at <https://www.hud.gov/sites/documents/50059.PDF> (HUD 50059) and <https://www.hud.gov/sites/documents/50059-A.PDF> (HUD 50059A - Partial Certification).

Since the mid-1990s, HUD has maintained centralized repositories for submitted data. These include:

- **Inventory Management System/Public and Indian Housing Information Center (IMS/PIC):** Public housing authorities electronically transmit data on households enrolled in the public housing and HCV programs on either the HUD-50058 or HUD-50058 MTW forms. HUD did not require the small number (approximately 23–30 during this period) of public housing authorities participating in the MTW demonstration⁷ to submit HUD-50058 data until 2006, and today MTW agencies have the option of using an abbreviated HUD-50058 MTW form that omits income-based rent calculations. Prior to the early 2000s, this system was known as the Multifamily Tenant Characteristics System.
- **Tenant Rental Assistance Certification System (TRACS):** Owners or other responsible entities of properties participating in HUD Multifamily Programs collect and electronically transmit data through the Tenant Rental Assistance Certification System (TRACS) using the HUD-50059 form. Data submitted to TRACS are substantially like data transmitted to IMS/PIC and include information on family composition, income, date of entry, and reason for the submission.

Given the number of programs through which HUD provides subsidized housing, the linkage condenses many of these programs into larger categorical measures. The classification scheme has been used by prior linkages of administrative data to HUD records (NCHS, 2016). The specific program classifications used in this linkage include (note that first-order bullets in the list below are the categories included in the linked dataset, while second-order bullets are categories included in IMS/PIC or TRACS):

- Public housing (IMS/PIC)
 - Public Housing
- HCVs (IMS/PIC)
 - Section 8 Certificates
 - Section 8 Vouchers
 - Mod Rehab
 - MTW Tenant-Based Voucher
 - MTW Project-Based Voucher
- Project-Based Section 8 (TRACS)
 - Project-Based Section 8
- Other MF (TRACS)
 - Section 101 (Rent Supplement)

⁷ For a list of agencies participating in MTW by year, see Webb et al. (2015).

- Rental Assistance Program
- Section 236
- Section 221(d)(3) BMIR (Below Market Interest Rate)
- Section 202 PRAC (Project Rental Assistance Contract)
- Section 811 PRAC (Project Rental Assistance Contract)
- Section 202/162 PAC (Project Assistance Contract)

Linkage Process

The report now discusses the process used to find and link HUD records for members of the Add Health sample. The linkage process is described in greater detail in another report submitted by the research team (Jaramillo et al., 2020).

Over 70.6 million HUD unique resident (member) and household-level records were searched to locate Add Health study participants. Add Health and HUD records were linked probabilistically because there was no unique identifier (e.g., social security number) available in both data sources. Probabilistic linkage attempts to uniquely identify individuals with a set of partial identifiers, such as last name and mother's maiden name (Winkler, 2015).

Eight partial identifiers were used to identify probable matches: first, middle, and last name; month, day, and year of birth; sex; and census block group of residence (12-digit FIPS code) (see exhibit 3). All members of the original Add Health longitudinal cohort ($n = 20,745$) with non-missing data on these eight variables were linkage eligible.

Exhibit 3. HUD-Add Health Linkage Matching Variables

Data Item	Matching Method	Notes
First Name	First Name	Incorporates both partial (Jaro-Winkler Metric) and value-specific matching and NYSIIS phonetic code. Accounts for minor typographical errors; hyphenated names; misspellings; nicknames. Weights by frequency of name in database.
Middle Name	Middle Name	Accounts for occurrence of middle initial vs. full middle name.
Last Name	Last Name	Incorporates both partial (Jaro-Winkler Metric) and value-specific matching and NYSIIS phonetic code. Accounts for minor typographical errors; hyphenated names; misspellings; nicknames. Weights by frequency of name in database.
Month of Birth	Date	Evaluated as one DOB variable. Incorporates partial matching to account for missing month and/or day values. Checks for month (M) and day (D) swapping and digit transpositions. Weighted by level of agreement (MDY agreement is weighted highest; MY second highest; Y lowest).
Day of Birth	Date	See Month of Birth.
Year of Birth	Date	See Month of Birth.
Sex	Exact	A character-for-character string comparison.
12-Digit FIPS Code	Exact	A character-for-character string comparison.

DOB = date of birth. FIPS = Federal Information Processing Standards. NYSIIS = New York State Immunization Information System. Y = year.

The initial search of 70.6 million HUD member-level records was restricted to the 7 years in which Add Health actively surveyed participants: 1995 (Wave I), 1996 (Wave II), 2001–2002 (Wave III), and 2007–2009 (Wave IV). Because not all partial identifiers were fixed—particularly residence block group—this approach leveraged the most current (and, hence, the most accurate) partial identifier data on study participants when searching for matches in the vast HUD database.

This initial phase of the linkage, restricted to the seven annual periods, identified 1,159 unique Add Health participants within the HUD records regardless of timing. Next, using the uniquely identifying HUD household head and member identification numbers found from these matches, the search for additional HUD records of these Add Health participants was expanded to the full set of 23 annual HUD administrative files (1995–2017). This expanded search yielded an additional 5,526 nonunique transaction records of Add Health participants.

Linkage Methods

Because there was no unique identifier that would locate Add Health participants in HUD administrative records, a probabilistic linkage approach was used. Probabilistic linkage exploits the discriminatory power of partial identifiers to produce links. Specifically, it assigns heavier “agreement weights” to partial identifiers that are particularly unique; for example, an uncommon last name will have more

discriminatory power than a common last name and would be assigned a stronger agreement weight. After assigning these weights, the overall match or linkage score is calculated as the sum of agreement weights for the full set of partial identifiers. Whereas a low linkage score indicates a low degree of agreement across partial identifiers, a high linkage score indicates the opposite. Calculating agreement weights as the sum of multiple, partial identifiers can ensure a more accurate match.

The probabilistic linkage was executed using Link Plus (version 2.0), a free and publicly available software program included in the Centers for Disease Control and Prevention’s suite of packages developed for use with cancer registry data (CDC-NPCR, 2020). Link Plus has been successfully applied to link a variety of databases including hospital discharge data (Bigback et al., 2015), survey data (Wilson et al., 2010), and vital records (Zhang et al., 2012).

Add Health staff adhered to the typical steps involved in the linkage process, which included:

1. Cleaning data
2. Blocking variable selection
3. Phonetic system specification
4. Match variable selection
5. Match method specification
6. Probability calculation method
7. Cutoff value specification
8. Report generation
9. Manual review

These steps are described in greater detail in the corresponding linkage report for this project (Jaramillo et al., 2020).

Linkage Results and Summary

A schematic diagram of the linkage process is presented below in exhibit 5. At the top center of the schematic the total count of HUD member records (70,670,107) is reported. These HUD records are distributed between eligible and ineligible records in the two large boxes below. Each box contains one column for each of the 7 calendar years that Add Health actively engaged in data collection. These 7 years are significant because they are the source of the current names and residential addresses (12-digit FIPS) of Add Health respondents that are used for matching.

Focusing on the left box labeled “Eligible for Linkage” and the column for 1995, we see, for example, that approximately 7.99 million of the 70.67 million total HUD member records are for this calendar year. Moving down this column, about 1.58 million records also share the same birth year with an Add Health respondent. The number of eligible HUD records is further reduced to the 383,338 members who also share the same county of residence with Add Health respondents surveyed in 1995.

The second box on the left side of exhibit 5 reports the counts of eligible Add Health respondents from each calendar year, and the third box reports the counts of ineligible Add Health respondents. Add Health eligibility was based on having complete data on the partial (quasi) identifiers.

