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ORIGINAL PAPER

Changing SNAP-Participation Trends Among Farmworker Households in the U.S., 2003–2012

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Abstract We investigated Supplemental Nutrition Assistance Program (SNAP) participation among citizen, documented and undocumented immigrant hired crop farmworkers for ten recent years. We analyzed population representative data from the National Agricultural Workers Survey for 2003–2012 (N = 18,243 households). Time-chart, simple mean differences, and logistic regressions described farmworker household participation in SNAP. The 2008 financial crisis almost doubled SNAP-participation by agriculture households (6.5% in 2003–2007 vs. 11.3% in 2008–2012). The increasing SNAP-participation was found for citizen, documented and undocumented immigrant households. We found low participation among documented (OR 0.67, 95% CI 0.56–0.8) and undocumented immigrants (OR 0.63, 95% CI 0.54–0.74) compared to citizens. Low odds ratios (OR 0.70, 95% CI 0.55–0.89) were found for Hispanic-citizens as compared with non-Hispanic white-citizens. Our results may help inform the debate surrounding the effects of the financial crisis on SNAP-participation and on differences in participation among citizens, immigrants, Hispanics and non-Hispanics, the latter suggesting ethnic farmworker disparities in SNAP-participation.

Keywords SNAP participation · Food Stamps · Farmworkers · Nutrition programs and policies

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Background

The Supplemental Nutrition Assistance Program (SNAP), formerly called Food Stamps, is a federal aid program administered by the U.S. Department of Agriculture (USDA). SNAP facilitates food purchases by low income people in order to reduce hunger and improve nutrition. Secondarily, SNAP-participation stimulates spending and edible agricultural products. Overall, SNAP has been judged to be among the most cost-effective of all government programs and tax options [1–3].

SNAP benefits are limited to U.S. citizens and certain non-citizens lawfully residing in the US [4]. Historically, SNAP-participation has been low among eligible immigrant households [4]. Reasons for the lower participation among legal immigrants include the 5-year waiting period, fear that participation in SNAP may affect immigration status, language or literacy issues, and lack of knowledge about the program [4].

There are two pathways to be eligible to SNAP-participation: (1) meeting specific federal eligibility requirements or (2) being "categorically eligible", that is, being eligible for benefits from other specified low-income assistance programs that makes them automatically eligible for SNAP benefits [5]. Specific federal SNAP eligibility requirements include income and resource limits, expenses, employment, age 60 or older, and disability [4–7]. Non-citizens must meet at least one additional condition: 5 years of residence or 40 qualifying work quarters; a child (<18 years); blind or disabled; elderly (60+ years) born on or before 8-22-31 who lawfully resided in the U.S. since 8-22-96; military service; and some unique circumstances [4]. Those who are "categorically eligible" for benefits from other specified low-income assistance programs might bypass the specific federal eligibility requirements [5]. A wide variation

of benefits, which differ among the states, can be conveyed within SNAP-categorical eligibility. There are even different income eligibility thresholds among states resulting in "broad-based" categorical eligibility and wide variation between states [5]. Finally, SNAP has been found to have one of the most rigorous quality control systems among all public benefit programs and as a result of efforts to curb fraud and abuse payments to ineligible households reached a record low in recent years [1].

State agencies cannot deny an entire household merely because one family member is ineligible. SNAP eligibility must be accessed for each person individually [4–8]. Households with both undocumented and documented family members are able to receive benefits. Thus, although SNAP benefits have never been extended to undocumented immigrants [4], undocumented immigrants can get benefit indirectly. Undocumented immigrants with eligible children can get benefits from SNAP since they can apply for their children. Also, ineligible adult-children may be in the same household as eligible elderly parents. This explains why some households classified as undocumented receive benefits.

