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REPORT

FINAL REPORT

Evaluation of the Effect of the Older Americans Act Title III-C Nutrition Services Program on Participants' Health Care Utilization

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INTRODUCTION BY THE ADMINISTRATION FOR COMMUNITY LIVING

The 2018 evaluation of the Older Americans Act (OAA) Nutrition Services Program (NSP) Outcomes Report Part II describes the effect of the OAA Title III-C NSP on participants' Medicare-funded health care utilization. Part I of this report, available on the ACL website, provided statistical evidence that the OAA Title III-C nutrition programs are fulfilling the statutory purpose: reducing hunger and food insecurity, promoting socialization and promoting health and well-being through providing a nutritious meal.

This purpose is accomplished through the provision of not only a meal, but also providing access to a range of services (nutrition screening, education, and counseling), opportunities for social engagement, and information on healthy aging. OAA nutrition services also provide an important link to other supportive in-home and community-based supports, such as homemaker and home-health aide services, transportation, physical activity and chronic disease self-management programs, home repair and modification, and falls prevention programs. Meals are often a gateway for other home- and community-based services. The correct mix of services can contribute to an older individual's overall well-being and play a vital role in ensuring older adult's independence. Maximizing the independence, well-being, and health of older adults and people with disabilities is ACL's core mission.

Several studies have validated the importance of senior nutrition programs on health in a variety of ways. Dr. James Mabli et al.'s recent *Evaluation of the Effect of the Older Americans Act Title III-C Nutrition Services Program on Participants' Food Security, Socialization, and Diet Quality* showed that lower-income older adults who participated in the congregate meal program were significantly less food insecure than nonparticipants (23.2 versus 31.0 percent).[1] Drs. Craig Gundersen and James Ziliak's research shows that food insecure seniors have worse health outcomes when compared to food secure seniors. For example, food insecure seniors were 65 percent more likely to be diabetic, twice as likely to report fair or poor general health, 2.3 times more likely to suffer from depression, 57 percent more likely to have congestive heart failure, 66 percent more likely to have experienced a heart attack, twice as likely to report having gum disease, and 91 percent more likely to have asthma.[2] Dr. Laura Wright et al.'s 2015 study indicates that the home-delivered meal program is effective for new participants at improving their nutritional status, dietary intake, well-being, loneliness, and food security levels.[3] Other research demonstrates the economic benefits to states of these programs. For example, Dr. Kali Thomas et al. showed that when states invest more in delivering meals to older adults' homes they have lower rates of "low-care" seniors living in nursing homes, after adjusting for several other factors. For every $25 per year per older adult that states spent on home-delivered meals,

[1] Mabli, J. et al. (2017). Evaluation of the Effect of the Older Americans Act Title III-C Nutrition Services Program on Participants' Food Security, Socialization, and Diet Quality, April 21, 2017.
[2] Gundersen, C. & Ziliak, J. (2017). The Health Consequences of Senior Hunger in the United States: Evidence from the 1999-2014 NHANES. Report submitted to Feeding America.
[3] Wright, L., Vance L., Sudduth C. & Epps J. (2015). The Impact of a Home-Delivered Meal Program on Nutritional Risk, Dietary Intake, Food Security, Loneliness, and Social Well-Being, *Journal of Nutrition in Gerontology and Geriatrics*, 34:2, 218-227, DOI: 10.1080/21551197.2015.1022681

they reduced their percentage of low-care nursing home residents compared to the national average by 1 percent.[4]

ACL contracted with Mathematica Policy Research to evaluate the effect of the OAA NSP on participant's health outcomes, health care utilization, and healthcare costs by comparing congregate and home-delivered meal participants to similar nonparticipants. Health care utilization and costs outcomes were determined through examining Medicare records and included hospital admissions and readmissions, emergency department use, physician visits, home health episodes, and admissions to nursing homes and skilled nursing facilities.

The evaluation results suggest that those that participated in the congregate meal program had lower health care expenditures. Key findings for congregate meal participants include:

- Congregate meal participants were more able to remain living in their home. When compared to nonparticipants, congregate meal participants were 2.3 percentage points less likely to be admitted into a nursing care facility.
- For lower-income congregate meal participants, the rate of nursing home admissions was 8.5 percentage points lower than the rate for nonparticipants.
- Congregate meal participants who lived alone were less likely than nonparticipants to have a hospital admission or have an emergency department visit that led to a hospital admission.

The home-delivered meal participant's health care expenditure outcomes were not consistent with the congregate meal participants. It is important to understand these findings within the context that OAA home-delivered meal participants differ from congregate meal participants in a few important ways. For example, home-delivered meal participants are more likely than both congregate meal participants and the general public to be over age 85, rate their health as fair or poor, and to have difficulties with 3 or more activities of daily living.[5] In addition, home-delivered meal participants are more likely than congregate meal participants to have 5 or more medical conditions (77 versus 57 percent), self-report that their health has become a little worse or worse over the past 12 months (42 versus 27 percent) and to indicate that over the past 4 weeks they have accomplished less than they would have liked to because of their health (52 versus 26 percent).[6] The complexity that surrounds chronic disease management and health care utilization are influenced by a wide range of factors, not just home-delivered meal services.

The research team used both a propensity-score matching procedure and regression analysis to control for the population differences in observable characteristics. However, the populations may have differed in other unobservable ways, which could have influenced the estimates of program impacts. For example, the study was not designed to control for differences in local programming models.

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[4] Thomas K. and V. Mor. The Relationship Between Older Americans Act Title III State Expenditures And Prevalence Of Low-Care Nursing Home Residents, *Health Serv Res*. 2013; 48 (3): 1215–26 .
[5] https://www.acl.gov/sites/default/files/programs/2016-11/AoA-Research-Brief-8-2015.pdf accessed 7-3-2018
[6] 2016 NSOAAP data available on AGID https://agid.acl.gov/DataFiles/NPS

This study lays the groundwork for future evaluations. For example, it may be helpful to assess further what specific variable or combination of variables (e.g., the meal service, additional supportive services, opportunity for socialization) may be responsible for the lower health care expenditures and health care utilization among congregate meal participants compared to nonparticipants. Therefore, additional, more specific research should identify effective programming and service models and to better understand the interplay of other variables such as specific health conditions, time of intervention, whether health care utilization reflects appropriate preventive care.

Overall, we find this report very informative. We hope this study will increase the attention to this program and other researchers will build upon this study. ACL agrees with a recent research paper suggesting that more rigorous research is needed to better identify what home-delivered meal models alone and in combination with other services work best and for whom, and better target home-delivered meal programs where and when resources are scarce.[7] Subsequent findings can inform the development of new approaches for delivering and tailoring the meals programs and wrap around services to meet the individual needs of participants.

We plan to use the results of this evaluation to continue efforts to improve the health and well-being, address food insecurities, and meet the needs of OAA program participants. Further, we plan to encourage the use of these results to support the evidenced-based congregate meal program, and encourage further research in the home-delivered meal program to help assess models that have the most success.

[7] Buys, D., Locher, J. (2015) What Does the Evidence Reveal Regarding Home- and Community-Based Nutrition Services for Older Adults? *Journal of Nutrition in Gerontology and Geriatrics*. 34:2, pages 81-84

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EXECUTIVE SUMMARY

The health needs of older adults vary widely. Older adults in the same age group can face different health conditions and a range of life circumstances. Though some maintain excellent health well into old age, there is nonetheless a clear decline in population measures of physical and cognitive function at older ages. The Centers for Disease Control, for example, reports that the proportion of adults with two or more chronic conditions increases from 21 percent for those ages 45 to 64 to over 45 percent of those ages 65 and over (Freid et al. 2012). Older adults are also more likely to experience falls leading to serious injury. More than 30 percent of older adults fall each year and in half of the cases falls are recurrent (Dionyssiotis 2012). In general, they face an elevated risk of limitations in activities of daily living, decline in cognitive functioning, social isolation, and depression (van der Vorst et al. 2016; Murman 2015; Sözeri-Varma 2012). Consequently, many older adults—in particular those who are frail, disabled, or homebound—receive assistance from caregivers and obtain support services provided by home- and community-based agencies to help meet their health and social needs.

In an effort to ensure that the health and social needs of older adults are adequately met and to rebalance the provision of long-term care away from institutionalization and toward home- and community-based services, the Administration on Aging (AoA) within the Administration for Community Living (ACL) of the U.S. Department of Health and Human Services (DHHS) administers the Title III-C Nutrition Services Program (NSP) as part of the Older Americans Act (OAA). The NSP promotes access to nutritious meals, nutrition education, and nutrition counseling; facilitates social contact; and conducts health promotion activities, all which help older adults maintain their independence in their homes and communities.

Two core components of the program are the provision of congregate (group) and home-delivered meals. NSP congregate meal participants can receive a nutritious meal at a senior center or other community location, where they can socialize with peers and may receive other services such as nutrition education, screening, and counseling. Non-nutrition services, including health promotion activities, transportation, and case management services, may also be offered. Such services include information and referrals to programs such as Medicare and to evidence-based health promotion and disease prevention programs.

Participants who are homebound receive nutritious home-delivered meals. Like congregate meal settings, home-delivered meals may offer an opportunity for socializing through interactions with meal delivery drivers and other volunteers. Homebound participants may also receive nutrition education, screening, and counseling. In this way, the NSP provides homebound participants with a primary access point for many home- and community-based services to help meet their health and nutrition needs.

The mission of AoA is to develop a comprehensive, coordinated, and cost-effective system of long-term care that helps older adults maintain their independence in their homes and communities. As part of its ongoing efforts to support program planning, improve program efficiency, and strengthen program effectiveness, ACL's Office of Performance and Evaluation contracted with Mathematica Policy Research to conduct the Title III-C NSP Evaluation. The three-part evaluation consists of a process evaluation of program administration and service delivery, a program cost analysis, and an evaluation of the effect of the program on participants'

outcomes. This report is the second of two reports about the NSP outcomes evaluation. It describes NSP participants' health status, Medicare characteristics, and health care utilization, and examines the effect of the program on participants' health outcomes using survey data and detailed Medicare enrollment and claims data for program participants and matched nonparticipants.

Background

Organizations in the National Aging Network, an informal network of home- and community-based care providers, administer the NSP. AoA's central and regional offices provide overall federal coordination; however, the State Units on Aging (SUAs) and the Area Agencies on Aging (AAAs) both support key aspects of program operations. In turn, local service providers (LSPs) typically provide the direct nutrition services.

The NSP is authorized under Title III of the OAA.[8] Under Title III, SUAs receive federal grants from AoA for providing congregate nutrition services (authorized under Part C-1), home-delivered nutrition services (authorized under Part C-2), meals (authorized under Part A) and support services (authorized under Part B).

SUAs support the provision of daily meals and related nutrition services in either group (congregate) or home settings to adults ages 60 and older. The NSP does not have a financial means test, but services target older adults with the greatest economic or social need. Participants are not charged for meals but are encouraged to contribute toward the total cost of the meal voluntarily. However, within site capacity, participants' inability or unwillingness to contribute does not deny them of meals or other services. Congregate meals and support services are provided at LSPs' meal sites (such as senior centers, religious facilities, and public or low-income housing facilities). Home-delivered meals are provided to homebound individuals by the congregate meal sites, affiliated central kitchens, or nonaffiliated food service organizations.

Congregate and home-delivered LSPs must provide meals that comply with the most recent *Dietary Guidelines for Americans* (DHHS and U.S. Department of Agriculture 2015) and provide a minimum of one-third of the Dietary Reference Intakes established by the Food and Nutrition Board of the Institute of Medicine of the National Academy of Science (2006). In addition to meals, LSPs also provide nutrition education, nutrition screening and assessment, and nutrition counseling if appropriate.[9]

In fiscal year 2015, the most recent year in which counts of meals and individuals served are available, 79 million meals were served to 1.6 million people at congregate sites and 143 million home-delivered meals were provided to 859,000 homebound older adults. OAA Title III-C funding was $448 million for congregate nutrition services and $226 million for home-delivered nutrition services in fiscal year 2016.

[8] Similar nutrition and supportive services for elderly American Indians, Alaska Natives, and Native Hawaiians are authorized separately under Title VI. This report focusses on the Title III NSP.

[9] Additional LSP requirements are available in Section 339 of the OAA.

Evaluation objectives and research approach

The objectives of the Title III-C NSP evaluation included the following:

- Provide information to support program planning, including an analysis of program processes (referred to as the *process study*)
- Develop information about program efficiency and cost issues (referred to as the *cost study*)
- Assess program effectiveness, as measured by the program's effects on a variety of important outcomes, including diet quality, socialization opportunities, health outcomes, and—ultimately—helping older adults avoid institutionalization (referred to as the *outcomes evaluation*)

The process study report (Mabli et al. 2015) and cost study report (Ziegler et al. 2015) shed light on the diversity and organizational structure of the National Aging Network and whether the system operates efficiently. However, policymakers and program administrators also need to know whether the NSP succeeds in delivering services of benefit to older adults. Thus, a third major objective of the NSP evaluation is to assess whether the program improves participants' diet quality (and opportunities for socialization and health promotion activities) in the short run and, thereby, improves health outcomes in the longer run—outcomes that would allow participants to age in place in their homes and communities and delay or avoid institutionalization. The following are the specific objectives of the outcomes evaluation:

1. Describe NSP participants' demographic and household characteristics, health status, mobility, eating behaviors, diet quality, food security, socialization, and other characteristics
2. Describe NSP participants' experiences with and impressions of the NSP and their valuation of meals and supportive services received through the program
3. Determine the impact of NSP meals and related services on participants' nutrition, food security, and diet quality (with a focus on nutrients linked to health of older adults) by comparing outcomes for NSP participants and nonparticipants
4. Determine the impact of NSP meals and nutrition services on overall wellness and well-being by comparing outcomes for NSP participants and nonparticipants

The first outcomes evaluation report (Mabli et al. 2017) addressed the first three objectives and part of the fourth objective that assessed well-being based on loneliness, depression, and socialization opportunities. This current report, referred to as the health care utilization report, addresses the final portion of the fourth objective that describes participants' health and health care utilization and examines overall wellness measured using longer-term outcomes related to health and avoidance of institutionalization. The analysis measures participants' patterns of health care utilization using information on hospital admissions and readmissions, emergency department use, physician visits, home health episodes, and admissions to nursing homes and skilled nursing facilities.[10]

[10] Home health episodes involve skilled health care services provided at home for an illness or injury, following a physician's orders for the provision of such services. Examples of home health services include wound care for

The findings in this report draw on information obtained from Medicare claims data and comprehensive surveys of congregate and home-delivered meal participants and a matched comparison group of program-eligible nonparticipants. A comparison group of eligible nonparticipants makes it possible to estimate program impacts by comparing outcomes for participants with outcomes for nonparticipants that have similar demographic, economic, and health characteristics as participants, but do not participate in the program. Surveys were administered to random samples of congregate and home-delivered meal participants, based on probability samples of AAAs and LSPs that were surveyed as part of the process study. The research team formed the nonparticipant comparison group by obtaining administrative lists of Medicare beneficiaries from 2014 and using statistical matching techniques to identify older adults living in the same geographic area who had similar characteristics to those in the congregate meal and home-delivered meal samples. The team constructed outcome measures using 2015–2017 Medicare claims data. Using descriptive, tabular analysis, the research team assessed NSP participants' health status, Medicare characteristics, and health care utilization; the team used multivariate analysis and matching methods to estimate the effect of congregate and home-delivered meal participation on participants' outcomes. The findings from the descriptive analyses are nationally representative of the population of congregate and home-delivered meal participants. The estimates of the effects of congregate and home-delivered meal participation on outcomes are representative of the effects for the population of congregate and home-delivered meal participants. In other words, the study intends to assess the effect of the programs on those who choose to participate in the program, not on the entire population.

Study findings

Following are key findings of the evaluation.

NSP participants' health status, Medicare characteristics, and healthcare utilization

Most NSP participants were poor or near poor, with about one-third of participants having income below the federal poverty guidelines and most of the rest of participants having income between 100 and 200 percent of the poverty threshold. Medicare data showed that 30 percent of congregate meal participants and 39 percent of home-delivered meal participants were dually eligible for Medicare and Medicaid. Dually eligible beneficiaries are an important subpopulation because they often have complex health care needs on account of the intersection of old age, illness, and low income or because of disability, and have substantially higher health care expenditures than non-dual Medicare beneficiaries (MedPAC 2016). As expected, these percentages were much higher among lower-income participants (52 percent for congregate meal participants and 65 percent for home-delivered meal participants), and, among congregate meal participants, for those who lived alone (36 percent).

Many NSP participants reported being in fair or poor health, having experienced falls in the past three months, and having functional impairments that require them to need help to perform activities critical to remaining in their homes. This is especially true of home-delivered meal

pressure sores or a surgical wound, intravenous or nutrition therapy, injections, and monitoring serious illness or unstable health status.

participants, where about 50 percent reported being in fair or poor health, 32 percent had experienced a fall in the past three months, and 69 percent had trouble climbing stairs.

Chronic conditions were highly prevalent among NSP participants. Approximately 74 percent of congregate meal participants and 80 percent of home-delivered meal participants had at least one chronic condition. Eight percent of congregate meal participants and 11 percent of home-delivered meal participants had five or more conditions. Diabetes, specified heart arrhythmias, vascular disease, congestive heart failure, and chronic obstructive pulmonary disease and other lung disorders were common.

Based on Medicare claims data, NSP participants experienced many health events in the nine months before the survey interview. For congregate meal participants, primary care physician visits and outpatient emergency department visits were the most common (experienced by 76 and 29 percent of participants, respectively), though nontrivial percentages of participants did have a hospital admission (8 percent), a home health episode (6 percent), or an emergency department visit that led to a hospital admission (5 percent). The likelihood of experiencing these health events was dramatically higher for home-delivered meal participants than for congregate meal participants. Although the percentages of home-delivered meal participants who had primary care physician visits and outpatient emergency department visits (82 and 30 percent, respectively) were similar to those of congregate meal participants, the percentages who had a home health episode (42 percent), a hospital admission (26 percent), and an emergency department visit leading to a hospital admission (21 percent) were much higher for home-delivered meal participants. Furthermore, among participants who had a home health episode, home-delivered meal participants had about four episodes, on average, whereas congregate meal participants had about two.

Health care utilization did not differ greatly by income for both congregate and home-delivered meal participants. For home-delivered meal participants, utilization differed according to whether the participant lived alone or with other family members. With the exception of skilled nursing facility admission, the likelihood of experiencing each health event was higher for individuals who lived alone than for those who lived with other family members. The largest differences were in hospital admissions (30 versus 19 percent), emergency department visits leading to a hospital admission (25 versus 14 percent), and home health episodes (47 versus 33 percent).

Congregate meal participants spent $631 per month, on average, on Medicare expenditures in the nine months before the survey interview. For home-delivered meal participants, average monthly expenditures were nearly twice as large as expenditures for congregate meal participants ($1,223). For both types of participants, the most common expenditures were for outpatient services and physician and non-institutional services (apart from professional services provided by physicians, non-institutional services include laboratory services, imaging services, ambulance use, and physical and occupational therapy).

NSP participation and participants' outcomes

The research team estimated the effect of congregate and home-delivered meal participation on health care utilization outcomes using survey and Medicare administrative data from program participants and a matched sample of nonparticipants. The team examined differences in health

care utilization outcomes between NSP participants and nonparticipants in the 9 months before the survey interview (referred to as pre-interview impacts) and in the 12 months after the survey interview (referred to as post-interview impacts).

1. Congregate meal participation in the nine months before the interview

Health care utilization was lower for congregate meal participants than for nonparticipants in the nine months before the survey interview. Participants were less likely than nonparticipants to have a hospital admission (8.5 versus 13.7 percent) and were less likely to have an emergency department visit that led to a hospital admission (5.4 versus 10.4 percent). Although there were no differences between participants and nonparticipants in the likelihood of a home health episode occurring, among those who had at least one episode, participants experienced almost one episode less than nonparticipants (1.8 versus 2.6 episodes). Overall, these are sizable differences in outcomes between congregate meal participants and nonparticipants.

Differences in outcomes by program participation status generally existed for lower-income individuals, but not higher-income individuals.[11] Among lower-income individuals, the percentage of congregate meal participants with a hospital admission in the nine months preceding the interview was 8.6 percentage points lower than the percentage of nonparticipants (9.1 versus 17.7 percent). The percentage who had an emergency department visit leading to a hospital admission was 11.4 percentage points lower than the percentage of nonparticipants (4.5 versus 15.9 percent). In contrast, among higher-income individuals, there were no statistically significant differences for either outcome between participants and nonparticipants.

Similarly, these program effects generally existed for individuals living alone, but not for individuals living with other family members. For individuals who lived alone, congregate meal participants were less likely than nonparticipants to have a hospital admission or an emergency department visit that led to a hospitalization (6.3 versus 14.1 percent for hospital admissions and 5.0 versus 11.3 for emergency department visits leading to a hospital admission). For individuals who lived with other family members, there were no significant differences in these outcomes between participants and nonparticipants.

2. Congregate meal participation in the 12 months following the interview

The NSP strives to avoid or delay the institutionalization of older adults in the program. Thus, one of the main outcomes of the evaluation was the likelihood of admission into long-term care facilities or nursing homes in the 12 months following the interview. Congregate meal participation had an effect on reducing institutionalization: the percentage of congregate meal participants with a nursing home admission in the 12 months following the survey interview was 2.3 percentage points lower than the percentage of nonparticipants (3.7 versus 6.0 percent). For nearly all of the other outcomes, there were no statistically significant differences between participants and nonparticipants.

[11] Individuals are referred to as lower-income if their income relative to the federal poverty threshold was less than the median value in the sample (128 percent for congregate meal participants and nonparticipants and 122 percent for home-delivered meal participants and nonparticipants). Higher-income individuals had income-to-poverty ratios that were greater than or equal to the median value.

The effect on the likelihood of nursing home admission was present for lower-income individuals, but not higher-income individuals, and was sizably larger than the effect found for the full sample of participants. For lower-income individuals, the effect was almost four times as large as in the full sample, with participants' nursing home admission rate 8.5 percentage points lower than the rate for nonparticipants (1.6 versus 10.1 percent). In contrast, for higher-income individuals, the effect was small (a –0.2 percentage point difference) and not statistically significant.

3. Home-delivered meal participation in the nine months before the interview

The main evaluation findings for home-delivered meal participants and nonparticipants differed from those for congregate meal participants and nonparticipants. Home-delivered meal participants were more likely than nonparticipants to have an emergency department visit leading to a hospital admission (18.0 versus 8.1 percent) and to have a home health episode (35.0 versus 19.7 percent). For those who experienced these health events, home-delivered meal participants were more likely to experience slightly more of them. Compared with nonparticipants, participants who had emergency department visits leading to a hospitalization experienced more of them and participants who had a primary care physician visit had fewer of them.

With one exception, there were no differences by income in the likelihood of health events occurring for home-delivered meal participants and nonparticipants. The percentage of higher-income individuals who experienced a home health episode was 25.0 percentage points higher for home-delivered meal participants than for nonparticipants (40.1 versus 15.1 percent), but there was no statistically significant difference for lower-income individuals. Many of the differences in the likelihood of an event occurring between program participants and nonparticipants that were observed in the full sample were typical for individuals who lived alone, but not for individuals who lived with other family members.

4. Home-delivered meal participation in the 12 months following the interview

Although congregate meal participants were less likely than nonparticipants to have a nursing home admission, the opposite was true for home-delivered meal participants and nonparticipants. The percentage of home-delivered meal participants who had a nursing home admission in the 12 months following the interview was 9.1 percentage points higher than the percentage of nonparticipants (14.3 versus 5.2 percent). Home-delivered meal participants also were more likely than nonparticipants to have a hospital admission (31.6 versus 21.9 percent) or readmission (8.7 versus 3.3 percent), and to have an outpatient emergency department visit (48.3 versus 38.8). They also had higher average monthly Medicare expenditures ($1,695 versus $1,195).

Where there were differences by household income in the effects of home-delivered meal participation on health care utilization outcomes, effects existed for higher-income individuals, but not lower-income individuals. For example, among higher-income individuals, the percentage of participants with a nursing home admission was higher for participants than for nonparticipants (16.3 versus 4.1), but there was no statistically significant difference for lower-income individuals.

5. Discussion and implications for future research

The descriptive findings of participants' health and health care utilization showed that many NSP participants were in fair or poor health, had functional impairments that limited daily activities, and had multiple chronic conditions. These and other indicators of health and economic need described in this report underscore the vulnerability of the population of older adults the program serves. This is especially true for home-delivered meal participants who, compared with congregate meal participants, were older, had less income, were more likely to be in poor health, and were more likely to have difficulty walking or climbing stairs. These vulnerabilities were reflected in higher health care needs and the extent to which participants experienced adverse health outcomes. For example, many NSP participants recently had an emergency department visit or hospital admission. Home health episodes were also common, especially for home-delivered meal participants.

The evaluation examined the effect of NSP participation on overall wellness and well-being by comparing health care utilization outcomes for participants and nonparticipants. Congregate meal participants had a lower likelihood in the short run of having a hospital admission and having an emergency department visit that led to a hospital admission. They also had fewer home health episodes. These program effects were generally typical for lower-income individuals, but not higher-income individuals, and for individuals living alone, but not individuals living with other family members. In the longer run, participants were less likely than nonparticipants to have a nursing home admission—an effect that was especially large for low-income individuals.

In contrast, home-delivered meal participants were more likely than nonparticipants in the short run to have an emergency department visit leading to a hospital admission and to have a home health episode. They also had more home health episodes, more skilled nursing facility admissions, and higher average Medicare expenditures. In the longer run, home-delivered meal participants were more likely than nonparticipants to have a nursing home admission and had greater health care utilization—in the form of hospital admission or readmissions and outpatient emergency department visits—and higher Medicare expenditures. These effects were generally present for higher-income home-delivered meal participants, but not for lower-income participants.

For congregate meal participants, the lower rates of hospitalization, emergency department visits leading to inpatient admissions, and nursing home admissions align with expectations of how the combination of receiving nutritious meals and social support by peers and program staff at the meal site can affect health outcomes. However, although participants did not experience these events as often as nonparticipants, a nontrivial percentage of participants still experienced these events and were admitted to a nursing home. This points to the need to examine the characteristics associated with congregate meal participants experiencing these events. Exploring differences in these relationships by income would be a fruitful area for future research given the stark differences in program effectiveness for higher- and lower-income individuals. More broadly, additional research is needed to explore the mechanisms through which receiving congregate meals and supportive services leads to lower acute care and nursing home admissions. Obtaining qualitative information from program participants and program staff

would help identify the mechanisms and explore whether they differ by age, geography, or some other key characteristics.

