Changes to Dietary Supplement and Non-Prescription Antacid Data Collection During the NHANES August 2021–August 2023 Cycle

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March 2025

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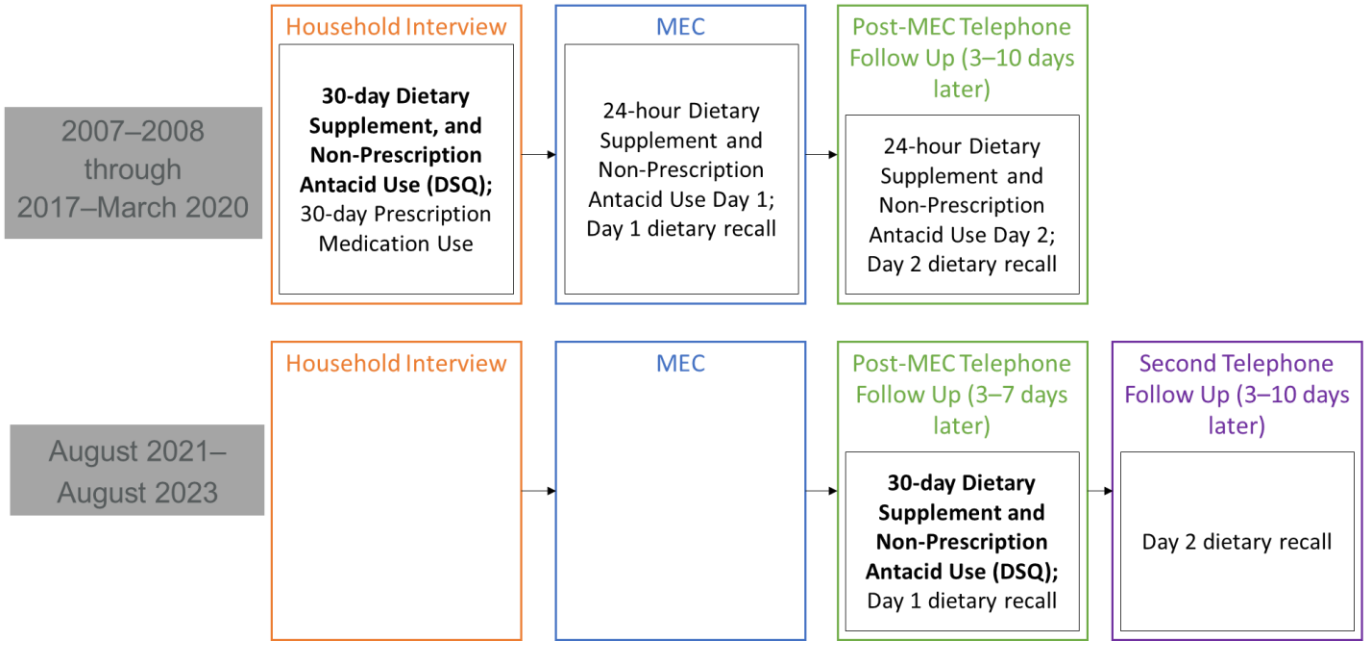
Executive Summary

The August 2021–August 2023 NHANES cycle included several modifications to increase safety during the COVID-19 pandemic (1), including mode changes for certain interviews. For the August 2021–August 2023 cycle, the timing and mode of the Day 1 dietary recall interview was changed from an in-person interview during the Mobile Examination Center (MEC) visit to a post-MEC telephone interview that occurred 3–7 days later. The 30-day dietary supplement and non-prescription antacid use (DSQ) questions were moved from the in-person household interview to the post-MEC Day 1 dietary recall telephone interview **(Figure 1)**. The 24-hour Day 1 and Day 2 dietary supplement intake questionnaires, historically conducted during the Day 1 dietary recall and Day 2 dietary recall interviews, were dropped.

Figure 1 – Flow diagram of dietary recall, dietary supplement, non-prescription antacid, and prescription medication use questionnaires included within NHANES components by survey cycle.



NOTES: MEC is Mobile Examination Center.
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2007–2008 through August 2021–August 2023.

Additional changes for August 2021–August 2023 included the removal of prescription medication use questions, which in past cycles captured some dietary supplements that had been prescribed by a healthcare professional. For past cycles, dietary supplements reported by participants as prescription medications were included in the dietary supplement data files rather than the prescription medication data files. During August 2021–August 2023, the DSQ interview was conducted by specially trained dietary interviewers rather than field interviewers as in past cycles. Direct visualization of dietary supplement labels by the interviewer, previously performed when the container was available during face-to-face interviews, was not possible during August 2021–August 2023. Instead, participants read out all the words on the front label during the telephone interview. Several questions pertaining to duration of supplement use and reason for use were dropped in August 2021–August 2023.

Based on the condensed window of time to restart NHANES as quickly as possible after the pause in data collection during the COVID-19 pandemic (data collection was paused in March 2020), there was not time to formally pilot or test the mode change of the DSQ interview.

Evaluations were performed to assess the impact of operational changes to the August 2021–August 2023 cycle:

- Response rates and sample sizes for the DSQ component were compared to past cycles (2011–2012 through 2017–2018). Response rates and sample sizes were lower than previous cycles.
- Completeness and quality of DSQ data were compared to past cycles. In general, the quality of data appeared as high or higher in August 2021–August 2023 compared to earlier cycles.
- Dietary supplement and non-prescription antacid use estimates in August 2021–August 2023 were compared to past cycles.

Analytic Guidance: Analysts may want to consider the following issues when analyzing the August 2021–August 2023 dietary supplement and non-prescription antacid data, particularly when combining these data with other NHANES cycles such as when examining trends over time:

- Changes in data collection mode, lower response rates, and lower sample sizes may impact findings.
- As a result of lower response rate and sample sizes, estimates may have lower precision and there may be lower statistical power to discern significant differences between groups. For details pertaining to sample design, weighting methods, and analytic guidelines, please refer to the brief overview that accompanied the initial data release for the August 2021–August 2023 cycle.
- Because the DSQ component was included in the household interview in past cycles, interview response rates were appropriate to consider. However for the August 2021-August 2023 cycle, the response rates for the Day 1 dietary recall interview that are now provided on the NHANES website are the appropriate rates to consider. These account for household screening, health interview, and MEC examination response rates in addition to non-response to the Day 1 dietary recall interview conducted by telephone after the MEC visit.
- The Dietary Day 1 sample weights (WTDRD1) are recommended for use in analyses of the August 2021–August 2023 DSQ data. These weights were constructed by adjusting the MEC sample weights (WTMEC2YR) for: (a) the additional non-response to the telephone interview; and (b) the differential allocation by weekdays (Monday through Thursday) and weekends (Friday through Sunday) for the data collection. This adjustment for weekdays and weekends, while important for 24-hour dietary recall data, is not necessary for 30-day dietary supplement data. However, these weights provide a necessary adjustment for component non-response. When using Dietary Day 1 sample weights (WTDRD1), several participants who do not meet reliable or minimum criteria for the dietary recall data but have available DSQ data will have a weight of "0" and will not contribute to estimates. Additionally, several participants who have a WTDRD1 > 0 do not have available DSQ data. Exploratory analyses to assess missingness patterns are useful when analyzing these data.
- From 2007–2008 through 2017–March 2020, 24-hour dietary supplement and non-prescription antacid data were collected alongside 24-hour dietary recalls to allow for combination with dietary intake data when estimating total nutrient intakes. During August 2021–August 2023 and prior to 2007, only 30-day dietary supplement use data were collected. NHANES dietary analyses tutorials provide information on averaging the daily nutrient intake of supplements from the 30-day DSQ files and adding them to the nutrient intake from the 24-hour dietary intake files to assess mean total nutrient intakes from foods, beverages, and dietary supplements.

Suggested citation: Stierman B, Mishra S. Changes to Dietary Supplement and Non-Prescription Antacid Data Collection During the NHANES August 2021–August 2023 Cycle. Published March 2025.

I. Background

During the August 2021–August 2023 NHANES cycle, several changes were made to the collection of dietary supplements and non-prescription antacids data to minimize in-person interactions during the COVID-19 pandemic (1). These changes **(Figure 1)** include:

1. Moving the DSQ interview from the in-person household interview administered prior to the mobile examination center (MEC) visit to the Day 1 dietary recall interview (that was moved from the MEC visit to a telephone interview 3–7 days after the MEC visit);
2. Changing the personnel administering the questionnaire from field interviewers to dietary interviewers;
3. Removing the two 24-hour dietary supplement use interviews;
4. Removing the 30-day prescription medication questions (prescription dietary supplements were sometimes captured in these questions in past cycles); and
5. Eliminating some additional questions, including duration of supplement use and reasons for taking the supplement.

Based on the condensed window of time to restart NHANES as quickly as possible after the pause in data collection during the COVID-19 pandemic, there was not time to formally pilot or test the mode change of the DSQ interview.

II. Objectives

This memo describes analyses to compare NHANES DSQ data from past cycles (2011–2012 through 2017–2018) with the August 2021–August 2023 cycle to assess impact of changes in administration of the interview.

Objectives include:

1. Compare response rates and sample sizes to previous NHANES cycles
2. Evaluate changes in DSQ data collection quality using measures collected across all cycles
3. Examine estimates of dietary supplement and non-prescription antacid use over time, including products containing select ingredients (multivitamin-mineral products; botanical, vitamin C, vitamin D, zinc, fluoride, melatonin, and iron).

III. Analyses (Methods and Results)

A. Inclusion Criteria

Participants from NHANES 2011–2012 through August 2021–August 2023 who had non-missing responses for at least one of the two following measures were included in sample size and response rate calculations, operational analyses, and weighted analyses: 1) any dietary supplement taken in the past 30 days (DSD010), or 2) any non-prescription antacids taken in the past 30 days (DSD010AN). Additionally, participants were only included if they had a non-zero, non-missing survey weight for the component (Interview weights for 2011–2012 through 2017–2018: WTINT2YR > 0; Dietary Day 1 weights for August 2021–August 2023: WTDRD1 > 0).

B. Response Rates and Sample Sizes

B.1. Response Rates and Sample Sizes by Survey Cycle

Response rates and sample sizes were calculated by survey cycle **(Table 1)**. Response rates were calculated as unconditional response rates, incorporating all stages of the survey required to complete the DSQ. During 2011–2012 through 2017–2018, participation in the DSQ occurred during the household interview. During August 2021–August 2023, participation in the DSQ occurred during a telephone interview and required both participation in the prior components (Household Interview and MEC) and being able to complete the interview in English or Spanish. That is, for the first time, the dietary recall and DSQ interview that occurred by telephone following the MEC visit became an additional stage of the survey with additional nonresponse. For 2015–2016, 2017–2018, and August 2021–August 2023, response rate calculations accounted for the screener response rate. The weighted distributions of the sample were calculated by age. Additional information on response rates is available on the NHANES website.(2)

Overall sample sizes were lower during August 2021–August 2023 than in prior cycles (2017–2018: 9,251 vs. August 2021–August 2023: 6,722). Sample sizes were lower among those ages 0–19 and 20–59 but higher among those age 60 and older.

Table 1 – Sample Sizes and Response Rates for 30-Day Dietary Supplement and Non-Prescription Antacid Questionnaire, by Survey Cycle

	Response Rate (%)					Sample Size (n)					Weighted percent of total (%)				
	2011-2012	2013-2014	2015-2016	2017-2018	Aug 2021-Aug 2023	2011-2012	2013-2014	2015-2016	2017-2018	Aug 2021-Aug 2023	2011-2012	2013-2014	2015-2016	2017-2018	Aug 2021-Aug 2023
Overall	72.6	71.0	61.3	51.9	19.5	9752	10174	9971	9251	6722	N/A	N/A	N/A	N/A	N/A
Age															
0-19 years	81.0	79.3	67.9	59.3	18.0	4196	4406	4252	3684	1945	27.0	26.4	25.9	25.6	25.0
20–59 years	71.3	69.1	58.8	49.0	18.9	3768	3928	3818	3418	2437	54.2	53.9	53.4	52.7	51.7
≥60 years	60.3	59.6	54.2	46.3	21.6	1788	1840	1901	2149	2340	18.8	19.8	20.7	21.7	23.3

NOTES: Response rates and sample sizes for the 30-day dietary supplement and non-prescription antacid questionnaire were reported based on participants who had a non-zero weight for the component (interview weights for 2011–2012 through 2017–2018; dietary day 1 weights for August 2021–August 2023) and answered at least one of the following: 1) any dietary supplement taken in the past 30 days (DSD010); 2) any antacids taken in the past 30 days (DSD010AN). During August 2021–August 2023, 11 participants had available dietary supplement or antacid information but did not have a Dietary Day 1 weight > 0. These participants were excluded from the sample sizes and were considered non-respondents for response rate calculations. Response rates were calculated as unconditional response rates, as those who participated in the 30-day dietary supplement and non-prescription antacid questionnaire out of the entire screened sample. For 2011–2012 and 2013–2014, calculated as [(Unweighted sample size) / (Screener sample size)]. For 2015–2016, 2017–2018, and August 2021–August 2023, accounted for the screener response rate and calculated as [(Unweighted sample size) / (Screener sample size)] * (screener response rate). The weighted percent of the total was calculated using interview weights (WTINT2YR) for 2011–2012 through 2017–2018 and Dietary Day 1 weights (WTDRD1) for August 2021–August 2023. For more on NHANES response rates, see: https://wwwn.cdc.gov/nchs/nhanes/ResponseRates.aspx