SNAP has historically been debated in the political arena because of the large expenses in nutrition programs and their crucial role in reducing poverty and food insecurity [1–3, 9–11]. SNAP benefited over 47 million participants in about 23 million low-income households in 2013 [1]. The Agricultural Act of 2014 introduced substantial changes; Congress passed a bill to reduce SNAP spending by $39 billion over 10 years [10, 11]. This cut occurred when the economy was still recovering from the so-called 2008 financial crisis which caused a remarkable gradual increase in SNAP benefits [12, 13]. In 2010 there were an estimated 11.2 million undocumented immigrants accounting for 3.2% of the US population [14, 15]. Considerable controversy surrounds the provision of SNAP benefits to undocumented immigrants, especially the potential impact of those undocumented immigrants on the SNAP-benefits increases during and since the 2008 recession [1, 16–21]. Some commentators argue that benefits are too generous and attract a disproportionate number of undocumented immigrants [21]; others argue that benefits are not generous enough and result in greater spending on Medicaid [22].

We aim to analyze SNAP-participation on agricultural households over ten recent years focusing analysis on the 2008 Great Recession, poverty rates, respondent' legal status and race-ethnicity.

Materials and Methods

Data were drawn from the National Agricultural Workers Survey (NAWS). NAWS is an employment-based, nationally representative random-sample survey of hired crop workers sponsored by the United States Department of Labor. The NAWS provide individual and household information on demographic, employment, health history and income from a random sample of hired crop workers. Crop workers with an H-2A visa are not included in the NAWS sampling universe. Each year between 1500 and 3600 farmworkers are interviewed at workplaces in face-to-face interviews. NAWS interviews last 48–65 min and participants are paid $20 cash for their participation; interviews were completed across 467 counties within 40 states [23]. The NAWS implements a multi-stage sampling to account for regional and seasonal fluctuations. The sampling year is divided into three interviewing cycles in order to capture seasonal fluctuations in the agricultural work force. Apart from these three cycles there are five levels of selection US area, counties or farm labor areas (FLA), ZIP code region, employer and respondent. In the employer sampling stage, a simple random sample of hired farmworkers is selected.

The NAWS database is publicly available. Specific individuals within the NAWS database cannot be identified. The NAWS has the great advantage that it contains information on the legal status of farmworkers. Undocumented immigrants accounted for 49.5% of farmworkers from 2003 to 2012 in the NAWS.

Our analysis included assessing differences in means, trends in time charts, and logistic regressions all using Stata 13.1 (StataCorp, College Station, TX). Logistic regression analyses were chosen for our analysis since it fits our objectives and data and it is of widespread use in health sciences [24]. Binary logistic analysis was conducted in order to analyze binary qualitative responses (SNAP participation/no-participation of survey respondent) based on one or more predictor variables. Resulting OR values must be properly interpreted [24]. The odds of SNAP participation by survey respondent represents the odds for SNAP-participation given a predictor variable (exposure), compared to the odds for SNAP-participation in the absence of that predictor variable. Analyzed predictor variables included current legal-status, race-ethnic origin, gender, age, household composition (presence or absence of wife/partner, parents, children under 18 and adult children), family above/below poverty line, education, year of survey, and region within the USA. Legal status of the household was defined as the legal status of the survey-respondent in the household. Unfortunately, we do not have data on the legal status for all household members, which undoubtedly limit to the possibilities of analysis, as will discuss.

The households whose respondents were under 18 were excluded from analysis (558 out of 19,087, 2.9%). We eliminated the relatively small percentage of households (1.5%, 286 out of 18,529) with missing data on any of the above variables except family income. Our sample,

therefore, represents a total of 18,243 households. Roughly 18.9% (3441) of the households had missing income and therefore missing data on the poverty variable. Rather than discarding such a large percentage we created an indicator variable for the 18.9% with missing income. Our dependent variable, SNAP, was binary and equaled 1 if the subject or anyone in his or her household received SNAP benefits in the preceding 24 months. The SNAP variable therefore represented the household, not simply the individual subject answering the question.

The households were divided first into three categories according the respondent's legal status: documented immigrants (19.8%), undocumented immigrants (49.3%) and citizens (30.9%). Citizen households were secondly also stratified into three groups given the race-ethnic heterogeneity of citizen respondents: non-Hispanic white citizen households (17.8%), Hispanic citizen households (9%) and households of citizens of any other race or ethnicity (4%). However virtually all immigrants were Latinos (99.2%), mostly born in Mexico (93.6%). The racial-ethnic homogeneity found on immigrants allowed us to ignore further racial-ethnic classification among immigrants. Moreover, overlapping categories (immigrants and Latinos into different categories) must not be introduced in the regression models since it is methodologically incorrect and leads to confusing results. Finally, the number of non-Latinos immigrants is not a numerically relevant group (105 out of 18,243, 0.58%), too small to be statistically significant in the regressions and not of great interest to our analysis. Thus, the possibility to create a separate category for non-Latinos immigrants was rejected.