The findings for home-delivered meal participants were less intuitive than those for congregate meal participants. A potential explanation for the findings lies in the ability of the evaluation design to successfully address the potential bias associated with choosing to participate in the NSP. The research team performed a rigorous matching process to identify potential nonparticipants, but it is possible that the unobservable factors associated with differences in health care utilization at the time of matching partially influenced the findings in the 9 months before and 12 months after the survey interview for home-delivered meal participants. That is, differences in program outcomes could reflect differences in underlying characteristics of participants and nonparticipants, such as the degree to which individuals were truly homebound, rather than any effect of the program itself. The potential for this bias was much lower for congregate meal participants and nonparticipants, as the matching was more successful based on comparisons of observable characteristics for congregate meal participants and nonparticipants.

Additional research using the existing design is needed to understand the differences in outcomes between home-delivered meal participants and nonparticipants. This includes obtaining greater detail about the types of health events that occur, such as the reasons for hospitalization and emergency department visits leading to inpatient admissions. Using the specific diagnosis codes associated with those events would aid in obtaining such information. Additional research could also include describing the characteristics of older adults who experience these events, which could shed light on why participants' health care utilization was greater than that for nonparticipants for higher-income individuals, yet no differences in utilization existed for lower-income individuals. Because one of the goals of the NSP is to allow participants to remain in their homes and communities and delay or altogether avoid institutionalization, it is vital to understand the health care utilization of home-delivered meal participants in the years before nursing home admission. This analysis would provide a profile of participants' health care utilization to help AoA identify whether specific health events precede institutionalization, for which AoA could use program resources to develop strategies for maintaining independent living. Finally, one of the main distinctions between receiving congregate and home-delivered meals is that congregate meal participants can socialize with peers at meal sites, whereas home-delivered meal participants have more limited socialization opportunities that might involve face-to-face contact or conversation with meal delivery drivers. Because of the differences in findings related to receiving congregate and home-delivered meals, additional research could explore whether and how the availability of socialization opportunities and participants' satisfaction with those opportunities affect the relationship between receiving program meals and experiencing adverse health events or requiring institutionalization.

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I. INTRODUCTION

The health needs of older adults vary widely. Older adults in the same age group can face different health conditions and a range of life circumstances. Though some maintain excellent health well into old age, there is nonetheless a clear decline in population measures of physical and cognitive function at older ages. The Centers for Disease Control, for example, reports that the proportion of adults with two or more chronic conditions increases from 21 percent for those ages 45 to 64 to over 45 percent of those ages 65 and over (Freid et al. 2012). Older adults are also more likely to experience falls leading to serious injury. More than 30 percent of older adults fall each year and in half of the cases falls are recurrent (Dionyssiotis 2012). In general, they face an elevated risk of limitations in activities of daily living, decline in cognitive functioning, social isolation, and depression (van der Vorst et al. 2016; Murman 2015; Sözeri-Varma 2012). Consequently, many older adults—in particular those who are frail, disabled, or homebound—receive assistance from caregivers and obtain support services provided by home- and community-based agencies to help meet their health and social needs.

In an effort to ensure that the health and social needs of older adults are adequately met and to rebalance the provision of long-term care away from institutionalization and toward home- and community-based services, the Administration on Aging (AoA) within the Administration for Community Living (ACL) of the U.S. Department of Health and Human Services (DHHS) administers the Title III-C Nutrition Services Program (NSP) as part of the Older Americans Act (OAA). The NSP promotes access to nutritious meals, facilitates social contact, and helps older adults maintain their independence in their homes and communities.

Two core components of the program are the provision of group (congregate) and home-delivered meals. NSP congregate meal participants can receive a nutritious meal at a senior center or other congregate meal sites. Most sites serve lunch on one or more weekdays and some sites offer breakfast or dinner or provide meals on weekends (Mabli et al. 2015). Congregate meal sites offer an opportunity for participants to socialize with peers and receive other services such as nutrition education, screening, and counseling. These services help older adults identify their general and specific needs related to maintaining their health and managing individual nutrition-related diseases such as heart disease, hypertension, and diabetes. Participants may also receive non-nutrition services, including transportation and case management services. Such services include information and referrals to programs such as Medicare and to evidence-based health promotion and disease prevention programs.

Participants who are homebound receive nutritious home-delivered meals, typically five days per week. Most deliveries consist of a single meal such as a hot lunch, but meals come in a variety of forms including hot, cold, frozen, dried, canned, or shelf-stable, and some participants receive breakfast and/or dinner as well (Mabli et al. 2015). Like congregate meal settings, home-delivered meals offer an opportunity for socializing. Home-delivered meal volunteers might be older adults as well and, in addition to delivering meals, might offer the opportunity for face-to-face contact or conversation. This enables volunteers to relay important information about participants' well-being and needs to service providers. Homebound participants also receive nutrition education, nutrition screening and assessment, and nutrition counseling. More than half of local service providers also provide participants with information and referrals to Medicaid waiver programs, Medicare, and transportation services. In this way, the NSP provides

homebound participants with a primary access point for many home- and community-based services to help meet their health and nutrition needs.

The mission of the AoA is to develop a comprehensive, coordinated, and cost-effective system of long-term care that helps older adults maintain their independence in their homes and communities. As part of its ongoing efforts to support program planning, improve program efficiency, and strengthen program effectiveness, AoA contracted with Mathematica Policy Research to conduct the Title III-C NSP Evaluation. The three-part evaluation consists of a process evaluation of program administration and service delivery, a program cost analysis, and an evaluation of the effect of the program on participants' outcomes. This report summarizes findings from one component of the outcomes evaluation that uses data collected from program participants and nonparticipants to examine the effect of the program on participants' health outcomes. Another outcomes evaluation report examined the effects of the program on outcomes related to food security, socialization, and diet quality (Mabli et al. 2017). The findings from the process and cost components of the evaluation are presented separately (see Mabli et al. [2015] and Ziegler et al. [2015], respectively). The remainder of this chapter provides an overview of the NSP, summarizes the research objectives of the evaluation, and describes the organization of the report.

A. Overview of the Title III-C Nutrition Services Program

The NSP is authorized under Title III of the OAA. Through Title III, State Units on Aging (SUAs) implement a system of coordinated, community-based services targeted to older adults. Title III authorized the provision of nutrition and supportive services, such as meals, nutrition education, transportation, personal and homemaker services, and information and referrals.[12] The OAA has been amended frequently since the creation of the NSP in 1972. These amendments have added new responsibilities for agencies in the aging network and clarified responsibilities previously performed under the original legislation.

Under Title III-C of the OAA, AoA provides grants to SUAs to support the provision of daily meals and related nutrition services in either congregate or home settings to adults age 60 and older. In fiscal year (FY) 2015, the most recent year in which counts of meals and individuals served are available, 79 million meals were served to 1.6 million people at congregate sites and 143 million home-delivered meals were provided to 859,000 homebound older adults (ACL 2016). OAA Title III-C funding was $448 million for congregate nutrition services and $226 million for home-delivered nutrition services in FY 2016 (ACL 2017).

1. Funding and administration

Organizations in the National Aging Network, one of the nation's largest provider networks of home- and community-based care for older adults and their caregivers, administer the NSP. AoA's central and regional offices provide overall federal coordination; however, the SUAs and the Area Agencies on Aging (AAAs) both support key aspects of program operations. In turn, local service providers (LSPs) typically provide the direct nutrition services.

[12] Similar nutrition and supportive services for elderly American Indians, Alaska Natives, and Native Hawaiians are authorized separately under Title VI.

Under Title III, SUAs receive federal grants from AoA for providing congregate nutrition services (authorized under Part C-1), home-delivered nutrition services (authorized under Part C-2), and supportive services (authorized under Part B). AoA allocates funds to states and territories according to a formula that is largely based on the state's or territory's share of the population age 60 and older among all states and territories.

SUAs distribute the funds to AAAs, which administer the nutrition services program within their respective planning and service areas. AAAs receive funds from SUAs on the basis of state-determined formulas that reflect the proportion of older adults in their planning and service areas and other factors. AAAs award grants to and contract with LSPs to provide nutrition and supportive services in their planning areas. AAAs, with a waiver from their state, can be direct providers of nutrition services as well. In addition to receiving AoA funds, AAAs and LSPs receive financial support from state and local government, in-kind contributions, private donations, and voluntary contributions from participants. Congregate meals and supportive services are provided at LSPs' meal sites (such as senior centers, religious facilities, and public or low-income housing facilities). Home-delivered meals are provided to homebound individuals through the congregate meal sites, affiliated central kitchens, or nonaffiliated food service organizations.

2. Eligibility requirements

Adults age 60 and older, and their spouses of any age, may participate in the NSP's congregate meal program. In addition, the members of the following groups are eligible to receive congregate meals:

- Disabled people younger than age 60 who reside in housing facilities, occupied primarily by older adults where congregate meals are served
- Disabled people who reside at home with, and accompany, people age 60 and older to meal sites
- Nutrition service volunteers

For home-delivered meals, people who are homebound because of disability, illness, or isolation and are age 60 and older are eligible, as are their spouses of any age. Disabled people younger than age 60 living with older adults are also eligible.

The NSP is not an entitlement program. It also does not have a means test, but the program specifically targets older adults with the greatest economic or social need, with special attention given to low-income older adults, minorities, those living in rural areas, those with limited English proficiency, and those at risk of institutional care. Payment for meals is not mandatory, but participants are encouraged to make a voluntary contribution toward the total cost of the meal. However, within site capacity, participants' inability or unwillingness to contribute does not deny them of meals or other services.

3. Meals and services

LSPs must provide congregate and home-delivered meals that comply with the most recent *Dietary Guidelines for Americans* ("*Dietary Guidelines*"; DHHS and U.S. Department of

Agriculture 2015) and provide a minimum of one-third of the Dietary Reference Intakes (DRIs) established by the Food and Nutrition Board of the Institute of Medicine of the National Academy of Sciences (Institute of Medicine 2006). In addition to meals, LSPs also offer nutrition education, nutrition screening and assessment, and nutrition counseling if appropriate.[13]

4. Referrals from and to home- and community-based service providers

Clients come to participate in the NSP through many channels, one of which is the network of health professionals and health service agencies. Common referral sources for congregate meal participants other than family and friends are information and assistance systems; case management systems; hospital, health care facility, and discharge planners; and physicians (Mabli et al. 2015). Referral sources are similar for home-delivered meal participants, except that they are much more likely than congregate meal participants to be referred to the NSP through a hospital, health care facility, or discharge planner and through a physician, reflecting differences in the health of the target populations.

NSP agencies strive to understand the needs of program participants by seeking information on how clients learn about services of other programs in the community. They also strive to help meet the non-nutritional needs of clients by making it easier for them to access other programs. The majority of LSPs have a formal process for assessing the non-nutritional needs of congregate and home-delivered meal participants (Mabli et al. 2015). Many agencies refer clients to other programs such as Medicare Parts A and B, Medicare Part D, Medicaid waiver programs, and evidence-based health promotion and disease prevention programs.

B. Nutrition Services Program evaluation objectives and research questions

The objectives of the Title III-C NSP evaluation were to:

- Provide information to support program planning, including an analysis of program processes (referred to as the *process study*)
- Develop information about program efficiency and cost issues (referred to as the *cost study*)
- Assess program effectiveness, as measured by the program's effects on a variety of important outcomes, including diet quality, socialization opportunities, health outcomes, and—ultimately—helping older adults avoid institutionalization (referred to as the *outcomes evaluation*)

Separate reports present findings from the process study (Mabli et al. 2015) and the cost study (Ziegler et al. 2015). The process study report used data collected from SUAs, AAAs, and LSPs to assess the ways in which the program operates to serve older adults. The process study analyzed NSP structure, administration, staffing, coordination, processes, and service delivery. It also described the nutrition and supportive services that agencies offer; differences in participant access to services, prioritization of services, and the use of waiting lists; and program resources.

The cost study report estimated the average costs of a congregate and a home-delivered meal provided under the NSP and assessed whether these average costs vary by meal preparation

[13] Additional LSP requirements are available in Section 339 of the OAA.

method or by other program characteristics. The cost study report also examined program efficiency by generating unit cost estimates for individual LSPs and examining cost variation within the program by cost component, meal preparation method, program size, and other program characteristics.

The process and cost studies shed light on the diversity and organizational structure of the National Aging Network and whether the system operates efficiently. However, policymakers and program administrators also need to know whether the NSP succeeds in delivering services of benefit to older adults. Thus, a third major objective of the NSP evaluation is to assess whether the program improves participants' diet quality in the short run and, thereby, improves health outcomes in the longer run—outcomes that would allow participants to stay in their homes and communities and delay or avoid institutionalization.

The objectives of the outcomes evaluation are to:

1. Describe NSP participants' demographic and household characteristics, health status, mobility, eating behaviors, diet quality, food security, socialization, and other characteristics
2. Describe NSP participants' experiences with and impressions of the NSP and their valuation of meals and supportive services received through the program
3. Determine the impact of NSP meals and related services on participants' nutrition, food security, and diet quality (with a focus on nutrients linked to health of older adults) by comparing outcomes for NSP participants and nonparticipants
4. Determine the impact of NSP meals and nutrition services on overall wellness and well-being by comparing outcomes for NSP participants and nonparticipants

The first outcomes evaluation report (Mabli et al. 2017) addressed the first three objectives and part of the fourth objective that assessed well-being based on loneliness, depression, and socialization opportunities. This current report, referred to as the health care utilization report, addresses the final portion of the fourth objective that describes participants' health and health care utilization and examines overall wellness measured using longer-term outcomes related to health and avoidance of institutionalization based on Medicare claims data. The analysis measures participants' patterns of health care utilization using information on hospital admissions and readmissions, emergency department care, doctor visits, home health episodes, and admissions to nursing homes and skilled nursing facilities. It compares outcomes for NSP participants and nonparticipants using a combination of survey data and matched Medicare administrative records to determine the effect of the NSP on older adults' ability to age in place and maintain current quality of life.

C. Organization of the report

The remaining chapters of this report discuss the methodology used in the analysis and present findings. Chapter II provides an overview of the study design and the data and methodology used in the analysis. Chapter III presents detailed tables describing NSP participants' demographic characteristics, health characteristics, health care utilization, and Medicare expenditures. Chapter IV presents estimates of the effect of participating in congregate

and home-delivered meal programs on health care utilization outcomes. Chapter V summarizes findings to inform policy and discusses implications for future research.

The appendices of the report provide supporting material and additional tables. Appendix A supplements Chapter II with a more detailed discussion of the data and methodology, and Appendix B supplements the Chapter III tables by presenting auxiliary tables.

II. OVERVIEW OF DATA AND METHODOLOGY

The outcomes evaluation draws primarily on information obtained from comprehensive surveys collected from samples of program participants and a matched comparison group of program-eligible nonparticipants and Medicare administrative data for participants and nonparticipants. This chapter presents an overview of the sampling design, discusses the data collection, describes the Medicare administrative data and additional data sources used in the analysis, defines the evaluation's outcome measures, and presents the analytic methods used to address the evaluation's research objectives.

A. Sampling design

The evaluation used a multistage clustered sample design. The stages of sampling were:

1. AAAs
2. LSPs within AAAs
3. Congregate meal sites and home-delivered meal distribution locations within LSPs
4. Home-delivered meal routes within home-delivered meal distribution locations
5. Congregate meal participants within each congregate meal site and home-delivered meal participants within each home-delivered meal route

In addition, the research team obtained a matched sample of congregate and home-delivered meal nonparticipants. Details are available in Appendix A.

The research team conducted two surveys—one in 2015–2016 and another in 2016–2017. Data collection for the first survey spanned one week for each randomly selected congregate meal site and home-delivered meal route. In congregate meals sites, field staff attended the main congregate meal (usually lunch) on the first day meals were provided during the week. They randomly sampled and interviewed congregate meal participants. Similarly, on the first day of meal provision for each home-delivered meal distribution location, program staff provided a list of all home-delivered meal participants for the sampled route, participants were randomly sampled, and field staff interviewed participants in homes or another convenient location.

In the same geographic area as the sampled congregate meal sites and home-delivered meal routes, the research team obtained a list of Medicare beneficiaries from the Centers for Medicare & Medicaid Services (CMS) and used statistical matching techniques drawing on 2014 Medicare claims and enrollment data to identify older adults with characteristics similar to those in the congregate and home-delivered meal samples to form the study's comparison groups. The research team screened potential program-eligible nonparticipants by phone to exclude anyone who (1) participated in congregate or home-delivered meal programs in the past year; (2) lived in a nursing home, assisted living facility, group home, or rehabilitation facility; or (3) did not live in the same zip code as the participant to whom they were matched. Field staff interviewed nonparticipants in their homes or, for some congregate meal nonparticipants, a public location such as a local library.

Approximately 12 months after the first survey, the research team conducted a second survey. The sample consisted solely of the individuals who had responded to the first survey. For the second survey, interviewers collected data from respondents by phone for congregate meal and home-delivered meal participants and nonparticipants.

B. Data collection

The research team used multiple instruments to collect data from NSP participants and nonparticipants. The team pretested and pilot-tested the instruments and conducted interviews from October 2015 to April 2016 for the first survey, and from November 2016 to March 2017 for the second survey.

1. Instruments

In 2015–2016, the research team collected data from NSP participants and nonparticipants in a computer-assisted personal interview using an outcomes survey and a 24-hour dietary recall. For nonparticipants, the team also administered a short survey to screen and recruit individuals into the study.

The 2015–2016 outcomes survey collected information on a comprehensive set of topic areas including demographic characteristics, food security, health insurance coverage, health status and depression, and loneliness. In addition, the survey asked all respondents about their NSP participation history, and asked congregate and home-delivered meal participants about the types of services they received, their impressions of the program and services, and monetary contributions for program meals. The dietary recall collected information on the foods and beverages that participants and nonparticipants consumed over 24 hours on the day before the interview. Finally, the research team used a short computer-assisted telephone interview survey to screen and recruit meal program nonparticipants to participate in the study. The screener determined whether nonparticipants were eligible for the study using the criteria described in the sampling section.

The 2016–2017 outcomes survey assessed program participation patterns between the 2015–2016 and 2016–2017 interviews. It collected information on whether respondents who had received congregate or home-delivered meals at the time of the 2015–2016 survey were still receiving congregate or home-delivered meals about 12 months later. In addition, all respondents were asked how many months in the past year they had received meals and, for those who reported receiving fewer meals or a greater number of meals than they did 12 months earlier, the reasons for the change.

2. Pretesting

The research team pretested the outcomes survey with nine congregate and home-delivered meal participants (described in Appendix A). The team also conducted a small-scale pilot to test the operational aspects of data collection. The pilot included conducting both the 2015–2016 outcomes survey and the 24-hour dietary recall with 32 congregate and home-delivered meal participants from five meal program sites. As a result of the pilot test, the research team significantly reduced the length of the survey and incorporated “frail skips” that interviewers could use to bypass noncritical sections of the survey when respondents struggled to complete the survey due to length or fatigue.

3. Conducting interviews

The field data collection for the 2015–2016 survey began in October 2015 and ended in April 2016. From late October 2015 through early January 2016, field interviewers collected information from program participants. Data collection in each site spanned five days. Field interviewers randomly selected congregate and home-delivered meal participants to take part in the study on one day and, over the next four days, administered the outcomes survey and 24-hour dietary recall to sampled participants who agreed to participate in the study. The research team conducted a second dietary recall with a subsample of participants at least one day after their first dietary recall. From late January 2016 through early April 2016, field interviewers returned to the same geographic areas where they had interviewed program participants to interview a predetermined matched sample of nonparticipants identified through the nonparticipant screener. As with the participant samples, a second dietary recall took place with a subsample of nonparticipants at least one day after their first dietary recall.

The field data collection for the 2016–2017 survey began in November 2016 and ended in March 2017. Telephone interviewers collected information predominantly from program participants early in this period, from both participants and nonparticipants in the middle of the period, and predominantly from nonparticipants toward the end of the period.

Response rates. The research team used the American Association for Public Opinion Research's (2016) *Standard Definitions,* ninth edition, to calculate response rates. The 2015–2016 outcomes survey response rates were 76.1 percent for congregate meal participants and 54.1 percent for home-delivered meal participants (Appendix A, Table A.1). The outcomes survey completion rates for nonparticipants who were recruited from the telephone screener were 79.1 percent for congregate meal nonparticipants and 76.6 percent for home-delivered meal nonparticipants (Appendix A, Table A.2). The 2016–2017 outcomes survey response rates were 73.3 percent for congregate meal participants and 70.1 percent for home-delivered meal participants and were 82.2 percent for congregate meal nonparticipants and 84.0 percent for home-delivered meal nonparticipants (Appendix A, Table A.3).

C. Additional data sources

To address the research objectives, the research team linked the outcomes survey data to two other data sources: Medicare administrative data and American Community Survey data.

1. Medicare administrative data

The research team used Medicare claims and enrollment data obtained through the CMS Research Data Assistance Center to construct outcome measures and define Medicare beneficiary characteristics such as hierarchical condition category (HCC) scores, the original reason for an individual's Medicare eligibility, whether the individual had dual enrollment in Medicare and Medicaid, and whether the individual had chronic conditions. The team obtained the following files for 2015 through the first quarter of 2017: Medicare claims data (inpatient, outpatient, carrier, home health, and skilled nursing facility files); the Medicare long-term care Minimum Data Set with comprehensive assessment information on residents of long-term care facilities; and the Medicare enrollment database.

Because Medicare claims data from 2014 were used to statistically match congregate and home-delivered meal participants to NSP nonparticipants living in the same geographic area, all NSP nonparticipants who responded to the 2015–2016 survey had a valid Medicare beneficiary identification number. Thus, all nonparticipants were matched successfully to the 2015–2017 Medicare claims data as well. Some participants, however, chose not to provide a full or partial Social Security number during the 2015–2016 survey interview, which prevented the research team from matching them successfully to the Medicare administrative data. Overall, 11 percent of participants who had responded to the 2015–2016 survey were not matched successfully to the Medicare data and, thus, were not included in the analysis.

Because Medicare claims, which identify specific events such as a hospital stay or emergency department visit, are not available for beneficiaries enrolled in managed care plans such as Medicare Advantage, the research team limited the analysis to those who were enrolled in fee-for-service (FFS) Medicare (known as Original Medicare). Among the individuals with a valid Medicare beneficiary identification number, 64 percent of participants and 62 percent of nonparticipants were FFS beneficiaries for either all or part of the 2015-2017 analysis period and were included in the analysis.

2. Neighborhood contextual data from the American Community Survey

The research team used data from the American Community Survey to obtain local-area population characteristics. To obtain characteristics for small-census geographies, such as census tracts, the Census Bureau aggregates data over five years. The research team drew on the 2010 to 2014 American Community Survey summary file to obtain tract-level measures of population, the percentage of families with income below 200 percent of the federal poverty threshold, the percentage of the total population that is non-white, the percentage of the total population that is Hispanic, and the percentage of housing units without access to a vehicle.

D. Outcome measures

The research team analyzed three sets of health care utilization outcomes: whether health events occurred in a specific period of time, the number of events that occurred among those individuals who experienced them, and the Medicare cost associated with the events (Table II.1). The research team defined outcomes relative to the date of the 2015–2016 interview. One set of outcomes measured health care utilization and Medicare costs in the 9 months preceding the 2015–2016 interview and another set measured utilization and costs in the 12 months following the 2015–2016 interview. For example, if the interview took place on December 15, 2015, one set of outcomes measured the occurrence of events from March 15, 2015, through December 14, 2015, and another set measured outcomes from December 16, 2015, to December 15, 2016. The outcomes included the following:

- Hospital admissions
- Hospital readmission within 30 days of discharge
- Emergency department visits that resulted in an inpatient stay
- Outpatient emergency department visits (those that did not result in an inpatient stay)
- Primary care physician visits in any setting

- Home health episodes (where an episode lasts 60 days and involves at least one or a mix of the following services for homebound patients: skilled nursing care, physical or speech therapy, occupational therapy, home health aide, and medical social services)
- Admittance to a skilled nursing facility
- Admittance to a long-term care nursing home

For all outcomes except hospital readmission and nursing home admission, a second set of outcomes counted the number of times the event occurred in the observation period. This set includes, for example, the number of hospital admissions in the 9 months preceding the 2015–2016 interview or the number of primary care physician visits in the 12 months following the 2015–2016 interview. A third set of outcomes consisted of total Medicare Part A and Part B cost and Medicare costs by service category (inpatient, outpatient, home health, skilled nursing, and physician or non-institutional services) in the 9 months preceding and the 12 months following the 2015–2016 interview.

The data provided by CMS was at the beneficiary claim level, meaning that each observation corresponded to a claim associated with a health event experienced by a beneficiary. The research team aggregated the data to the beneficiary level to produce the outcome measures needed for the analysis. For each beneficiary, claim information was aggregated separately over each observation period (9 months before and 12 months after the 2015–2016 interview). Health care utilization outcomes measuring whether an event occurred in the observation period were defined as binary variables equal to 1 if there was at least one claim in the observation period indicating the event occurred, and equal to 0 otherwise. Health care utilization outcomes measuring the number of times an event occurred in the observation period were annualized to reflect the number of events an individual experienced over one year (dividing total number of events in observation period by the number of FFS eligible months in that period, and multiplying by 12). Outcomes measuring the number of hospital admissions in the 9 months preceding the 2015–2016 interview, for example, were annualized to reflect the number of admissions over one year. Finally, to calculate Medicare expenditure outcomes, the research team summed the costs of all claims over the observation period and divided by the number of Medicare FFS months in the observation period to measure average expenditures per month in the observation period for each beneficiary.

E. Other beneficiary characteristics based on Medicare data

In addition to the outcome measures, the research team also used the Medicare claims and enrollment files to measure the following characteristics for NSP participants and nonparticipants: HCC score, original reason for Medicare eligibility, dual enrollment status, and presence of chronic conditions. The following describes the construction of each measure.

- The original reason for Medicare entitlement was obtained from the Medicare Enrollment Database and was measured at the time of enrollment into Medicare. This enabled the research team to distinguish between beneficiaries who originally qualified for Medicare due to disability or end-stage renal disease (ESRD), versus those who qualified due to age. Among older adults in the analysis, those who are disabled or those with ESRD are likely to have higher health care utilization and costs.