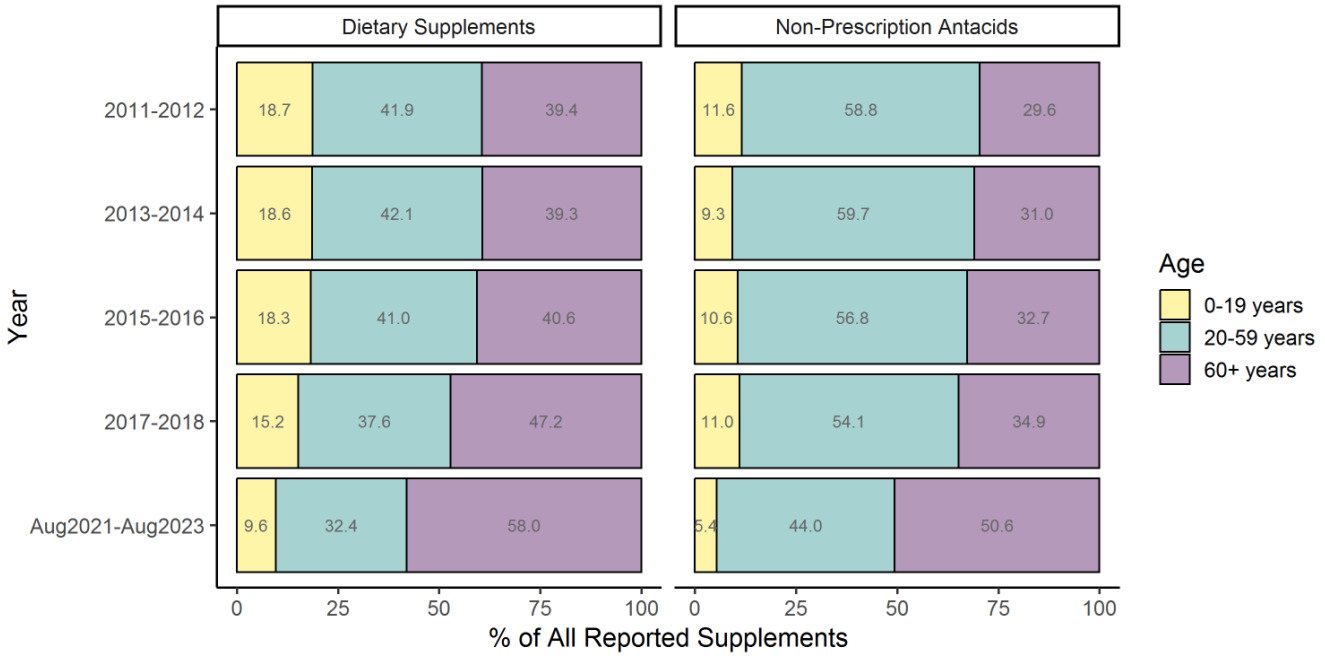
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

B.2. Reported Dietary Supplements and Non-Prescription Antacids by Age

Participants were able to report more than one dietary supplement or non-prescription antacid. The unweighted distribution of all reported dietary supplements and non-prescription antacids was calculated by age to show differences across the lifespan and survey cycles **(Figure 2)**.

The unweighted percentage of all reported dietary supplements and non-prescription antacids was higher during August 2021–August 2023 for those age 60 and older. This pattern reflects the increases in the unweighted percentage of respondents age 60 and older in the August 2021–August 2023 cycle compared to past cycles as well as the higher number of dietary supplements typically taken by respondents age 60 and older. Such differences in the unweighted percentage of respondents by age and cycle are accounted for by using survey weights when weighted estimates are presented.

Figure 2 – Unweighted Distribution of All Reported Dietary Supplements and Non-Prescription Antacids by Age



SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

C. Operational Analyses

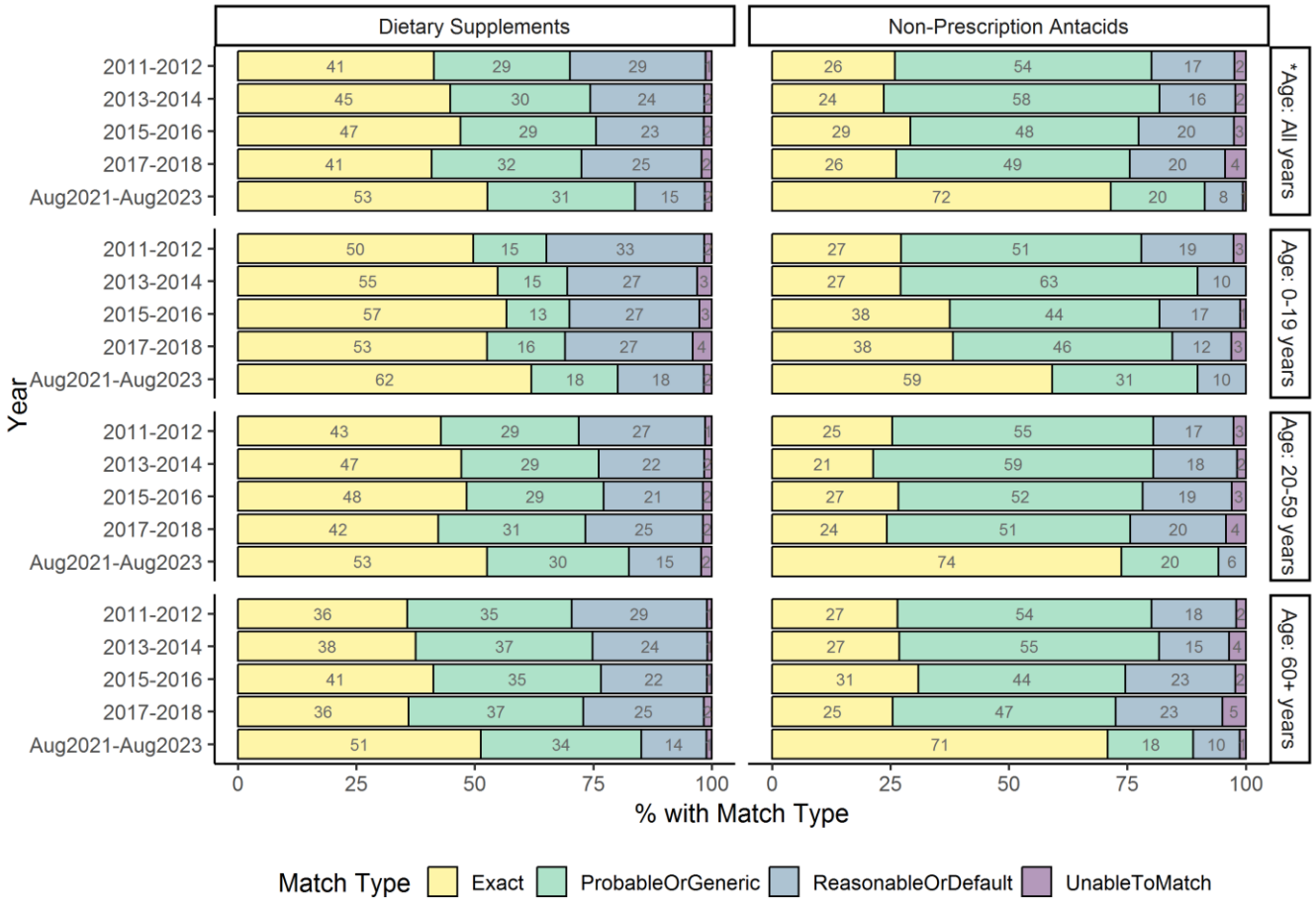
Several measures related to data quality for dietary supplements and non-prescription antacids were available across all cycles. Given the large differences in the unweighted response to the DSQ interview by age over time, quality measures were assessed overall and by age group.