Weights supplied by the database were used for all descriptive statistics and regressions. NAWS authorities suggested that we use the weight multiplied by 1/2 for respondents whose spouse does US farm work. We therefore estimated that the 20,039 respondents included in our sample represented a total of 18,243 households.

Results

Descriptive Statistics

Nationally, SNAP-participation varies strongly over time. Figure 1 shows poverty and participation moving in tandem even for small fluctuations. The percent of households under the poverty line increased from 15.0% in 2008 to 24.0% in 2012. The increase in SNAP-participation was even higher, from 4.9 to 18.7.

Figure 2 shows SNAP-participation among citizens and both documented and undocumented immigrants. The increasing SNAP-participation was observed in citizens (9.5% in 2007 vs. 26.9% in 2012), undocumented
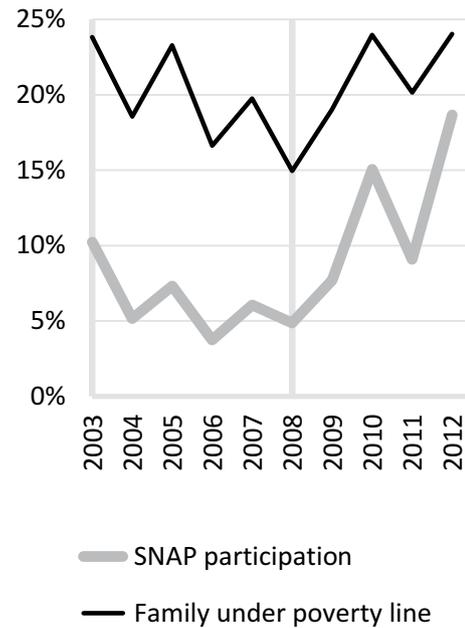

Fig. 1 SNAP participation and households under poverty line in US agricultural worker households. 2003–2012
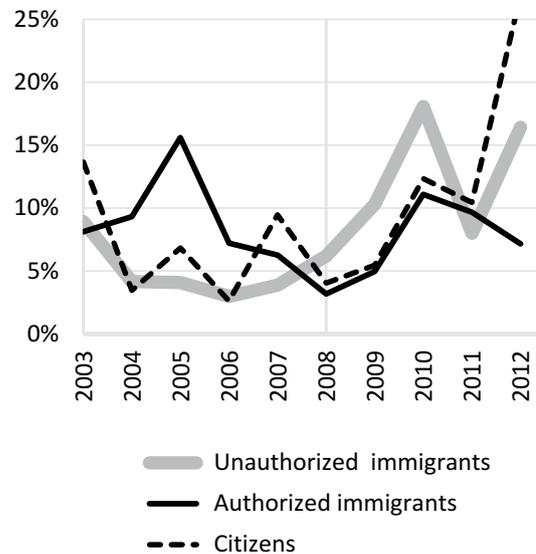

Fig. 2 SNAP-participation among citizens, authorized and unauthorized immigrants. US agricultural worker households. 2003–2012

immigrants (3.9% in 2007 vs. 16.4% in 2012) and to a lesser extent, in documented immigrants (6.3% in 2007 vs. 7.2% in 2012).

Table 1 reports descriptive statistics on variables within those using and those not using SNAP separately. The SNAP participants and non-participants differed in most characteristics: We found a relative low presence of unauthorized among those participating in SNAP compared to

Table 1 Sample characteristics of farmworker households. Data divided into those receiving and those not receiving SNAP