- Information on whether the individual had dual enrollment in Medicare and Medicaid was obtained from the Medicare Enrollment Database, but was measured in the month of the 2015–2016 interview. Because individuals enrolled in Medicaid are likely to have lower incomes or be medically needy, dual eligibility is a potential indicator of low socioeconomic status.
- HCC scores were estimated using the CMS scoring algorithm. Specifically, the research team applied the latest version of the HCC software (version 22) on the Medicare inpatient, outpatient, and carrier claims for the nine months preceding the 2015–2016 interview. The algorithm for calculating HCC scores relies on identifying health conditions based on Medicare claims and sorts those into hierarchical categories before combining them into a single measure or score that captures the risk for subsequent health care expenditures (see Pope et al. 2004 for details on constructing HCC scores). CMS calculates these scores such that the average for the Medicare FFS population nationally is 1.0. A patient with a risk score of 1.30 is predicted to have costs that would be approximately 30 percent above the average, whereas a patient with a risk score of 0.70 is expected to have costs that would be approximately 30 percent below the average.
- Information on whether an individual had a chronic condition and the type of condition was measured using individual HCC groups from the nine months preceding the 2015–2016 interview that were produced as part of estimating the HCC score. The research team mapped HCC groups into chronic condition codes. Groups were included (1) if they measured one of the 27 chronic conditions (including, for example, heart disease, diabetes, and chronic obstructive pulmonary disease) in the chronic condition warehouse; (2) if more than 1 percent of beneficiaries experienced the condition; or (3) if the conditions were nutrition-related, for example, protein-calorie malnutrition, cirrhosis of the liver, or inflammatory bowel disease.

F. Analytic methods

The research team described NSP participants' demographic and economic characteristics; health and other characteristics from Medicare data (HCC score, original reason for Medicare eligibility, dual enrollment status, and chronic conditions); and health care utilization and Medicare expenditures. For categorical variables, the research team estimated the percentage of participants who responded in each category. For continuous variables such as HCC scores and Medicare expenditures, the mean and the 25th, 50th, and 75th percentiles of the distribution are presented. (The 50th percentile, or median, of the distribution is the value for which 50 percent of the observations are less than or equal to. Similarly, the 25th percentile is the value at or below which 25 percent of the observations lie, and the 75th percentile is the value with 25 percent of the observations lying above it). Several tables in this report contain percentages of participants with values in different ranges of the distribution, such as the percentage of individuals with income below the federal poverty threshold. The research team conducted all analyses separately for congregate and home-delivered meal participants. The research team also conducted the analyses separately for two important household and economic subgroups: by monthly household income relative to poverty, dividing the sample roughly in half into lower-income and higher-income groups, and according to individuals' living arrangement (that is, whether they lived alone or with other family members).

Table II.1. Outcome measures and data sources[a]

Outcome measures	Data source	Description of variables
Hospital admissions	Medicare claims data—inpatient file	Binary variable indicating whether the individual had an acute care hospital admission in the observation period Continuous variable equal to the number of acute care hospital admissions in the observation period
Emergency department (ED) visits	Medicare claims data—inpatient and outpatient files	Binary variable indicating whether the individual had an ED visit and observation stay in the observation period, including visits that lead to a hospitalization Continuous variable equal to the number of ED visits and observation stays in the observation period
Outpatient ED visits	Medicare claims data—outpatient file	Binary variable indicating whether the individual had an ED visit and observation stay in the observation period that did not lead to a hospitalization Continuous variable equal to the number of ED visits and observation stays in the observation period that did not lead to a hospitalization
Primary care physician (PCP) visits in all settings	Medicare claims data—carrier file	Binary variable indicating whether the individual had a visit to a PCP in the observation period Continuous variable equal to the number of PCP visits in the observation period
Hospital readmission	Medicare claims data—inpatient file	Binary variable indicating whether the individual was discharged from the hospital and had an unplanned hospitalization within 30 days of discharge in the observation period
Home health episodes	Medicare claims data—home health file	Binary variable indicating whether the individual had a home health episode in the observation period Continuous variable equal to the number of home health episodes in the observation period
Admittance to a nursing home	Long-term care Minimum Data Set	Binary variable indicating whether the individual was admitted to a nursing home in the observation period
Admittance to a skilled nursing facility (SNF)	Medicare claims data—SNF	Binary variable indicating whether the individual was admitted to a SNF in the observation period Continuous variable equal to the number of SNF stays in the observation period
Medicare expenditures[b]	Multiple Medicare claims files	Total expenditures on Medicare Part A and Part B services excluding hospice care and durable medical equipment
Medicare expenditures by type of service[b]	Multiple Medicare claims files	Medicare expenditures by type of service: inpatient, outpatient, physician and noninstitutional services, home health, and skilled nursing facility

[a] Observation periods are 9 months preceding and 12 months following the 2015–2016 interview.

[b] Medicare expenditures include only payments made by Medicare for Part A and Part B services as reported in administrative data, and exclude out-of-pocket costs and third party payments.

To estimate the effect of receiving a congregate meal or home-delivered meal on health care utilization outcomes and Medicare expenditures, the research team compared outcomes for participants and a matched comparison group of program-eligible nonparticipants. A comparison group of eligible nonparticipants makes it possible to estimate program impacts by comparing outcomes for participants with outcomes for nonparticipants that have similar demographic, economic, and health characteristics as participants, but do not participate in the program. The comparison group of nonparticipants should ideally be as similar as possible to the sample of participants, except for program participation and random variation. Despite thorough and targeted efforts to use Medicare administrative data from 2014 to identify a group of nonparticipants who were comparable to participants across several critical individual characteristics related to outcomes (that is, demographics, Medicare eligibility, chronic conditions, and health care service utilization and expenditures [see Appendix A]), the characteristics of the two samples differed. Consequently, the analyses used statistical methods and both the survey data and Medicare data to control for differences in the characteristics of participants and nonparticipants that affect both outcomes and program participation decisions. (See Appendix A for a description of these multivariate regressions.) The research team also

used weights for nonparticipants generated using a propensity-score matching algorithm based on machine learning called boosting (Ridgeway and McCaffrey 2007; Lee et al. 2010), that, when used in the analyses, ensured that participants and nonparticipants were similar in terms of all of the characteristics the model includes.

The analyses compared outcomes of participants and nonparticipants separately for each of the two observation periods. The first analysis compared outcomes defined over the 9 months preceding the 2015–2016 interview, and the second analysis compared outcomes defined over the 12 months following the 2015–2016 interview. The research team conducted all multivariate analyses separately for congregate meal participants and nonparticipants and for home-delivered meal participants and nonparticipants, as well as by monthly household income relative to poverty and according to individuals' living arrangement (that is, whether they lived alone or with other family members). The research team performed additional, exploratory analyses when comparing outcomes over the 12 months following the 2015–2016 interview that used information on how often the individual received congregate or home-delivered meals throughout the observation period.

The research team accounted for the multistage sampling design of the outcomes evaluation when estimating standard errors. Appendix A describes this in detail.

G. Analysis weights

Analysis weights allow one to compute unbiased estimates based on sample survey responses from the study population. Weights account for both the probability of selection into the sample and the differential response patterns that might exist in the respondent sample. They also account for whether the individual had a successful match to the Medicare claims data used to construct outcomes and, if so, whether the individual was a Medicare FFS beneficiary. Weights were constructed separately for congregate meal participants and nonparticipants and home-delivered meal participants and nonparticipants.

Based on weighted data, the findings regarding congregate and home-delivered meal participants in Chapter III of this report are nationally representative of the population of congregate and home-delivered meal participants. This is not true for the nonparticipants who completed interviews, however, because, by design, they were not sampled from a frame of nonparticipating older adults. Instead, the estimates of the effects of congregate and home-delivered meal participation on outcomes that use weighted participant and nonparticipant data are representative of the effects for the population of congregate and home-delivered meal participants. In other words, the study intends to assess the effect of the programs on those who choose to participate in the program, not on the entire population.

H. Study limitations

This report represents a comprehensive assessment of the effectiveness of the Title III-C NSP in improving participants' health care outcomes. When interpreting the report's findings, it is important to consider two limitations.

Item nonresponse. Although interviewers administered the surveys, respondents were able to respond "don't know" or refuse to answer questions. The percentages and estimates based on

the survey data presented in Chapter III of this report are based on responses that exclude both types of missing data. As a result, item nonresponse bias is possible for those estimates. Item nonresponse bias occurs when individuals who respond to a question differ in meaningful ways from those who do not respond. However, this was not a serious problem for most survey questions, as all of the estimates presented in the tables either had no item nonresponse or had a particularly low percentage of item nonresponse, which was defined as at least an 80 percent response rate.

Causality. Both the propensity-score matching procedure and regression analysis can adjust for differences only in observable characteristics, whereas program participants might also differ from nonparticipants in unobservable ways that could influence the estimates of program impacts on outcomes. Therefore, the findings based on either approach cannot be definitively interpreted as causal effects of the extent to which program participation affects health care utilization and Medicare expenditures. Instead, these procedures adjust—to the extent possible—for observable differences likely to correlate with the outcome measures. This allows for the comparison of similar groups of participants and nonparticipants, while still acknowledging that unobservable factors might influence differences in outcome measures. However, the research team attempted to minimize this possibility by using a powerful research design that (1) matched participants and nonparticipants based on a comprehensive set of demographic and health characteristics in Medicare administrative records and (2) identified matched nonparticipants within small, local geographic areas (zip codes) in which participants lived. The validity of the impact estimates necessarily rests on the degree to which the comparison sample and the statistical model succeed in approximating the counterfactual results—the outcomes that congregate meal participants and home-delivered meal participants would have experienced had they not received those meals.

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III. NSP PARTICIPANTS' HEALTH AND MEDICARE CHARACTERISTICS

This chapter describes congregate and home-delivered meal participants' health and Medicare characteristics. Information appears separately for each program and describes differences and similarities between congregate and home-delivered meal participants. Section A describes participants' demographic characteristics, including age, education, marital status, race and ethnicity, income, health status, functional ability, and mobility. Section B describes participants' health and Medicare enrollment characteristics, including HCC scores, original reason for Medicare eligibility, and chronic conditions. Finally, Section C presents information on participants' health care utilization and Medicare expenditures.

A. Characteristics of participants

1. Demographic characteristics

The majority of congregate and home-delivered meal participants were older than 75, were female, were high school graduates, and lived alone. The average congregate meal participant was 77 years old; the average home-delivered participant was age 82 (Table III.1). Fifty-nine percent of congregate meal participants and 79 percent of home-delivered meal participants were 75 and older. More than two-thirds of congregate and home-delivered meal participants were women and about 16 percent were veterans. The percentage of participants who had not completed high school was about one-quarter (24 percent) of congregate meal participants and just over two-fifths (42 percent) of home-delivered meal participants. Twenty-four percent of congregate meal participants and 23 percent of home-delivered meal participants were married; 49 and 51 percent, respectively, were widowed. Many participants lived alone (60 percent of congregate meal participants and 63 percent of home-delivered meal participants). Non-Hispanic blacks constituted approximately 14 percent of congregate meal participants and 18 percent of home-delivered meal participants, and Hispanics accounted for another 14 percent and 9 percent, respectively, of participants in the two programs. Twenty-eight percent of congregate meal participants and 25 percent of home-delivered participants resided in rural areas.

Although the OAA prohibits financial means tests for participation in the NSP, most participants were poor or near poor. Thirty-one percent of congregate meal participants and 35 percent of home-delivered meal participants had annual household incomes below 100 percent of the DHHS federal poverty guidelines (Table III.1). (For a one-person household, this corresponds to $11,770.) Most of the rest had annual household incomes between 100 and 200 percent of the poverty guidelines. Only about one-quarter of congregate and 20 percent of home-delivered meal participants had annual household incomes above 200 percent of the poverty guidelines.

Table III.1. Selected demographic and household characteristics of Nutrition Services Program participants

Characteristic	Congregate meal participants	Home-delivered meal participants
Age		
74 and younger	41.2	20.9
75 and older	58.8	79.1
Average age (years)	77.3	81.8
Gender		
Male	33.1	31.5
Female	66.9	68.5
Military service		
Veteran	16.1	15.8
Nonveteran	83.9	84.2
Highest grade level completed		
Completed less than high school	24.2	41.5
High school graduate, GED, or equivalent	75.8	58.5
Race/ethnicity		
Non-Hispanic black	13.8	17.7
Hispanic	13.8	9.2
Marital status		
Married or living with partner	23.8	23.2
Widowed	48.8	51.4
Divorced, separated, or never married	27.3	25.4
Number of other people living in household		
Live alone	60.4	62.9
1	28.8	24.1
2 or more	10.9	13.0
Urbanicity		
Urban	72.3	74.9
Rural	27.7	25.1
Monthly income-to-poverty ratio[a]		
0 to 100	31.2	34.6
101 to 200	45.7	45.8
201 and above	23.1	19.6

Source: AoA NSP outcomes survey, 2015-2016, weighted data.

Note: All units are percentages, unless otherwise noted.

Tabulations restricted to survey respondents who had valid matches to Medicare administrative records and were not participating in Medicare Advantage for the full year.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants. Individual estimates within the table may have slightly fewer observations due to item nonresponse to individual questions.

[a] Income-to-poverty based on DHHS' poverty guidelines (https://aspe.hhs.gov/2015-poverty-guidelines).

2. Health status, functional ability, and mobility

Compared to congregate meal participants, a greater percentage of home-delivered meal participants reported being in fair or poor health and taking multiple medications. About half of home-delivered meal participants reported being in fair or poor health, compared to 21 percent of congregate meal participants (Table III.2). Many older adults take multiple medications concurrently: 68 percent of congregate meal participants and 82 percent of home-delivered meal participants reported taking three or more prescription medications daily.

Table III.2. Selected health, functional ability, and mobility characteristics of Nutrition Services Program participants (percentages)

Characteristic	Congregate meal participants	Home-delivered meal participants
General health		
Excellent, very good, or good	78.7	50.2
Fair or poor	21.3	49.8
Number of prescription medications taken every day		
0	10.3	2.2
1 or 2	21.5	15.6
3 or more	68.2	82.2
Number of falls in the past three months		
0	76.8	68.3
1	18.4	15.2
2 or more	4.7	16.6
Number of falls in the past three months that caused an injury		
0	83.0	48.8
1 or more	17.0	51.2
Mobility		
Able to walk	99.5	88.3
Able to walk, but has difficulty walking or climbing stairs	37.9	69.1

Source: AoA NSP outcomes survey, 2015-2016, weighted data.

Note: Tabulations restricted to survey respondents that had valid matches to Medicare administrative records and were not participating in Medicare Advantage for the full year.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants. Individual estimates within the table may have slightly fewer observations due to item nonresponse to individual questions.

The prevalence of recent falls and injuries from falls was much higher for home-delivered meal participants than for congregate meal participants. Seventeen percent of home-delivered meal participants reported having had two or more falls during the past three months compared with 5 percent of congregate meal participants. Among those individuals who experienced a fall, 51 percent of home-delivered meal participants reported a fall that had resulted in an injury, compared with 17 percent for congregate meal participants (Table III.2).

A substantial proportion of home-delivered meal participants reported functional impairments and needed help performing one or more activities critical for them to remain in their homes. Less than 1 percent of congregate meal participants were not able to walk and 38 percent had difficulty climbing stairs; in comparison, 12 percent of home-delivered meal participants could not walk and 69 percent had difficulty climbing stairs (Table III.2).

B. Health and Medicare enrollment characteristics of participants

HCC scores are a summary measure of Medicare beneficiaries' health risk, or more specifically, the relative risk for subsequent health care expenditures, with higher scores reflecting greater health risk. In 2015, the national average score among all Medicare FFS beneficiaries was 1.0 (Pope et al. 2004). The average HCC risk score was below the national average for congregate meal participants (equal to 0.8) and was slightly above the national average for home-delivered participants (equal to 1.1) (Table III.3). At least 25 percent of congregate meal participants had a score that was at most 0.6, whereas another 25 percent had a score that was at least 1.2. For home-delivered meal participants, these scores were 0.9 and 1.2,

respectively. The scores suggest that congregate meal participants have slightly better health, and home-delivered meal participants have slightly worse health relative to the average older adult Medicare beneficiary. The scores generally did not vary by income or participants' living arrangement.

Table III.3. HCC score, dual enrollment status, and original reason for Medicare eligibility among Nutrition Services Program participants, by household income and living arrangement

Variable	All individuals	Individuals in lower-income households	Individuals in higher-income households	Individuals who live with other family members	Individuals who live alone
Congregate meal participants					
HCC score					
Mean	0.8	0.9	0.8	0.8	0.9
25th percentile	0.6	0.6	0.6	0.6	0.6
50th percentile (median)	0.9	0.9	0.9	0.9	0.9
75th percentile	1.2	1.2	1.2	1.2	1.2
Dual enrollment status	29.8	52.3	7.3	20.8	35.6
Original reason for Medicare eligibility					
Old age and survivor's insurance	85.4	84.7	86.2	86.5	84.8
Disability insurance benefits	14.6	15.3	13.8	13.5	15.2
End-stage renal disease	0.0	0.0	0.0	0.0	0.0
Home-delivered meal participants					
HCC score					
Mean	1.1	1.1	1.2	1.2	1.1
25th percentile	0.9	0.9	0.9	0.9	1.0
50th percentile (median)	1.2	1.2	1.2	1.2	1.2
75th percentile	1.2	1.2	1.2	1.2	1.2
Dual enrollment status	39.4	64.5	16.1	38.6	39.9
Original reason for Medicare eligibility					
Old age and survivor's insurance	84.0	83.8	84.1	90.6	80.0
Disability insurance benefits	16.0	16.1	15.9	9.2	20.0
End-stage renal disease	0.0	0.1	0.0	0.1	0.0

Source: Medicare claims and enrollment data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: All units are percentages, unless otherwise noted.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants.

The percentages of NSP participants who were dually eligible for Medicare and Medicaid were much larger than the national average of 19.5 percent (CMS 2016). Nearly one-third (30 percent) of congregate meal participants and more than one-third (39 percent) of home-delivered meal participants were dually eligible for Medicare and Medicaid (Table III.3). As expected, lower-income participants were much more likely than higher-income participants to be dually eligible (52 versus 7 percent among congregate meal participants and 65 versus 16 percent among home-delivered meal participants). The percentage was nearly twice as large for congregate meal participants who lived alone than for those who lived with others (36 versus 21 percent); this difference was not present for home-delivered meal participants (40 versus 39 percent).

For the majority of congregate and home-delivered meal participants (85 and 84 percent, respectively), the original reason for Medicare eligibility was age (65 or older) (Table III.3). Compared with Medicare beneficiaries nationwide, congregate and home-delivered meal participants were less likely to have disability as the original reason for being entitled to Medicare coverage. About 14 percent of congregate meal participants and 16 percent of home-delivered meal participants were originally eligible because they had a disability, compared with 24 percent nationwide.[14] The original reason for eligibility generally did not vary by income or participants' living arrangement. Home-delivered meal participants who lived alone were an exception; the percentage of these participants who were originally eligible for Medicare because they had a disability was more than twice the share of those who lived with others (20 versus 9 percent).

About 74 percent of congregate meal participants had at least one chronic condition (Table III.4).[15] Nearly 50 percent had one or two conditions and 8 percent had at least five conditions. The most common were diabetes with complications (25 percent), specified heart arrhythmias (19 percent), diabetes without complication (16 percent), vascular disease (15 percent), and congestive heart failure (15 percent) (Table III.5). Although having a chronic condition did not differ much by income, the percentage of participants with at least three conditions was much higher for lower-income individuals than for higher-income individuals (31 versus 19 percent). Individuals who lived alone were also more likely than those who lived with other family members to have three or more chronic conditions.

[14] National percentage includes all individuals age 65 and older and includes Medicare beneficiaries not in Medicare FFS.

[15] The chronic condition information presented in this report are based on Medicare claims and enrollment data and may differ from the health condition information in the National Survey of Older American Act Participants (https://agid.acl.gov/CustomTables/NPS/Year/) that participants self-report. The classification of conditions also differs across the two data sources.

Table III.4. Number of chronic conditions among Nutrition Services Program participants, by household income and living arrangement

Variable	All individuals	Individuals in lower-income households	Individuals in higher-income households	Individuals who live with other family members	Individuals who live alone
Congregate meal participants					
Number of chronic conditions					
0	26.4	26.3	26.5	27.8	25.5
1	30.0	29.2	30.8	29.9	30.1
2	18.4	13.1	23.8	20.9	16.8
3	11.9	16.0	7.9	7.5	14.8
4	5.7	3.0	8.4	6.7	5.0
5 or more	7.6	12.6	2.6	7.2	7.8
Mean	1.7	1.8	1.5	1.6	1.7
Home-delivered meal participants					
Number of chronic conditions					
0	18.7	21.5	16.1	20.2	17.8
1	28.7	28.3	29.1	29.7	28.2
2	17.2	15.6	18.7	16.0	18.0
3	13.0	10.2	15.7	12.2	13.5
4	11.6	10.2	13.0	13.4	10.6
5 or more	10.7	14.2	7.4	8.6	12.0
Mean	2.1	2.1	2.1	2.0	2.1

Source: Medicare claims and enrollment data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: All units are percentages, unless otherwise noted.

Incidence of chronic conditions measured at the end of 2014 before the 2015–2016 survey was conducted.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants.

More than 80 percent of home-delivered meal participants had at least one chronic condition (Table III.4). Slightly less than 50 percent had one or two conditions and 22 percent had at least four conditions. The most common were diabetes with complications (24 percent), vascular disease (22 percent), congestive heart failure (21 percent), and chronic obstructive pulmonary disease, fibrosis of the lung, and other chronic lung disorders (20 percent) (Table III.5). Lower-income individuals were less likely to have a chronic condition (79 versus 84 percent), but were twice as likely to have at least five chronic conditions (14 versus 7 percent). Individuals who lived alone were also more likely than those who lived with other family members to have a chronic condition (82 versus 80 percent).

Table III.5. Most common chronic conditions among Nutrition Services Program participants, by household income and living arrangement (percentages)

Condition	All individuals	Individuals in lower-income households	Individuals in higher-income households	Individuals who live with other family members	Individuals who live alone
Congregate meal participants					
Diabetes with complications	24.7	26.8	22.6	24.9	24.5
Specified heart arrhythmias	18.9	20.9	16.9	14	22.1
Diabetes without complication	16.2	18.4	13.9	15	16.9
Vascular disease	15.2	14.4	16.1	18.8	12.9
Congestive heart failure	15.1	17.9	12.2	17.5	13.5
Major depressive, bipolar, paranoid disorders, and schizophrenia	10.7	9.5	11.9	3.9	15.2
Rheumatoid arthritis and inflammatory connective tissue disease	7.1	5.6	8.7	6.7	7.4
Chronic obstructive pulmonary disease, fibrosis of lung, and other chronic lung disorders	7.1	7.5	6.7	8	6.5
Coagulation defects and hematological disorders	6.5	4.9	8.2	6.7	6.4
Ischemic heart disease or angina	5.3	6.0	4.5	8.2	3.3
Home-delivered meal participants					
Diabetes with complications	24.0	28.1	20.2	25.5	23.1
Vascular disease	21.9	18.3	25.3	12.7	27.5
Congestive heart failure	21.4	23.3	19.7	19.1	22.7
Chronic obstructive pulmonary disease, fibrosis of lung, and other chronic lung disorders	19.7	17.5	21.8	14.4	22.9
Diabetes without complication	14.8	16.6	13.2	24	9.3
Specified heart arrhythmias	14.6	11.1	17.9	15.9	13.9
Stroke/transient ischemic attack	8.1	8.9	7.4	14.6	4.2
Breast, prostate, and other cancers and tumors	7.7	6.7	8.6	10.1	6.2
Coagulation defects and hematological disorders	6.9	3.5	10	4.6	8.2
Drug/alcohol psychosis or dependence/cirrhosis of liver	6.4	3.9	8.7	2.9	8.5

Source: Medicare claims and enrollment data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Incidence of chronic conditions measured at the end of 2014 before the 2015–2016 survey was conducted.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants.

Table presents the 10 most common conditions for all congregate and home-delivered meal participants and the corresponding rates for participants by income and living arrangement. See Tables B.1 to B.3 for the prevalence of the full set of chronic conditions for each income and family subgroup.

C. Health care utilization and Medicare expenditures among participants

Many congregate meal participants had at least one emergency department visit, hospital admission, or other type of health event during the nine months before the 2015–2016 survey interview. About 5 percent of participants had an emergency department visit leading to a hospital admission, 8 percent had a hospital admission (with or without an emergency department visit), and 1 percent had a readmission within 30 days of hospital discharge (Table III.6). Emergency department visits not resulting in an inpatient stay were common, with 29 percent of participants having at least one visit in the nine-month period. Some participants (6 percent) experienced a home health episode and few (2 percent) had an admission to a skilled nursing facility. Three-quarters of participants visited a primary care physician. With the exception of primary care physician visits, participants who experienced each event did so about twice, on average, through the nine-month period.

The likelihood of experiencing these health events was dramatically higher for home-delivered meal participants than for congregate meal participants. About 21 percent of participants had an emergency department visit leading to a hospital admission, 26 percent had a hospital admission (with or without an emergency department visit), and 4 percent had a readmission within 30 days of hospital discharge (Table III.6). The prevalence of outpatient visits was only slightly greater for home-delivered meal participants than for congregate meal participants (30 versus 29 percent). However, home health episodes and admission into skilled nursing facilities were much higher (42 versus 6 percent and 6 versus 2 percent, respectively). Participants who experienced each event did so about twice, on average, through the nine-month period, with the exception of primary care visits and home health episodes, which occurred seven and four times on average, respectively.

Table III.6. Health care utilization among Nutrition Services Program participants

Outcome	Congregate meal participants	Home-delivered meal participants
Experienced the event (%)		
Hospital admission	7.9	25.6
30-day hospital readmission	1.2	4.3
Emergency department visit leading to a hospital admission	5.3	21.3
Outpatient emergency department visit	28.5	30.1
Primary care physician visit in any setting	76.0	82.2
Home health episode	6.3	41.7
Skilled nursing facility admission	2.0	6.1
Number of times the event occurred among those who experienced the event		
Hospital admission	1.7	1.9
Emergency department visit leading to a hospital admission	1.9	2.0
Outpatient emergency department visit	2.1	2.6
Primary care physician visit in any setting	6.8	7.0
Home health episode	1.7	3.5
Skilled nursing facility admission	1.6	1.4

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Utilization was measured in the nine months preceding the survey interview for each participant.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants.