Finally, moving to the bottom right side of exhibit 5, we see the linkage counts by Add Health data collection year. The box in the bottom right shows that, following completion of the linkage process, HUD member IDs that were successfully attached to Add Health respondents within a given survey year were used to identify records belonging to these respondents outside of those survey years. After identifying matches based on these linkage variables, we then used the HUD member IDs and head of household IDs to search for additional HUD transaction records for each linked sample member. This, in turn, allowed us to collect any HUD records that existed for linked sample members from 1995–2017.

For those Add Health participants with HUD records,⁸ nearly three-fourths (73 percent) resided in only one HUD-assisted program, with a plurality (42 percent) only participating in the HCV program (see exhibit 4). Fewer HUD residents participated in only the project-based Section 8 or public housing programs (18 and 10 percent, respectively). Over one-fourth (27 percent) of the HUD residents participated in two or more HUD-assisted programs during the study period.

Exhibit 4. HUD-Assisted Programs in Which Sample Members Participated

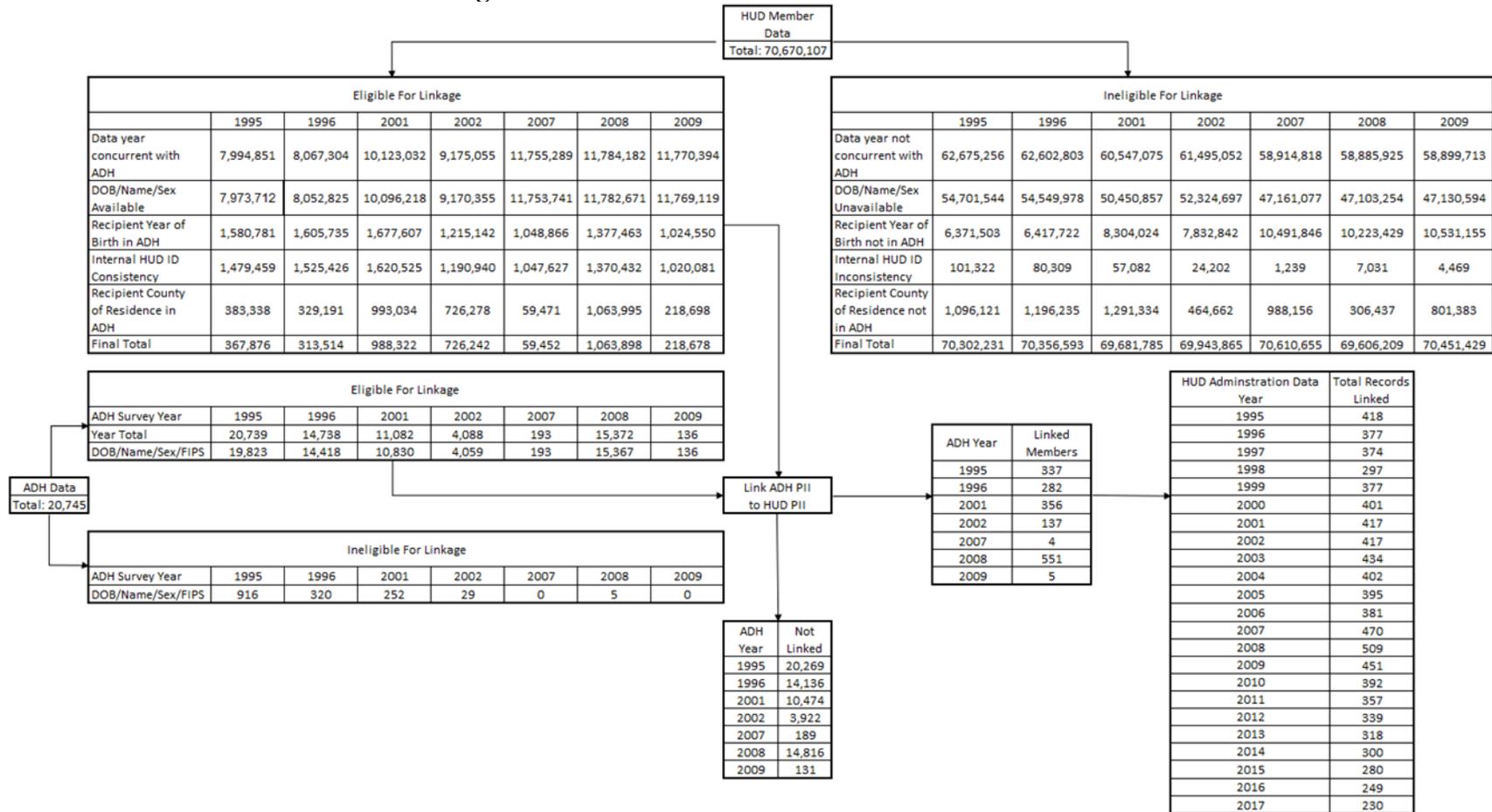
HUD-assisted program	N	%
<i>One program only</i>	<i>851</i>	<i>73%</i>
HCV	488	42%
Project-based Section 8	206	18%
Public housing	126	10%
Other multifamily	31	3%
Two or more programs	308	27%
Total	1,159	100%

HCV = Housing Choice Voucher.

Source: HUD

⁸ This includes *all* Add Health respondents who were linked to the HUD administrative data, not only those who resided in HUD-assisted housing as an adolescent.

Exhibit 5. HUD-Add Health Data Linkage Schematic



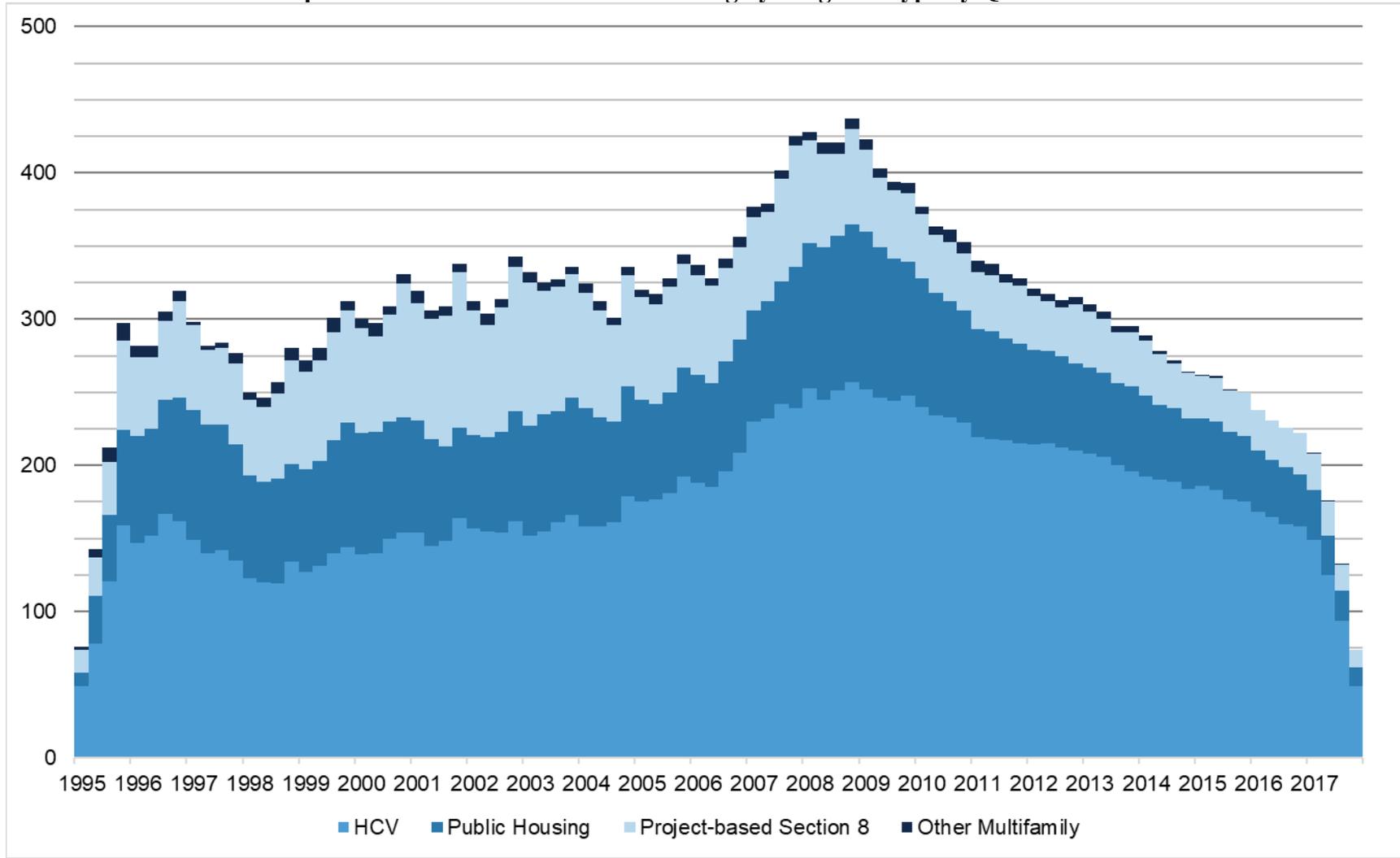
ADH = Add Health. DOB = date of birth.

