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Retention Among Participants in the National Diabetes Prevention Program Lifestyle Change Program, 2012–2017

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Abstract

OBJECTIVE—To assess retention in the National Diabetes Prevention Program (DPP) lifestyle change program, which seeks to prevent type 2 diabetes in adults at high risk.

RESEARCH DESIGN AND METHODS—We analyzed retention among 41,203 individuals who enrolled in Centers for Disease Control and Prevention (CDC)-recognized in-person lifestyle change programs at organizations that submitted data to CDC's Diabetes Prevention Recognition Program during January 2012–February 2017.

RESULTS—Weekly attrition rates were typically <1–2% but were between 3.5% and 5% at week 2 and at weeks 17 and 18, where session frequency typically transitions from weekly to monthly. The percentage of participants retained through 18 weeks varied by age (45.9% for 18–29 year olds, 53.4% for 30–44 year olds, 60.2% for 45–54 year olds, 66.7% for 55–64 year olds, and 67.6% for ≥65 year olds), race/ethnicity (70.5% for non-Hispanic whites, 60.5% for non-Hispanic blacks, 52.6% for Hispanics, and 50.6% for other), mean weekly percentage of body weight lost (41.0% for ≤0% lost, 66.2% for >0% to <0.25% lost, 72.9% for 0.25% to <0.5% lost, and 73.9% for ≥0.5% lost), and mean weekly physical activity minutes (12.8% for 0 min, 56.1% for >0 to

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<60 min, 74.8% for 60 to <150 min, and 82.8% for ≥150 min) but not by sex (63.0% for men and 63.1% for women).

CONCLUSIONS—Our results demonstrate the need to identify strategies to improve retention, especially among individuals who are younger or are members of racial/ethnic minority populations and among those who report less physical activity or less early weight loss. Strategies that address retention after the first session and during the transition from weekly to monthly sessions offer the greatest opportunity for impact.

An estimated 30.3 million people in the U.S. have diabetes (1). Diabetes is associated with millions of hospitalizations each year for major cardiovascular diseases; can lead to other serious outcomes such as chronic kidney disease, vision loss, and lower-extremity amputation; and is the seventh leading cause of death (1). Furthermore, individuals with diabetes incur increased medical expenditures (2,3), with direct and indirect costs in the U.S. estimated at $327 billion in 2017 (4). Type 2 diabetes, the most common form, is typically preceded by prediabetes, which is estimated to occur in 84.1 million adults (1).

The Diabetes Prevention Program (DPP) study and its associated translation studies showed that, among individuals with prediabetes, the development of type 2 diabetes can be prevented or delayed through weight loss and increased physical activity (5–7). Many individuals have effectively made these changes by participating in the National Diabetes Prevention Program (National DPP) of the Centers for Disease Control and Prevention (CDC) lifestyle change program (8). The CDC's Diabetes Prevention Recognition Program (DPRP) ensures fidelity to the proven behavioral intervention structure of the DPP studies and monitors the achievement of outcomes associated with diabetes prevention. This yearlong program consists of a minimum of 22 sessions offered over the course of a year. Because the program has a relatively low cost to deliver and can prevent the many serious sequelae of diabetes, it is cost-effective, especially when delivered to groups in community or primary care settings (9) according to CDC recognition standards (10).

Success in the CDC National DPP lifestyle change program is strongly associated with retention (8,11–13). Most participants who stay in the program at least 6 months achieve program goals for weight change (≥5%) and weekly physical activity (≥150 min). The likelihood of achieving these goals increases throughout that time frame, highlighting the importance of participant retention. Nevertheless, many participants who begin the program do not complete it. A recent literature review concluded that retention in similar programs may be associated with a variety of demographic, behavioral, psychological, and structural factors (14).

To better understand factors that may be associated with retention in the National DPP lifestyle change program, we examined data collected by CDC through its DPRP (10). In particular, we focused our analyses on factors that could help programs and coaches identify individuals at risk for attrition (e.g., age, race/ethnicity) or make programmatic adjustments that could increase retention (e.g., physical activity or early weight loss).