For congregate meal participants, there were several differences by income and living arrangement in the likelihood of experiencing health events and in the number of events that occurred. The percentage of participants with a hospital admission was similar for lower- and higher-income individuals (8 percent), but the percentage with a readmission within 30 days after discharge was 2 percent for lower-income individuals and close to 0 percent for higher-income individuals (Table III.7). Outpatient emergency department visits were also much more common among lower-income individuals (33 versus 24 percent). The likelihood of experiencing a health event was higher for individuals who lived alone than for those who lived with other family members for outpatient emergency department visits (33 versus 23 percent), but was lower for hospital admissions (7 versus 10 percent) and hospital readmissions (0 versus 3 percent). Among those who experienced an event, more events occurred for lower-income participants than for higher-income participants for home health episodes and skilled nursing facility admissions (2 times versus 1 time for both outcomes). The number of events that occurred was similar for individuals who lived alone and those who lived with others with the exception of skilled nursing facility admissions (2 times for individuals who lived with other family members and 1 time for individuals who lived alone).

Table III.7. Health care utilization among congregate meal participants, by household income and living arrangement

Outcome	All individuals	Individuals in lower-income households	Individuals in higher-income households	Individuals who live with other family members	Individuals who live alone
Experienced the event (%)					
Hospital admission	7.9	8.0	7.9	9.9	6.6
30-day hospital readmission	1.2	2.2	0.2	2.7	0.2
Emergency department visit leading to a hospital admission	5.3	4.1	6.4	5.6	5.1
Outpatient emergency department visit	28.5	32.9	24.1	22.5	32.5
Primary care physician visit in any setting	76.0	75.8	76.1	77.3	75.1
Home health episode	6.3	6.7	5.9	6.7	6.0
Skilled nursing facility admission	2.0	1.8	2.3	1.9	2.1
Number of times the event occurred among those who experienced the event					
Hospital admission	1.7	1.7	1.8	1.7	1.7
Emergency department visit leading to a hospital admission	1.9	2.0	1.8	2.1	1.7
Outpatient emergency department visit	2.1	2.0	2.3	2.1	2.1
Primary care physician visit in any setting	6.8	7.1	6.5	6.1	7.3
Home health episode	1.7	2.0	1.4	1.7	1.7
Skilled nursing facility admission	1.6	1.9	1.3	2.0	1.3

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Utilization was measured in the nine months preceding the survey interview for each participant.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants.

For home-delivered meal participants, there were also sizable differences by income and living arrangement in the likelihood of experiencing health events. Although hospital admission rates were similar for lower- and higher-income individuals (25 versus 27 percent), the percentage of participants with a readmission within 30 days of being discharged was 9 percent for lower-income participants and close to 0 percent for higher-income participants (Table III.8). Outpatient emergency department visits were also more common for lower-income participants (34 versus 26 percent), whereas primary care visits were higher among higher-income individuals (85 versus 79 percent). Individuals who lived alone were more likely than those who lived with other family members to experience each health event, with the exception of a skilled nursing facility admission. The largest differences were in hospital admissions (30 versus 19 percent), emergency department visits leading to a hospital admission (25 versus 14 percent), and home health episodes (47 versus 33 percent). The number of events that occurred was greater for lower-income participants than for higher-income participants for outpatient emergency department visits (3 versus 2 times), but were roughly similar for individuals who lived alone and those who lived with others.

Table III.8. Health care utilization among home-delivered meal participants, by household income and living arrangement

Outcome	All individuals	Individuals in lower-income households	Individuals in higher-income households	Individuals who live with other family members	Individuals who live alone
Experienced the event (%)					
Hospital admission	25.6	24.6	26.5	18.8	29.6
30-day hospital readmission	4.3	8.5	0.4	1.7	5.8
Emergency department visit leading to a hospital admission	21.3	21.1	21.5	14.4	25.3
Outpatient emergency department visit	30.1	34.3	26.2	26.7	32.1
Primary care physician visit in any setting	82.2	78.7	85.3	75.9	85.8
Home health episode	41.7	40.7	42.5	32.5	47.1
Skilled nursing facility admission	6.1	7.0	5.3	8.2	4.9
Number of times the event occurred among those who experienced the event					
Hospital admission	1.9	2.1	1.7	1.7	2.0
Emergency department visit leading to a hospital admission	2.0	2.2	1.7	1.7	2.0
Outpatient emergency department visit	2.6	3.0	2.1	2.9	2.4
Primary care physician visit in any setting	7.0	7.6	6.5	6.3	7.3
Home health episode	3.5	3.9	3.1	3.4	3.5
Skilled nursing facility admission	1.4	1.4	1.4	1.5	1.3

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Utilization was measured in the nine months preceding the survey interview for each participant.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants.

The amount of Medicare expenditures capture the extent to which participants experience health events, as well as the types of events and how long they last. Average monthly Medicare expenditures in the nine months preceding the first interview were lower than the national average in 2015 of $878 per beneficiary per month for congregate meal participants ($631) (Table III.9)[16]. Nearly all participants (91 percent) had non-zero expenditures. Approximately 91 percent of participants had expenditures for physician and non-institutional services and 72 percent had expenditures for outpatient services. Most participants did not have expenditures for inpatient, skilled nursing facility, and home health services. Average expenditures for inpatient and skilled nursing facility services were greatest among participants who received these services compared to other types of services ($2,314 and $1,129, respectively).

Average expenditures were nearly twice as large for home-delivered meal participants than for congregate meal participants ($1,223 versus $631) (Table III.9). Nearly all participants (96 participant) had non-zero expenditures. Like congregate meal participants, home-delivered meal participants were most likely to have expenditures for physician and non-institutional services (94 percent) and outpatient services (74 percent). Unlike congregate meal participants, however, many home-delivered meal participants (42 percent) had expenditures for home health services. The average expenditure for home health services was $777 among those participants who received them.

Congregate meal participants' average Medicare expenditures were greater for lower-income individuals than for higher-income individuals ($739 versus $641 per month among those with non-zero expenditures) (Table III.10). Average expenditures were greater for lower-income individuals than for higher-income individuals for all types of services, except inpatient services. Home-delivered meal participants' Medicare expenditures were similar for lower-income individuals and higher-income individuals ($1,284 versus $1,261 per month among those with non-zero expenditures), reflecting lower-income participants having greater expenditures on inpatient services ($1,931 versus $1,421 per month) and physician and non-institutional services ($239 versus $221 per month), but lower expenditures on the other types of services. For both congregate and home-delivered meal participants, individuals who lived alone had greater expenditures than those who lived with other family members ($727 versus $637 for congregate meal participants and $1,360 versus $1,119 per month for home-delivered meal participants).

[16] The national average for total Part A and Part B Medicare expenditures of $878 per beneficiary per month for 2015 includes all seven types of Medicare claims. However, total Medicare expenditures in this analysis of congregate meal and home-delivered meal participants exclude expenditures on hospice and durable medical equipment services.

Table III.9. Monthly Medicare expenditures among Nutrition Services Program participants

Expenditure	Congregate meal participants	Home-delivered meal participants
Total Medicare expenditures		
Percentage of participants with non-zero expenditures	91.4	96.1
Average among those with non-zero expenditures	$690	$1,272
Average among all participants	$631	$1,223
Inpatient		
Percentage of participants with non-zero expenditures	8.0	25.2
Average among those with non-zero expenditures	$2,314	$1,660
Average among all participants	$184	$419
Outpatient		
Percentage of participants with non-zero expenditures	72.0	74.4
Average among those with non-zero expenditures	$287	$246
Average among all participants	$207	$183
Skilled nursing facility		
Percentage of participants with non-zero expenditures	2.0	6.0
Average among those with non-zero expenditures	$1,129	$1,356
Average among all participants	$23	$82
Home health		
Percentage of participants with non-zero expenditures	6.3	41.6
Average among those with non-zero expenditures	$340	$777
Average among all participants	$21	$324
Physician services		
Percentage of participants with non-zero expenditures	91.1	93.6
Average among those with non-zero expenditures	$215	$230
Average among all participants	$196	$215

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Expenditures were measured in the nine months preceding the survey interview for each participant.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants.

Table III.10. Monthly Medicare expenditures among Nutrition Services Program participants, by household income and living arrangement

Expenditure	All individuals	Individuals in lower-income households	Individuals in higher-income households	Individuals who live with other family members	Individuals who live alone
Congregate meal participants					
Total Medicare expenditures					
Percentage with non-zero expenditures	91.4	92.0	90.8	93.1	90.3
Average[a]	$690	$739	$641	$637	$727
Inpatient					
Percentage with non-zero expenditures	8.0	8.0	8.0	9.5	6.9
Average[a]	$2,314	$2,097	$2,531	$2,280	$2,345
Outpatient					
Percentage with non-zero expenditures	72.0	73.6	70.4	70.7	72.8
Average[a]	$287	$340	$233	$206	$340
Skilled nursing facility					
Percentage with non-zero expenditures	2.0	1.8	2.3	1.9	2.1
Average[a]	$1,129	$1,367	$940	$1,223	$1,073
Home health					
Percentage with non-zero expenditures	6.3	6.7	5.9	6.7	6.0
Average[a]	$340	$379	$295	$377	$313
Physician and non-institutional services					
Percentage with non-zero expenditures	91.1	91.7	90.5	92.4	90.2
Average[a]	$215	$233	$197	$197	$228
Home-delivered meal participants					
Total Medicare expenditures					
Percentage with non-zero expenditures	96.1	97.5	94.8	94.7	96.9
Average[a]	$1,272	$1,284	$1,261	$1,119	$1,360
Inpatient					
Percentage with non-zero expenditures	25.2	24.6	25.8	18.8	29.0
Average[a]	$1,660	$1,931	$1,421	$1,700	$1,644
Outpatient					
Percentage with non-zero expenditures	74.4	76.4	72.5	69.4	77.3
Average[a]	$246	$202	$289	$205	$268
Skilled nursing facility					
Percentage with non-zero expenditures	6.0	7.0	5.2	8.0	4.9
Average[a]	$1,356	$1,097	$1,676	$1,617	$1,106
Home health					
Percentage with non-zero expenditures	41.6	40.7	42.4	32.3	47.1
Average[a]	$777	$777	$777	$839	$752
Physician and non-institutional services					
Percentage with non-zero expenditures	93.6	95.8	91.6	89.2	96.3
Average[a]	$230	$239	$221	$223	$234

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Expenditures were measured in the nine months preceding the survey interview for each participant.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants.

[a] Average expenditures estimated among those participants with non-zero expenditures.

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IV. CONGREGATE AND HOME-DELIVERED MEAL PARTICIPATION AND PARTICIPANTS' OUTCOMES

This chapter presents estimates of the effects of congregate and home-delivered meal participation on participants' health care utilization outcomes. The descriptive tabulations of outcomes presented in the previous chapter characterize the population of congregate and home-delivered meal participants. The findings presented in this chapter describe how participation in congregate and home-delivered meal programs affects these outcomes. The findings are based on multivariate analyses that account for observed differences between participants and matched nonparticipants. These findings are referred to as regression-adjusted findings.[17]

This chapter presents findings about the impact of program participation on three sets of outcomes: whether health events occurred in a specific period of time, the number of events that occurred among those individuals who experienced them, and the total Medicare cost associated with the events. Section A examines impacts on health care utilization that occurred prior to the initial interview, comparing outcomes of participants with those of nonparticipants in the 9-month period preceding the survey interview ("pre-interview impacts"). Section B compares outcomes over the 12-month period following the survey interview ("post-interview impacts"). Unless stated otherwise, all differences between participants and nonparticipants are statistically significant at the 0.10, 0.05, or 0.01 levels (specified in the tables).

A. Congregate and home-delivered meal participation and pre-interview impacts on health care utilization

Overall, congregate meal participants were less likely than nonparticipants to have a hospital admission and have an emergency department visit that led to a hospital admission. Although there were no differences between participants and nonparticipants in the likelihood of experiencing a home health episode, participants experienced nearly half as many episodes as nonparticipants. These program effects were generally evident for lower-income individuals, but not higher-income individuals, and for individuals living alone, but not individuals living with other family members. In contrast, home-delivered meal participants were more likely than nonparticipants to have an emergency department visit leading to a hospital admission and to have a home health episode. For those who had an emergency department visit leading to a hospital admission, home-delivered meal participants were more likely to experience slightly more of them.

1. Congregate meal participation

The percentage of congregate meal participants with a hospital admission in the nine months preceding the interview was 5.2 percentage points lower than the percentage of nonparticipants (8.5 versus 13.7 percent; Table IV.1). Similarly, the percentage of congregate meal participants who had an emergency department visit leading to a hospital admission was 5.0 percentage

[17] The utilization statistics presented in this chapter differ from the descriptive statistics presented in Chapter III because they have been regression-adjusted. Appendix A describes the regression-adjustment process.

points lower than the percentage of nonparticipants (5.4 versus 10.4 percent). There were no statistically significant differences between the percentages of congregate meal participants and nonparticipants experiencing other health events such as a readmission within 30 days of hospital discharge, experiencing a home health episode, and admission to a skilled nursing facility.

Among individuals who had a home health episode in the nine months preceding the interview, congregate meal participants experienced almost one episode less than nonparticipants (1.8 versus 2.6 episodes per year; Table IV.1). For all other types of health events, however, there were no statistically significant differences between congregate meal participants and nonparticipants in the average number of times the events occurred. Average monthly Medicare expenditures in the nine months preceding the interview were lower for congregate meal participants relative to nonparticipants ($619 versus $688 per beneficiary per month), although the difference was not statistically significant.

2. Home-delivered meal participation

The percentage of home-delivered meal participants who had an emergency department visit leading to a hospital admission was 10.0 percentage points higher than the percentage of nonparticipants (18.0 versus 8.1 percent; Table IV.2). Similarly, the percentage of participants who had experienced a home health episode was 15.3 percentage points higher than the percentage of nonparticipants (35.0 versus 19.7 percent). There were no statistically significant differences between the percentages of home-delivered meal participants and nonparticipants experiencing other health events.

Among individuals who experienced health events in the nine months preceding the interview, home-delivered meal participants experienced more emergency department visits leading to a hospitalization and fewer primary care physician visits, on average, than did nonparticipants. The average number of emergency department visits leading to a hospital admission was marginally higher for participants than nonparticipants (2.1 versus 1.4 visits; Table IV.2). In contrast, the average number of primary care physician visits was lower for participants than nonparticipants (6.3 versus 7.6 visits). The number of hospital admissions, outpatient emergency department visits, home health episodes, and skilled nursing facility admissions were statistically similar for participants and nonparticipants. The differences in the likelihood of experiencing emergency department visits leading to a hospital admission and home health episodes, and the differences in the frequency of several of the events, resulted in slightly higher average monthly Medicare expenditures for home-delivered meal participants than nonparticipants in the nine months preceding the interview ($1,102 versus $964 per beneficiary per month), though the difference was not statistically significant.

Table IV.1. Regression-adjusted percentages of individuals who experienced health events, the number of events they experienced, and total Medicare spending, by congregate meal participation status

	Participants		Nonparticipants		Difference	
Outcome	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Experienced the event (%)						
Hospital admission	8.5	(1.8)	13.7	(2.0)	-5.2*	(2.9)
30-day hospital readmission	1.4	(0.6)	2.3	(0.9)	-0.9	(1.2)
Emergency department visit leading to a hospital admission	5.4	(1.5)	10.4	(2.1)	-5.0*	(2.8)
Outpatient emergency department visit	28.7	(2.5)	22.8	(3.1)	5.9	(3.9)
Primary care physician visit in any setting	75.8	(3.2)	74.2	(2.8)	1.6	(4.0)
Home health episode	7.1	(1.3)	8.1	(1.7)	-1.0	(2.4)
Skilled nursing facility admission	3.0	(1.2)	2.2	(1.1)	0.8	(1.7)
Number of times the event occurred among those who experienced the event						
Hospital admission	1.8	(0.1)	1.8	(0.2)	0.0	(0.2)
Emergency department visit leading to a hospital admission	1.7	(0.1)	1.9	(0.1)	-0.2	(0.2)
Outpatient emergency department visit	2.1	(0.2)	2.1	(0.2)	0.0	(0.3)
Primary care physician visit in any setting	6.8	(0.5)	6.6	(0.5)	0.3	(0.7)
Home health episode	1.8	(0.2)	2.6	(0.2)	-0.8*	(0.4)
Skilled nursing facility admission	NA	NA	NA	NA	NA	NA
Average total Medicare expenditures[a] ($)	619	(84)	688	(90)	-69	(118)

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Estimates are based on an unweighted sample size of 683 congregate meal participants and nonparticipants.

[a] Total expenditures exclude expenditures for durable medical equipment and hospice care.

*Significantly different from zero at the .10 level, two-tailed test.

NA = not available due to small sample size.

Table IV.2. Regression-adjusted percentages of individuals who experienced health events, the number of events they experienced, and total Medicare spending, by home-delivered meal participation status

	Participants		Nonparticipants		Difference	
Outcome	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Experienced the event (%)						
Hospital admission	21.8	(2.3)	16.4	(2.8)	5.3	(3.5)
30-day hospital readmission	3.2	(1.0)	3.6	(0.9)	-0.4	(1.2)
Emergency department visit leading to a hospital admission	18.0	(2.2)	8.1	(2.0)	10.0***	(3.0)
Outpatient emergency department visit	28.6	(2.7)	31.4	(3.8)	-2.7	(4.3)
Primary care physician visit in any setting	80.3	(2.2)	82.6	(2.8)	-2.3	(3.7)
Home health episode	35.0	(3.2)	19.7	(3.0)	15.3***	(4.4)
Skilled nursing facility admission	5.4	(1.0)	3.1	(0.8)	2.2	(1.4)
Number of times the event occurred among those that experienced the event						
Hospital admission	1.9	(0.1)	1.7	(0.2)	0.2	(0.3)
Emergency department visit leading to a hospital admission	2.1	(0.1)	1.4	(0.2)	0.7***	(0.2)
Outpatient emergency department visit	2.3	(0.1)	2.5	(0.2)	-0.2	(0.2)
Primary care physician visit in any setting	6.3	(0.4)	7.6	(0.5)	-1.3*	(0.7)
Home health episode	3.6	(0.1)	3.0	(0.3)	0.6	(0.4)
Skilled nursing facility admission	1.3	(0.1)	1.6	(0.3)	-0.3	(0.4)
Average total Medicare expenditures[a] ($)	1,102	(120)	964	(133)	138	(146)

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Estimates are based on an unweighted sample size of 658 home-delivered meal participants and nonparticipants.

[a] Total expenditures exclude expenditures for durable medical equipment and hospice care.

***Significantly different from zero at the .01 level, two-tailed test.

*Significantly different from zero at the .10 level, two-tailed test.

3. Differences by income and living arrangement

As described in Chapter II, the research team assessed whether program impacts varied by household income and individuals' living arrangement (that is, whether they lived alone or with other family members). The sections below summarize these findings.

Congregate meal participants and nonparticipants. Among lower-income individuals, the percentage of congregate meal participants with a hospital admission in the nine months

preceding the interview was 8.6 percentage points lower than the percentage of nonparticipants (9.1 versus 17.7 percent; Table IV.3). The percentage who had an emergency department visit leading to a hospital admission was 11.4 percentage points lower than the percentage of nonparticipants (4.5 versus 15.9 percent). In contrast, among higher-income individuals there were no statistically significant differences for either outcome between participants and nonparticipants. Although there was no difference in the full sample in the percentage of participants and nonparticipants who had an outpatient emergency department visit or had an admission to a skilled nursing facility, lower-income participants were more likely than lower-income nonparticipants to have one of these visits.

Because individuals might experience health events differently if they live with other family members, the research team also assessed the effect of participation in congregate meal programs on the likelihood of health events occurring and whether it differed for individuals who lived with other family members and individuals who lived alone. For individuals who lived alone, congregate meal participants were less likely than nonparticipants to have a hospital admission or have an emergency department visit that led to a hospitalization (6.3 versus 14.1 percent for hospital admissions and 5.0 versus 11.3 percent for emergency department visits leading to a hospital admission); for individuals who lived with other family members, there were no significant differences in these outcomes between participants and nonparticipants.

Table IV.3. Regression-adjusted percentages of individuals who experienced health events in the nine months before the interview, by congregate meal participation status, household income, and living arrangement

	Participants		Nonparticipants		Difference	
Outcome	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Hospital admission (%)						
Full sample	8.5	(1.8)	13.7	(2.0)	-5.2*	(2.9)
Lower-income individuals	9.1	(2.3)	17.7	(3.1)	-8.6**	(4.0)
Higher-income individuals	7.3	(2.3)	10.5	(2.2)	-3.2	(3.4)
Individuals who live alone	6.3	(1.7)	14.1	(2.8)	-7.8**	(3.5)
Individuals who live with other family members	10.9	(2.6)	14.7	(2.7)	-3.7	(4.3)
30-day hospital readmission (%)						
Full sample	1.4	(0.6)	2.3	(0.9)	-0.9	(1.2)
Lower-income individuals	4.2	(1.3)	4.8	(2.1)	-0.7	(2.5)
Higher-income individuals	0.3	(0.4)	1.6	(0.9)	-1.3	(1.0)
Individuals who live alone	1.5	(0.3)	1.2	(0.9)	-1.1	(1.0)
Individuals who live with other family members	5.8	(1.9)	4.9	(1.1)	0.8	(1.5)
Emergency department visit leading to a hospital admission (%)						
Full sample	5.4	(1.5)	10.4	(2.1)	-5.0*	(2.8)
Lower-income individuals	4. 5	(1.9)	15.9	(3.2)	-11.4***	(4.1)
Higher-income individuals	5.9	(1.8)	5.6	(1.9)	0.3	(2.7)

Table IV.3. (continued)

Outcome	Participants		Nonparticipants		Difference	
	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Individuals who live alone	5.0	(1.7)	11.3	(2.6)	-6.3*	(3.4)
Individuals who live with other family members	6.0	(1.9)	9.9	(2.1)	-3.8	(3.1)
Outpatient emergency department visit (%)						
Full sample	28.7	(2.5)	22.8	(3.1)	5.9	(3.9)
Lower-income individuals	33.6	(3.8)	23.4	(4.7)	10.2*	(5.9)
Higher-income individuals	24.1	(2.8)	22.0	(3.2)	2.0	(4.4)
Individuals who live alone	33.0	(3.6)	19.9	(5.0)	13.1**	(6.3)
Individuals who live with other family members	21.9	(2.8)	26.9	(3.4)	-0.05	(4.7)
Primary care physician visit in any setting (%)						
Full sample	75.8	(3.2)	74.2	(2.8)	1.6	(4.0)
Lower-income individuals	75.3	(4.1)	72.9	(3.6)	2.4	(5.3)
Higher-income individuals	75.7	(3.6)	76.0	(3.8)	-0.3	(4.9)
Individuals who live alone	74.5	(3.7)	73.5	(3.7)	1.0	(5.6)
Individuals who live with other family members	78.2	(4.3)	74.3	(3.1)	3.9	(4.9)
Home health episode (%)						
Full sample	7.1	(1.3)	8.1	(1.7)	-1.0	(2.4)
Lower-income individuals	6.9	(1.5)	9.4	(3.7)	-2.5	(4.4)
Higher-income individuals	7.4	(1.5)	7.1	(1.7)	0.2	(2.6)
Individuals who live alone	6.2	(1.4)	5.5	(2.4)	0.7	(3.0)
Individuals who live with other family members	7.6	(1.8)	12.2	(2.0)	-4.6	(3.2)
Skilled nursing facility admission (%)						
Full sample	3.0	(1.2)	2.2	(1.1)	0.8	(1.7)
Lower-income individuals	2.0	(0.9)	0.0	(0.5)	2.3*	(1.3)
Higher-income individuals	2.2	(1.1)	4.4	(2.2)	-2.2	(2.1)
Individuals who live alone	2.1	(1.1)	3.0	(1.8)	-0.9	(1.9)
Individuals who live with other family members	3.6	(2.2)	2.5	(1.4)	1.1	(3.0)

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Estimates are based on an unweighted sample size of 683 congregate meal participants and nonparticipants.

***Significantly different from zero at the .01 level, two-tailed test.

**Significantly different from zero at the .05 level, two-tailed test.

*Significantly different from zero at the .10 level, two-tailed test.

Home-delivered meal participants and nonparticipants. With one exception, there were no differences by income in the likelihood of health events occurring for home-delivered meal participants and nonparticipants. In the full sample, the largest difference between participants and nonparticipants was in the likelihood of having a home health episode. The percentage of higher-income individuals who experienced an episode was 25.0 percentage points higher for home-delivered meal participants than for nonparticipants (40.1 versus 15.1 percent; Table IV.4), but there was no statistically significant difference for lower-income individuals.

Many of the differences in the likelihood of an event occurring between program participants and nonparticipants observed in the full sample pertained to individuals who lived alone rather than those who lived with other family members. Among those who lived alone, the percentage with a hospital admission, an emergency department visit that resulted in a hospital admission, or a home health episode was higher for home-delivered meal participants than nonparticipants. Although there was no statistically significant difference for the full sample, the percentage of individuals who had an admission to a skilled nursing facility was also higher for participants than for nonparticipants among those who lived alone.