Note: See the companion linkage report (Jaramillo et al., 2020) for greater detail on the linkage procedure.

Exhibit 6 provides information on episodes by program by charting the number of active HUD-assisted housing episodes by quarter. An episode (also known as a “HUD spell”) is the specific period in which an individual resided in HUD-assisted housing. To compute episodes, we used HUD records to determine whether households had consistently maintained residence in HUD-assisted housing between their first and last transactions records or, alternatively, whether they had left and re-entered HUD-assisted housing during these periods. Thus, exhibit 6 shows the total number of active episodes per quarter. Further details about the methods used to compute episodes are provided in the accompanying linkage report.

Between quarter 1 (Q1) 1996 and Q2 2007, the number of active episodes consistently ranged between 200 and 275 (except for a brief dip in 1998 and 1999). After this point in time, the number of active episodes rose rapidly, reaching a high of roughly 350 linked sample members in HUD-assisted housing from mid-2007 through mid-2009. After mid-2009, the sample size gradually decreases.

Exhibit 6. Add Health Sample Members in HUD-Assisted Housing by Program Type by Quarter



HCV = Housing Choice Voucher. Q = quarter.

Chapter 3: Methods

The report now turns to the analysis of descriptive statistics on adverse childhood experiences (ACEs) and health trajectories for three analytic subgroups: (1) the linked adolescent HUD residents (i.e., those who entered HUD-assisted housing at any time between their 12th and 19th birthdays), (2) a comparison group of low-income National Longitudinal Study of Adolescent to Adult Health (Add Health) respondents with no history of residing in HUD-assisted housing from 1995–2017, and (3) the full Add Health sample.

This analysis will utilize a variety of survey and biomarker measures. Specifically, the analysis of exposure to ACEs is based on survey measures that were collected via surveys of both Add Health respondents and their parents; all measures that were obtained from parent surveys are flagged with an asterisk throughout the report. The specific ACE measures analyzed include (1) self-reported abuse and maltreatment and (2) perceptions of neighborhood and school safety. The analysis of trajectories of chronic disease risk is based on a combination of survey and biomarker data; all measures that use biomarker data are flagged with an asterisk throughout this report. The specific chronic conditions that we explore include (1) diabetes prevalence, (2) hypertension, (3) body mass index (BMI), (4) depression, and (5) substance use. For both ACEs and trajectories of chronic disease risk, percentage tabulations are based on the total sample of people who provided valid responses; non-responses and missing values are omitted from these tabulations.

The remainder of this section describes the methods used to develop the different analysis groups and three main caveats of this analysis, including (1) truncation and quality of the HUD data, (2) changes to survey questions across Add Health waves, and (3) attrition across the Add Health waves.

HUD Adolescent Residents

As Chapter 2 shows, 1,159 Add Health respondents resided in HUD-assisted housing at some point between 1995–2017. However, only 42 percent of these respondents (N = 489) resided in HUD-assisted housing as an adolescent (i.e., between ages 12–18). There is no precise age cutoff for adolescence. However, this definition distinguishes between the pre- and post-high school period, an important transition in the life course. Because this project focuses on adolescent residence in HUD-assisted housing, the report specifically investigates summary and descriptive statistics on this subgroup, which we will refer to as “linked HUD adolescent residents” or “HUD residents” for brevity.

Add Health Comparison Group

One goal of this project is to understand whether adolescents who resided in HUD-assisted housing experienced significantly different health outcomes relative to a comparison group of low-income Add Health respondents who did not reside in HUD-assisted housing as an adolescent or adult. As a first step in this analysis, this report compares the outcomes of the adolescent subgroup with a comparison group of Add Health respondents who meet two criteria: (1) their parent’s income was below the 1994 federal

poverty threshold at Wave I of the Add Health survey (see exhibit 7), and (2) they are not a member of the overall linked dataset (n = 1,159)—meaning they were never linked to HUD administrative records from 1995–2017.

Exhibit 7. Add Health Poverty Thresholds

Family Size	Actual 1994 Poverty Threshold	Rounded 1994 Poverty Threshold
1	\$7,547	\$8,000
2	\$9,661	\$10,000
3	\$11,821	\$12,000
4	\$15,141	\$15,000
5	\$17,900	\$18,000
6	\$20,235	\$20,000
7	\$22,923	\$23,000
8	\$25,427	\$25,000
9 or more	\$30,300	\$30,000

Source: U.S. Census Bureau

Future analyses will employ matching procedures that better control for additional sociodemographic differences between these two groups (see the final chapter for more details on next research steps).

Analysis Caveats

As discussed earlier, the primary caveat of the analysis presented here relates to HUD data availability. HUD only began tracking data on participants in 1995, and the data quality of early HUD records is quite poor (see HUD-OIG, 2007). Thus, it is likely that some Add Health participants resided in HUD-assisted housing prior to 1995 but are not considered part of the linked HUD residents.

Further, Add Health has altered or dropped certain survey questions over the course of the study. For example, Add Health slightly altered the wording and response options of substance use questions across waves. In such instances, we have attempted to aggregate the frequencies and descriptive statistics for each wave so that they are as comparable as possible (see exhibit 20). However, this was not always possible; thus, readers should be mindful of how they are interpreting similar—but not identical—survey questions across waves.

Finally, some linked HUD adolescent respondents participated only in some waves of Add Health data collection create methodological issues. At each wave, Add Health researchers attempted to contact and survey each of 20,745 adolescents who participated in the Wave I in-home interview regardless of whether they had participated in previous waves. Many linked HUD residents participated in some but not all waves of data collection; for example, some residents participated in Wave I, skipped Wave II, and then participated in Wave III. Due to these missing data patterns, the size and demographic composition of the linked HUD residents slightly differs across Add Health survey waves.