C.1. Quality of match

For all NHANES data cycles, trained NCHS nutritionists match the name of reported dietary supplement and non-prescription antacids to an in-house Product Label Database.(3) Matching quality is categorized based on the accuracy and completeness of information provided during the interview. The quality of the match is recorded as: 1) Exact or near exact match; 2) Probable match; 3) Generic match; 4) Reasonable match; 5) Default match; 6) No match; 7) Refused by participant; or 8) Don't know by participant. The percentage of reported dietary supplements and non-prescription antacids by match quality was assessed by survey cycle **(Figure 3)**. Match quality was collapsed into 4 categories: 1) Exact (highest quality match); 2) Probable or Generic (without an exact match but considered to have accurate ingredient names and amounts); 3) Reasonable or Default (requiring assumptions to be matched); and 4) Unable to Match (No Match, Refused, or Don't Know).

The percentage of dietary supplements with exact matches was higher in August 2021–August 2023 (53%) compared to 2017–2018 (41%). This improvement was similar across age groups. The percentage of non-prescription antacids with exact matches was much higher during August 2021–August 2023 (72%) compared to 2017–2018 (26%). The percentage of non-prescription antacids that were unable to be matched was lower in August 2021–August 2023 (<1%) compared to 4% in 2017–2018. These improvements were similar across age groups.

Figure 3 – Quality of Matches (Among All Reported Dietary Supplements and Non-Prescription Antacids Taken in the Past 30 Days)



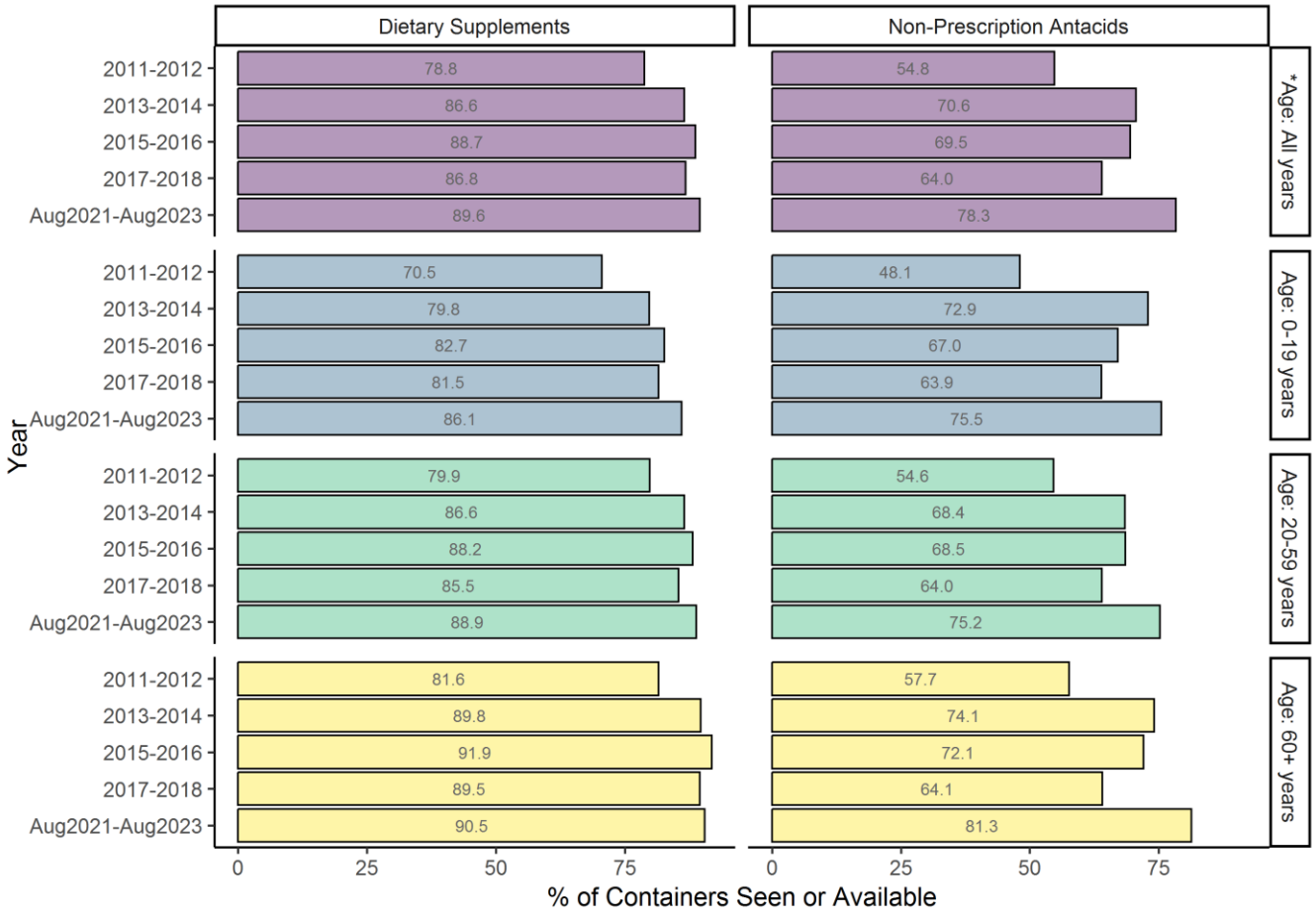
NOTES: For further information, see: https://wwwn.cdc.gov/Nchs/Data/Nhanes/Public/2017/DataFiles/DSQIDS_J.htm#DSDMTCH
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