Table IV.4. Regression-adjusted percentages of individuals who experienced health events in the nine months before the interview, by home-delivered meal participation status, household income, and living arrangement

	Participants		Nonparticipants		Difference	
Outcome	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Hospital admission (%)						
Full sample	21.8	(2.3)	16.4	(2.8)	5.3	(3.5)
Lower-income individuals	19.2	(2.9)	19.2	(3.8)	0.0	(4.2)
Higher-income individuals	22.3	(2.5)	16.7	(2.6)	5.6	(3.9)
Individuals who live alone	25.2	(2.8)	16.5	(3.6)	8.7*	(4.8)
Individuals who live with other family members	17.9	(3.4)	16.6	(3.7)	1.3	(6.1)
30-day hospital readmission (%)						
Full sample	3.2	(1.0)	3.6	(0.9)	-0.4	(1.2)
Lower-income individuals	6.3	(2.6)	2.8	(2.3)	3.5	(3.5)
Higher-income individuals	0.3	(0.6)	2.5	(1.2)	-2.2	(1.6)
Individuals who live alone	3.8	(1.8)	2.0	(1.3)	1.8	(2.3)
Individuals who live with other family members	2.4	(1.4)	2.8	(1.5)	-0.5	(1.4)
Emergency department visit leading to a hospital admission (%)						
Full sample	18.0	(2.2)	8.1	(2.0)	10.0***	(3.0)
Lower-income individuals	16.1	(2.1)	8.1	(2.6)	8.0***	(2.9)
Higher-income individuals	18.0	(2.2)	10.7	(2.2)	7.2**	(3.4)
Individuals who live alone	22.1	(2.7)	7.9	(2.3)	14.2***	(4.0)
Individuals who live with other family members	13.5	(2.7)	8.6	(2.6)	4.9	(4.0)

Table IV.4. (continued)

Outcome	Participants		Nonparticipants		Difference	
	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Outpatient emergency department visit (%)						
Full sample	28.6	(2.7)	31.4	(3.8)	-2.7	(4.3)
Lower-income individuals	34.9	(3.2)	31.3	(5.3)	3.6	(6.2)
Higher-income individuals	27.0	(3.4)	29.8	(5.5)	-2.8	(6.3)
Individuals who live alone	33.5	(4.3)	28.9	(4.5)	4.7	(5.9)
Individuals who live with other family members	26.6	(3.8)	28.5	(4.2)	-1.9	(6.0)
Primary care physician visit in any setting (%)						
Full sample	80.3	(2.2)	82.6	(2.8)	-2.3	(3.7)
Lower-income individuals	77.6	(2.5)	84.4	(3.4)	-6.8	(4.4)
Higher-income individuals	82.9	(2.8)	80.0	(4.1)	2.9	(5.2)
Individuals who live alone	84.3	(2.2)	82.1	(3.8)	2.2	(4.9)
Individuals who live with other family members	76.8	(5.0)	81.0	(3.5)	-4.1	(6.2)
Home health episode (%)						
Full sample	35.0	(3.2)	19.7	(3.0)	15.3***	(4.4)
Lower-income individuals	30.8	(3.2)	25.8	(3.3)	5.0	(4.4)
Higher-income individuals	40.1	(4.2)	15.1	(3.4)	25.0***	(5.6)
Individuals who live alone	40.8	(4.0)	14.8	(2.7)	26.0***	(5.2)
Individuals who live with other family members	28.6	(4.1)	22.9	(3.6)	5.7	(5.6)
Skilled nursing facility admission (%)						
Full sample	5.4	(1.0)	3.1	(0.8)	2.2	(1.4)
Lower-income individuals	4.9	(1.1)	2.4	(0.8)	2.4	(1.5)
Higher-income individuals	5.9	(1.3)	3.9	(0.9)	1.9	(1.8)
Individuals who live alone	4.8	(1.3)	1.7	(0.6)	3.1*	(1.6)
Individuals who live with other family members	8.1	(2.2)	4.8	(1.4)	3.3	(3.3)

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Estimates are based on an unweighted sample size of 658 congregate meal participants and nonparticipants.

***Significantly different from zero at the .01 level, two-tailed test.

**Significantly different from zero at the .05 level, two-tailed test.

*Significantly different from zero at the .10 level, two-tailed test.

B. Congregate and home-delivered meal participation and post-interview impacts on health care utilization

Overall, congregate meal participants were less likely than nonparticipants to have a nursing home admission within 12 months of the interview. The difference in admittance to a nursing home was over four times larger for lower-income individuals than for the full sample. Although there were no differences between participants and nonparticipants in the likelihood of an outpatient emergency department visit or an admission to a skilled nursing facility, among those who experienced these events, the number was slightly greater for participants than nonparticipants. In contrast, home-delivered meal participants were more likely than nonparticipants to have a hospital admission or readmission, to have an outpatient emergency department visit, and to have a nursing home admission. They also had higher average Medicare expenditures.

1. Congregate meal participation

The percentage of congregate meal participants with a nursing home admission in the 12 months following the interview was 2.3 percentage points lower than the percentage of nonparticipants (3.7 versus 6.0 percent; Table IV.5). There were no statistically significant differences between the percentages of participants and nonparticipants experiencing other health events such as having a hospital admission or experiencing a home health episode.

Among individuals who had an outpatient emergency department visit, in the 12 months following the interview, congregate meal participants had 0.8 more visits than nonparticipants (2.7 versus 1.9 visits per year; Table IV.5). Similarly, among individuals with at least one admission to a skilled nursing facility, the number of admissions was slightly higher for participants than nonparticipants (1.5 versus 1.1 per year). For all other types of health events, however, there were no statistically significant differences between congregate meal participants and nonparticipants in the average frequency of the event. Similarly, although average monthly Medicare expenditures were lower for participants than nonparticipants, the difference was not statistically significant.

2. Home-delivered meal participation

The percentage of home-delivered meal participants who had a hospital admission in the 12 months following the interview was 9.8 percentage points higher than the percentage of nonparticipants (31.6 versus 21.9 percent; Table IV.6). Relative to nonparticipants, participants also had higher hospital readmission rates within 30 days of being discharged (8.7 versus 3.3 percent) and rates of outpatient emergency department visits (48.3 versus 38.8 percent). Finally, the percentage of home-delivered participants with a nursing home admission in the 12 months following the interview was 9.1 percentage points higher than the percentage of nonparticipants (14.3 versus 5.2 percent).

Table IV.5. Regression-adjusted percentages of individuals who experienced health events, the number of events they experienced, and total Medicare spending in the 12 months following the interview, by congregate meal participation status

	Participants		Nonparticipants		Difference	
Outcome	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Experienced the event (%)						
Hospital admission	25.1	(2.9)	22.6	(2.9)	2.5	(3.8)
30-day hospital readmission	3.0	(1.0)	3.3	(1.0)	-0.3	(1.4)
Emergency department visit leading to a hospital admission	14.9	(2.0)	18.2	(2.7)	-3.3	(2.8)
Outpatient emergency department visit	34.0	(3.1)	32.5	(3.0)	1.4	(4.3)
Primary care physician visit in any setting	85.8	(2.5)	80.8	(2.6)	5.1	(3.5)
Home health episode	13.5	(1.7)	12.5	(1.9)	1.0	(3.1)
Nursing home admission	3.7	(0.6)	6.0	(1.2)	-2.3*	(1.3)
Skilled nursing facility admission	8.7	(1.8)	8.3	(1.9)	0.4	(2.9)
Number of times the event occurred among those who experienced the event						
Hospital admission	1.4	(0.1)	1.7	(0.1)	-0.3	(0.2)
Emergency department visit leading to a hospital admission	1.4	(0.1)	1.5	(0.1)	-0.1	(0.1)
Outpatient emergency department visit	2.7	(0.2)	1.9	(0.2)	0.8**	(0.3)
Primary care physician visit in any setting	6.8	(0.3)	6.9	(0.6)	-0.2	(0.7)
Home health episode	1.6	(0.1)	1.9	(0.2)	-0.3	(0.3)
Skilled nursing facility admission	1.5	(0.1)	1.1	(0.1)	0.4*	(0.2)
Average total Medicare expenditures[a] ($)	998	(142)	1,006	(145)	-7.63	(215)

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Estimates are based on an unweighted sample size of 683 congregate meal participants and nonparticipants.

[a] Total expenditures exclude expenditures for durable medical equipment and hospice care.

**Significantly different from zero at the .05 level, two-tailed test.

*Significantly different from zero at the .10 level, two-tailed test.

Among individuals who experienced certain health events in the 12 months following the interview, home-delivered meal participants experienced more events, on average, than did nonparticipants. The average number of primary care physician visits and the average number of home health episodes were higher for participants than nonparticipants (9.8 versus 7.9 primary care physician visits, respectively, and 3.1 versus 2.6 home health episodes, respectively; Table IV.6). For other types of events, such as hospital admissions and readmissions, outpatient emergency department visits, and admissions to skilled nursing facilities, participants and nonparticipants experienced a similar number of events. Taken together, the higher rates of health care utilization for home-delivered meal participants related to hospital admissions and readmissions, outpatient emergency department visits, and nursing home admissions is reflected in home-delivered meal participants spending $500 more in average monthly Medicare expenditures in the 12 months following the interview relative to nonparticipants ($1,695 versus $1,195 per beneficiary per month).

3. Differences by income and living arrangement

This section describes the extent to which post-interview impacts varied by household income and individuals' living arrangement (alone or with other family members).

Congregate meal participants and nonparticipants. There were few differences by household income in the effects of congregate meal participation on health care utilization outcomes. In the full sample, the percentage of participants with a nursing home admission within 12 months of the interview was 2.3 percentage points lower for participants than for nonparticipants (Table IV.7). For lower-income individuals, the effect was almost four times as large as in the full sample, with participants' nursing home admission rate being 8.5 percentage points lower than the rate for nonparticipants (1.6 versus 10.1 percent; Table IV.7). In contrast, for higher-income individuals, the effect was small (a –0.2 percentage point difference) and not statistically significant. The effect on two other outcomes also differed by income. Among lower-income individuals, the percentage of congregate meal participants who had an emergency department visit leading to a hospital admission was 9.8 percentage points lower than the percentage of nonparticipants (13.7 versus 23.5 percent); there was no significant difference for higher-income individuals. However, the percentage of lower-income participants who visited a primary care physician was 8.5 percentage points higher than for lower-income nonparticipants (89.2 versus 80.7 percent); there was no statistically significant effect for higher-income individuals. None of the effects on outcomes was statistically significant for individuals who lived alone or for individuals who lived with other family members.

Table IV.6. Regression-adjusted percentages of individuals who experienced health events, the number of events they experienced, and total Medicare spending in the 12 months following the interview, by home-delivered meal participation status

	Participants		Nonparticipants		Difference	
Outcome	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Experienced the event (%)						
Hospital admission	31.6	(3.4)	21.9	(3.4)	9.8*	(5.4)
30-day hospital readmission	8.7	(1.8)	3.3	(0.9)	5.3**	(2.4)
Emergency department visit leading to a hospital admission	22.5	(3.3)	17.5	(3.6)	5.0	(5.5)
Outpatient emergency department visit	48.3	(4.6)	38.8	(3.6)	9.5*	(5.2)
Primary care physician visit in any setting	81.7	(2.9)	86.9	(3.0)	-5.2	(3.4)
Home health episode	31.6	(3.4)	24.1	(3.5)	7.5	(4.7)
Nursing home admission	14.3	(1.9)	5.2	(1.7)	9.1***	(3.0)
Skilled nursing facility admission	17.5	(2.6)	11.0	(2.9)	6.6	(4.8)
Number of times the event occurred among those who experienced the event						
Hospital admission	2.0	(0.2)	1.8	(0.2)	0.2	(0.3)
Emergency department visit leading to a hospital admission	1.8	(0.1)	1.5	(0.2)	0.3	(0.3)
Outpatient emergency department visit	2.3	(0.1)	2.0	(0.2)	0.3	(0.2)
Primary care physician visit in any setting	9.8	(0.8)	7.9	(0.5)	1.9*	(1.0)
Home health episode	3.1	(0.1)	2.6	(0.2)	0.5**	(0.2)
Skilled nursing facility admission	1.9	(0.1)	1.9	(0.2)	0.1	(0.3)
Average total Medicare expenditures[a] ($)	1,695	(183)	1,195	(143)	500*	(269)

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Estimates are based on an unweighted sample size of 658 home-delivered meal participants and nonparticipants.

[a] Total expenditures exclude expenditures for durable medical equipment and hospice care.

***Significantly different from zero at the .01 level, two-tailed test.

**Significantly different from zero at the .05 level, two-tailed test.

*Significantly different from zero at the .10 level, two-tailed test.

Table IV.7. Regression-adjusted percentages of individuals who experienced health events in the 12 months following the interview, by congregate meal participation status, household income, and living arrangement

	Participants		Nonparticipants		Difference	
Outcome	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Hospital admission (%)						
Full sample	25.1	(2.9)	22.6	(2.9)	2.5	(3.8)
Lower-income individuals	23.6	(3.6)	25.2	(4.6)	-1.7	(6.4)
Higher-income individuals	26.0	(3.6)	20.9	(3.3)	5.1	(4.5)
Individuals who live alone	28.2	(3.6)	27.3	(5.1)	0.9	(5.4)
Individuals who live with other family members	21.8	(3.5)	18.6	(3.0)	3.1	(5.2)
30-day hospital readmission (%)						
Full sample	3.0	(0.9)	3.3	(1.0)	-0.3	(1.4)
Lower-income individuals	3.4	(1.7)	1.9	(0.8)	1.5	(1.7)
Higher-income individuals	4.2	(1.6)	4.1	(1.7)	0.1	(2.5)
Individuals who live alone	5.3	(1.7)	5.9	(2.3)	-0.6	(3.0)
Individuals who live with other family members	1.1	(1.3)	4.2	(2.6)	-3.1	(3.6)
Emergency department visit leading to a hospital admission (%)						
Full sample	14.9	(2.0)	18.2	(2.7)	-3.3	(2.8)
Lower-income individuals	13.7	(2.6)	23.5	(4.2)	-9.8*	(5.4)
Higher-income individuals	16.7	(2.4)	13.1	(2.8)	3.6	(3.7)
Individuals who live alone	18.9	(3.0)	25.2	(4.6)	-6.3	(4.8)
Individuals who live with other family members	12.8	(2.3)	10.8	(2.0)	2.0	(3.2)
Outpatient emergency department visit (%)						
Full sample	34.0	(3.1)	32.5	(3.0)	1.4	(4.3)
Lower-income individuals	43.2	(4.3)	35.3	(3.6)	7.9	(6.2)
Higher-income individuals	29.6	(3.5)	29.8	(4.0)	-0.2	(5.6)
Individuals who live alone	36.5	(3.6)	34.9	(5.1)	1.6	(6.2)
Individuals who live with other family members	33.7	(4.9)	30.4	(3.4)	3.3	(6.8)
Primary care physician visit in any setting (%)						
Full sample	85.8	(2.5)	80.8	(2.6)	5.1	(3.5)
Lower-income individuals	89.2	(2.5)	80.7	(3.5)	8.5*	(4.8)
Higher-income individuals	82.4	(2.6)	81.2	(3.5)	1.2	(4.0)
Individuals who live alone	85.1	(3.5)	80.0	(3.7)	5.1	(4.9)
Individuals who live with other family members	87.0	(3.2)	80.7	(3.6)	6.4	(4.8)

Table IV.7. (continued)

Outcome	Participants		Nonparticipants		Difference	
	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Home health episode (%)						
Full sample	13.5	(1.7)	12.5	(1.9)	1.0	(3.1)
Lower-income individuals	16.5	(2.9)	16.3	(2.8)	0.2	(4.9)
Higher-income individuals	10.5	(1.8)	9.6	(2.3)	0.9	(2.8)
Individuals who live alone	15.7	(2.5)	13.0	(2.7)	2.7	(3.9)
Individuals who live with other family members	10.1	(1.5)	12.4	(1.6)	-2.3	(2.6)
Nursing home admission (%)						
Full sample	3.7	(0.6)	6.0	(1.2)	-2.3*	(1.3)
Lower-income individuals	1.6	(0.8)	10.1	(3.3)	-8.5**	(3.8)
Higher-income individuals	5.5	(1.5)	5.7	(1.8)	-0.2	(2.4)
Individuals who live alone	5.1	(1.2)	8.4	(1.8)	-3.3	(1.9)
Individuals who live with other family members	3.6	(1.8)	5.9	(1.5)	-2.3	(2.7)
Skilled nursing facility admission (%)						
Full sample	8.7	(1.8)	8.3	(1.9)	0.4	(2.9)
Lower-income individuals	9.4	(2.9)	9.4	(3.5)	0.0	(5.4)
Higher-income individuals	13.4	(2.8)	8.0	(1.6)	5.4	(3.5)
Individuals who live alone	13.3	(3.0)	11.0	(2.8)	2.3	(4.5)
Individuals who live with other family members	5.5	(2.4)	3.7	(0.8)	1.8	(2.7)

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Estimates are based on an unweighted sample size of 683 congregate meal participants and nonparticipants.

**Significantly different from zero at the .05 level, two-tailed test.

*Significantly different from zero at the .10 level, two-tailed test.

Home-delivered meal participants and nonparticipants. Where differences existed by household income in the effects of home-delivered meal participation on health care utilization outcomes, higher-income individuals, but not lower-income individuals, experienced these effects. Among higher-income individuals, the percentage of home-delivered meal participants with a hospital readmission within 30 days of discharge was higher than the percentage of nonparticipants (12.4 versus 4.7 percent); the percentage of participants with an admission to a skilled nursing facility was higher than the percentage of nonparticipants (20.0 versus 9.7 percent); and the percentage of participants with an admission to a nursing home was higher than the percentage of nonparticipants (16.3 versus 4.1 percent; Table IV.8). In contrast, the percentage of higher-income participants who had a primary care physician visit was lower than the percentage of nonparticipants (80.0 versus 87.0 percent). For lower-income individuals, none of the differences in outcomes of participants and nonparticipants was statistically significant.

Many of the differences in the likelihood of an event occurring between program participants and nonparticipants that were observed in the full sample were evident for individuals who lived with other family members, but not for individuals who lived alone. Among those who lived with other family members, the percentage with a hospital admission, readmission within 30 days of discharge, and an outpatient emergency department visit was higher for home-delivered meal participants than nonparticipants.

Table IV.8. Regression-adjusted percentages of individuals who experienced health events in the 12 months following the interview, by home-delivered meal participation status, household income, and living arrangement

	Participants		Nonparticipants		Difference	
Outcome	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Hospital admission (%)						
Full sample	31.6	(3.4)	21.9	(3.4)	9.8*	(5.4)
Lower-income individuals	32.2	(4.8)	23.3	(4.2)	8.9	(7.0)
Higher-income individuals	28.9	(3.8)	23.6	(4.0)	5.3	(5.9)
Individuals who live alone	31.2	(3.5)	26.4	(4.0)	4.8	(5.6)
Individuals who live with other family members	32.0	(4.7)	16.1	(3.4)	15.9**	(7.1)
30-day hospital readmission (%)						
Full sample	8.7	(1.8)	3.3	(0.9)	5.3**	(2.4)
Lower-income individuals	2.5	(1.2)	3.6	(1.9)	-1.2	(2.4)
Higher-income individuals	12.4	(2.7)	4.7	(1.1)	7.8**	(3.5)
Individuals who live alone	8.1	(1.7)	8.0	(2.1)	0.2	(3.5)
Individuals who live with other family members	8.9	(2.7)	-0.6	(1.4)	9.5**	(3.6)
Emergency department visit leading to a hospital admission (%)						
Full sample	22.5	(3.3)	17.5	(3.6)	5.0	(5.5)
Lower-income individuals	19.6	(3.9)	17.7	(3.1)	2.0	(5.3)
Higher-income individuals	23.0	(4.0)	20.0	(4.5)	3.0	(6.7)
Individuals who live alone	22.7	(3.4)	22.2	(4.5)	0.6	(6.3)
Individuals who live with other family members	22.7	(4.3)	12.6	(3.5)	10.1	(6.4)
Outpatient emergency department visit (%)						
Full sample	48.3	(4.6)	38.8	(3.6)	9.5*	(5.2)
Lower-income individuals	46.6	(3.8)	41.4	(4.9)	5.2	(5.4)
Higher-income individuals	48.8	(5.2)	37.8	(4.1)	11.0	(7.0)
Individuals who live alone	49.8	(4.8)	41.0	(4.2)	8.8	(5.8)
Individuals who live with other family members	47.4	(4.6)	34.9	(4.0)	12.4**	(5.9)
Primary care physician visit in any setting (%)						
Full sample	81.7	(2.9)	86.9	(3.0)	-5.2	(3.4)
Lower-income individuals	84.8	(2.2)	85.1	(3.5)	-0.2	(4.0)

Table IV.8. (continued)

Outcome	Participants		Nonparticipants		Difference	
	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Higher-income individuals	80.0	(3.6)	87.0	(3.2)	-7.0*	(3.6)
Individuals who live alone	86.2	(2.8)	87.3	(4.2)	-1.1	(4.7)
Individuals who live with other family members	78.9	(5.1)	82.8	(3.9)	-3.8	(6.3)
Home health episode (%)						
Full sample	31.6	(3.4)	24.1	(3.5)	7.5	(4.7)
Lower-income individuals	35.9	(3.2)	28.0	(3.6)	7.9	(5.3)
Higher-income individuals	26.5	(3.6)	22.3	(4.2)	4.3	(5.7)
Individuals who live alone	35.8	(4.1)	28.9	(5.3)	7.0	(6.9)
Individuals who live with other family members	24.7	(4.5)	21.7	(4.3)	3.0	(6.3)
Nursing home admission (%)						
Full sample	14.3	(1.9)	5.2	(1.7)	9.1***	(4.8)
Lower-income individuals	13.7	(2.2)	8.0	(3.0)	5.7	(4.1)
Higher-income individuals	16.3	(2.2)	4.1	(1.5)	12.2***	(3.0)
Individuals who live alone	16.8	(2.5)	5.5	(2.0)	11.3***	(3.6)
Individuals who live with other family members	13.0	(2.4)	5.0	(2.8)	8.0*	(4.7)
Skilled nursing facility admission (%)						
Full sample	17.5	(2.6)	11.0	(2.9)	6.6	(4.8)
Lower-income individuals	15.6	(3.7)	13.1	(3.0)	2.5	(5.4)
Higher-income individuals	20.0	(2.8)	9.7	(2.2)	10.3**	(4.3)
Individuals who live alone	19.8	(2.5)	13.5	(3.2)	6.3	(5.0)
Individuals who live with other family members	17.0	(4.3)	6.4	(2.5)	10.7*	(5.5)

Source: Medicare claims data matched to AoA NSP outcomes survey, 2015-2016, weighted data.

Note: Estimates are based on an unweighted sample size of 658 congregate meal participants and nonparticipants.

***Significantly different from zero at the .01 level, two-tailed test.

**Significantly different from zero at the .05 level, two-tailed test.

*Significantly different from zero at the .10 level, two-tailed test.

V. CONCLUSION

This chapter discusses the findings from the evaluation on health care utilization. It also presents recommendations for additional research motivated by the evaluation findings.

A. NSP participants' health status, Medicare characteristics, and health care utilization

Although one of the primary research objectives of the evaluation was to determine the impact of NSP participation on overall wellness, this report also makes a valuable contribution to the knowledge base on NSP participants' well-being by describing NSP participants' health status, Medicare characteristics, and health care utilization using survey data and detailed Medicare enrollment and claims data. This section highlights some of the main findings from the descriptive analysis.

Many NSP participants reported being in fair or poor health, having experienced falls in the past three months, and having functional impairments that require them to need help to perform activities critical to remaining in their homes. This is especially true of home-delivered meal participants, where about 50 percent reported being in fair or poor health, 32 percent had experienced a fall in the past three months, and 69 percent had trouble climbing stairs.

HCC scores that measure Medicare beneficiaries' health risk, especially relative risk for subsequent health care expenditures, were slightly above the national average for home-delivered meal participants (1.1 versus 1.0) and slightly below the average for congregate meal participants (0.8 versus 1.0). This suggests that congregate meal participants have slightly better health, and home-delivered meal participants have slightly worse health, than the average older adult Medicare beneficiary.

Most NSP participants are poor or near poor, with about one-third of participants having income below the federal poverty guidelines and most of the rest of participants having income between 100 and 200 percent of the poverty threshold. Medicare data showed that 30 percent of congregate meal participants and 39 percent of home-delivered meal participants were dually eligible for Medicare and Medicaid. As expected, these percentages were much higher among lower-income participants (52 percent for congregate meal participants and 65 percent for home-delivered meal participants), and, among congregate meal participants, for those who lived alone (36 percent).

Chronic conditions were highly prevalent among NSP participants. About 74 percent of congregate meal participants and 80 percent of home-delivered meal participants had at least one chronic condition. Eight percent of congregate meal participants and 11 percent of home-delivered meal participants had five or more conditions. Diabetes, specified heart arrhythmias, vascular disease, congestive heart failure, and chronic obstructive pulmonary disease and other lung disorders were common.

NSP participants experienced many health events in the nine months before the survey interview. For congregate meal participants, primary care physician visits and outpatient emergency department visits were the most common (experienced by 76 and 29 percent of

participants, respectively), though nontrivial percentages of participants did have a hospital admission (8 percent), a home health episode (6 percent), or an emergency department visit that led to a hospital admission (5 percent). The likelihood of experiencing these health events was higher for home-delivered meal participants than for congregate meal participants. Although the percentages of home-delivered meal participants who had primary care physician visits and outpatient emergency department visits (82 and 30 percent, respectively) were similar to those of congregate meal participants, the percentages who had a hospital admission (26 percent), an emergency department visit leading to a hospital admission (21 percent), and a home health episode (42 percent) were much higher for home-delivered meal participants. Furthermore, among participants who had a home health episode, home-delivered meal participants had about four episodes, on average, whereas congregate meal participants had about two.

Health care utilization did not differ greatly by income for both congregate and home-delivered meal participants. For home-delivered meal participants, utilization differed according to whether the participant lived alone or with other family members. With the exception of skilled nursing facility admission, the likelihood of experiencing each health event was higher for individuals who lived alone than for those who lived with other family members. The largest differences were in hospital admissions (30 versus 19 percent), emergency department visits leading to a hospital admission (25 versus 14 percent), and home health episodes (47 versus 33 percent).

Congregate meal participants incurred $631 per month, on average, on Medicare expenditures in the nine months before the survey interview. For home-delivered meal participants, average monthly expenditures were nearly twice as large as expenditures for congregate meal participants ($1,223). For both types of participants, the most common expenditures were for outpatient services and physician and non-institutional services.

B. NSP participation and participants' outcomes

The research team examined differences in health care utilization outcomes between NSP participants and nonparticipants in the 9 months before and in the 12 months after the survey interview.

Congregate meal participation in the nine months before the interview. Health care utilization was lower for congregate meal participants than for nonparticipants in the nine months before the survey interview. Participants were less likely than nonparticipants to have a hospital admission (8.5 versus 13.7 percent) and were less likely to have an emergency department visit that led to a hospital admission (5.4 versus 10.4 percent). Unlike outpatient emergency department visits that can sometimes substitute for office-based physician visits, hospital admissions and emergency department visits leading to inpatient stays are typically regarded as reflecting adverse, acute health events, rather than substitutes for primary care physician visits (Aminzadeh and Dalziel 2002). Although there were no differences between participants and nonparticipants in the likelihood of a home health episode occurring, among those who had at least one episode, participants experienced almost one episode less than nonparticipants (1.8 versus 2.6 episodes). Overall, these are sizable differences in outcomes between congregate meal participants and nonparticipants.