Characteristic	Receiving SNAP in last 2 years N (column %)	Not receiving SNAP in last 2 years N (column %)	Difference = receiving − not receiving (%)
Legal status and ethnicity			
Authorized immigrants	308 (19.1)	3309 (19.9)	−0.8
Unauthorized immigrants	744 (46.1)	8246 (49.6)	−3.5**
Hispanic citizens	154 (9.5)	1494 (9)	0.6
Non-Hispanic white citizens	318 (19.7)	2937 (17.7)	2.1*
Non-Hispanic non-white citizens	89 (5.5)	644 (3.9)	1.7*
Family under poverty line	668 (41.4)	3071 (18.5)	22.9**
Family under poverty line (missing)	250 (15.5)	3192 (19.2)	−3.7**
Household composition (family members living at home in USA)			
Spouse presence	1004 (62.2)	6593 (39.6)	22.6**
No children	445 (27.6)	11,345 (68.2)	−40.6**
1 Child aged 0–17	292 (18.1)	1845 (11.1)	7.0**
2 Children aged 0–17	323 (20)	1660 (10)	10.0**
3 Children aged 0–17	320 (19.8)	990 (6)	13.9**
4+ Children aged 0–17	219 (13.6)	413 (2.5)	11.1**
Children aged 18+	15 (0.9)	376 (2.3)	−1.3**
Parents present in household	50 (3.1)	186 (1.1)	2.0**
Gender (female)	615 (38.1)	3338 (20.1)	18.0**
Age (range)			
18–25	289 (17.9)	4591 (27.6)	−9.7**
26–35	618 (38.3)	4219 (25.4)	12.9**
36–45	501 (31)	3625 (21.8)	9.2**
46–59	164 (10.2)	3327 (20)	−9.8**
60+	43 (2.7)	867 (5.2)	−2.6**
Education: above primary school, (from no schooling to 7th grade vs. 8th grade or more)	930 (57.6)	8752 (52.6)	5.0**
Region			
California	332 (20.6)	5552 (33.4)	−12.8**
East	168 (10.4)	2554 (15.4)	−4.9**
Southeast	239 (14.8)	2039 (12.3)	2.5*
Midwest	390 (24.1)	2981 (17.9)	6.2**
Southwest	133 (8.3)	1324 (8)	0.3
Northwest	352 (21.8)	2179 (13.1)	8.7**
Year			
2003	195 (12.1)	1714 (10.3)	1.8*
2004	104 (6.5)	1925 (11.6)	−5.1**
2005	137 (8.5)	1732 (10.4)	−1.9*
2006	66 (4.1)	1687 (10.1)	−6.1**
2007	110 (6.8)	1701 (10.2)	−3.4**
2008	82 (5.1)	1607 (9.7)	−4.6**
2009	139 (8.6)	1669 (10)	−1.4
2010	268 (16.6)	1508 (9.1)	7.5**
2011	151 (9.3)	1507 (9.1)	0.3
2012	362 (22.5)	1579 (9.5)	13.0**

Table 1 (continued)

Characteristic	Receiving SNAP in last 2 years N (column %)	Not receiving SNAP in last 2 years N (column %)	Difference = receiving − not receiving (%)
Sample size	1,614	16,629	

Percent figures are estimated in the column categories. The database does not allow disaggregating the data by state. The six major regions of the USA were defined by the database. States included in the six regions analyzed: EAST (North Carolina, Virginia, Kentucky, Tennessee, West Virginia, Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont, Delaware, Maryland, New Jersey, Pennsylvania); SOUTHEAST (Arkansas, Louisiana, Mississippi, Alabama, Georgia, South Carolina, Florida); MIDWEST (Illinois, Indiana, Ohio, Iowa, Missouri, Kansas, Nebraska, North Dakota, South Dakota, Michigan, Minnesota, Wisconsin); SOUTHWEST (Arizona, New Mexico, Oklahoma, Texas); NORTHWEST (Idaho, Montana, Wyoming, Colorado, Nevada, Utah, Oregon, Washington); CALIFORNIA (California)