Chapter 4: Cohort Characteristics and Demographics

This chapter contrasts summary statistics on income, demographic characteristics, and HUD program participation during adolescence (before age 19)⁹ of the linked HUD adolescent residents relative to the National Longitudinal Study of Adolescent to Adult Health (Add Health) comparison group and overall Add Health sample. Demographic composition statistics are based on respondent answers to survey questions. Income, in contrast, is based on a combination of parent and respondent answers. Specifically, the Wave I income variable reflects parents' reports of their total household income, whereas the Waves III and IV income variable reflects respondents' reports of their own individual earned income.

Wave I Demographics

At Wave I, most of the linked HUD adolescent residents identified as female (61 percent) and non-Hispanic Black¹⁰ (52 percent) (see exhibit 8). In contrast, only 23 percent of the 489 respondents from the linked group identify as White, followed by Hispanic or Latino (16 percent) and another race or ethnicity (9 percent). A plurality of linked HUD residents participated in the Housing Choice Voucher (HCV) program as an adolescent (44 percent), with smaller numbers participating in multiple programs (27 percent), the project-based Section 8 program (14 percent), the public housing program (12 percent), and other multifamily programs (3 percent).

⁹ Note that due to HUD data limitations, we are only able to ascertain if an individual resided in HUD housing in 1995 or later. Thus, it is possible for someone to have resided in HUD housing but left prior to 1995 and not be considered a member of the linked HUD sample.

¹⁰ Throughout this section, all references to a specific race are to non-Hispanic members of that race. Any references to Hispanic or Latino will be to Hispanic or Latino members of any race.

Exhibit 8. Wave I Demographics and Program of Participation as Adolescent

Wave I Demographics	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Sex						
Male	189	39%	1,130	51%	10,263	49%
Female	300	61%	1,098	49%	10,480	51%
Race & ethnicity						
Hispanic or Latino (all races)	76	16%	610	27%	3,525	17%
White, non-Hispanic	114	23%	726	33%	10,455	50%
Black, non-Hispanic	256	52%	705	32%	4,320	21%
Other Race/Ethnicity	43	9%	186	8%	2,424	12%
Missing	0	0%	1	0%	21	0%
Total	489	100%	2,228	100%	20,745	100%
Median age at Wave I interview (SD)	15	(1.46)	16	(1.72)	16	(1.72)
Median family income (SD)	\$12,000	(\$26,683)	\$10,000	(\$6,696)	\$38,000	(\$51,616)
Program of participation as adolescent						
Public Housing	58	12%	-	-	-	-
Housing Choice Voucher (HCV)	215	44%	-	-	-	-
Project-Based Section 8	70	14%	-	-	-	-
Other multifamily	16	3%	-	-	-	-
Multiple programs before age 19	130	27%	-	-	-	-

ADH = Add Health. SD = standard deviation.

The Wave I demographics of the Add Health comparison group and overall Add Health sample differ from the linked HUD residents in both sex and racial-ethnic identity. In terms of sex, both the Add Health comparison and overall cohorts are nearly equally divided between male and female respondents, while the linked HUD residents are again disproportionately female. The goal of providing these figures is to descriptively contrast the linked HUD residents to the broader Add Health population; in the project's final report, we will utilize a matched comparison group in all analyses.

In terms of racial-ethnic identity, the Add Health comparison group contains nearly the same number of White (33 percent), Black (32 percent), and Hispanic (27 percent) respondents, with the remaining respondents identifying as another race or ethnicity (8 percent). For the Add Health overall group, one-half of its Wave I respondents identified as White, with relatively fewer identifying as Black (21 percent), Hispanic or Latino (17 percent), or another race/ethnicity (12 percent).

Wave III Demographics

As in Wave I, the Wave III linked HUD adolescent residents are mostly female (63 percent) and Black (53 percent; see exhibit 9). One-fourth of the 379 individuals in the linked group identify as White, followed by Hispanic (15 percent) and other races and ethnicities (7 percent). Program participation as an adolescent is largely similar to Wave I, with a plurality (45 percent) participating in the HCV program as an adolescent and 27 percent participating in multiple HUD programs.

Exhibit 9. Wave III Demographics and Program of Participation as Adolescent

Wave III Demographics	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Sex						
Male	142	37%	739	50%	7,167	47%
Female	237	63%	743	50%	8,030	53%
Race & ethnicity						
Hispanic or Latino (all races)	57	15%	365	25%	2,477	16%
White, non-Hispanic	93	25%	502	34%	7,890	52%
Black, non-Hispanic	201	53%	480	32%	3,153	21%
Other Race/Ethnicity	28	7%	133	9%	1,662	11%
Missing race/ethnicity data	0	0%	2	0%	15	0%
Total	379	100%	1,482	100%	15,197	100%
Median age at Wave III interview (SD)	21	(1.51)	22	(1.76)	22	(1.77)
Median personal earned income (SD)	\$7,000	(\$17,282)	\$10,000	(\$14,163)	\$10,000	(\$18,590)
Program of participation as adolescent						
Public Housing	47	12%	-	-	-	-
Housing Choice Voucher (HCV)	170	45%	-	-	-	-
Project-Based Section 8	46	12%	-	-	-	-
Other multifamily	12	3%	-	-	-	-
Multiple programs before age 19	104	27%	-	-	-	-

ADH = Add Health. SD = standard deviation.

The demographic composition of the Add Health comparison and overall sample are again similar to Wave I. The sex distribution of each is nearly equally split between males and females. The Add Health comparison group is plurality White (34 percent) with roughly similar numbers of Black (32 percent) and Hispanic or Latino (25 percent) members, while the Add Health overall sample is majority White (52 percent) with smaller numbers of Black (21 percent) and Hispanic or Latino (16 percent) members.

Wave IV Demographics

Echoing figures at Waves I and III, most of the Wave IV linked HUD residents also identify as female (64 percent) and Black (53 percent). Compared with Wave III, the 393 respondents of the Wave IV group have an equal proportion of Hispanic respondents (15 percent), slightly fewer White respondents (23 percent), and slightly more respondents of another race or ethnicity (9 percent). Type of HUD subsidy as an adolescent is also like Wave III, with a smaller plurality (41 percent) participating in the HCV program, whereas a greater proportion participated in multiple programs before age 19 (30 percent).

Exhibit 10. Wave IV Demographics and Program of Participation as Adolescent

Wave IV Demographics	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Sex						
Male	141	36%	764	49%	7,349	47%
Female	252	64%	806	51%	8,352	53%
Race & ethnicity						
Hispanic or Latino (all races)	57	15%	402	26%	2,498	16%
White, non-Hispanic	92	23%	553	35%	8,294	53%
Black, non-Hispanic	207	53%	496	32%	3,235	21%
Other Race/Ethnicity	37	9%	118	8%	1,661	11%
Missing race/ethnicity data	0	0%	1	0%	13	0%
Total	393	100%	1,570	100%	15,701	100%
Median age at Wave IV interview (SD)	28	(1.49)	29	(1.72)	29	(1.74)
Median personal earned income (SD)	\$20,000	(\$36,959)	\$25,000	(\$53,819)	\$30,000	(\$45,017)
Program of participation as adolescent						
Public Housing	48	12%	-	-	-	-
Housing Choice Voucher (HCV)	160	41%	-	-	-	-
Project-Based Section 8	54	14%	-	-	-	-
Other multifamily	14	4%	-	-	-	-
Multiple programs before age 19	117	30%	-	-	-	-

ADH = Add Health. SD = standard deviation.

The Wave IV demographics show similar differences between the linked HUD residents and the two Add Health cohorts. Members of the comparison group are more likely to identify as male and either White or Hispanic/Latino relative to the linked HUD residents. Members of the overall Add Health sample are also more likely to identify as male and White and roughly equally as likely to identify as Hispanic or Latino.