C.2. Containers Seen or Available During Interview

During 2011–2012 through 2017–2018, interviewers asked participants to show them the containers of dietary supplements and non-prescription antacids used in the past 30 days. Containers that were viewed by interviewers were recorded as seen. During August 2021–August 2023, interviewers asked participants if the containers were available. Containers that were reported as available at the time of the telephone interview by the participant were recorded as available, and the participant was asked to read the label information while interviewers recorded this information. The percentage of dietary supplements and non-prescription antacids recorded as seen or available was assessed by survey cycle **(Figure 4)**.

The percent of dietary supplement containers seen or available was similar to recent cycles (2017–2018: 86.8% vs. August 2021–August 2023: 89.5%). There was an apparent increase in non-prescription antacid containers seen or available (2017–2018: 64.0% vs. August 2021–August 2023: 78.3%). Such findings were generally similar among age groups.

Figure 4 – Percent of Dietary Supplements and Non-Prescription Antacids Seen or Available During Interview



SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

C.3. Impact of Removing the Prescription Medication Questionnaire During August 2021–August 2023

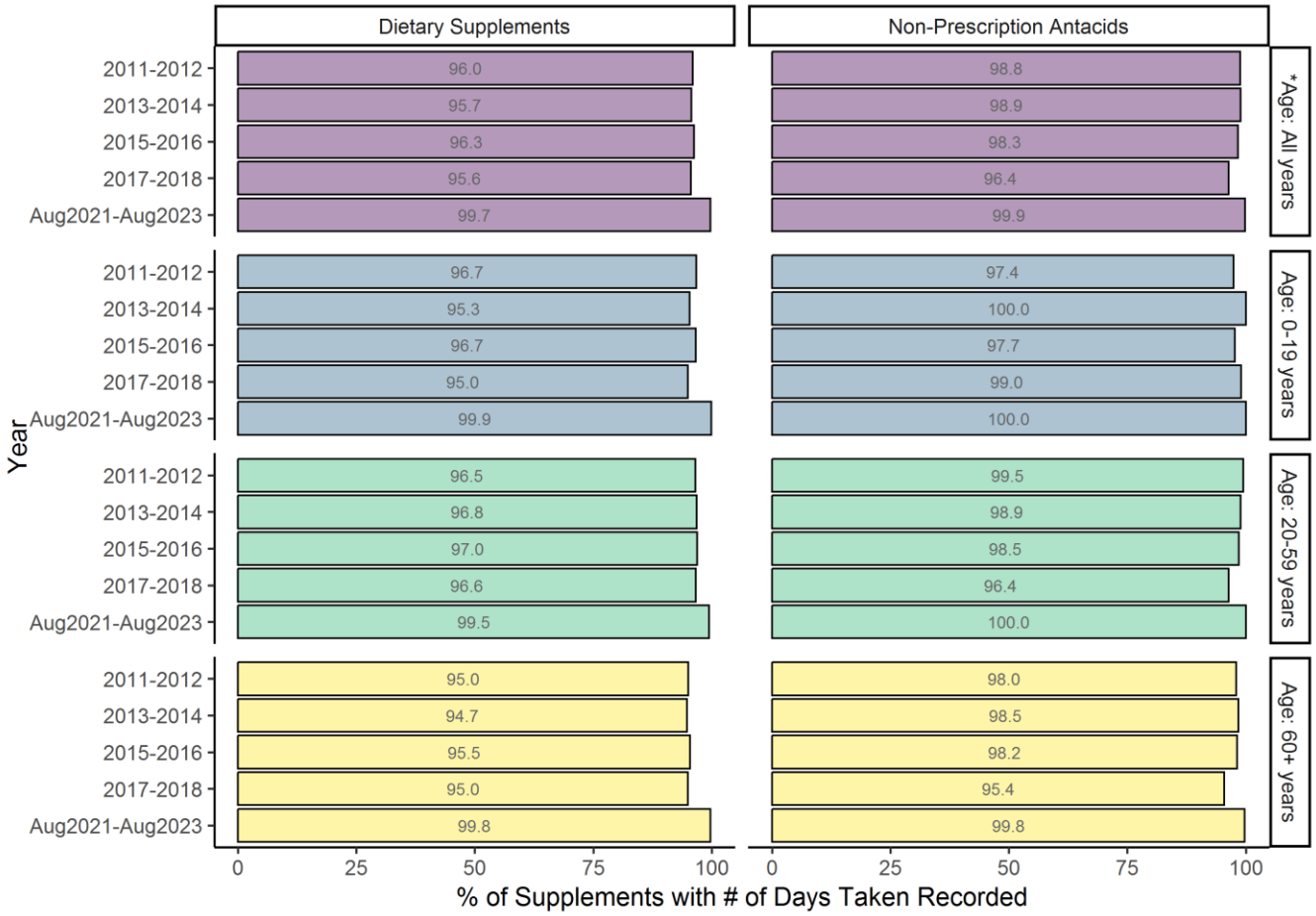
The Prescription Medication Questionnaire (RXQ) was not included in August 2021–August 2023. In previous cycles, some participants reported use of dietary supplements during the RXQ instead of during the DSQ. During data processing, trained NCHS nutritionists reclassified dietary supplements reported in the RXQ as supplements rather than prescriptions, and these were then included in the public use dietary supplements data set rather than the prescription medication data set. Because participants in August 2021–August 2023 didn't have the opportunity to report prescription medications, some dietary supplements that may have been reported only as prescriptions were not captured in this cycle. For example, during 2017–2018, three product ingredients had >5% of mentions captured by the RXQ rather than the DSQ: 1) Fluoride (38.6%), 2) Melatonin (10.8%), and 3) Iron (5.4%)**.** It is possible that August 2021–August 2023 estimates for these products may be underestimated. Estimates for use of products containing these ingredients are reported below, in **Tables 11–13.**

C.4. Days Taken

For each dietary supplement or non-prescription antacid reported, interviewers asked how many days that the participant took it in the past 30 days. During 2011–2018, this information was not captured if a supplement was reported in response to the prescription medication questionnaire. The percentage of dietary supplements and non-prescription antacids with this information available was assessed by survey cycle **(Figure 5)**. As mentioned above, no prescription medication component was administered during August 2021–August 2023.