*Statistical significance at the 0.05 level, two-tailed test

**Statistical significance at 0.01 level, two-tailed test

those not participating (46.1 vs. 49.6%). We found a relative high presence of non-Hispanic white citizens (19.7% 138 vs. 17.7%) among those participating in SNAP compared to those not participating; no statistically significant differences were found for authorized immigrants (19.1 vs. 19.9%) and for Hispanic citizens (9.5 vs. 9%). Of those receiving SNAP, 41.4% were below the poverty line compared to 18.5% among those not receiving SNAP. A lower proportion of missing cases for poverty line was found for those households participating in SNAP (15.5 vs. 19.2%). Higher participation was found among those with spouse present verses not present (62.2 vs. 39.6%) and parents in the household vs. no parents in the household (3.1 vs. 1.1%). We found lower participation among survey responds from households with no children compared to households with children (27.6 vs. 68.2%). Although there were fewer women than men in both samples, the percentage of women was particularly low for those not receiving SNAP vs. those receiving (38.1 vs. 20.1%). The clusters in the childbearing age-ranges (aged 26–45) for those receiving SNAP were higher than those not receiving SNAP (69.3 vs. 47.2% aged 26–45). About half of the sample attained more than basic education (schooling 7+ years), and a higher proportion was observed in those receiving SNAP (57.6 vs. 52.6%). The plurality of households not receiving SNAP (33.4%) were located in California, however only 20.6% of those receiving SNAP were located in California. California, therefore, had a disproportionately low participation rate. The first 5 years of the time series (2003–2007) contributed 37.9% of all households receiving SNAP compared to 62.1% for the last 5 years, 2008–2012.

Logistic Analysis

Table 2 shows the odds ratios (OR) corresponding to logistic regressions that included and excluded various sets of covariates.

Model 1 did not adjust for any covariates. We found lower odds to participate among documented immigrants (OR 0.84, 95% CI 0.73–0.97, p = 0.02) as well as among undocumented immigrants (OR 0.81, 95% CI 0.73–0.91, p < 0.001) compared to citizens. Similarly, we found no differences for documented compared with undocumented (1.033, p = 0.650) in a regression with no other covariates (results not shown in Table 2).

Model 2 shows results after adjusting for all covariates listed in Table 1. Compared to the first simple no-covariates regression, the second one (Model 2, Table 2), produced lower odds ratios for both documented immigrants (OR 0.67, 95% CI 0.56–0.8, p < 0.001) and undocumented immigrants (OR 0.63, 95% CI 0.54–0.74, p < 0.001) compared to citizens. In results not shown in Table 2 that included the same covariates as Model 2, we found that the difference for documented immigrants compared with undocumented immigrants was not statistically significant (OR 1.06, 95% CI 0.90–1.25, p = 0.465).

Model 3 shows the results when citizens were desegregated into three categories according to their race-ethnic origin. Immigrants are not sub-classified into Latinos vs. non-Latinos since immigrants were virtually all Latinos (99.2%), as detailed in the methodology. The odds ratios for authorized (OR 0.60, 95% CI 0.48–0.74, p < 0.001) and for unauthorized immigrants (OR 0.57, 95% CI 0.47–0.69, p < 0.001) were reduced still further by comparing immigrants to non-Hispanic white citizens rather than with all citizens together. These results suggested that non-Hispanic citizens participated more than Hispanic citizens. Very low odds to participate on SNAP for Hispanic citizens compared with non-Hispanic white citizens (OR 0.70, 95% CI 0.55–0.89, p = 0.003) were also found. Finally, no statistically significant difference was found for non-Hispanic non-white citizens (OR 1.34, 95% CI 1–1.78, p = 0.050) compared with non-Hispanic white citizens. In results not shown in Table 2 that included the same covariates as Model 3, no difference between Hispanic citizens and immigrants were found. Odds ratios for authorized (OR 0.85, 95% CI

Table 2 Logistic regressions for participation in SNAP program by farmworker households 2003–2012