Summary

The analysis presented in this report relies on three waves of Add Health data collection—Wave I, when respondents were in high school; Wave III, when respondents were in their late teens to early twenties; and Wave IV, when respondents were in their late 20s to early 30s. At each period, a majority of the linked HUD adolescent residents identified as female (61–64 percent) and non-Hispanic Black (52–53 percent). Approximately one-fourth of the linked residents at each wave identified as White, and about 15 percent identified as Hispanic or Latino of any race.

These figures differ from the sex and racial/ethnic composition of both the Add Health comparison and Add Health overall groups. Both groups have higher proportions of male respondents and relatively fewer female respondents. Relative to the linked HUD residents, the Add Health comparison group has fewer respondents identifying as Black and more respondents identifying as either White or Hispanic/Latino of any race. Relative to the linked HUD adolescent residents, the overall Add Health

sample has more respondents identifying as White, fewer identifying as Black, and a similar number identifying as Hispanic or Latino of any race.

In terms of types of HUD subsidy received as an adolescent, a plurality of linked HUD residents (40–45 percent) participated in only the HCV program before age 19, while 27–30 percent participated in multiple HUD programs prior to age 19. Roughly equal figures (~12–14 percent each) of linked HUD residents participated in either the public housing program or project-based Section 8 programs, whereas a very small proportion (<5 percent at each wave) participated in other multifamily programs.

Chapter 5: Adverse Childhood Experiences

This chapter analyzes exposure to adverse childhood experiences (ACEs), as measured by childhood neighborhood and school context, exposure to abuse, and exposure to maltreatment. The neighborhood and school context statistics come from the Wave I adolescent and parent surveys. Thus, some statistics reflect the responses of National Longitudinal Study of Adolescent to Adult Health (Add Health) respondents themselves whereas others reflect the responses of their parents; statistics that come from the parent survey are distinguished throughout this section. All comparisons made in this report are descriptive; future reports will utilize a matched comparison group and statistical analyses of differences between the linked HUD residents and this matched comparison group.

Abuse and maltreatment statistics come from Waves III and IV. These statistics are based on retrospective survey questions that asked Add Health respondents about their childhood experiences. Thus, although these statistics come from the Wave III and IV surveys, they reflect respondents' childhood experiences.

There are notable disparities among Wave I measures in perceptions of neighborhood safety and school quality between the linked HUD adolescent residents and the two non-HUD Add Health cohorts. Relative to the Add Health comparison group, a lower proportion of linked HUD adolescent residents reported that they “felt safe” in their neighborhood (74 percent vs. 81 percent). Correspondingly, a higher proportion of linked residents' parents believe that litter (68 percent vs. 54 percent) and drug dealing (63 percent vs. 52 percent) were “somewhat of a problem” or a “big problem” in their neighborhood relative to the comparison group.

The analysis also indicates that the linked HUD adolescent residents were slightly more likely to report experiencing neglect and physical abuse during childhood relative to the comparison group. At Wave III, a higher proportion of HUD residents reported that they were left home unattended before 6th grade (49 percent vs. 45 percent), that their parents had failed to meet their basic needs during childhood (20 percent vs. 17 percent), and that they were subjected to physical abuse in childhood (38 percent vs. 31 percent). At Wave IV, a similar disparity (59 percent vs. 50 percent) is observable with respect to self-reported exposure to verbal abuse during childhood.

Abuse and Maltreatment

At the Wave III interview (when respondents were age 18–24), the linked HUD adolescent residents generally reported higher rates of abuse and maltreatment as an adolescent relative to the Add Health comparison group and overall Add Health sample (see exhibit 11). In terms of maltreatment, the percentage of respondents who reported ever experiencing being left at home unattended before 6th grade is marginally higher for the linked HUD residents (49 percent) relative to the Add Health comparison group (45 percent) and overall Add Health sample (40 percent). Similarly, the percentage of respondents who reported their parents ever failed to take care of their basic needs was modestly higher for the linked

HUD residents (20 percent) relative to the Add Health comparison (17 percent) and overall Add Health sample (12 percent).

Exhibit 11. Abuse and Maltreatment (Wave III)

Abuse and maltreatment (Wave III)	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Left at home unattended before 6th grade						
0 times	172	51%	754	56%	8,353	59%
1-10 times	136	40%	470	35%	4,560	32%
More than 10 times	32	9%	133	10%	1,165	8%
Parents failed to take care of basic needs						
0 times	291	81%	1,148	83%	12,796	88%
1-10 times	49	14%	179	13%	1,276	9%
More than 10 times	21	6%	61	4%	412	3%
Physical abuse as child						
0 times	219	62%	949	69%	10,153	71%
1-10 times	108	30%	336	24%	3,326	23%
More than 10 times	29	8%	93	7%	920	6%
Sexual abuse as child						
0 times	338	94%	1,283	93%	13,909	95%
1-10 times	19	5%	92	7%	581	4%
More than 10 times	3	1%	11	1%	115	1%

ADH = Add Health.

Source: Wave III Add Health interview

For more specific measures of abuse, the linked HUD residents are more likely to report ever experiencing physical abuse as a child or adolescent (38 percent) relative to the Add Health comparison group (31 percent) and overall Add Health sample (29 percent). Reported rates of sexual abuse are similar for all three cohorts and lower relative to other forms of abuse and maltreatment.

In terms of the frequency of abuse or maltreatment, it appears that variation across the three cohorts is largely confined to infrequent forms of abuse or maltreatment (1–10 times). The rate of frequent (more than 10 times) abuse and maltreatment are comparable across the three cohorts. Rates of being frequently left at home unattended more than 10 times (8–10 percent for all three groups) and physical abuse more than 10 times (6–8 percent for all three groups) are higher than other rates of frequent abuse.

In response to similar questions about abuse and maltreatment as an adolescent at Wave IV (asked when Add Health respondents were 24–32 years old), the linked HUD residents continued to report higher rates of abuse and maltreatment as an adolescent relative to both the Add Health comparison group and overall Add Health sample (see exhibit 12). A substantially higher percentage of the linked

HUD adolescent respondents reported ever experiencing verbal abuse as a child (59 percent) relative to the Add Health comparison group (50 percent) and the overall Add Health sample (47 percent). Similarly, the percentage of respondents that reported ever experiencing physical abuse as a child was higher for the HUD adolescent residents (29 percent) relative to the Add Health comparison group (22 percent) and the overall Add Health sample (19 percent). In contrast to the substantial variation in the rates of verbal and physical abuse as a child, reported rates of ever being sexual abused as a child are relatively similar and considerably lower for all three cohorts.

Exhibit 12. Abuse and Maltreatment (Wave IV)

Abuse and maltreatment (Wave IV)	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Verbal abuse as a child						
0 times	155	41%	771	50%	8,103	52%
1-10 times	164	43%	553	36%	5,481	35%
More than 10 times	63	16%	215	14%	1,885	12%
Physical abuse as a child						
0 times	269	71%	1,207	78%	12,613	81%
1-10 times	80	21%	248	16%	2,155	14%
More than 10 times	30	8%	88	6%	742	5%
Sexual abuse as a child						
0 times	348	91%	1,448	94%	14,716	95%
1-10 times	22	6%	81	5%	643	4%
More than 10 times	13	3%	17	1%	177	1%

ADH = Add Health.