The percentage of dietary supplements and non-prescription antacids with a recorded response for the number of days taken during the previous 30 days increased during August 2021–August 2023 compared to past cycles. For dietary supplements, 99.7% had a response during August 2021–August 2023 compared to 95.6% during 2017–2018. This improvement was generally consistent across age groups. For non-prescription antacids, 99.9% had this information available during August 2021–August 2023 compared to 96.4% during 2017–2018. When excluding dietary supplements and non-prescription antacids captured during the prescription medication component in 2017–2018, using internal data, 99.1% of dietary supplements and 96.9% of non-prescription antacids had number of days taken within the previous 30 days recorded, closer to but still lower than the percentage reported during August 2021–August 2023.

Figure 5 – Percent of Dietary Supplements and Non-Prescription Antacids with Number of Days Taken in Past 30 Days Recorded



SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D. Weighted Estimates

Weighted estimates, including means and proportions with standard error, were calculated using R (version 4.4.0) and the "Survey" package (version 4.4-2).(4) Proportions were evaluated according to the NCHS Data Presentation Standards for Proportions.(5) Those estimates that did not meet NCHS Presentation Standards were noted. Linear time trends from 2011–2012 through August 2021–August 2023 were tested using linear regression. Estimates from 2017–2018 were directly compared to August 2021–August 2023 cycle using a two-sided univariate t statistic. Interview weights were used for 2011–2012 through 2017–2018 (WTINT2YR) and Dietary Day 1 weights were used for August 2021–August 2023 (WTDRD1). All weighted estimates accounted for the survey's complex sample design.

Dietary supplement products, excluding non-prescription antacids, were selected for weighted estimates based on meeting one of the following three criteria:

- Commonly reported products or ingredients (multivitamin-mineral; botanical)
- Potential increases associated with the COVID-19 pandemic (vitamin C, vitamin D, zinc)(6)
- A high percentage of products containing the ingredient (>5%) were previously captured during the prescription medication questions during 2017–2018 (fluoride, melatonin, iron)

D.1. Any Dietary Supplement

Any dietary supplement use was defined as use of one or more dietary supplements during the past 30 days **(Table 2).**

There were significant increases among adults ages 20–59 (46.2% to 53.1%, *P=0.001*) and 60 and older (68.7% to 75.9%, *P=0.001*) from 2011–2012 through August 2021–August 2023. Use of any dietary supplement did not change significantly among any age group between 2017–2018 and August 2021–August 2023.

Table 2 – Any Dietary Supplement Use (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	31.5 (1.8)	33.1 (1.4)	34.1 (2.6)	34.0 (1.8)	35.7 (2.6)	0.192	0.593
20–59	46.2 (1.7)	47.7 (1.4)	48.8 (1.6)	50.7 (1.5)	53.1 (1.6)	0.001	0.284
≥60	68.7 (1.2)	70.5 (2.2)	74.2 (2.0)	74.3 (1.8)	75.9 (1.5)	0.001	0.488

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.2. Greater than 1 Dietary Supplement

Greater than 1 dietary supplement use was defined as use of more than one dietary supplement during the past 30 days **(Table 3).**

There were significant increases among children and adolescents ages 0–19 (5.2% to 11.3%, *P<0.001*), adults ages 20–59 (23.4% to 30.8%, *P<0.001*), and adults 60 and older (45.6% to 56.4%, *P=0.001*) from 2011–2012 through August 2021–August 2023. The percentage of children and adolescents taking more than one dietary supplement increased from 7.1% during 2017–2018 to 11.3% during August 2021–August 2023 (*P=0.008),* but did not change significantly among adults over the same time period.

Table 3 – Greater than 1 Dietary Supplement Used (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	5.2 (0.6)	6.4 (0.9)	8.5 (1.4)	7.1 (0.8)	11.3 (1.3)	<0.001	0.008
20–59	23.4 (1.5)	23.9 (1.2)	25.7 (1.9)	27.5 (1.4)	30.8 (1.3)	<0.001	0.098
≥60	45.6 (2.0)	50.0 (2.3)	53.2 (2.8)	53.6 (1.8)	56.4 (2.1)	0.001	0.314

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.3. Mean Number of Dietary Supplements

The mean number of dietary supplements used during the past 30 days was calculated **(Table 4).**

The mean number of dietary supplements used in the past 30 days by children and adolescents ages 0–19 increased from 0.39 during 2011–2012 to 0.54 during August 2021–August 2023 (*P=0.010)*, but there was no significant change from 2017–2018 to August 2021–August 2023. Similarly for adults, the mean number of dietary supplements used increased between 2011–2012 and August 2021–August 2023 (ages 20–59: 0.99 to 1.29 [*P<0.001]*; age 60 and older: 2.02 to 2.59 [*P=0.001]*), but there was no significant change from 2017–2018 to August 2021–August 2023.

Table 4 – Mean Number of Dietary Supplements Used (Past 30 Days)

Age in years	2011–2012 mean (SE)	2013–2014 mean (SE)	2015–2016 mean (SE)	2017–2018 mean (SE)	August 2021–August 2023 mean (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	0.39 (0.03)	0.43 (0.03)	0.48 (0.05)	0.45 (0.03)	0.54 (0.05)	0.010	0.129
20–59	0.99 (0.07)	1.03 (0.04)	1.11 (0.07)	1.17 (0.08)	1.29 (0.06)	<0.001	0.208
≥60	2.02 (0.10)	2.18 (0.13)	2.53 (0.24)	2.47 (0.15)	2.59 (0.13)	0.001	0.548

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.4. Any Non-Prescription Antacid

Any non-prescription antacid use was defined as use of one or more non-prescription antacids during the past 30 days **(Table 5).**

Non-prescription antacid use increased among adults between 2011–2012 and August 2021–August 2023 (ages 20–59: 13.3% to 16.3% [*P=0.009]*; age 60 and older: 13.6% to 18.9% [*P=0.001]*). Use did not significantly change among adults or children from 2017–2018 to August 2021–August 2023.

Table 5 – Any Non-Prescription Antacid Use (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	3.8 (0.7)	2.2 (0.4)	3.4 (0.5)	4.0 (0.5)	2.8 (0.5)	0.635	0.102
20–59	13.3 (1.0)	12.6 (0.6)	15.6 (1.2)	17.2 (1.1)	16.3 (1.2)	0.009	0.573
≥60	13.6 (1.5)	14.3 (0.8)	18.7 (1.8)	16.5 (1.3)	18.9 (0.9)	0.001	0.147

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.5. Multivitamin-Mineral Products

Multivitamin-mineral products were defined as products having three or more vitamins and one or more mineral **(Table 6)**.(7, 8)

Use of multivitamin-mineral products did not significantly change from 2011–2012 through August 2021–August 2023 or from 2017–2018 to August 2021–August 2023.