	Model 1 odds ratios (95% CIs, p values)	Model 2 odds ratios (95% CIs, p values)	Model 3 odds ratios (95% CIs, p values)
Legal status			
Citizen	Omitted	Omitted	
Authorized	0.84 (0.78–0.97, p=0.020)	0.67 (0.56–0.8, p=0)	
Unauthorized	0.82 (0.73–0.91, p<0.001)	0.63 (0.54–0.74, p=0)	
Legal status and ethnicity			
Authorized non-citizens[a]			0.60 (0.48–0.74, p<0.001)
Unauthorized non-citizens			0.57 (0.47–0.69, p<0.001)
White citizens			Omitted
Hispanic citizens			0.70 (0.55–0.89, p=0.003)
Non-white non-Hispanic citizens			1.34 (1–1.78, p=0.050)
Family under poverty line		2.76 (2.42–3.16, p<0.001)	2.73 (2.38–3.12, p<0.001)
Family under poverty line (missing)		1.99 (1.67–2.37, p<0.001)	1.98 (1.66–2.35, p<0.001)
Household composition			
Spouse		0.93 (0.79–1.1, p=0.393)	0.91 (0.77–1.08, p=0.297)
No children		Omitted	Omitted
1 Child aged 0–17		4.62 (3.77–5.66, p=0)	4.78 (3.89–5.86, p<0.001)
2 Children aged 0–17		4.92 (3.99–6.08, p=0)	5.13 (4.15–6.34, p<0.001)
3 Children aged 0–17		8.66 (6.87–10.93, p=0)	9.08 (7.19–11.47, p<0.001)
4+ Children aged 0–17		12.33 (9.51–15.97, p=0)	13.20 (10.16–17.15, p<0.001)
Children aged 18+		1.44 (0.83–2.5, p=0.199)	1.46 (0.84–2.54, p=0.180)
Parents		4.86 (3.38–6.99, p=0)	5.02 (3.49–7.22, p<0.001)
Gender (female)		1.43 (1.26–1.62, p=0)	1.42 (1.25–1.61, p<0.001)
Age (range)			
Age 18–25		Omitted	Omitted
Age 26–35		1.44 (1.21–1.71, p=0)	1.43 (1.21–1.7, p<0.001)
Age 36–45		1.15 (0.96–1.39, p=0.13)	1.12 (0.93–1.35, p=0.215)
Age 46–59		0.72 (0.58–0.91, p=0.005)	0.71 (0.57–0.9, p=0.004)
Age 60+		0.89 (0.61–1.29, p=0.539)	0.91 (0.63–1.32, p=0.616)
Education: above primary		0.98 (0.86–1.13, p=0.822)	0.95 (0.83–1.09, p=0.465)
Region			
California		Omitted	Omitted
East		1.39 (1.12–1.72, p=0.003)	1.33 (1.07–1.65, p=0.01)
Southeast		2.11 (1.73–2.57, p=0)	1.98 (1.62–2.41, p<0.001)
Midwest		2.08 (1.74–2.49, p=0)	1.98 (1.65–2.38, p<0.001)
Southwest		1.58 (1.26–2, p=0)	1.63 (1.29–2.07, p<0.001)
Northwest		2.65 (2.23–3.16, p=0)	2.65 (2.22–3.16, p<0.001)
Time period			
fy2003		1.74 (1.33–2.26, p=0)	1.78 (1.37–2.32, p<0.001)
fy2004		0.87 (0.65–1.17, p=0.369)	0.87 (0.65–1.17, p=0.359)
fy2005		1.35 (1.02–1.79, p=0.033)	1.37 (1.04–1.81, p=0.027)
fy2006		0.7 (0.5–0.97, p=0.031)	0.7 (0.5–0.98, p=0.036)
fy2007		Omitted	Omitted
fy2008		0.87 (0.64–1.2, p=0.401)	0.88 (0.64–1.2, p=0.404)
fy2009		1.25 (0.95–1.65, p=0.115)	1.26 (0.95–1.67, p=0.102)
fy2010		2.93 (2.27–3.78, p=0)	2.99 (2.32–3.86, p<0.001)
fy2011		1.49 (1.13–1.96, p=0.005)	1.49 (1.13–1.97, p=0.005)
fy2012		3.95 (3.08–5.05, p=0)	3.87 (3.02–4.96, p<0.001)

Table 2 (continued)

	Model 1 odds ratios (95% CIs, p values)	Model 2 odds ratios (95% CIs, p values)	Model 3 odds ratios (95% CIs, p values)
Sample size	18,243	18,243	18,243

The number of non-citizens who are not Latinos over the decade analyzed is so small (105) that it cannot allow us to create their own category

[a]All non-citizens are virtually Latinos (99.2%, 12,502 out of 12,607). Classify the non-citizens according to ethnicity means introduce overlapping categories in the model, which is erroneous from a methodological point of view. Due to overlapping between ethnicity and legal status for those non-citizens respondents non-citizens are not divided according ethnicity

0.68–1.07, p = 0.168) and unauthorized (OR 0.81, 95% CI 0.65–1.01, p = 0.056) compared with Hispanic citizens were not statistically significant.