RESEARCH DESIGN AND METHODS

Population, Time Frame, and Exclusion Criteria

To be eligible for participation in the National DPP lifestyle change program during the time period these data were collected, participants needed to *1*) be at least 18 years of age, *2*) have prediabetes identified by a blood test or a self-reported risk test or have a history of gestational diabetes mellitus (GDM), and *3*) have a BMI ≥24 kg/m^2 for non-Asians and ≥22 kg/m^2 for Asians. Because so few participants in our data set had BMI <24 kg/m^2, we restricted our analyses to participants with BMI ≥24 kg/m^2. To allow sufficient time to assess participant retention, we only examined records from participants who had the opportunity to attend for at least 1 year. While organizations are expected to offer a minimum of six monthly sessions in months 7–12 of the program, we know there is variability in the number of sessions actually being offered during these months. For this reason, we limited our retention analysis to the first 44 weeks.

The National DPP lifestyle change program can be offered in person, online, through distance learning, or through a combination of these modalities, and retention issues are somewhat different in each case. For this article, we restricted our analyses to data collected from in-person programs.

Data Description

The data used for this analysis include National DPP records submitted to CDC by 581 recognized organizations that participated in the DPRP from January 2012 to February 2017. During this time, recognized organizations were required to submit data to CDC every 6 or 12 months depending on the version of the CDC standards under which the program was currently operating (15). Data submission included one record for each session attended by each participant during the preceding year. After the previously described exclusions and restrictions, we conducted our analyses with data from 41,203 participants.

Variables

Information collected included the date of attended session, age, sex, race/ethnicity, program eligibility category (blood test, risk test, history of GDM), height, weight, and self-reported physical activity minutes during the preceding week. With this information, we calculated BMI, mean percent change in a participant's weight per week, mean physical activity minutes per week, and number of attended sessions. If any entries seemed implausible for weight (e.g., weight difference between sessions >5%), we set these values to missing.

Despite the program having a prescribed intensity and duration, not all organizations follow these exactly. In addition, many participants miss sessions. For these reasons, participant entries for weight are not always recorded at prescribed intervals. Furthermore, some entries for physical activity minutes may have been missing because many organizations do not require the recording of physical activity minutes until the topic has been introduced in the curriculum (typically during the fifth session).

We calculated both the percent retained and weekly attrition rates. The percent retained through a given week was defined as the ratio of the number of participants who remained in the program and the number of participants present during the 1st week in the program, multiplied by 100%. The weekly attrition rate was defined as the ratio of the number of participants leaving the program at a given week to the number of participants present during the 1st week in the program, multiplied by 100%. A participant was considered to be retained in the program through a given week if he or she attended a session that week or during a subsequent week. We considered the first session attended, regardless of the session number, week one.

Mean physical activity minutes were calculated as the cumulative number of minutes reported by the participant by a given week (i.e., at all sessions where he or she reported physical activity minutes up to the given week) divided by the number of sessions for which physical activity was reported. For a given week, a participant was excluded from analyses involving mean physical activity minutes if he or she had never reported on physical activity minutes before or during that week. Weight change was calculated for participants who attended more than one session. If a given session had a missing or implausible weight measurement but such a measurement was available for a subsequent session, we imputed the previous value by setting it equal to the value from the subsequent session. However, this only applied to a small number of observations (<1%). Percent weight change was calculated as the difference between the participant's weight at the first session and the latest session, divided by the weight at the first session. Percent weight change per week was calculated as the percent weight change divided by the number of weeks since the first session.