Source: Wave IV Add Health interview

In terms of the frequency of abuse, the rate of infrequent (1-10 times) verbal abuse varies the most across the three analytic cohorts and is significantly higher for all three groups relative to their rates of infrequent physical and sexual abuse. This figure is moderately higher for the linked HUD group (43 percent) relative to the comparison group (36 percent) and overall Add Health sample (35 percent). Unlike the variation in rates of infrequent abuse, the rates of frequent (more than 10 times) verbal, physical, and sexual abuse as a child are comparable across the three cohorts. Rates of frequently being verbally abused (12–16 percent for all three groups) are the highest relative to the other rates of frequent abuse.

School/Neighborhood Quality

Self-reported Wave I school safety and quality measures among linked HUD adolescent residents are marginally worse than those reported by the Add Health comparison group and overall Add Health sample (see exhibit 13). Among the linked HUD adolescent residents, 62 percent of respondents agreed that their school was safe at Wave I (when respondents were in high school) compared with 66 percent of the Add Health comparison group and 68 percent of the overall Add Health sample. On the Wave I parent survey, 76 percent of linked HUD residents' parents considered their child's schools safe—a figure

modestly lower than comparable responses from parents of the Add Health comparison group (80 percent) and overall Add Health sample (82 percent).

Exhibit 13. Self-Reported School and Neighborhood Quality

School and neighborhood (Wave I)	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Agree that school is safe	300	62%	1,428	66%	13,802	68%
Agree that school is 'a good school'*	167	76%	848	80%	7,116	82%
Feel safe in neighborhood	359	74%	1,802	81%	18,182	88%
Litter is problem in neighborhood*						
No problem	132	32%	1,012	46%	9,509	54%
Small problem	196	48%	937	42%	6,887	39%
Big problem	84	20%	269	12%	1,165	7%
Drug dealers are a problem in neighborhood*						
No problem	149	37%	1,060	49%	10,282	60%
Small problem	142	35%	732	34%	5,339	31%
Big problem	115	28%	382	18%	1,642	10%

* Frequencies are based on a survey of the parents of Add Health respondents at Wave I. Missingness is higher on these surveys.

ADH = Add Health.

Source: Wave I Add Health interview

Relative to perceived differences in school quality, differences in self-reported Wave I neighborhood quality between linked HUD adolescent residents (and their parents) and the Add Health comparison and overall cohorts were relatively larger, with linked HUD adolescent residents (and their parents) consistently rating their neighborhoods as lower quality or less safe. Seventy-four percent of HUD adolescent residents felt safe in their neighborhood at Wave I; this figure is considerably higher for the Add Health comparison group (81 percent) and overall Add Health sample (88 percent). Additionally, parents of linked HUD residents were more likely to report that litter (68 percent) or drug dealers (63 percent) were a problem in their neighborhood relative to parents of the Add Health comparison group (54 percent and 51 percent) and parents of the overall Add Health sample (46 percent and 40 percent, respectively). These disparities are especially large for parents viewing both litter and drug dealers as a “big problem” in their neighborhood—20 and 28 percent, respectively, for the linked HUD residents compared with 12 and 18 percent for the Add Health comparison group and 7 and 10 percent for the overall Add Health sample.

Summary

This chapter analyzes exposure to ACEs—as measured by childhood neighborhood and school context, exposure to abuse, and exposure to maltreatment—using both self-reported and biomarker data. Abuse and maltreatment data come from retrospective survey questions on the Waves III and IV Add Health interviews that queried respondents’ childhood experiences.

With the caveat that this report relies solely on descriptive frequencies and lacks a weighted comparison group, some of the greatest disparities between the linked HUD residents and the Add Health comparison group relate to their Wave I (adolescent) neighborhood and school characteristics. Fewer HUD residents reported that they “felt safe” in their neighborhood (74 percent) relative to the Add Health comparison group (81 percent) or the Add Health overall sample (88 percent). Furthermore, the parents of the HUD residents were more likely to say that litter (68 percent) and drug dealers (63 percent) were “somewhat” or a “big problem” in their neighborhood relative to the Add Health comparison group (54 percent and 51 percent, respectively).

Differences in rates of abuse and maltreatment among the linked HUD residents and the Add Health comparison group and overall Add Health sample are less noticeable, but linked residents are more likely to report the same or higher incidence of abuse or maltreatment relative to those groups. In response to retrospective Wave IV questions, HUD residents were somewhat more likely to report experiencing physical or verbal abuse as a child (59 and 29 percent, respectively) relative to the Add Health comparison group (50 and 22 percent, respectively). Differences with respect to other forms of abuse and maltreatment between the linked HUD residents and the Add Health comparison group were smaller.

Chapter 6: Trajectories of Health and Chronic Disease Risk

The report now turns to analyze trajectories of health and chronic disease risk among the three analytic groups. We draw on both self-reported and biomarker data—with the latter available to calculate the prevalence of diabetes and hypertension, as well as body mass index (BMI), at Wave IV. The chapter also analyzes the frequency of cigarette, alcohol, and marijuana usage for the three groups.

Overall, we find similar health outcomes and patterns of substance use for the linked HUD residents and National Longitudinal Study of Adolescent to Adult Health (Add Health) comparison group across Waves I, III, and IV data. Specifically, there are no major differences concerning (1) diabetes prevalence, (2) blood pressure/hypertension, (3) depression, and (4) BMI. There is also very little difference in reports of negative health behaviors, including smoking cigarettes, alcohol use, and marijuana use, between the linked HUD adolescent residents and the Add Health comparison group.

There are, however, notable differences between the linked HUD adolescent residents and Add Health comparison group with the Add Health sample. For example, the incidence of depressive symptoms among the HUD residents and Add Health comparison group is much higher relative to the overall Add Health sample—whereas at Wave IV only 16 percent of the overall sample fell in the highest range of depressive symptoms, and nearly 25 percent of the HUD adolescent residents and Add Health comparison group members fell within the same category.

Diabetes, Hypertension, and Body Mass Index

Self-reported rates of diabetes¹¹ are largely similar across the three analytic groups, and as expected, rise from Wave I to Wave III (see exhibit 14). At Wave I, fewer than 1 percent of respondents in each group reported being diagnosed with diabetes; by Wave III, this figure was around 1 percent for each group. At Wave IV, the HUD adolescent residents had somewhat higher rates of self-reported diabetes (5.4 percent vs. 3.6 percent for the Add Health comparison group and 2.8 percent for the overall Add Health sample) and slightly higher rates of diabetes identified through biomarker data (11 percent vs. 10 percent for the Add Health comparison group and 7 percent for the overall Add Health sample).

¹¹ These figures include all forms of diabetes mellitus, including Type 1 and Type 2.

Exhibit 14. Diabetes Prevalence (Self-Reported and Biomarker)

Diabetes	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Wave I (self-report)*	3	0.7%	10	0.5%	78	0.4%
Wave III (self-report)	4	1.1%	23	1.6%	152	1.0%
Median age of onset (SD)	18	(2.08)	17	(4.84)	19	(5.7)
Wave IV (self-report)	21	5.4%	56	3.6%	447	2.8%
Median age of onset (SD)	25	(6.18)	25	(6.75)	25	(6.4)
Wave IV (biomarker)**	45	11%	152	10%	1,102	7%

* Frequencies are based on a survey of parents of Add Health respondents at Wave I. Missingness is higher on these surveys.

**At Wave IV, Add Health collected biomarker data from all respondents and used that data to identify whether respondents had diabetes. Not all participants knew they had diabetes prior to participating the study, hence the difference between self-reported vs. biomarker-identified frequencies.

ADH = Add Health. SD = standard deviation.