Table 6 – Taking a Multivitamin-Mineral Product (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	22.7 (1.8)	24.8 (1.5)	25.0 (2.2)	23.8 (1.7)	23.6 (2.0)	0.953	0.938
20–59	28.3 (1.3)	30.8 (1.1)	27.8 (1.2)	26.9 (1.4)	29.6 (1.3)	0.979	0.173
≥60	38.2 (1.3)	40.6 (2.1)	39.0 (2.0)	39.4 (1.9)	41.2 (1.5)	0.293	0.467

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.6. Botanical Ingredients

Any product containing a botanical was defined based on inclusion of at least one botanical ingredient, regardless of other included ingredients **(Table 7)**.

Use of dietary supplements containing botanical ingredients increased among children and adolescents aged 0–19 from 2011–2012 to August 2021–August 2023 (3.4% to 6.2%, *P = 0.015*) as well as from 2017–2018 to August 2021–August 2023 (3.5% to 6.2%, *P = 0.006*). Use of these products increased among adults age 60 and older from 2011–2012 to August 2021–August 2023 (18.1% to 23.9%, *P=0.013*), but there were no significant changes among adults between 2017–2018 and August 2021–August 2023.

Table 7 – Any Dietary Supplement Containing a Botanical Ingredient (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	3.4 (0.6)	4.0 (0.5)	3.9 (0.8)	3.5 (0.3)	6.2 (0.9)	0.015	0.006
20–59	13.5 (1.0)	14.2 (1.1)	14.1 (1.1)	16.0 (1.3)	15.3 (0.8)	0.108	0.637
≥60	18.1 (1.2)	18.2 (2.2)	22.6 (2.6)	20.7 (1.9)	23.9 (1.8)	0.013	0.223

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.7. Vitamin C

Products with vitamin C were defined based on inclusion of any vitamin C, regardless of other included ingredients **(Table 8)**.

Use of dietary supplements containing vitamin C increased from 2011–2012 to August 2021–August 2023 among adults age 60 and older (44.7% to 51.7%, *P=0.014*); there was also an increase in use of these supplements from 2017–2018 to August 2021–August 2023 (46.0% to 51.7%, *P=0.041*). There were no significant changes among those ages 0–19 or 20–59.

Table 8 – Any Dietary Supplement Containing Vitamin C (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	26.3 (1.9)	28.3 (1.3)	28.5 (2.3)	26.8 (1.7)	27.5 (1.8)	0.917	0.807
20–59	33.0 (1.4)	35.3 (1.2)	33.8 (1.3)	33.4 (1.6)	34.8 (1.2)	0.605	0.496
≥60	44.7 (1.4)	47.8 (1.9)	47.5 (2.0)	46.0 (1.9)	51.7 (1.8)	0.014	0.041

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.8. Vitamin D

Products with vitamin D were defined based on inclusion of any vitamin D, regardless of other included ingredients **(Table 9)**.

There was a significant increase in use of dietary supplements containing vitamin D from 2011–2012 to August 2021–August 2023 among those age 60 and older (56.4% to 63.5%, *P=0.001*). Use of these supplements increased from 2017–2018 to August 2021–August 2023 only among adults ages 20–59 (33.9% to 39.6%, *P=0.013*).

Table 9 – Any Dietary Supplement Containing Vitamin D (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	26.4 (1.9)	26.8 (1.5)	27.6 (2.2)	26.7 (1.8)	27.4 (2.1)	0.782	0.822
20–59	35.0 (1.5)	36.2 (1.2)	33.7 (1.4)	33.9 (1.5)	39.6 (1.5)	0.054	0.013
≥60	56.4 (1.8)	56.7 (2.2)	58.9 (1.5)	60.4 (1.8)	63.5 (1.6)	0.001	0.219

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.9. Zinc

Products with zinc were defined based on inclusion of any zinc, regardless of other included ingredients **(Table 10)**.

Use of dietary supplements containing zinc increased from 2011–2012 to August 2021–August 2023 among those age 60 and older (38.3% to 46.6%, *P=0.001*). Use of these supplements also increased from 2017–2018 to August 2021–August 2023 among adults ages 20–59 (24.5% to 31.4%, *P=0.001*) and those age 60 and older (40.0% to 46.6%, *P=0.011*) but did not significantly change among children and adolescents.

Table 10 – Any Dietary Supplement Containing Zinc (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	21.4 (1.5)	23.0 (1.3)	22.0 (1.9)	20.7 (1.5)	23.7 (1.7)	0.513	0.187
20–59	27.1 (1.3)	29.1 (1.2)	26.3 (1.3)	24.5 (1.3)	31.4 (1.3)	0.099	0.001
≥60	38.3 (1.3)	42.1 (1.9)	38.8 (1.7)	40.0 (1.9)	46.6 (1.5)	0.001	0.011

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.10. Fluoride

Dietary supplements containing fluoride were defined based on inclusion of any fluoride, regardless of other included ingredients **(Table 11)**.

There were no significant changes in use of dietary supplement products containing fluoride among children between 2011–2012 and August 2021–August 2023 or from 2017–2018 to August 2021–August 2023. Use of dietary supplements containing fluoride was reported only very rarely among adults across all cycles and is therefore not shown here.

Table 11 – Any Dietary Supplement Containing Fluoride (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	0.8 (0.3)	1.6 (0.8)	0.6 (0.4)	1.9 (0.7)	0.6 (0.6)	0.729	0.161

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.11. Melatonin

Products with melatonin were defined based on inclusion of any melatonin regardless of other included ingredients **(Table 12)**.

Use of dietary supplements containing melatonin increased from 2011–2012 to August 2021–August 2023 among all age groups (0–19: 0.7% to 2.4%, *P=0.001;* 20–59: 0.7% to 2.0%, *P<0.001*; 60 and older: 0.5% to 1.9%, *P=0.001*). There were no significant changes from 2017–2018 to August 2021–August 2023 for any age group.

Table 12 – Any Dietary Supplement Containing Melatonin (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	0.7 (0.2)	0.9 (0.3)	1.1 (0.2)	1.3 (0.3)	2.4 (0.5)	0.001	0.064
20–59	0.7 (0.2)	1.0 (0.3)	1.9 (0.2)	2.0 (0.4)	2.0 (0.3)	<0.001	0.884
≥60	0.5 (0.3)	1.3 (0.3)	2.1 (1.0)	2.3 (0.5)	1.9 (0.2)	0.001	0.465

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

D.12. Iron

Products with iron were defined based on inclusion of any iron, regardless of other included ingredients **(Table 13)**.