Analyses

Demographic and clinical characteristics of the population are described as means, medians, percentages, SDs, 95% CIs, and interquartile ranges (IQR). Characteristics of participants who were retained or who dropped out were compared for categorical variables by the Wald test and for continuous variables by the two-sided *t* test or the Wilcoxon test (for nonnormally distributed variables). We plotted percent retained and attrition rates by week, as well as percent retained stratified by key time-invariant variables (age, race/ethnicity, sex, weight loss by 3rd week) and time-variant variables (mean physical activity minutes per week, mean percent weight loss per week).

For the time-variant variables, we computed the percent retained through week *x* by *1*) placing retained participants through week *x* into categories based on the value of the variable at that week (e.g., 0 mean physical activity minutes, 1–60 mean physical activity minutes, etc.) and *2*) dividing the number of retained participants in a given category through week *x* (i.e., the numerator) by that number of participants plus all those participants who dropped out prior to week *x* but who were in that same category when they dropped out (i.e., the denominator).

We computed differences in retention proportions for several variables at weeks 4 and 18, along with corresponding CIs and *P* values. We chose to report findings from these weeks to look at both early and later effects on retention. However, when we computed

differences at other weeks, we found similar associations (data not shown). We also ran a multivariate predictive model to identify variables that were independently associated with retention at 18 weeks. Because we had a dichotomous outcome variable (i.e., retention) and participants were nested within various organizations, we used a generalized linear mixed model with logit link and binary distribution to estimate the associations between retention and demographics, mean physical activity per week, and weight loss per week. The model included the random intercept to account for participants nested in a specific organization. All analyses were performed in SAS 9.4.

RESULTS

Among the 41,203 in-person participants in the National DPP lifestyle change program, the mean age was 56.8 years, with the age distribution as follows: 2.4% were age 18–29 years, 14.5% were age 30–44 years, 23.0% were age 45–54 years, 29.2% were age 55–64 years, and 30.9% were age ≥65 years. Participants were more likely to be female (80.0%) than male (20.0%). Race/ethnicity was distributed as follows: 54.6% were non-Hispanic white, 14.6% non-Hispanic black, 8.6% Hispanic, and 22.2% other race/ethnicity. At baseline, the mean weight was 212.9 lb (range 96–597) and the mean BMI was 35.2 kg/m^2 (range 24.0–99.6), with 25.3% having BMI between 24 and 29.9 kg/m^2 and 74.7% having BMI ≥30 kg/m^2. Program eligibility for 66.7% was determined by a glucose test or history of GDM and for 33.3% was determined by a self-reported risk test only.

Among the participants, 78.4% lost weight, 4.7% did not change weight, 12.3% gained weight by their last session, and 4.6% could not have weight change computed due to missing or implausible records. The mean physical activity per week over the time for which activity was recorded was 98.5 min.

For all participants, median retention was 28 weeks (IQR 15, 41) (Fig. 1A), and the median number of sessions attended was 16 (IQR 9, 20). Weekly attrition rates were typically <1–2% but were between 3.5% and 5% at week 2 and at weeks 17 and 18, where session frequency typically transitions from weekly to monthly (Fig. 1B). As a result, 63.1% of participants were retained in the program through the 18th week and 31.9% through the 44th week.

Retention consistently increased with age (Fig. 2A and Table 1). Absolute differences between the oldest and youngest age-groups reached 21.7 percentage points by 18 weeks (Table 1). Retention was highest among non-Hispanic whites, followed by non-Hispanic blacks, and was lower for Hispanics and other race/ethnicity (Fig. 2B). Absolute differences between non-Hispanic white and other race/ethnicity reached 19.9 percentage points by 18 weeks (Table 1). In contrast, retention was not meaningfully different (<3%) by sex (Fig. 2C), BMI at session one, or program eligibility assessment category (Table 1).

Weight loss was strongly associated with retention (Fig. 2D). During the earlier part of the program (<25 weeks), those in the higher weekly weight loss groups had better retention in the program, especially compared with the group who did not lose weight (Fig. 3A). For example, at week 18 the percent retained in the highest weight loss group was 32.9

percentage points more than the percent retained in the no weight loss group (Table 1). However, during the later part of the program (>25 weeks), these associations were less consistent, and some of the retention plots crossed for different groups (Fig. 3A).