Differences in outcomes by program participation status generally existed for lower-income individuals, but not higher-income individuals. Among lower-income individuals, the percentage of congregate meal participants with a hospital admission in the nine months preceding the interview was 8.6 percentage points lower than the percentage of nonparticipants (9.1 versus 17.7 percent). The percentage who had an emergency department visit leading to a hospital admission was 11.4 percentage points lower than the percentage of nonparticipants (4.5 versus 15.9 percent). In contrast, among higher-income individuals, there were no statistically significant differences for either outcome between participants and nonparticipants.

Similarly, these program effects generally existed for individuals living alone, but not for individuals living with other family members. For individuals who lived alone, congregate meal participants were less likely than nonparticipants to have a hospital admission or an emergency department visit that led to a hospitalization (6.3 versus 14.1 percent for hospital admissions and 5.0 versus 11.3 for emergency department visits leading to a hospital admission). For individuals who lived with other family members, there were no significant differences in these outcomes between participants and nonparticipants.

Congregate meal participation in the 12 months following the interview. One of the main outcomes of the evaluation was the likelihood of admission into long-term care facilities or nursing homes in the 12 months following the interview. Congregate meal participation had a positive effect on institutionalization from the perspective of the NSP's goal to avoid or delay institutionalization: the percentage of congregate meal participants with a nursing home admission in the 12 months following the survey interview was 2.3 percentage points lower than the percentage of nonparticipants (3.7 versus 6.0 percent). For nearly all of the other outcomes, there were no statistically significant differences between participants and nonparticipants.

The effect on the likelihood of nursing home admission was present for lower-income individuals, but not higher-income individuals, and was sizably larger than the effect found for the full sample of participants. For lower-income individuals, the effect was almost four times as large as in the full sample, with participants' nursing home admission rate 8.5 percentage points lower than the rate for nonparticipants (1.6 versus 10.1 percent). In contrast, for higher-income individuals, the effect was small (a –0.2 percentage point difference) and not statistically significant.

Home-delivered meal participation in the nine months before the interview. The main evaluation findings for home-delivered meal participants and nonparticipants differed from those for congregate meal participants and nonparticipants. Home-delivered meal participants were more likely than nonparticipants to have an emergency department visit leading to a hospital admission (18.0 versus 8.1 percent) and to have a home health episode (35.0 versus 19.7 percent). For those who experienced these health events, home-delivered meal participants were more likely to experience slightly more of them. Compared with nonparticipants, participants who had emergency department visits leading to a hospitalization experienced more of them and participants who had a primary care physician visit had fewer of them.

With one exception, there were no differences by income in the likelihood of health events occurring for home-delivered meal participants and nonparticipants. The percentage of higher-income individuals who experienced a home health episode was 25.0 percentage points higher

for home-delivered meal participants than for nonparticipants (40.1 versus 15.1 percent), but there was no statistically significant difference for lower-income individuals. Many of the differences in the likelihood of an event occurring between program participants and nonparticipants that were observed in the full sample were typical for individuals who lived alone, but not for individuals who lived with other family members.

Home-delivered meal participation in the 12 months following the interview. Although congregate meal participants were less likely than nonparticipants to have a nursing home admission, the opposite was true for home-delivered meal participants and nonparticipants. The percentage of home-delivered participants who had a nursing home admission in the 12 months following the interview was 9.1 percentage points higher than the percentage of nonparticipants (14.3 versus 5.2 percent). Home-delivered meal participants also were more likely than nonparticipants to have a hospital admission (31.6 versus 21.9 percent) or readmission (8.7 versus 3.3 percent), and to have an outpatient emergency department visit (48.3 versus 38.8). They also had higher average monthly Medicare expenditures ($1,695 versus $1,195).

Where there were differences by household income in the effects of home-delivered meal participation on health care utilization outcomes, effects existed for higher-income individuals, but not lower-income individuals. For example, among higher-income individuals, the percentage with a nursing home admission was higher for participants than for nonparticipants (16.3 versus 4.1), but there was no statistically significant difference for lower-income individuals.

Discussion. This report addressed part of an evaluation research objective, specifically (1) to describe participants' health and health care utilization and (2) to examine overall wellness measured using longer-term outcomes related to health and avoidance of institutionalization. The descriptive findings showed that many NSP participants were in fair or poor health, had functional impairments that limited daily activities, and had multiple chronic conditions. These and other indicators of health and economic need described in this report underscore the vulnerability of the population of older adults the program serves. This is especially true for home-delivered meal participants who, compared with congregate meal participants, were older, had less income, were more likely to be in poor health and have difficulty walking or climbing stairs, and had worse health based on a summary measure of Medicare beneficiaries' health risk. These vulnerabilities were reflected in higher health care needs and the extent to which participants experienced adverse health outcomes. For example, many NSP participants recently had an emergency department visit or hospital admission. Home health episodes were also common, especially for home-delivered meal participants.

The evaluation examined the effect of NSP participation on overall wellness and well-being by comparing health care utilization outcomes for participants and nonparticipants. Overall, congregate meal participants had a lower likelihood in the short run of having a hospital admission and having an emergency department visit that led to a hospital admission. They also had fewer home health episodes. These program effects were generally typical for lower-income individuals, but not higher-income individuals, and for individuals living alone, but not individuals living with other family members. In the longer run, participants were less likely than nonparticipants to have a nursing home admission—an effect that was especially large for low-income individuals.

In contrast, home-delivered meal participants were more likely than nonparticipants in the short run to have an emergency department visit leading to a hospital admission and to have a home health episode. They also had more home health episodes, more skilled nursing facility admissions, and higher average Medicare expenditures. In the longer run, home-delivered meal participants were more likely than nonparticipants to have a nursing home admission and had greater health care utilization—in the form of hospital admission or readmissions and outpatient emergency department visits—and Medicare expenditures. These effects were generally present for higher-income home-delivered meal participants, but not for lower-income participants.

To some extent, these findings are similar to those found in the first evaluation report for the outcomes of food security, socialization, and diet quality. Mabli et al. (2017) found positive effects of congregate meal participation on food security, socialization, and diet quality and mixed effects of home-delivered meal participation on these outcomes. Congregate meal participants, relative to nonparticipants, had lower food insecurity rates, more favorable socialization outcomes for most of the outcomes examined, and higher diet quality assessed using multiple measures. In contrast, home-delivered meal participants and nonparticipants had similar rates of food security, except for participants who received fewer than five meals per week, who experienced lower rates of food security. Home-delivered meal participants either had similar or less favorable socialization outcomes compared with nonparticipants, depending on the outcome examined. Home-delivered meal participants had higher diet quality than nonparticipants, but generally had fewer differences in quality compared with congregate meal participants and nonparticipants. The findings in the current report are similar to those in Mabli et al. (2017) in that congregate meal participation had positive or favorable effects on health care utilization, particularly for lower-income individuals and those who lived alone, but home-delivered meal participation had either no effect on health care utilization or was associated with less favorable outcomes.

For congregate meal participants, the lower rates of hospitalization, emergency department visits leading to inpatient admissions, and nursing home admissions align with expectations of how the combination of receiving nutritious meals and social support by peers and program staff at the meal site can affect health outcomes. However, although participants did not experience these events as often as did nonparticipants, a nontrivial percentage of participants still experienced these events and were admitted to a nursing home. This points to the need to examine the characteristics associated with congregate meal participants experiencing these events. Exploring differences in these relationships by income would be a fruitful area for future research given the stark differences in program effectiveness for higher- and lower-income individuals. More broadly, although the research findings aligned with expectations, more research is needed to explore the mechanisms through which receiving congregate meals and supportive services leads to lower acute care and nursing home admissions. Obtaining qualitative information from program participants and program staff would help identify the mechanisms and explore whether they differ by age, geography, or some other key characteristic.

The findings for home-delivered meal participants were less intuitive than those for congregate meal participants. A potential explanation for the findings lies in the ability of the evaluation design to successfully address the potential bias associated with choosing to participate in the NSP. It was not possible to conduct a randomized controlled trial in which program participation was randomly assigned to a group of older adults who are eligible for

program meals and services. In the absence of random assignment, differences in program outcomes might reflect differences in underlying characteristics of participants and nonparticipants, rather than any effect of the program itself. The research team tried to minimize this possibility by using a powerful research design that (1) matched participants and nonparticipants based on a comprehensive set of demographic and health characteristics in Medicare administrative records and (2) identified matched nonparticipants within small, local geographic areas (zip codes) in which participants lived. As discussed in Appendix A, the groups of participants and matched nonparticipants were more similar for congregate meals than for home-delivered meals; home-delivered meal participants had greater health care utilization than the set of matched nonparticipants for outcomes such as hospitalizations and home health episodes (Table A.6). Although the research team accounted for this in the evaluation's analytic approach, it is possible that the unobservable factors associated with differences in health care utilization at the time of matching partially influenced the findings in the 9 months before and 12 months after the survey interview for home-delivered meal participants. In particular, the Medicare data do not provide a means to identify homebound status for most beneficiaries. It is therefore possible that a greater fraction of home-delivered meal participants were homebound than were their counterparts in the matched comparison group.[18]

One promising direction for future research would explore the prospects for selecting home-delivered meal nonparticipants by using both Medicare and Medicaid data. By focusing on what could be a substantial subset of home-delivered meal participants—those enrolled in Medicaid—the research team could match participants to a local comparison group using both Medicare and Medicaid data. Because supportive programs furnished by Medicaid in some states are available only to people with specific limitations in activities of daily living (for example, bathing, grooming, toileting), Medicaid data offer the prospect of better matching home-delivered meal participants to nonparticipants using characteristics associated with limitations in activities of daily living, and thus more robust program impact estimates.

Apart from potential changes in the research design, additional research using the existing design is important to understand the differences in outcomes between home-delivered meal participants and nonparticipants. Specific elements of such research are outlined below:

[18] Assessing the extent to which home-delivered meal nonparticipants were homebound was challenging. One of the main eligibility criteria for receiving home-delivered meals is that an older adult must be homebound because of disability, illness, or isolation. The research team attempted to approximate homebound status as best it could in the matching criteria. First, the team identified potential nonparticipants using information from Medicare administrative data on whether the older adults had recently experienced home health episodes. In addition, interviewers asked questions as part of the survey eligibility screen to assess potential nonparticipants' difficulty performing various everyday activities on their own without the help of another person and, if so, confirmed whether the difficulty was because of a medical problem, physical condition, or emotional or psychological problem. Activities included leaving the house, walking from one room to another on the same level of the home, getting up from a chair, and getting in and out of bed. It is possible that nonparticipants reported having greater functional limitations than they actually had. Alternatively, nonparticipants' reported limitations may be of more recent onset, on average. Either circumstance could explain why the nonparticipants who passed the survey eligibility screen and completed an interview subsequently had lower rates of home health care utilization than did home-delivered meal participants (particularly for hospital admissions and home health episodes).

- **Provide greater details about the types of health events that occur for home-delivered meal participants and nonparticipants**. Although the current report described the percentage of individuals who experienced events and, for those who did, the number of times they occurred, more information is needed about the events, including the reasons for hospitalization and emergency department visits leading to inpatient admissions. Using the specific diagnosis codes associated with such claims would aid in obtaining such information.
- **Describe the characteristics of older adults who experience these events.** These would include demographic, economic, and health characteristics, as well as measures of participants' duration in the program. It is especially important to learn more about why participants' health care utilization is greater than that for nonparticipants for higher-income individuals, yet no differences in utilization exist for lower-income individuals.
- **Assess the types and prevalence of health events that occur among new home-delivered meal participants.** The analysis would offer new information on whether the decision to start receiving home-delivered meals is precipitated by an acute care event followed by a period of prolonged post-acute care use.
- **Understand the health care utilization of home-delivered meal participants in the two years before their admittance to a nursing home**. This analysis would provide a profile of participants' health care utilization to help AoA identify whether specific health events precede institutionalization, for which AoA could use program resources to develop strategies for maintaining independent living.
- **Explore the connection between the types of services offered to home-delivered meal participants and the health care utilization outcomes observed in the 12 months following the survey interview.** An important distinction between receiving congregate and home-delivered meals, for example, is that congregate meal participants can socialize with peers at meal sites, whereas home-delivered meal participants have more limited socialization opportunities that might involve face-to-face contact or conversation with meal delivery drivers. Additional research could explore whether and how the availability of socialization opportunities and participants' satisfaction with those opportunities affect the relationship between receiving program meals and experiencing adverse health events or requiring institutionalization.

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APPENDIX A

DATA AND METHODOLOGY

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The Title III-C Nutrition Services Program (NSP) outcomes evaluation draws primarily on information obtained from comprehensive surveys and 24-hour dietary recalls collected from samples of program participants and a matched comparison group of program-eligible nonparticipants, as well as linked Medicare administrative records. This appendix presents an overview of the sampling design for the data collection and describes topics covered in the surveys. It describes the Medicare administrative data and additional data sources used in the analysis and defines the evaluation's outcome measures. Next, the appendix presents the analytic methods used to address the evaluation's research objectives, including how the research team constructed sampling weights so that findings from the sample would be representative of the population of congregate and home-delivered meal participants (and the group of matched nonparticipants). A final section discusses study limitations.

A. Sampling design

The evaluation used a multistage clustered sample design. The stages of sampling were:

1. Area Agencies on Aging (AAAs)
2. Local service providers (LSPs) within AAAs
3. Congregate meal sites and home-delivered meal distribution locations within LSPs
4. Home-delivered meal routes within home-delivered meal distribution locations
5. Congregate meal participants within each congregate meal site and home-delivered meal participants within each home-delivered meal route

In addition, the research team obtained a matched sample of congregate and home-delivered meal nonparticipants.

In the process study, the research team administered the AAA survey to a probability sample of AAAs. The team used an equal-probability random sample to select most of the AAAs, although the six largest AAAs were selected with certainty.[19] For LSPs, the research team administered the survey to a probability sample of LSPs from the sampled and participating AAAs. The sample frame was formed using lists of LSPs obtained from these AAAs. LSPs were selected within AAAs using sequential sampling with probability proportional to size, with the measure of size being a composite measure incorporating both congregate and home-delivered meals. The research team also asked LSPs to provide a list of their congregate and home-delivered meal sites, which it then used as sample frames to select sites for the cost evaluation.

Among those LSPs that participated in the process and cost studies, the research team used the lists of congregate meal sites at each LSP to select the congregate meal sites for the outcomes

[19] Size was defined using a composite measure based on information provided by State Units on Aging and by the National Association of States United for Aging and Disabilities on the total, unduplicated number of people who received NSP congregate nutrition services and home-delivered nutrition services during the most recently completed fiscal year in each of the AAAs. The six AAAs selected with certainty were the Chicago Department of Family and Support Services, New York City Department for the Aging, New Hampshire Bureau of Elderly and Adult Services, Los Angeles County Community and Senior Services, New Mexico Non-metro Area Agency on Aging, and the Greater Wisconsin Agency on Aging Resources, Inc.

evaluation. One congregate meal site was randomly selected among all of the LSPs' sites using probability proportional to size sampling. On the first day of meal provision in the data collection week for each selected site, field staff attended the main congregate meal that day (usually lunch) and randomly sampled and interviewed congregate meal participants. Approximately 12 months after the first survey, the research team conducted a second survey consisting solely of the individuals who had responded to the first survey.

The research team selected the home-delivered meal distribution location at the congregate meal site location or in its service area, obtained a list of each distribution location's routes, and randomly sampled one route. On the first day of meal provision in the data collection week for each selected home-delivered meal distribution location, the research team obtained a list of all home-delivered meal participants for the sampled route, randomly sampled participants, and conducted interviews in their homes or in another convenient location. The team conducted a second set of interviews, approximately 12 months later, among those who completed the first interview.

In the same geographic area as the sampled congregate meal sites and home-delivered meal routes, the research team obtained a list of Medicare beneficiaries from the Centers for Medicare & Medicaid Services (CMS) and used statistical matching techniques drawing on 2014 Medicare claims and enrollment data to identify older adults with characteristics similar to those in the congregate and home-delivered meal samples to form the study's comparison groups. The team screened potential program-eligible nonparticipants by phone to exclude anyone who (1) participated in the congregate meal or home-delivered meal programs in the past year; (2) lived in a nursing home, assisted living facility, group home, or rehabilitation facility; or (3) did not live in the same zip code as the participant to whom they were matched. Field staff conducted one set of survey interviews in 2015 and 2016 with nonparticipants in their homes or, for some congregate meal nonparticipants, a public location such as a local library. Field staff conducted a second set of interviews by phone, among those who completed the first interview, in 2016 and 2017.

B. Data collection

The research team used multiple instruments to collect data from NSP participants and nonparticipants. The team pretested and pilot-tested the instruments and conducted interviews from October 2015 to April 2016 for the first survey, and from November 2016 to March 2017 for the second survey.

1. Instruments

In 2015–2016, the research team collected data from NSP participants and nonparticipants in a 75-minute computer-assisted personal interview using two main instruments: an outcomes survey and a 24-hour dietary recall. For nonparticipants, the team also administered a short survey to screen and recruit individuals into the study.

The 2015–2016 outcomes survey collected information on a comprehensive set of topic areas including demographic characteristics, food security, health insurance coverage, health status and depression, and loneliness. In addition, the survey asked all respondents about their NSP participation history, and asked congregate and home-delivered meal participants about the

types of services they received, their impressions of the program and services, and monetary contributions for program meals.

The dietary recall collected information on the foods and beverages that participants and nonparticipants consumed over 24 hours on the day before the interview. A second day of dietary recalls were collected from a subsample of participants and nonparticipants to estimate distributions of usual intakes of key nutrients. The research team used the Automated Self-Administered 24-hour dietary recall system (ASA24 Adult Version 2014), developed by the National Cancer Institute (2014), as an in-person interviewer-administered tool to collect the 24-hour dietary recall data. The ASA24 is a web-based dietary intake data collection system that is modeled closely on the Automated Multiple Pass Method and uses the same general methodology as the National Health and Nutrition Examination Survey. Additional information about the dietary recall methodology is available in Mabli et al. (2017).

Finally, the research team used a short computer-assisted telephone interview survey to screen and recruit meal program nonparticipants to participate in the study. The screener determined whether nonparticipants were eligible for the study using the criteria described in the sampling section.

The 2016–2017 outcomes survey assessed program participation patterns between the 2015–2016 and 2016–2017 interviews. It collected information on whether respondents who had received congregate or home-delivered meals at the time of the 2015–2016 survey were still receiving congregate or home-delivered meals about 12 months later. In addition, the survey asked all respondents how many months in the past year they had received meals and, for those who reported receiving fewer meals or a greater number of meals than they did 12 months earlier, the reasons for the change.

2. Pretesting

The research team pretested questions from the outcomes survey by phone with nine respondents: two congregate meal participants, three home-delivered meal participants, and four nonparticipants. Most pretest participants thought the questions were easy to understand. As a result of the pretest, the team made minor modifications to some of the terminology in the survey, such as referring to home-delivered meals as “meals-on-wheels.”

The research team also conducted a small-scale pilot to test the operational aspects of data collection. The pilot included conducting both the 2015–2016 outcomes survey and the 24-hour dietary recall with 32 individuals (12 congregate meal participants and 20 home-delivered meal participants) from five meal program sites. The purpose of pilot testing these instruments was to gauge respondent burden, ASA24 administration and features, and the usefulness of supplemental forms and scripts in collecting the 24-hour recall data.

As a result of the pilot test, the research team significantly reduced the number of items in the outcomes survey. The team also incorporated a “frail skip” into the outcomes survey so interviewers could bypass noncritical sections of the survey to significantly reduce its length when respondents struggled to complete the survey due to length or fatigue. Finally, the team developed additional procedures to help interviewers identify when a proxy was needed.

3. Conducting interviews

The field data collection for the 2015–2016 survey began in October 2015 and ended in April 2016. In the first half of the field period, from late October 2015 through early January 2016, field interviewers visited 92 LSPs during a prescheduled one-week period (the target week) to select a random sample of congregate and home-delivered meal participants and collect information from them.

Data collection in each site spanned five days. On the first day of the target week, field interviewers randomly selected congregate and home-delivered meal participants to participate in the study. If necessary, field interviewers attempted to identify a proxy at the time of sampling. The research team targeted participants who were at least age 67 at the time of the interview to ensure it would have at least one year of Medicare records for each participant for the purposes of identifying potential nonparticipants. Over the next four days, field interviewers administered the outcomes survey and 24-hour dietary recall to sampled participants who agreed to participate in the study. Interviews with congregate and home-delivered meal participants took place at the meal site, in their homes, or in another convenient location such as a public library. A second dietary recall was conducted with a subsample of participants at least one day after their first dietary recall.

Trained telephone interviewers conducted a nonparticipant screener from December 2015 through March 2016. For each congregate and home-delivered meal participant, the research team selected a sample of up to 50 potential nonparticipants from the same geographic area using propensity score matching and a list of Medicare beneficiaries from CMS.

Potential nonparticipants were ranked in numerical order based on the strength of the match to the participant. On the first dialing attempt, interviewers started with the nonparticipant ranked as the best match for each participant and continued down the list of ranked potential nonparticipants in descending order. If the interviewer reached the end of the list and at least one nonparticipant match had not been recruited to participate in the study, the interviewer went back to the top of the list (the best match) and dialed cases that had not received a final status a second time in ranked order. This process continued until the research team recruited up to two nonparticipants for each participant or had exhausted efforts to recruit a nonparticipant match for a participant.[20]

Nonparticipants who were eligible for the study based on the criteria described in the sampling section and agreed to participate received a scheduled time for an in-person interview to complete the 24-hour dietary recall and outcomes survey in person with a field interviewer. These in-person interviews were typically scheduled about four weeks in advance.

From late January 2016 through early April 2016, field interviewers returned to the same geographic areas where they had interviewed congregate and home-delivered meal participants,

[20] For half of the program participants from each LSP (randomly selected), the research team aimed to recruit two nonparticipant matches to participate in the study. For the other half of participants, the research team aimed to recruit one nonparticipant match. This ensured that the number of nonparticipants who completed the 24-hour dietary recall and outcomes survey would be comparable to the sample of meal participants, as it was clear that some recruited nonparticipants would not complete the field interview.

and for one week interviewed the predetermined matched sample of nonparticipants identified through the nonparticipant screener. Field interviewers administered the 24-hour dietary recall and outcomes survey to nonparticipants in nonparticipants' homes or another convenient location. A second dietary recall took place with a subsample of nonparticipants at least one day after their first dietary recall.

The field data collection for the 2016–2017 survey began in November 2016 and ended in March 2017. Telephone interviewers collected information predominantly from program participants early in this period, from both participants and nonparticipants in the middle of the period, and predominantly from nonparticipants toward the end of the period.

4. Response rates

The research team used the American Association for Public Opinion Research's *Standard Definitions* (2016), ninth edition, to calculate unweighted response rates for participants. The response rate (RR3) for the 2015–2016 outcomes survey was defined as equal to $I / (I + P + R + NC + O + e(UH + UO))$, where I = complete interviews, P = partial interviews, R = refusal and break off, NC = non-contact, O = other, UH = unknown if housing unit was occupied, UO = unknown other, and e = proportion of cases with unknown eligibility estimated to be eligible. The estimated eligibility rate for unknown cases was based on the observed eligibility rate. The response rates for the outcomes survey were 76.1 percent for congregate meal participants and 54.1 percent for home-delivered meal participants (Table A.1). The completion rates for the 2015–2016 outcomes survey for nonparticipants who were recruited from the telephone screener were 79.1 percent for congregate meal nonparticipants and 76.6 percent for home-delivered meal nonparticipants (Table A.2). The response rates for the 2016–2017 outcomes survey were 73.3 percent for congregate meal participants and 70.1 percent for home-delivered meal participants and were 82.2 percent for congregate meal nonparticipants and 84.0 percent for home-delivered meal nonparticipants (Table A.3).

Table A.1. Final disposition and response rates for participants in the 2015–2016 outcomes survey

	Initial sample	Study-ineligible	Study-eligible noncomplete	Study eligibility undetermined	Complete	Response rate (%)
Outcomes survey						
Congregate meal participant	980	151	29	198	602	76.1
Home-delivered meal participant	1,306	216	43	539	508	54.1
24-hour dietary recall						
Congregate meal participant	980	151	31	198	600	75.9
Home-delivered meal participant	1,306	216	39	539	512	54.6

Table A.2. Completion rates for screened nonparticipants[a] in the 2015–2016 outcomes survey

	Screened and eligible	Study-eligible noncomplete	Complete	Completion rate (%)
Outcomes survey				
Congregate meal nonparticipant	808	169	639	79.1
Home-delivered meal nonparticipant	691	162	529	76.6
24-hour dietary recall				
Congregate meal nonparticipant	808	179	629	77.8
Home-delivered meal nonparticipant	691	172	519	75.1

[a] Because interviewers likely attempted each potential nonparticipant sample member only once before going to the next person on the list, rather than making a full attempt to reach each one (as was done for the probability sample of program participants), this table presents neither a screener completion rate nor an actual response rate that accounts for all potential sample members ever attempted. Instead, the table presents the completion rates among those nonparticipants who were recruited from the telephone screener.

Table A.3. Final disposition and response rates for participants and nonparticipants in the 2016–2017 outcomes survey

	Initial sample[a]	Study-ineligible	Study-eligible noncomplete	Study eligibility undetermined	Complete	Response rate (%)
Congregate meal participant	596	6	19	140	431	73.3
Home-delivered meal participant	504	32	18	131	323	70.1
Congregate meal nonparticipant	630	9	6	106	509	82.2
Home-delivered meal nonparticipant	525	11	4	80	430	84.0

[a] The number of completed interviews in the 2015-2016 survey and the initial sample size for the 2016-2017 differ slightly due to the exclusion from the analysis of several individuals at one LSP that completed the 2015-2016 survey. See Appendix A, Section I, for details.

C. Additional data sources

To address the research objectives, the research team linked the outcomes survey data to several other data sources.

1. Medicare administrative data

The research team used Medicare claims and enrollment data obtained through the CMS Research Data Assistance Center to construct outcome measures and define Medicare beneficiary characteristics such as hierarchical condition category (HCC) scores, the original reason for an individual's Medicare eligibility, whether the individual had dual enrollment in Medicare and Medicaid, and whether the individual had chronic conditions. The team obtained the following files for 2015 through the first quarter of 2017: Medicare claims data (inpatient, outpatient, carrier, home health, and skilled nursing facility files); the Medicare long-term care Minimum Data Set with comprehensive assessment information on residents of long-term care facilities; and the Medicare enrollment database.