Model 3 presents results for all relevant covariates which differ little from the covariates values found in Model 2. A high odds ratio was observed for "Family under poverty line" (OR 2.73, 95% CI 2.38–3.12, p < 0.001). Missing values for "Family under poverty line" had a statistically significant odds ratio above 1 (OR 1.98, 95% CI 1.99–2.77, p < 0.001) suggesting that many respondents who did not report family income would likely fall below the poverty line so that they qualified for SNAP.

The odds ratios for household composition were among the highest of all in our analysis and appeared to be the factors contributing most explaining SNAP participation among survey respondents. Having children, whether one (OR 4.78, 95% CI 3.89–5.86, p < 0.001), two (OR 5.13, 95% CI 4.15–6.34, p < 0.001), three (OR 9.08, 95% CI 7.19–11.47, p < 0.001), or four or more children (OR 13.20, 95% CI 10.16–17.15, p < 0.001) generated large odds ratios. Presence of parents in the home were also strong and significant (OR 5.02, 95% CI 3.49–7.22, p < 0.001). Having a spouse at home or adult children were not statistically significant. Women (OR 1.42, 95% CI 1.25–1.61, p < 0.001) and the age range 26–35 were more likely to participate in SNAP (OR 1.43, 95% CI 1.21–1.7, p < 0.001) compared to men and those in the youngest and oldest age-ranges. Educational level was not statistically significant.

We also discovered a "U" shaped time trend with high SNAP participation by survey respondents at the beginning and end of our 10 years and lower values in the middle years (Table 2). The omitted year was 2007. Odds ratios slightly below 1.0 were estimated for 2006 and 2008 whereas the highest odds ratios were estimated for the beginning year, 2003 (OR 1.78, 95% CI 1.37–2.32, p < 0.001) and especially ending year, 2012 (OR 3.87, 95% CI 3.02–4.96, p < 0.001). Finally, even after adjusting for covariates, farmworkers in all regions showed higher odds ratios than California; the highest odds ratio was found for the Northwest (OR 2.65, 95% CI 2.22–3.16, p < 0.001).

Discussion

Our study produced two main findings. First, we document that the financial crisis of 2008 dramatically increased poverty and household SNAP participation. There was an increase in household SNAP participation across all three legal status categories of household respondents: citizens, authorized, and unauthorized immigrants. Second, we found lower SNAP participation in households where the survey respondent was an immigrant compared to households where the survey respondent was a citizen; we also found markedly lower SNAP participation in households where the survey respondent was a Hispanic-citizen compared to households where the survey respondent was a non-Hispanic citizen, the latter suggesting ethnic disparities in SNAP-participation.

Research on participation in SNAP or other government programs by undocumented immigrants has been limited, in part, because it is difficult to obtain data on undocumented immigrants. NAWS has been recognized as a database with considerable success in collecting information about undocumented immigrants, despite which NAWS has been underutilized [23, 25]. There are also weaknesses in the NAWS pertaining to our study. A sizeable portion of the sample had missing data on income which is a critical variable in determining eligibility. The database does not provide all the necessary variables to allow us to determine which respondents are eligible for SNAP, thus our study does not control for eligibility status. Therefore, although the study may find some association between SNAP household participation and SNAP participation status of the respondent, we cannot say whether it is because some groups are more likely to be eligible or it is because they are more likely to participate when eligible. In any case, regardless of whether a potential association is attributable to criteria that limit eligibility of certain groups or to a different degree of participation of eligible subjects, we can establish a differential SNAP-participation according to legal status by applying unadjusted and adjusted regression models. Importantly, the above differences on SNAP participation in households were not due to differences on the family size, but to the legal status of the respondent itself, since

resulting ORs were adjusted by number of children and presence of spouse and parents in the household.

Finally, unfortunately, we do not have data on the legal status for all household members, which undoubtedly limit to the possibilities of analysis and leads to interpret the data with caution because of mixed-status families [26]. Actually, the participation of those undocumented household can only be explained by the presence of children or other eligible members in the household since undocumented immigrants are not eligible for SNAP.