Use of dietary supplements containing iron decreased between 2011–2012 and August 2021–August 2023 among those ages 0–19 (10.2% to 6.7%, *P=0.012)* and those ages 20–59 (18.5% to 15.8%, *P=0.011*). There were no significant changes from 2017–2018 to August 2021–August 2023 for any age group.

Table 13 – Any Dietary Supplement Containing Iron (Past 30 Days)

Age in years	2011–2012 % (SE)	2013–2014 % (SE)	2015–2016 % (SE)	2017–2018 % (SE)	August 2021–August 2023 % (SE)	Linear Trend (2011–2012 through Aug 2021–Aug 2023) *P*	T-Test (2017–2018 vs. Aug 2021–Aug 2023) *P*
0–19	10.2 (0.9)	7.9 (0.7)	5.9 (0.7)	6.0 (0.8)	6.7 (0.9)	0.012	0.577
20–59	18.5 (1.2)	18.4 (0.8)	14.6 (0.8)	15.6 (0.8)	15.8 (0.6)	0.011	0.863
≥60	19.1 (1.0)	19.7 (1.5)	19.3 (0.9)	18.6 (1.3)	21.8 (1.1)	0.109	0.075

NOTES: Interview weight (WTINT2YR) used for 2011–2018; Day 1 dietary weight (WTDRD1) used for August 2021-August 2023
SOURCE: National Center for Health Statistics, National Health and Nutrition Examination Survey 2011–2012 through August 2021–August 2023.

IV. Discussion

Changes in data collection for the August 2021–August 2023 cycle directly impacted administration of the DSQ. First, the mode was changed from in-person to telephone, which required participants to read product labels to interviewers, whereas previously interviewers directly observed available container labels. Second, the timing of the DSQ interview changed from during the household interview to 3–7 days after the MEC visit. This change resulted in additional nonresponse between the household interview and the Day 1 Dietary Interview during which the DSQ interview was conducted. This additional nonresponse contributed to decreased sample sizes, which in turn may lead to higher variance for some estimates, though changes in variance are also dependent upon the variation in sampling weights, design effect, and variation in the variable of interest. The effect on specific subgroups may vary. The change in timing of the component could also lead to different behavior or preparation among participants. For example, advance instructions provided for the DSQ during the MEC visit in August 2021–August 2023 may have helped participants to remember to have their dietary supplement containers available during the telephone interview. Third, the type of interviewer changed from field interviewers to trained dietary interviewers. These interviewers have greater expertise with dietary supplements. Fourth, the prescription medication questionnaire, a source for some prescribed dietary supplements, was removed for this cycle. While the absence of a crossover study precludes definitive conclusions about how these changes may have impacted operations and dietary supplement use estimates, our analyses found the following changes:

1. The quality of matches improved slightly for dietary supplements and improved markedly for non-prescription antacids during August 2021–August 2023 compared to past cycles.

2. A similar percentage of dietary supplement containers and a higher percentage of non-prescription antacid containers than in previous cycles were available for participants to directly provide label information during the interview. Given the change in mode of questionnaire administration, the percentage of containers seen or available was not directly equivalent between 2011–2018 and August 2021–August 2023.

3. There were improvements in the capture of the number of days supplements were taken in the past 30 days. For dietary supplements, most of this improvement may be due to the removal of the prescription medication component during August 2021–August 2023. Improvement in capture of this information for non-prescription antacids appeared independent of the prescription medication component.

4. Estimates for non-prescription antacid use did not change from 2017–2018 to August 2021–August 2023.

5. Observed significant changes in dietary supplement use from 2017–2018 to August 2021–August 2023 included increased use of more than one dietary supplement (ages 0–19), dietary supplements containing a botanical ingredient (ages 0–19), dietary supplements containing vitamin C (age 60 and older), dietary supplements containing vitamin D (ages 20–59), and dietary supplements containing zinc (ages 20–59 and 60 and older). Reports show that sales of some dietary supplements increased early during the COVID-19 pandemic.(9) Dietary supplements containing ingredients associated with immune function, such as vitamin C, vitamin D, and zinc, received significant media attention.(6) It is unclear whether such increased sales and attention would have been sustained or led to meaningful changes in dietary supplement intake behavior in the population over the study period. However, the increase in use of products containing vitamin C, vitamin D, or zinc among adults seem consistent with other data sources.

6. Although overall use of products containing fluoride and melatonin is low, a high percentage of the products (38.6% and 10.8% respectively) were previously reported during the prescription medication questions in 2017–2018. In addition, about 5% of the products containing iron were previously reported during the prescription medication questionnaire in 2017-2018. There were no significant changes in use of products containing these ingredients from 2017–2018 to August 2021–August 2023.

There are several limitations for these analyses. For weighted analyses, products were assessed by ingredients; however, more detailed information such as single-ingredient vs. combinations of ingredients was not assessed. Other classification systems for dietary supplement products could yield different conclusions. A prior study showed that differences were small between two modes of administration of 24-hour recall for dietary supplements (telephone interview- vs. self-administered).(10) This suggests that mode changes may have had minimal impact; however, the mode change and length of recall in that study were different than those for the August 2021–August 2023 NHANES cycle. These analyses cannot distinguish between actual changes in consumption, changes due to modifications in administration of the questionnaire, changes in behavior of participants based on participation in prior NHANES components (i.e. household interview and MEC prior to DSQ interview), and changes due to participant response to the survey (non-response bias) that are not accounted for by survey weights.

V. Conclusions

The mode change in the August 2021–August 2023 dietary supplement questionnaire from in-person to telephone was evaluated by assessing response rates, sample sizes, data quality, and supplement use estimates. Overall, during August 2021–August 2023, there were some improvements in data quality. Such improvements may be secondary to changes in the characteristics of responding participants or changes in the administration of the questionnaire itself. There were some changes in weighted estimates in dietary supplement use. The analyses could not discern whether any differences in dietary supplement and non-prescription antacid use were due to true changes that occurred over time, the mode of data collection, non-response bias from lower response rates that were not accounted for by survey weights, or any combination thereof. Analysts should consider and acknowledge these changes and the possibility that the mode change may impact findings.

VI. References

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VII. Acknowledgements

The authors would like to thank Lara J. Akinbami, Catherine A. Couch, Cynthia L. Ogden, and Anne M. Williams for their contributions.