Because Medicare claims data from 2014 were used to statistically match congregate and home-delivered meal participants to NSP nonparticipants living in the same geographic area, all NSP nonparticipants who responded to the 2015–2016 survey had a valid Medicare beneficiary identification number. Thus, all nonparticipants were matched successfully to the 2015–2017 Medicare claims data as well. Some participants, however, chose not to provide a full or partial Social Security number (SSN) during the 2015–2016 survey interview, which prevented the research team from matching them successfully to the Medicare administrative data. Overall, 11 percent of participants who had responded to the 2015–2016 survey were not matched successfully to the Medicare data and, thus, were not included in the analysis.

Because Medicare claims, which identify specific events such as a hospital stay or emergency department visit, are not available for beneficiaries enrolled in managed care plans such as Medicare Advantage, the research team limited the analysis to those who were enrolled in fee-for-service (FFS) Medicare (known as Original Medicare). Among the individuals with a valid Medicare beneficiary identification number, 64 percent of participants and 62 percent of nonparticipants were FFS beneficiaries for either all or part of the 2015–2017 analysis period and were included in the analysis.

2. Neighborhood contextual data from the American Community Survey

The research team used data from the American Community Survey to obtain local-area population characteristics. To obtain characteristics for small-census geographies, such as census tracts, the Census Bureau aggregates data over five years. The research team drew on the 2010 to 2014 American Community Survey summary file to obtain tract-level measures of population, the percentage of families with income below 200 percent of the federal poverty threshold, the percentage of the total population that is non-white, the percentage of the total population that is Hispanic, and the percentage of housing units without access to a vehicle.

3. Geographic address data for participants and food retailers

To describe NSP participants' geographic access to food, the research team used residential address information for each respondent in the outcomes survey, data from the Census Bureau,

and address data for food retailers from the U.S. Department of Agriculture (USDA). The addresses were located using the geocoding tool in Google Maps API software. This process converted the address information to latitude and longitude coordinates and stored them in a newly created file. Using this information, the research team calculated measures of geographic access to food and determined whether a respondent lived in an urban or rural area. Additional information on the geocoding process is available in Mabli et al. (2017).

The research team determined whether an individual lived in an urban or rural area by overlaying the map of respondents' residential locations with a U.S. Census Bureau geographic boundaries file and identifying the census tract in which each respondent was located.[21] A binary indicator of urban/rural status was created using the census tract identification number. Using the Economic Research Service's (ERS 2016) food environment atlas, the research team obtained a variable that indicates whether the population-weighted centroid of a census tract is in an urban or rural area. According to ERS (2016), "Urban and rural are defined in the Census Bureau's urbanized area definitions, where rural areas are sparsely populated areas with fewer than 2,500 people, and urban areas are areas with more than 2,500 people. A census tract is urban if the geographic centroid of the tract is in an area with more than 2,500 people; all other tracts are rural." Urban/rural status in ERS (2016) is based on the 2010 census.

D. Outcome measures

In the first evaluation report, the research team analyzed outcomes in three domains—food security, socialization, and diet quality. Additional information about the construction of these outcomes is available in Mabli et al. (2017). For the current evaluation report, the research team analyzed three sets of health care utilization outcomes: whether health events occurred in a specific period of time, the number of events that occurred among those individuals who experienced them, and the Medicare cost associated with the events (Table A.4). The research team defined outcomes relative to the date of the 2015–2016 interview. One set of outcomes measured health care utilization and Medicare costs in the 9 months preceding the 2015–2016 interview and another set measured utilization and costs in the 12 months following the 2015–2016 interview. For example, if the interview took place on December 15, 2015, one set of outcomes measured the occurrence of events from March 15, 2015, through December 14, 2015, and another set measured outcomes from December 16, 2015, to December 15, 2016. The outcomes included the following:

- Hospital admissions
- Hospital readmission within 30 days of discharge
- Emergency department visits that resulted in an inpatient stay
- Outpatient emergency department visits (those that did not result in an inpatient stay)

[21] Census tracts are geographic boundaries developed by the U.S. Census Bureau. They are drawn to encompass similar population sizes and, thus, vary in spatial size depending on whether they are in a metropolitan or nonmetropolitan area. Census tracts are the largest subcounty geographies defined by the Census Bureau and generally contain 1,500 to 8,000 people and have a target size of 4,000. In 2010, the United States was divided into more than 73,000 census tracts.

- Primary care physician visits in any setting
- Home health episodes (where an episode lasts 60 days and involves at least one or a mix of the following services for homebound patients: skilled nursing care, physical or speech therapy, occupational therapy, home health aide, and medical social services)
- Admittance to a skilled nursing facility
- Admittance to a long-term care nursing home

For all outcomes except hospital readmission and nursing home admission, a second set of outcomes counted the number of times the event occurred in the observation period. This set includes, for example, the number of hospital admissions in the 9 months preceding the 2015–2016 interview or the number of primary care physician visits in the 12 months following the 2015–2016 interview. A third set of outcomes consisted of total Medicare Part A and Part B cost and Medicare costs by service category (inpatient, outpatient, home health, skilled nursing, and physician or non-institutional services) in the 9 months preceding and the 12 months following the 2015–2016 interview.

The data provided by CMS was at the beneficiary claim level, meaning that each observation corresponded to a claim associated with a health event experienced by a beneficiary. The research team aggregated the data to the beneficiary level to produce the outcome measures needed for the analysis. For each beneficiary, claim information was aggregated separately over each observation period (9 months before and 12 months after the 2015–2016 interview). Health care utilization outcomes measuring whether an event occurred in the observation period were defined as binary variables equal to 1 if there was at least one claim in the observation period indicating the event occurred, and equal to 0 otherwise. Health care utilization outcomes measuring the number of times an event occurred in the observation period were annualized to reflect the number of events an individual experienced over one year (dividing total number of events in observation period by the number of FFS eligible months in that period, and multiplying by 12). Outcomes measuring the number of hospital admissions in the 9 months preceding the 2015–2016 interview, for example, were annualized to reflect the number of admissions over one year. Finally, to calculate Medicare expenditure outcomes, the research team summed the costs of all claims over the observation period and divided by the number of Medicare FFS months in the observation period to measure average expenditures per month in the observation period for each beneficiary.

E. Other beneficiary characteristics based on Medicare data

In addition to the outcome measures, the research team also used the Medicare claims and enrollment files to measure the following characteristics for NSP participants and nonparticipants: HCC score, original reason for Medicare eligibility, dual enrollment status, and presence of chronic conditions. The following describes the construction of each measure.

- The original reason for Medicare entitlement was obtained from the Medicare Enrollment Database and was measured at the time of enrollment into Medicare. This enabled the research team to distinguish between beneficiaries who originally qualified for Medicare due to disability or end-stage renal disease (ESRD), versus those who qualified due to age.

Among older adults in the analysis, those who are disabled or those with ESRD are likely to have higher health care utilization and costs.

- Information on whether the individual had dual enrollment in Medicare and Medicaid was obtained from the Medicare Enrollment Database, but was measured in the month of the 2015–2016 interview. Because individuals enrolled in Medicaid are likely to have lower incomes or be medically needy, dual eligibility is a potential indicator of low socioeconomic status.
- HCC scores were estimated using the CMS scoring algorithm. Specifically, the research team applied the latest version of the HCC software (version 22) on the Medicare inpatient, outpatient, and carrier claims for the nine months preceding the 2015–2016 interview. The algorithm for calculating HCC scores relies on identifying health conditions based on Medicare claims and sorts those into hierarchical categories before combining them into a single measure or score that captures the risk for subsequent health care expenditures (see Pope et al. [2004] for details on constructing HCC scores). CMS calculates these scores such that the average for the Medicare FFS population nationally is 1.0. A patient with a risk score of 1.30 is predicted to have costs that would be approximately 30 percent above the average, whereas a patient with a risk score of 0.70 is expected to have costs that would be approximately 30 percent below the average.
- Information on whether an individual had a chronic condition and the type of condition was measured using individual HCC groups from the nine months preceding the 2015–2016 interview that were produced as part of estimating the HCC score. The research team mapped HCC groups into chronic condition codes. Groups were included (1) if they measured one of the 27 chronic conditions (including, for example, heart disease, diabetes, and chronic obstructive pulmonary disease) in the chronic condition warehouse; (2) if more than 1 percent of beneficiaries experienced the condition; or (3) if the conditions were nutrition-related, for example, protein-calorie malnutrition, cirrhosis of the liver, or inflammatory bowel disease.

Table A.4. Outcome measures and data sources[a]

Outcome measures	Data source	Description of variables
Hospital admissions	Medicare claims data—inpatient file	Binary variable indicating whether the individual had an acute care hospital admission in the observation period Continuous variable equal to the number of acute care hospital admissions in the observation period
Emergency department (ED) visits	Medicare claims data—inpatient and outpatient files	Binary variable indicating whether the individual had an ED visit and observation stay in the observation period, including visits that lead to a hospitalization Continuous variable equal to the number of ED visits and observation stays in the observation period
Outpatient ED visits	Medicare claims data—outpatient file	Binary variable indicating whether the individual had an ED visit and observation stay in the observation period that did not lead to a hospitalization Continuous variable equal to the number of ED visits and observation stays in the observation period that did not lead to a hospitalization
Primary care physician (PCP) visits in all settings	Medicare claims data—carrier file	Binary variable indicating whether the individual had a visit to a PCP in the observation period Continuous variable equal to the number of PCP visits in the observation period
Hospital readmission	Medicare claims data—inpatient file	Binary variable indicating whether the individual was discharged from the hospital and had an unplanned hospitalization within 30 days of discharge in the observation period
Home health episodes	Medicare claims data—home health file	Binary variable indicating whether the individual had a home health episode in the observation period Continuous variable equal to the number of home health episodes in the observation period
Admittance to a nursing home	Long-term care Minimum Data Set	Binary variable indicating whether the individual was admitted to a nursing home in the observation period
Admittance to a skilled nursing facility (SNF)	Medicare claims data—SNF	Binary variable indicating whether the individual was admitted to a SNF in the observation period Continuous variable equal to the number of SNF stays in the observation period
Medicare expenditures	Multiple Medicare claims files	Total expenditures on Medicare Part A and Part B services excluding hospice care and durable medical equipment
Medicare expenditures by type of service	Multiple Medicare claims files	Medicare expenditures by type of service: inpatient, outpatient, physician and noninstitutional services, home health, and skilled nursing facility

[a] Observation periods are 9 months preceding and 12 months following the 2015–2016 interview.

F. Analytic methods

The research team used both descriptive and multivariate analysis methods to address the research objectives in the evaluation.

1. Descriptive analysis

The research team described NSP participants' demographic and economic characteristics; health and other characteristics from Medicare data (HCC score, original reason for Medicare eligibility, dual enrollment status, and chronic conditions); and health care utilization and Medicare expenditures. For categorical variables, the research team estimated the percentage of participants who responded in each category. For continuous variables such as HCC scores and Medicare expenditures, the mean and the 25th, 50th, and 75th percentiles of the distribution are presented in tables in Chapter III. (The 50th percentile, or median, of the distribution is the value for which 50 percent of the observations are less than or equal to. Similarly, the 25th percentile is the value at or below which 25 percent of the observations lie, and the 75th percentile is the value with 25 percent of the observations lying above it). In several cases, the tables contain percentages of participants with values in different ranges of the distribution, such as the percentage of individuals with income below the federal poverty threshold. The research team

conducted all analyses separately for congregate and home-delivered meal participants. The team also conducted the analyses separately for two important economic and household subgroups: by monthly household income relative to poverty, dividing the sample roughly in half into lower-income and higher-income groups, and according to individuals' living arrangement (that is, whether they lived alone or with other family members).

2. Multivariate analysis

To estimate the effect of receiving a congregate meal or home-delivered meal on health care utilization outcomes and Medicare expenditures, the research team compared outcomes for participants and a matched comparison group of program-eligible nonparticipants. The purpose of a comparison group of eligible nonparticipants is to represent what would happen to participants in the absence of the program. The comparison group of nonparticipants should ideally be as similar as possible to the sample of participants, except for program participation and random variation. After NSP participants completed the survey and provided their SSN, the research team selected a group of potential nonparticipants from the 2013–2014 Medicare Beneficiary Summary File of nonparticipants who lived in the same geographic area as participants and who were similar to participants on a set of demographic, economic, and health-related variables. For each NSP participant, the research team used propensity score matching to identify the best potential nonparticipant matches based on observable characteristics,[22] contacted them and confirmed they met the eligibility criteria described in the sampling section (including that they were not participating in the congregate or home-delivered meal programs), and administered the 2015–2016 outcomes survey and dietary recall.

Despite efforts to use Medicare administrative data to identify a group of nonparticipants who were comparable to participants across individual characteristics related to outcomes, the characteristics of the two samples differed. Tables A.5 and A.6 present characteristics of participants and nonparticipants used in the matching process. It is important to note two differences between these tables and the original matching comparisons. First, the research team matched participants with *potential* nonparticipants, whereas these tables show characteristics of participants and the group of nonparticipants who were surveyed. As described in section B.3 above, potential nonparticipants were ranked in numerical order based on the strength of the match to the participant. Telephone interviewers started with the nonparticipant ranked as the best match for each participant and, if the potential nonparticipant did not pass the eligibility screen or if the interview was incomplete, the interviewer continued down the list of ranked potential nonparticipants in descending order until completing an interview. Thus, the characteristics of the nonparticipants in the table might not reflect the characteristics of the full set of potential nonparticipants to which the participants were matched. Second, the research team matched participants and potential nonparticipants within each LSP service area. Tables

[22] The research team estimated a logistic regression model of NSP participation as a function of age; gender; race and ethnicity; Medicare eligibility; whether the beneficiary was dually eligible for both Medicare and Medicaid (which served as a proxy for socioeconomic status); indicators for cancer conditions (breast, colon, prostate, lung, endometrial); indicators for and counts of chronic conditions for some of the 27 chronic conditions on the file including cataract, chronic kidney disease, glaucoma, hip fracture, depression, stroke, diabetes, and asthma; Medicare service utilization indicators including inpatient and emergency department visits and skilled nursing facility and home health visits; and total Part A and Part B Medicare expenditures.

A.5 and A.6 aggregate this information for the full analytic sample, but the original matching procedure was performed within each LSP's service area.

Congregate meal participants were very similar to congregate meal nonparticipants (Table A.5). The only characteristic for which the difference between participants and nonparticipants was statistically significant was the percentage of individuals who originally qualified for Medicare due to disability. However, home-delivered meal participants and nonparticipants were less similar. Although home-delivered meal participants and nonparticipants were similar in terms of gender, age, race and ethnicity, dual-eligibility status, original reason for Medicare entitlement, prevalence of cancer, and prevalence of many chronic conditions, participants were more likely than nonparticipants to have experienced some chronic conditions (such as chronic obstructive pulmonary disease, diabetes, and asthma). They were also more likely than nonparticipants to have had an emergency department visit or admission to a hospital, and to have had a home health episode or admission to a skilled nursing facility. Home-delivered meal participants had higher total annual Medicare expenditures as well.

Because the characteristics of the sampled participants and nonparticipants differed, particularly for home-delivered meal participants, the research team used statistical methods and both the survey data and Medicare data in the analyses to control for differences in the characteristics of participants and nonparticipants that affect both outcomes and program participation decisions. The team used multivariate regressions to estimate the effect of NSP participation on the outcomes, controlling for characteristics that could relate to both program participation and the outcomes studied. The regressions are described in greater detail below. The research team also used weights for nonparticipants, generated using a propensity-score matching algorithm based on machine learning called *boosting* (Ridgeway and McCaffrey 2007; Lee et al. 2010), that when used in the analyses ensured that the characteristics of participants and nonparticipants were similar in terms of all of the characteristics the model includes. (The weighting section below describes the weight construction procedure in greater detail.)

Regression analysis. The research team used ordinary least squares (OLS) regression analysis for outcome measures that are continuous variables: the number of events that occurred in the observation period and average monthly Medicare expenditures. The team used logistic regression analysis for binary variables measuring whether a health event occurred in the observation period.[23]

[23] For several subgroup analyses for the binary outcomes, the research team used OLS in place of logistic regression analyses due to lack of convergence of the nonlinear model likely attributed to the smaller sample sizes and limited variation in the dependent variable.

Table A.5. Characteristics of congregate meal participants and nonparticipants in the 2014 Medicare data used for matching

	Participants		Nonparticipants		Difference	
Outcome	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Gender (percentage male)	32.4	4.8	30.0	3.9	2.4	5.7
Age (mean years)	76.6	0.8	76.7	0.7	-0.1	1.0
Race (percentage white, non-Hispanic)	74.5	8.0	66.6	6.1	7.9	6.5
Dual enrollment status (percentage)	31.6	6.1	37.0	4.7	-5.3	5.7
Original reason for Medicare eligibility (percentage who receive disability insurance benefits)	17.0	3.6	8.7	1.8	8.3	3.4**
Cancer conditions (percentage who have breast, colon, prostate, lung, or endometrial cancer)	6.8	2.0	7.8	2.5	-1.0	2.6
First set of chronic conditions (percentage who have cataract, atrial fibrillation, chronic kidney disease, glaucoma, hip fracture, depression, or stroke or transient ischemic attack)	55.2	5.6	50.5	3.6	4.6	5.3
Second set of chronic conditions (percentage who have acute myocardial infarction, chronic obstructive pulmonary disease, congestive heart failure, diabetes, ischemic heart disease, or asthma)	52.2	6.4	51.8	3.6	0.4	7.1
Number of chronic conditions	3.9	0.4	3.5	0.2	0.5	0.4
Had an emergency department visit or hospital admission, including non-acute inpatient hospitalizations such as rehabilitation and psychiatric stays (percentage)	36.0	5.3	32.6	3.3	3.4	5.1
Was admitted to a skilled nursing facility or had a home health episode (percentage)	12.5	3.5	12.7	2.9	-0.2	3.2
Total annual Medicare expenditures (average dollars)	8,646	1,653	6,107	922	2,539	1,605

Source: 2014 Medicare claims data (Medicare Beneficiary Summary File) matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Estimates are based on an unweighted sample size of 683 congregate meal participants and nonparticipants.

**Significantly different from zero at the .05 level, two-tailed test.

Table A.6. Characteristics of home-delivered meal participants and nonparticipants in the 2014 Medicare data used for matching

	Participants		Nonparticipants		Difference	
Outcome	Percentage	Standard error	Percentage	Standard error	Percentage	Standard error
Gender (percentage male)	30.0	3.9	25.0	3.5	5.0	5.1
Age (mean years)	80.9	0.8	80.0	0.8	0.8	1.0
Race (percentage white, non-Hispanic)	74.1	6.4	78.8	5.6	-4.8	6.5
Dual enrollment status (percentage)	38.2	4.9	33.8	5.6	4.5	6.5
Original reason for Medicare eligibility (percentage who receive disability insurance benefits)	16.7	3.1	15.4	2.5	1.4	3.9
Cancer conditions (percentage who have breast, colon, prostate, lung, or endometrial cancer)	9.0	2.6	6.5	1.5	2.5	2.5
First set of chronic conditions (percentage who have cataract, atrial fibrillation, chronic kidney disease, glaucoma, hip fracture, depression, or stroke or transient ischemic attack)	60.0	4.5	62.4	4.2	-2.4	5.8
Second set of chronic conditions (percentage who have acute myocardial infarction, chronic obstructive pulmonary disease, congestive heart failure, diabetes, ischemic heart disease, or asthma)	69.1	3.9	59.9	3.8	9.2	4.4**
Number of chronic conditions	5.0	0.2	4.4	0.2	0.6	0.3*
Had an emergency department visit or hospital admission, including non-acute inpatient hospitalizations such as rehabilitation and psychiatric stays (percentage)	52.3	4.3	42.0	4.4	10.3	5.2*
Was admitted to a skilled nursing facility or had a home health episode (percentage)	42.5	5.6	17.1	3.1	25.4	5.4***
Total annual Medicare expenditures (average dollars)	15,490	2,316	9,047	1,245	6,443	2,593**

Source: 2014 Medicare claims data (Medicare Beneficiary Summary File) matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Estimates are based on an unweighted sample size of 658 home-delivered meal participants and nonparticipants.

***Significantly different from zero at the .01 level, two-tailed test.

**Significantly different from zero at the .05 level, two-tailed test.

*Significantly different from zero at the .01 level, two-tailed test.

The analyses compared outcomes of participants and nonparticipants separately for each of the two observation periods. The first analysis compared outcomes defined over the 9 months preceding the 2015–2016 interview and the second analysis compared outcomes defined over the 12 months following the 2015–2016 interview. All multivariate analyses took place separately for congregate meal participants and nonparticipants and for home-delivered meal participants and nonparticipants. The regression models differed across the congregate and home-delivered meal samples only in terms of the set of independent variables. The independent variables used in the congregate meal regressions consisted of the following:

- Individual-level demographic and economic variables from the 2015–2016 survey (gender; age; age-squared; veteran status; educational attainment; whether the individual was white, non-Hispanic; whether the individual was Hispanic; whether the individual was married or had a partner; whether the individual lived with other people in the household; monthly household income relative to the federal poverty guidelines from the U.S. Department of Health and Human Services;[24] whether the individual lived in a lower-income household; and whether anyone in the household received Social Security benefits or Supplemental Security Income [SSI])
- Health variables from the 2015–2016 survey (whether the individual had ever been diagnosed with high blood pressure or hypertension, whether the individual had ever been diagnosed with diabetes or high blood sugar, and the number of falls in the past three months)
- Local-area population characteristics of the census tract in which the individual lived based on the 2015–2016 residential address information (total population, percentage of families with income below 200 percent of the federal poverty threshold, percentage of the total population that is non-white, percentage of the total population that is Hispanic, percentage of housing units without access to a vehicle, and urbanicity)
- Medicare characteristics from Medicare administrative data (original reason for Medicare entitlement; whether the individual had dual enrollment in Medicare and Medicaid)

The independent variables used in the home-delivered meal regressions consisted of this same set of variables plus indicators of (1) whether the individual was able to walk, was bed bound, or was chair bound or in a wheelchair; (2) whether the individual had serious difficulty concentrating, remembering, or making decisions because of a physical, mental, or emotional condition, and (3) whether the individual experienced a home health episode, had an emergency department visit, or had a hospital admission, including non-acute inpatient hospitalizations such as rehabilitation and psychiatric stays based on the 2013–2014 Medicare administrative data. The independent variables used in the home-delivered meal regressions did not include an indicator for whether the individual lived in a lower-income household or the square of an individual's age. To determine the set of variables to include in each model, the research team started with the variables included in similar models from the first evaluation report (Mabli et al. 2017) and both dropped variables and added new variables to maximize the fit of the model to the data.

[24] https://aspe.hhs.gov/2015-poverty-guidelines.

The results of regression analyses are presented using regression-adjusted tables of estimates of program effects that resemble descriptive tables (see Chapter IV). For example, a regression-adjusted table compares the percentages of congregate meal participants and nonparticipants who had a hospital admission during the observation period after accounting or adjusting for compositional differences across groups. To examine binary outcome measures using logistic regression analysis, the research team obtained the regression-adjusted estimates by estimating the regression, using the regression coefficients and variable values for each person in the sample to obtain a predicted probability of having a hospital admission, and averaging the predicted probabilities to obtain the adjusted (predicted) rate of hospital admission in the sample. By performing these steps assuming all sample members are participants, then repeating the procedure assuming all sample members are nonparticipants, the team obtained two averaged values. The difference between these values is the regression-adjusted estimate of the effect of program participation on hospital admission. The procedure is identical for continuous outcome measures, except that the tables contain regression-adjusted mean values of number of times health events occurred and Medicare expenditures.

The research team analyzed the effect of congregate and home-delivered meal participation on outcomes separately for two important household and economic subgroups. The models were reestimated by monthly household income relative to poverty by dividing the sample into those individuals with income-to-poverty ratios less than the median value in the sample and those with ratios greater than or equal to the median value. Median income as a percentage of poverty was equal to 128 percent for congregate meal participants and nonparticipants and 122 percent for home-delivered meal participants and nonparticipants. These groups are referred to as lower-income and higher-income groups. The models were also reestimated according to whether individuals lived alone or with other family members.

G. Accounting for item nonresponse

Missing data in the 2015–2016 outcomes survey are a potential source of bias in the regression analyses. The research team used three sequential methods to impute missing data for specific survey items to help reduce this bias. First, it used imputations of demographic and household information based on the empirical distributions of variables to correct for incomplete responses to survey items that were included as covariates in the regression model. Next, the team used a simple imputation method to fill in specific numeric values for categorical data for monthly and annual income variables in which the survey asked individuals to provide a range of values when they believed they could not provide a specific number. Finally, the team used predictive mean matching to fill in any remaining missing income information.

Imputation of demographic and household variables. Item nonresponse was low for the demographic and household variables included in the regression models. Based on the original sample of 2,255 participants and nonparticipants (before matching with Medicare administrative data), nonresponse ranged from 2 individuals for veteran status to 31 individuals for receipt of SSI by anyone in the household. The research team used simple random imputation to impute missing values of the following variables (the number of imputed cases for each variable is in parentheses): educational attainment (24); veteran status (2); whether the individual was white, non-Hispanic (10); whether the individual was Hispanic (5); whether the individual was married or had a partner (7); whether the individual had ever been diagnosed with hypertension (14); the

number of falls in the past three months (8); whether the individual had serious difficulty concentrating, remembering, or making decisions because of a physical, mental, or emotional condition (14); whether anyone in the household received Social Security benefits (19); and whether anyone in the household received SSI (31).

Imputation of categorical income data. For the monthly and annual household income variables in the outcomes survey, the research team asked respondents who were not able or refused to provide a specific dollar value to provide a categorical response. Using a simple imputation method, the team filled in values for these variables while maintaining the patterns observed for the group of individuals who provided numerical responses. For each individual providing a categorical response to a survey item, the research team randomly selected an individual in the same participation status group (congregate meal participant, congregate meal nonparticipant, home-delivered meal participant, or home-delivered meal nonparticipant) and the same educational attainment group (less than high school, high school, some college, or college) with income in the same category who provided an exact dollar response; this was called the donor observation. The individual with missing monthly income data inherited the donor's exact monthly income. The team repeated this process for annual income for individuals with missing annual income data.