Source: Waves I, III, and IV Add Health interviews and Wave IV Add Health biomarker data

Self-reported rates of hypertension are similar across the three groups at Waves III and IV, with approximately 6 percent reporting being diagnosed with hypertension at Wave III and 11–14 percent reporting the same at Wave IV (see exhibit 15). While Wave IV biomarker data identified higher rates of hypertension relative to self-reported measures, these were quite similar across the three groups (approximately 20 percent of respondents in each categorized as Hypertension 1 or 2).

Exhibit 15. Hypertension Prevalence (Self-Reported and Biomarker)

Hypertension	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Wave III (self-report)	21	6%	101	7%	846	6%
Wave IV (self-report)	53	14%	172	11%	14,331	11%
Median age of onset (SD)	25.0	(4.82)	26.0	(4.09)	26.0	(5.07)
Wave IV (biomarker)*						
Normal	131	35%	521	35%	5,157	34%
Prehypertension	168	45%	669	45%	6,975	46%
Hypertension 1 or 2	74	20%	312	21%	3,034	20%

ADH = Add Health. SD = Standard Deviation.

Source: Wave III and Wave IV Add Health interviews and Wave IV Add Health biomarker data

In terms of BMI classifications, rates of being overweight or obese are relatively similar across the three groups over time (see exhibit 16). At Wave I, 22–25 percent of respondents in each cohort were classified being overweight or obese; this increases to roughly 50–55 percent at Wave III and 67–71 percent at Wave IV. Correspondingly, median BMI increases from approximately 21.7 at Wave I to 25.2 at Wave III and 28–29 at Wave IV.

Exhibit 16. Body Mass Index Classifications

BMI	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Wave I (self-report)						
Underweight	55	12%	245	11%	2,578	13%
Normal weight	297	64%	1,346	63%	13,037	65%
Overweight	64	14%	349	16%	3,115	15%
Obese	49	11%	192	9%	1,445	7%
<i>Median BMI (SD)</i>	21.7	(4.91)	21.8	(4.77)	21.6	(4.46)
Wave III (self-report)						
Underweight	8	2%	34	2%	377	3%
Normal weight	157	44%	608	43%	6,590	46%
Overweight	95	27%	389	28%	3,433	24%
Obese	94	27%	369	26%	4,033	28%
<i>Median BMI (SD)</i>	25.2	(7.11)	25.5	(6.52)	25.1	(6.34)
Wave IV (biomarker)*						
Underweight	4	1%	19	1%	214	1%
Normal weight	108	28%	430	28%	4,869	32%
Overweight	102	27%	462	30%	4,654	30%
Obese	168	44%	634	41%	5,714	37%
<i>Median BMI (SD)</i>	29.0	(8.55)	28.4	(8.22)	27.7	(7.54)

* At Wave IV, Add Health collected biomarker data (height and weight) from all respondents and used that data to calculate respondents' BMIs. In prior waves, BMIs are calculated from respondents' self-reported height and weight.

ADH = Add Health. BMI = body mass index. SD = standard deviation.

Source: Waves I, III, and IV Add Health height and weight data.

Depression

This analysis uses a basic depression index that counts the total number of depressive symptoms reported at each wave. This depression index is based on a series of nine questions related to depression that were asked across each wave of the Add Health study. These questions asked respondents “how often” they had experienced a given depression symptoms in the 2 weeks before the survey. Respondents could choose one of the following response options:

- “Never or rarely.”
- “Sometimes.”
- “A lot of the time.”
- “Most of the time or all of the time.”
- “Refused.”
- “Don’t know.”

Exhibit 17. Add Health Questions Used to Create the Depressive Symptomatology Index

Question
You felt depressed
You felt sad
You felt that you could not shake off the blues, even with help from your family and your friends
You were bothered by things that usually don't bother you
You enjoyed life*
You felt that you were just as good as other people*
You felt that you were too tired to do things
You had trouble keeping your mind on what you were doing
You felt that people disliked you
*Positive affect questions were reverse-coded to make the depression index

To create the depression index, affirmative responses (i.e., “sometimes,” “a lot of time,” “most of the time or all of the time”) were assigned the numerical value of 1, as these responses indicated that the respondent experienced a single depressive symptom. All other responses were assigned the numerical value of 0. This classification scheme was reversed for the two positive affect questions identified in exhibit 17. The total number depression symptoms were summed to produce the underlying numerical values for the index. To facilitate interpretation across waves, exhibit 18 presents summary statistics for the depression index values at each wave broken down by quartiles, but note that due to rounding based on the number of symptoms, certain quartiles may have greater or fewer than 25 percent of respondents.

This depression index shows that, across all Waves, the linked HUD adolescent residents and Add Health comparison group have similar depressive symptomatology profiles, and respondents in these groups are more likely to experience greater depressive symptomatology than the overall Add Health sample (see exhibit 18). At Wave I, 27 percent of linked HUD adolescent residents fell within the highest symptomatology category whereas only 20 percent of the overall Add Health sample falls within the same quartile. This disparity persists to Wave IV, with 24 percent of the linked HUD adolescent residents falling within the 75th percentile compared with only 16 percent of the Add Health study sample.

Exhibit 18. Depressive Symptomatology (Index)

Depressive symptomatology	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Wave I						
0–1 symptoms	105	21%	476	21%	5,317	26%
2–3 symptoms	137	28%	629	28%	6,248	30%
4–5 symptoms	116	24%	589	26%	4,932	24%
6–9 symptoms	131	27%	534	24%	4,248	20%
Wave III						
0–1 symptoms	97	26%	509	34%	5,477	36%
2 symptoms	70	18%	208	14%	2,643	17%
3–4 symptoms	98	26%	352	24%	3,725	25%
5–9 symptoms	114	30%	413	28%	3,352	22%
Wave IV						
0–1 symptoms	59	15%	382	24%	4,208	27%
2–3 symptoms	137	35%	475	30%	5,467	35%
4–5 symptoms	101	26%	358	23%	3,510	22%
6–9 symptoms	96	24%	355	23%	2,516	16%

ADH = Add Health. SD = standard deviation.

Note: Symptom cut-off for each wave roughly corresponds to quartiles but, due to rounding, certain quartiles may have more or fewer respondents.

Source: Waves I, III, and IV Add Health interviews Substance Use

The report now analyzes rates of alcohol, cigarette, and marijuana use across the three analytic cohorts. Across the Wave I, III, and IV interviews, the linked HUD adolescent residents' self-reported alcohol consumption is relatively the same—if not modestly lower—than the Add Health comparison group and overall Add Health sample (see exhibit 19). Rates of alcohol consumption are rather similar at Wave I (when respondents were adolescents) and Wave III (when respondents were age 18–24) across all three groups. At Wave IV, both the linked HUD residents and the Add Health comparison group were less likely to consume alcohol at least weekly (19 and 22 percent, respectively) than the overall Add Health sample (30 percent).

Exhibit 19. Alcohol Usage

Used alcohol	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Wave I						
1-7 times per week	25	5%	139	6%	1,131	5%
1-3 times per month	40	8%	196	9%	2,215	11%
1-2 times per year	50	10%	222	10%	2,488	12%
Wave III						
1-7 times per week	22	6%	97	7%	1,416	9%
1-3 times per month	45	12%	203	14%	3,123	21%
1-2 times per year	55	15%	249	17%	2,871	19%
Wave IV						
1-7 times per week	75	19%	339	22%	4,687	30%
1-3 times per month	112	29%	435	28%	4,873	31%
1-2 times per year	51	13%	187	12%	1,689	11%

ADH = Add Health. SD = standard deviation.