Previous studies using the NAWS found lower Medicaid [25] but similar WIC participation [23] by undocumented immigrants compared to documented immigrants and citizens combined. Also consistent with our findings, a parallel course between increasing poverty and SNAP-participation for all households in the US following the financial crisis has been previously reported [1–3].

The downward trend we found for SNAP-participation in hired farmworkers for 2003–2007 (10.2% in 2003 vs. 6.1% in 2007) was reversed with the financial crisis of 2008. We found 18.7% in 2012. This reversal constitutes a dramatic blow, as farmworkers are among the poorest workers in USA [27]. This is undoubtedly a remarkable problem concerning public health and health prevention given the consequences that poverty and difficulties to access food have on farmworkers' health.

The Obama administration enacted the American Recovery and Reinvestment Act (ARRA) signed into law on 2009 in order to respond to the Great Recession, which increased SNAP benefit levels and expanded eligibility. ARRA-funded benefit increases ended in 2013 [28]. Even though the USDA has recognized the success and effectiveness of the SNAP program and its antipoverty effect [16] the increased expenses ($30.4 billion for 26.3 million recipients in 2007 compared to $74.6 billion and 46.6 million recipients in 2012) led some policy-makers to propose cuts arguing inefficiency and abuse by SNAP recipients [29]. The USDA contends, however, that as a result of efforts to curb fraud and abuse, SNAP payment accuracy is now at record highs after the 2008 recession [1]. The controversial Agricultural Act of 2014 aims to reduce SNAP spending by $39 billion over 10 years when the economy is still recovering from the financial crisis [1, 10–13].

The increasing participation in SNAP from 2008 to 2012 and the differential participation of citizens compared to non-citizens have been subjects of controversy in recent years. Some Americans believe there is a "tsunami of abuse" that allows far too many undocumented immigrants to receive benefits [19–21]. Although to accurately determine which arguments are more credible would require a more extensive study than this one, our results indicate that the surge in SNAP-participation was not the result of an increase in SNAP-participation by immigrants alone but was attributable to both immigrants and citizens (Fig. 2).

Finally, the highest ORs values in our logistic regressions were found for number of children. The number of children are the most important factor in explaining household SNAP participation in our logistic regressions. The presence of parents in the home as well as the gender and age of respondents were also important predictors of SNAP-participation. Being under the poverty line had great weight, with odds ratios around three. Previous studies associated having more education with reduced food insecurity in urban but not rural areas [30]; our insignificant results on education are consistent with these findings given that farmworkers are employed in rural areas. Finally, we found that SNAP-participation among farmworkers was disproportionately low in California (where nearly a third of the farmworkers households were located) as compared with other regions, which is not surprising since California's has been historically far behind the nation enrollment rate [31, 32]. Low SNAP enrollment in California was found for immigrants, seniors, students and homeless people; possible reasons are related to reluctance/difficulties to face in-person interviews and fingerprint imaging requirements, concerns on future legal-status or deportation and finally, confusion and unfamiliarity with the SNAP program [32].

New Contribution to the Literature

We analyzed data from the National Agricultural Workers Survey (NAWS), an underutilized national survey sponsored by the U.S. Department of Labor which has been recognized as a database with considerable success in collecting information on undocumented immigrants [18, 19]. The NAWS contains nationally representative data on citizen (30.9%), documented (19.8%) and undocumented crop workers (49.3%). Virtually all non-citizens were Latinos (99.2%). Our results show the effects of the financial crisis on SNAP-participation by agriculture workers and differences on SNAP-participation by legal-status which suggest ethnic disparities. The ethnic disparities suggest interventions to help Hispanic hired farmworkers better access to SNAP participation. Our results are noteworthy for nutrition and public health policy given the consequences that the increase in poverty and the disparities on food access will have on farmworkers' health.

Compliance with Ethical Standards

Conflict of interest The authors have no conflict of interest to declare.

Ethical Approval This article does not contain data concerning human participants or animals collected by either of the authors. Specific individuals within the National Agricultural Workers Survey (NAWS) cannot be identified. The NAWS data do not require special consideration by Human Subjects Ethics Committees because exemption #4 from the National Institutes for Health (NIH) involving publically available data applies.

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