To define monthly income in the regression analysis, the research team used reported monthly income for those individuals with a nonmissing value. There were 607 individuals missing a numerical value of monthly income. The research team imputed 325 cases using the categorical monthly income data imputation procedure described previously. Annual income (both reported and imputed based on categorical annual income data) divided by 12 was used to impute monthly income for another 24 cases. The team used predictive mean matching (described below) to impute monthly income values for the remaining 258 cases with missing monthly and annual income.

Predictive mean matching. The imputation process was based on predictive mean matching using five steps. First, an imputation model was estimated in which the reported monthly income was modeled as a linear function of program participation status, age, and educational attainment. The imputation model was estimated using only individuals who reported a nonmissing monthly income amount. Second, the estimated coefficients and standard errors from the imputation model were used to form a posterior distribution for the true coefficients of the imputation model. A random draw was obtained from this posterior distribution, producing a specific set of coefficients. Third, the team used the specific set of coefficients drawn in the previous step to generate predicted values of monthly income for individuals who responded to the question about monthly income and those who did not respond. Fourth, for each person who did not respond to the monthly income question, the team identified the five respondents who had the closest predicted values to that of the nonrespondent. Finally, the team randomly selected one of these five respondents, and the reported monthly income of the selected respondent served as the imputed value for the nonrespondent.

H. Standard errors

For all regression-based analyses, standard errors were estimated using a variance estimator based on a first-order Taylor series approximation. The research team accounted for the

multistage sampling design of the outcomes survey when estimating standard errors by using the Stata 15.1 software's "svy" commands and identifying the strata and primary sampling unit identifiers.

I. Analysis weights

Analysis weights allow for computation of unbiased estimates based on sample survey responses from the study population. Weights take into account both the probability of selection into the sample and the differential response patterns that might exist in the respondent sample. They also take into account whether the individual was matched successfully to the Medicare claims data used to construct outcomes, which is only possible when the individual provided a valid SSN and was a Medicare FFS beneficiary for at least part of the study's claims observation period. This section describes the construction of weights for the health and health care utilization analyses presented in this evaluation report. The technical appendix of Mabli et al. (2017) describes the weights used in the analyses based on the 24-hour dietary recalls.

Weights were constructed separately for congregate meal participants and nonparticipants and home-delivered meal participants and nonparticipants. Weights used in the health and health care utilization analyses in this report are based on the product of (1) the weights used in the first evaluation report based on 2015–2016 outcomes survey data and (2) factors that adjust for whether there was a successful match between the 2015–2016 outcomes survey data and the Medicare administrative records.

1. Weights for the 2015–2016 outcomes survey data

Because the sample design incorporated multiple stages of selection (AAA, LSP, congregate meal site, home-delivered meal route, congregate meal participant, and home-delivered meal participant), the weights had to account for selection and response at each stage. The analysis weights were the product of sampling weights and nonresponse adjustments to those weights across all stages of sampling. The first step of weighting in each stage consisted of calculating the sampling weight (the inverse of its selection probability) for each unit sampled and released. These sampling weights were by-products of the sampling procedures and had already been constructed for AAAs and LSPs for the process and cost studies (Mabli et al. 2015; Ziegler et al. 2015).

For congregate meal participants, the sampling weight was calculated for the selection of the following:

- Each AAA
- Each LSP selected within the AAA
- The congregate meal site selected within each LSP, and its associated home-delivered meal site
- Each congregate meal participant selected within each congregate meal site

For home-delivered meal participants, the sampling weight was calculated for the selection of the following:

- Each AAA
- Each LSP selected within the AAA
- The congregate meal site selected within each LSP that is associated with the home-delivered meal site
- The home-delivered meal route selected within the associated home-delivered meal site[25]
- Each home-delivered meal participant selected within each home-delivered meal route

Because of the way they were selected, home-delivered meal sites were assigned the sampling weight of their associated congregate meal site. The only exceptions to this were in the four LSPs containing only one home-delivered meal site and no congregate meal sites—these home-delivered meal sites received a sampling weight equal to one.

The sampling weights were adjusted to compensate for nonresponse and to help ensure accurate representation of the population at each stage of selection and data collection in the evaluation results. These adjustments included the following:

- Adjusting the AAA weight for process study nonresponse with respect to provision of its LSP list
- Adjusting the LSP weight for process study and cost study nonresponse
- Adjusting the LSP weight for outcomes evaluation nonparticipation
- Adjusting the home-delivered meal site–level sampling weights for one site that did not participate (no congregate meal sites within participating LSPs declined to participate)

The research team made the remaining nonresponse adjustments to the weights at the participant level, separately, for congregate and home-delivered meal participants. This took place in two stages: (1) adjusting for whether the screener obtained sufficient information so that the participant's study eligibility status was determined, and (2) adjusting for nonresponse among participants determined to be eligible. Due to the lack of any specific information about sampled participants who did not respond to the survey, participant sampling weights were adjusted for participant-level nonresponse within weighting cells defined by the AAA in which the LSP and its sites were operating.[26] The inverse of the weighted response rate within the weighting cell served as the nonresponse adjustment factor to the prevailing cumulative weight.

After applying the adjustments to the sampling weights for the responding sample members, the research team examined the weight distribution for outliers. The team then used weight

[25] The research team did not randomly select a home-delivered meal site within each LSP. Instead, the home-delivered meal site associated with each sampled congregate meal site was included in the study.

[26] In cases where using the AAA as the weighting cell was considered problematic (either due to a small number of respondents per cell or a large nonresponse adjustment per cell), the research team instead used census region crossed with a four-category LSP size variable (quartile for number of congregate or home-delivered meals) as the weighting cell.

trimming and redistribution to address outliers that were unduly increasing the design effect or could potentially give any one participant too much influence on an estimate.[27]

Weights for congregate and home-delivered meal nonparticipants. Despite efforts to identify a group of nonparticipants from Medicare beneficiaries within the same geographic areas who were comparable to participants across several critical individual characteristics related to outcomes, the characteristics of the two samples differed, both for the congregate and home-delivered meal samples. Consequently, the research team did not assign the matched comparison cases the sampling weight of their associated program participant. Instead, a propensity score matching algorithm was estimated based on a machine learning process called boosting, using the R package TWANG (Ridgeway et al. 2016), described below. Recent studies have concluded that propensity score estimation using boosting has consistently superior performance (Ridgeway and McCaffrey 2007; Lee et al. 2010).

The model used data from participants and nonparticipants and defined the dependent variable to measure whether the respondent was a participant. The matching algorithm, which the research team ran separately for congregate and home-delivered meal participants, used information from the outcomes survey that was not available in the 2014 Medicare administrative records used in the initial matching to identify a comparison group of nonparticipants. This information included age, gender, race, ethnicity, veteran status, education, monthly household income, monthly household income-to-poverty ratio, employment status, marital status, and household size. Among this set of potential candidate variables, the matching algorithm identified monthly household income, monthly household income-to-poverty ratio, race, ethnicity, and age as the variables that would achieve the best balance between participants of both types and their corresponding nonparticipants. The algorithm produced propensity score weights for nonparticipants that, when used in the analyses, make the characteristics of participants and nonparticipants similar in terms of all of the characteristics included in the model. This research team carried out this process for response to the outcomes survey and then again for response to both the outcomes survey and the dietary recall.

Nonresponse bias analysis. Because the response rates for the 2015–2016 outcomes survey were less than 80 percent for both congregate and home-delivered meal participants, the research team analyzed the potential for nonresponse bias—bias that results when respondents differ in meaningful ways from nonrespondents. As response rates decrease, the risk for nonresponse bias increases if nonrespondents respond differently from respondents. The goal was to assess the potential risk for nonresponse bias and whether nonresponse could be properly accounted for using the nonresponse-adjusted analysis weights, thereby mitigating any significant differences between the respondents and the sample as a whole. Nonresponse bias cannot usually be directly

[27] The congregate and home-delivered meal participants in one LSP ended up with extremely high weights due to a combination of factors, including expected size measures at the time of sampling that did not match actual size measures, and high nonresponse adjustment factors. These extremely high weights significantly increased the design effect, meaning that the participants in that LSP would have represented a substantial proportion of the estimated population, as well as imposed a risk that participants in that LSP would have an undue influence on the study findings. The research team tried various ways of trimming their weights but found no way to do so without risking the introduction of bias. Because the research team believed it did not have sufficient information about the LSP and its components to adequately describe the population it represented, the team ultimately excluded the participants from this LSP from the analysis.

measured. However, the research team can look for indications of the risk for nonresponse bias on key outcomes and examine whether the nonresponse-adjusted weights mitigate this risk.

Because the research team had little to no information about the sampled but nonresponding individuals, it used information on the census region for each participant and the size (number of meals served) of the LSP from which the research team sampled the participant's site. Because census region and LSP size could be related to key study outcomes, the team examined whether differences existed in response patterns with respect to these variables. Table A.7 presents the findings.

The second column of Table A.7 contains the weighted response rates for each census region and LSP size. The next column contains the weighted distribution of census region and LSP size for all sample members.[28] This column is the standard for comparison and is a best guess as to what the distribution of individuals looks like across regions and size. The next column shows what the distribution would be like among respondents and ineligible sample members had the research team not adjusted for nonresponse, and the last column shows the distribution after nonresponse adjustments and weight trimming.

The weighted response rates differed by census region. Congregate meal participants were more likely to respond if they lived in the Northeast (83.9 percent) and less likely to respond if they lived in the Midwest (74.6 percent). This is evident by comparing the census region distribution for the entire sample and for the responding (plus ineligible) sample. For the entire sample, the Midwest represents 21.5 percent, but among the respondents, the Midwest represents 20.2 percent. After nonresponse adjustments to the weights, the Midwest represents 21.6 percent of the population. For the home-delivered meal participants, the South had the highest weighted response rate (57.6 percent) and the West had the lowest (48.7 percent). The census region distribution before weighting adjustments overrepresented participants in the South by less than 2 percentage points, but this discrepancy narrowed after weighting. The corresponding discrepancy for the West did not resolve after weighting, but all discrepancies, both before and after nonresponse adjustments, were minor.

The weighted response rates differed slightly by the size of LSP (as measured by either number of congregate meals served or number of home-delivered meals served). Congregate meal participants were more likely to respond if they attended a site in a small LSP (84.3 percent) and less likely to respond if they attended a medium LSP (76.3 percent). This is evident by comparing the size distribution for the entire sample and for the responding (plus ineligible) sample. For the entire sample, participants in medium LSPs represent 43.4 percent, but among the respondents, they represent 41.9 percent. After nonresponse adjustments to the weights, they represent 43.0 percent of the population. For the home-delivered meal participants, small LSPs once again had the highest weighted response rate (55.9 percent) and large LSPs had the lowest (48.1 percent). The size distribution before weighting adjustments overrepresented participants in small LSPs by less than 2 percentage points, but this discrepancy narrowed after weighting. The

[28] The weighted response rate accounts for each participant's sampling weight, which incorporates prior sample selection stages.

corresponding discrepancies for medium and large LSPs did not resolve after weighting, but again, all discrepancies, both before and after nonresponse adjustments, were minor.

Table A.7. Nonresponse bias analysis for 2015–2016 outcomes survey

Characteristic	Weighted response rate (percentage)	Selected sample (weighted by sampling weight) (percentage)	Respondents plus ineligible sample (weighted by sampling weight) (percentage)	Respondents plus ineligible sample (weighted by nonresponse-adjusted weight) (percentage)
Congregate meal program				
Census region				
Midwest	74.6	21.5	20.2	21.6
Northeast	83.9	24.6	26.0	24.7
South	80.5	19.1	19.4	19.2
West	77.6	34.8	34.3	34.4
LSP size[a]				
Small	84.3	23.4	24.8	23.6
Medium	76.3	43.4	41.9	43.0
Large	79.0	33.2	33.3	33.5
Home-delivered meal program				
Census region				
Midwest	51.6	23.9	23.7	25.1
Northeast	54.5	15.7	16.1	16.6
South	57.6	17.4	18.8	18.3
West	48.7	43.0	41.3	40.0
LSP size[a]				
Small	55.9	20.3	21.3	20.7
Medium	52.5	48.4	50.2	46.8
Large	48.1	31.3	28.5	32.5

Source: AoA NSP outcomes survey, 2015–2016.

[a] For congregate meals, the categories were 1 to 168 meals, 169 to 532 meals, and more than 532 meals. For home-delivered meals, the categories were 1 to 135 meals, 136 to 406 meals, and more than 406 meals. These were based on LSP size distributions (tertiles among non-zero values).

Although there is no rule of thumb for how large of a relative bias is acceptable, the larger it is, the more caution it merits in analysis. In this study, for the two high-level variables that were available for analysis, respondent distributions differed from those of the full sample by less than 2 or 3 percentage points even before nonresponse weighting adjustments. In most cases, those small differences narrowed after adjustments. This is a good indication that the nonresponse adjustment reduces the potential bias that results from interview nonresponse.

2. Weights for the matched Medicare administrative data

To analyze health care utilization data, the research required a weight that accounted for study participants for whom the team could not match Medicare claims data during the 9-month period before or during the entire 12-month period after the 2015–2016 survey interview. Participants who had any Medicare claims data for either period were included in the health care utilization analysis. Reasons for non-matching include (1) program participants who did not

provide a valid SSN (2) study participants who died after the 2015–2016 interview, and (3) study participants who were in Medicare Advantage (instead of FFS Medicare), which reimburses doctors for patient care without their submitting claims. The research team called this the Matched FFS Weight (MATCHFFSWT). This weight started with the 2015–2016 outcomes survey weight, which the team adjusted for non-matches. The team separately carried out all weighting adjustments for congregate meal participants, congregate meal nonparticipants, home-delivered meal participants, and home-delivered meal nonparticipants.

The first weighting adjustment for those who did not provide a valid SSN applied only to congregate meal and home-delivered meal participants. (By design, all nonparticipants had a valid SSN because they were originally identified in the 2014 Medicare data.) In addition to the few variables available for adjusting 2015–2016 survey weights, the research team had the entire 2015–2016 survey available to identify variables that could influence the propensity for providing a valid SSN. Using stepwise logistic regression models combined with interaction detector procedures, the research team constructed a model to predict the provision of a valid SSN, and applied the inverse of the resulting propensity score to the 2015–2016 survey weight to get an interim "SSN provision" weight, setting the weight to zero for those who did not provide a valid SSN. This weight served as the starting point for the next adjustment for the presence of Medicare claims data for program participants, and the research team used the 2015–2016 survey weight as the starting point for program nonparticipants.

The second weighting adjustment was for the inability to match to any Medicare claims data in either the 9-month period before or the 12-month period after the 2015–2016 survey interview. Using an identical set of candidate variables as described above for the SSN adjustment, the research team used the same steps to develop a model to predict claims matching. The team applied the resulting propensity score to either the SSN provision weight (for program participants) or to the 2015–2016 survey weight (for program nonparticipants), setting the weight to zero for those with no matches in either the 9-month period before or the 12-month period after the interview. The weights were reviewed for outliers and trimmed as needed. As a last step, the research team raked the adjusted weights by age group, gender, race and ethnicity, rural or nonrural status, and poverty ratio category so that they matched corresponding distributions for the 2015–2016 survey weights.

Representativeness of weights. Based on weighted data, the findings regarding congregate and home-delivered meal participants in Chapter III of this report are nationally representative of the population of congregate and home-delivered meal participants. However, this is not true for the nonparticipants who completed interviews because, by design, they were not sampled from a frame of nonparticipating older adults. Instead, the estimates of the effects of congregate and home-delivered meal participation on outcomes that use weighted participant and nonparticipant data are representative of the effects for the population of congregate and home-delivered meal participants. In other words, the study intends to assess the effect of the programs on those who choose to participate in the program, not on the entire population.

3. Weights for the 2016–2017 outcomes survey data

The research team also constructed weights for the 2016–2017 survey data. Adjustments for nonresponse occurred two stages: (1) the team determined whether the study participant was alive or deceased at the time of the 2016–2017 interview and (2) among those known to be alive,

whether the study participant responded to the 2016–2017 survey. As with the matching weights described above, the research team used 2015–2016 survey responses as candidate variables in these models. The team followed the steps described above to construct a propensity score model to predict the ability to determine whether the study participant was alive; that is, whether interviewers were able to make contact with the person. The research team applied the inverse of the resulting propensity score to the 2015–2016 survey weight to create an interim weight for those they were able to make contact with, and set the interim weight to zero for those for whom the interviewers did not make contact. Because most of the adjustments happened in this first stage, the final weight was created using weighting class adjustments (rather than modeling) to adjust the interim weight for the small proportion of study participants who were successfully *contacted* at the time of the 2016–2017 interview but who did not respond to the survey at that time, setting the final weight to zero for the individuals who were contacted but did not respond. Finally, the research team examined the weights for outliers and trimmed as needed.

J. Study limitations

This report represents a comprehensive assessment of the effectiveness of the Title III-C NSP in improving participants' health care outcomes. When interpreting the report's findings, it is important to consider two limitations.

Item nonresponse. Although interviewers administered the surveys, respondents were able to respond "don't know" or refuse to answer questions. The percentages and estimates based on survey data presented in Chapter III of this report are based on responses that exclude both types of missing data. As a result, these estimates could potentially include item nonresponse bias. Item nonresponse bias occurs when individuals who respond to a question differ in meaningful ways from those who do not respond. However, this was not a serious problem for most survey questions, as all of the estimates presented in the tables in this report either had no item nonresponse or very little item nonresponse, which the research team defined as at least an 80 percent response rate.

Causality. Both the propensity score matching procedure and regression analysis can adjust for differences only in observable characteristics, whereas program participants might also differ from nonparticipants in unobservable ways that could influence the estimates of program impacts on outcomes. Therefore, the findings based on either approach cannot be definitively interpreted as causal effects of the extent to which program participation affects health care utilization and Medicare expenditures. Instead, these procedures adjust—to the extent possible—for observable differences likely to correlate with the outcome measures. This allows for comparison of similar groups of participants and nonparticipants, while still acknowledging that unobservable factors might influence differences in outcome measures. However, the research team attempted to minimize this possibility by using a powerful research design that (1) matched participants and nonparticipants based on a comprehensive set of demographic and health characteristics in Medicare administrative records and (2) identified matched nonparticipants within small, local geographic areas (zip codes) in which participants lived. The validity of the impact estimates necessarily rests on the degree to which the comparison sample and the statistical model succeed in approximating the counterfactual results—the outcomes that congregate meal participants and home-delivered meal participants would have experienced had they not received those meals.

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APPENDIX B

SUPPLEMENTARY TABLES

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Table B.1. Incidence of specific chronic conditions among Nutrition Services Program participants (percentages)

Condition	Congregate meal participants	Home-delivered meal participants
Acute myocardial infarction	1.2	0.6
Acute renal failure	1.3	4.9
Artificial openings for feeding or elimination	0.0	0.3
Breast, prostate, and other cancers and tumors	5.0	7.7
Chronic kidney disease, severe (stage 4)	0.6	0.6
Chronic kidney disease, stage 5 or dialysis status	2.2	1.5
Chronic obstructive pulmonary disease, fibrosis of lung, and other chronic lung disorders	7.1	19.7
Chronic ulcer of skin, except pressure	2.2	3.4
Coagulation defects and hematological disorders	6.5	6.9
Colorectal, bladder, and other cancers	1.7	1.2
Congestive heart failure	15.1	21.4
Diabetes with complications	24.7	24.0
Diabetes without complications	16.2	14.8
Drug/alcohol psychosis or dependence/cirrhosis of liver	0.8	6.4
Exudative macular degeneration	1.8	4.5
Hip fracture/dislocation	1.7	3.6
Inflammatory bowel disease	0.3	0.8
Ischemic heart disease/angina	5.3	1.9
Lung and other severe cancers	0.2	2.7
Lymphoma and other cancers	2.1	2.6
Major depressive, bipolar, paranoid disorders, and schizophrenia	10.7	4.8
Metastatic cancer and acute leukemia	1.0	1.8
Morbid obesity	4.9	2.0
Other significant endocrine and metabolic disorders	2.8	1.0
Protein-calorie malnutrition	0.0	3.9
Rheumatoid arthritis and inflammatory connective tissue disease	7.1	4.6
Seizure disorders and convulsions	3.7	4.6
Specified heart arrhythmias	18.9	14.6
Stroke/transient ischemic attack	2.2	8.1
Vascular disease	15.2	21.9
Vascular disease with complications	2.0	2.3
Vertebral fractures without spinal cord injury	0.2	4.3

Source: Medicare claims and enrollment data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Incidence of chronic conditions measured at the end of 2014 before the 2015—2016 survey was conducted.

Tabulations are based on unweighted sample sizes of 316 congregate meal participants and 310 home-delivered meal participants.

Table B.2. Incidence of specific chronic conditions among congregate meal participants, by household income and living arrangement (percentages)

Condition	Individuals in lower-income households	Individuals in higher-income households	Individuals who live with other family members	Individuals who live alone
Acute myocardial infarction	0.0	2.5	0.0	2.0
Acute renal failure	0.9	1.7	1.3	1.3
Artificial openings for feeding or elimination	0.0	0.0	0.0	0.0
Breast, prostate, and other cancers and tumors	3.9	6.1	5.0	5.0
Chronic kidney disease, severe (stage 4)	1.0	0.2	0.4	0.7
Chronic kidney disease, stage 5 or dialysis status	4.3	0.0	1.5	2.6
Chronic obstructive pulmonary disease, fibrosis of lung, and other chronic lung disorders	7.5	6.7	8.0	6.5
Chronic ulcer of skin, except pressure	3.1	1.3	1.1	2.9
Coagulation defects and hematological disorders	4.9	8.2	6.7	6.4
Colorectal, bladder, and other cancers	2.9	0.5	2.4	1.3
Congestive heart failure	17.9	12.2	17.5	13.5
Diabetes with complications	26.8	22.6	24.9	24.5
Diabetes without complications	18.4	13.9	15.0	16.9
Drug/alcohol psychosis or dependence/cirrhosis of liver	0.9	0.7	0.0	1.3
Exudative macular degeneration	2.6	1.0	1.2	2.2
Hip fracture/dislocation	2.2	1.1	0.0	2.8
Inflammatory bowel disease	0.0	0.5	0.7	0.0
Ischemic heart disease/angina	6.0	4.5	8.2	3.3
Lung and other severe cancers	0.4	0.0	0.5	0.0
Lymphoma and other cancers	3.6	0.7	0.8	3.0
Major depressive, bipolar, paranoid disorders, and schizophrenia	9.5	11.9	3.9	15.2
Metastatic cancer and acute leukemia	0.7	1.4	1.0	1.1
Morbid obesity	9.0	0.8	3.3	5.9
Other significant endocrine and metabolic disorders	1.9	3.8	3.5	2.4
Protein-calorie malnutrition	0.0	0.0	0.0	0.0
Rheumatoid arthritis and inflammatory connective tissue disease	5.6	8.7	6.7	7.4
Seizure disorders and convulsions	7.4	0.1	6.3	2.1
Specified heart arrhythmias	20.9	16.9	14.0	22.1
Stroke/transient ischemic attack	2.1	2.4	1.6	2.6
Vascular disease	14.4	16.1	18.8	12.9
Vascular disease with complications	2.3	1.8	4.3	0.6
Vertebral fractures without spinal cord injury	0.1	0.3	0.0	0.3

Source: Medicare claims and enrollment data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Incidence of chronic conditions measured at the end of 2014 before the 2015-2016 survey was conducted. Tabulations are based on unweighted sample sizes of 316 congregate meal participants.

Table B.3. Incidence of specific chronic conditions among home-delivered meal participants, by household income and living arrangement (percentages)

Condition	Individuals in lower-income households	Individuals in higher-income households	Individuals who live with other family members	Individuals who live alone
Acute myocardial infarction	0.1	1.1	1.5	0.1
Acute renal failure	1.8	7.8	5.2	4.7
Artificial openings for feeding or elimination	0.0	0.6	0.8	0.0
Breast, prostate, and other cancers and tumors	6.7	8.6	10.1	6.2
Chronic kidney disease, severe (stage 4)	0.6	0.6	0.6	0.6
Chronic kidney disease, stage 5 or dialysis status	2.2	0.8	0.8	1.9
Chronic obstructive pulmonary disease, fibrosis of lung, and other chronic lung disorders	17.5	21.8	14.4	22.9
Chronic ulcer of skin, except pressure	2.5	4.3	5.1	2.5
Coagulation defects and hematological disorders	3.5	10.0	4.6	8.2
Colorectal, bladder, and other cancers	1.5	0.8	1.0	1.2
Congestive heart failure	23.3	19.7	19.1	22.7
Diabetes with complications	28.1	20.2	25.5	23.1
Diabetes without complications	16.6	13.2	24.0	9.3
Drug/alcohol psychosis or dependence/cirrhosis of liver	3.9	8.7	2.9	8.5
Exudative macular degeneration	4.8	4.1	3.9	4.8
Hip fracture/dislocation	4.8	2.5	7.2	1.5
Inflammatory bowel disease	0.0	1.5	0.0	1.2
Ischemic heart disease/angina	2.9	0.9	1.7	2.0
Lung and other severe cancers	1.2	4.2	0.0	4.4
Lymphoma and other cancers	5.0	0.3	0.4	3.9
Major depressive, bipolar, paranoid disorders, and schizophrenia	4.6	5.1	4.8	4.8
Metastatic cancer and acute leukemia	0.3	3.1	0.5	2.5
Morbid obesity	1.6	2.3	2.5	1.7
Other significant endocrine and metabolic disorders	2.0	0.0	0.6	1.2
Protein-calorie malnutrition	6.5	1.4	4.6	3.4
Rheumatoid arthritis and inflammatory connective tissue disease	6.5	2.8	3.4	5.3
Seizure disorders and convulsions	2.0	7.1	8.1	2.6
Specified heart arrhythmias	11.1	17.9	15.9	13.9
Stroke/transient ischemic attack	8.9	7.4	14.6	4.2
Vascular disease	18.3	25.3	12.7	27.5
Vascular disease with complications	3.3	1.3	2.3	2.2
Vertebral fractures without spinal cord injury	5.3	3.3	2.7	5.2

Source: Medicare claims and enrollment data matched to AoA NSP outcomes survey, 2015–2016, weighted data.

Note: Incidence of chronic conditions measured at the end of 2014 before the 2015--2016 survey was conducted. Tabulations are based on unweighted sample sizes of 310 home-delivered meal participants.

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