Source: Waves I, III, and IV Add Health interviews

Rates of cigarette usage across the three cohorts are relatively similar across the Wave I, III, and IV interviews (see exhibit 20). At Wave I, approximately 22–26 percent of each cohort reported smoking cigarettes in the last 30 days; this figure increases to 28–32 percent at Wave III and 36–41 percent at Wave IV. However, one notable inter-cohort difference is the frequency of smoking cigarettes at Wave I, with linked HUD residents’ smoking markedly less often (median 9 days in past month) relative to the other two cohorts (both at median 15 days in past month). At the Wave III and IV interviews, the frequency of smoking cigarettes is comparable across the three groups.

Exhibit 20. Cigarette Usage

Smoked cigarettes in last 30 days	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Wave I	108	22%	526	24%	5,326	26%
<i>Median days used among users (SD)</i>	9	(12.3)	15	(12.7)	15	(12.5)
Wave III	106	28%	449	30%	4,784	32%
<i>Median days used among users (SD)</i>	30	(9.59)	30	(8.68)	30	(9.39)
Wave IV	156	41%	598	39%	5,557	36%
<i>Median days used among users (SD)</i>	30	(10.7)	30	(11.3)	30	(11.1)

ADH = Add Health. SD = standard deviation.

Source: Waves I, III, and IV Add Health interviews

Like cigarette usage, marijuana usage is also relatively similar across the three cohorts at Waves I, III, and IV, though the linked HUD adolescent residents were less likely to report using marijuana at Wave III¹² (see exhibit 21). At Wave I, when respondents were adolescents, approximately 28 percent of

¹² Note that most respondents were in their early 20s (median age 21–22, age range 18–24) at this time.

respondents reported using marijuana in the past 30 days. At Wave III, 23 percent of linked HUD adolescent residents reported doing so; this figure was comparatively higher for the Add Health comparison group (26 percent) and overall Add Health sample (30 percent). By Wave IV, rates of marijuana usage are again quite consistent across the three groups (approximately 21–22 percent for each). Note that, in general, marijuana usage declines between Wave I (when respondents were adolescents) and the Wave III and IV interviews.

Exhibit 21. Marijuana Usage

Used marijuana in the last 30 days	HUD Adolescent		ADH Comparison		ADH Overall	
	N	%	N	%	N	%
Wave I	133	28%	622	29%	5,719	28%
Wave III	86	23%	391	26%	4,609	30%
Wave IV	83	21%	340	22%	3,447	22%

ADH = Add Health.

Source: Waves I, III, and IV Add Health interviews

Summary

Using both self-reported and biomarker data, this chapter analyzed trajectories of health and chronic disease risk for the linked HUD adolescent residents relative to the Add Health comparison group and overall Add Health sample. The analysis presented here is solely descriptive, and the comparison group is solely based on Wave I economic characteristics, not a matched propensity score.

With these caveats, we note that the linked HUD residents experience largely the same health trajectories as the Add Health comparison group concerning the prevalence of diabetes, hypertension, depression, and obesity. This pattern extends to both self-reported incidence of these health risks as well as biomarker data, which was collected for BMI at all Waves and diabetes and hypertension at Wave IV only. Similarly, self-reported drug use—in terms of cigarette smoking, alcohol consumption, and marijuana usage—are also largely similar between the linked HUD residents and the Add Health comparison group.

The results of this section indicate that HUD-residing adolescents have comparable health risks to non-HUD residing low-income adolescents. This suggests that, before matching and multivariable analysis, the receipt of HUD rent assistance does not appear to be associated with any systematic differences in health outcomes. Our future analyses will use rigorous matching and analytical techniques to provide greater information on these relationships.

Chapter 7: Summary, Conclusions, and Next Steps

This report provides an update on research activities to-date on HUD Cooperative Agreement, “Understanding the Role of Adolescent Housing Residence on Adverse Childhood Experiences and Trajectories of Chronic Disease Risk.” It builds upon a recently published report on the linkage between National Longitudinal Study of Adolescent to Adult Health (Add Health) data and HUD administrative records (Jaramillo et al., 2020) to provide both demographic information on the linked HUD adolescent residents and a descriptive analysis of patterns of abuse and maltreatment as well as trajectories of adult health risks. In this final chapter, we review these findings and identify next steps in the research project.

In terms of demographics, most of the linked HUD adolescent residents identify both as female and non-Hispanic Black. Relative to the HUD residents, members of the Add Health comparison group were more likely to identify as male and either as White or Hispanic/Latino. Concurrently, members of the overall Add Health sample were also more likely to identify as male and to identify as White, with a comparable number identifying as Hispanic/Latino. In terms of HUD participation as an adolescent, a plurality of linked residents participated in the Housing Choice Voucher (HCV) program, with smaller numbers participating in multiple HUD programs or in the Project-based Section 8 or public housing program as an adolescent.

In terms of the descriptive analysis, the linked HUD adolescent residents were somewhat more likely to report exposure to adverse childhood experiences (ACEs), including substandard neighborhood conditions and exposure to abuse and maltreatment during childhood, than the Add Health comparison group or overall Add Health sample.

This analysis highlighted minimal differences in the health outcomes between the linked HUD adolescent residents and the Add Health comparison group and overall Add Health sample. This finding is notable because past research has suggested that receipt of HUD rent assistance has significant effects on health outcomes. However, the direction of that effect is still under debate.¹³ Thus, future analyses will have to clarify the potential reasons why HUD rent assistance is not associated with more significant differences in lifelong health among the HUD adolescent residents. Indeed, this result may change after using matching to develop a stronger comparison group.

Next Steps

Following the submission of this interim report, the research team will embark on three research activities in preparation for a final report. These are, in turn:

Identifying objective neighborhood characteristics. Numerous studies have identified neighborhood context as key to understanding health outcomes, and the research team anticipates incorporating

¹³ See Fenelon et al. (2017) and Ruel et al. (2010).

objective neighborhood measures (in addition to the subjective measures included above in exhibit 13) in future analyses (Diez Roux, 2001). The Add Health dataset contains rich contextual neighborhood information on all respondents through previous data linkages, such as census neighborhood data. We will work to incorporate these data into future analyses, including the propensity score matching.

Developing a robust comparison group. The research team will use statistical matching techniques to develop a robust comparison group from the Add Health sample, excluding all Add Health respondents who were linked to HUD administrative records at any time. Matching variables will include relevant adolescent measures from both the Add Health interview and relevant linkages to Add Health data (e.g., the contextual measures identified in the prior paragraph). The research team anticipates summarizing the matching procedure and presenting summary statistics for the matched comparison group (including balance and sensitivity analyses) in a separate memo to HUD.

Modeling health outcomes. The final research activity will be the modeling of health outcomes through an iterative process. Following verification of model assumptions and transformations of variables with non-normal distributions, we will construct a series of logistic regression models on bivariate chronic disease risks (diabetes and hypertension), conduct difference-in-differences of chronic disease risks captures at Waves I and IV (body mass index [BMI], depression, and substance use), and estimate a series of multiple regression models. These latter models will incorporate relevant socioeconomic controls, residence in different types of HUD-assisted housing, and ACE incidence and severity.

By taking these next steps, this project will provide a more robust picture of how, if at all, HUD rent assistance influences adolescents' exposure to ACEs and trajectories of chronic disease. This contribution is important because a principal goal of HUD rent assistance programs is to support the health and well-being of residents. However, the lack of robust data on HUD resident's health outcomes has hindered critical analysis of this topic. This contribution is also important because it will clarify what role, if any, that HUD rent assistance programs can play in preventing or delaying chronic disease onset among the U.S. general population and in addressing persistent health disparities.

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U.S. Department of Housing and Urban Development
Office of Policy Development and Research
Washington, DC 20410-6000



May 2022