Physical activity was also strongly associated with retention. Throughout follow-up, participants in the groups with higher levels of physical activity consistently had better retention in the program than the groups with lower levels of physical activity (Fig. 3B). By 18 weeks, those differences became large; for example, the percent retained in the highest physical activity group was 70.0 percentage points more than the percent retained for the group with no physical activity (Table 1).

We also found that variables associated with retention in the univariate analyses tended to have similar associations in the multivariate analysis. When compared with the oldest age-group (≥65 years), younger age-groups had a lower likelihood of being retained at 18 weeks, with odds ratios (ORs) as follows: 0.42 (95% CI 0.35, 0.49) for 18–29 years, 0.61 (0.56, 0.66) for 30–44 years, 0.76 (0.71, 0.82) for 45–54 years, and 0.88 (0.82, 0.95) for 55–64 years. When compared with non-Hispanic whites, racial/ethnic minority populations had a lower likelihood of being retained at 18 weeks, with ORs as follows: 0.87 (0.79, 0.94) for non-Hispanic blacks, 0.67 (0.60, 0.75) for Hispanics, and 0.88 (0.82, 0.95) for other race/ethnicity. When compared with females, males had a slightly lower likelihood of being retained at 18 weeks (OR 0.94 [95% CI 0.88, 1.00]). Similarly, when compared with the group that lost the most weight (≥0.5%), other groups had a lower likelihood of being retained at 18 weeks, with ORs as follows: 0.44 (95% CI 0.40, 0.48) for ≤0, 0.87 (0.80, 0.94) for >0% to <0.25%, and 0.99 (0.92, 1.07) for 0.25% to <0.5%. Finally, when compared with the group with the most physical activity minutes (≥150 per week), groups with lower physical activity had a lower likelihood of being retained at 18 weeks, with ORs as follows: 0.042 (0.038–0.047) for 0 min per week, 0.29 (0.27–0.31) for >0 to <60 min per week, and 0.61 (0.56–0.65) for 60 to <150 min per week.

CONCLUSIONS

The main findings of our study were as follows: *1*) half of participants in the National DPP lifestyle change program were retained past 28 weeks, and the median number of sessions attended was 16; *2*) attrition was highest at week 2 and at weeks 17 and 18; *3*) lower retention was strongly and independently associated with younger age and minority race/ethnicity, but not with sex, although enrollment of women was fourfold higher than that of men; and *4*) lower retention was strongly and independently associated with less weight loss and less physical activity during preceding weeks.

Our findings suggest that although retention needs improvement, organizations are having success in retaining one-half of participants past 28 weeks, which previous studies have shown is sufficient time to achieve program goals related to weight loss and physical activity. Our retention results were similar to those reported in 2017 using an earlier subset (~36%) of the National DPP data (8). That study showed that individuals who stayed in the program longer tended to have greater weight loss and increased physical activity. Weight

loss and physical activity were strongly associated with the prevention or delay of type 2 diabetes among the participants in the DPP randomized controlled trial (5,16).

There are specific time periods during which participants have a substantially higher risk of dropping out. Specifically, attrition is highest immediately after the 1st week and between 16 and 19 weeks. At the 1st week, attrition may be related to a misunderstanding of program expectations. One promising approach for clarifying expectations and marketing the program is through a so-called “Session Zero,” which a number of program delivery organizations have experimented with and which may improve retention and weight loss (17). For weeks 16–19, attrition is likely to be related to the program transition from weekly to monthly sessions. Anecdotally, some programs have recognized this issue and made the transition more gradual by moving to bimonthly sessions before eventually extending to monthly sessions. Future research may help to determine what leads participants to drop out of the program at these points, as well as identify new approaches to limit this attrition.

Several studies have examined demographic factors associated with retention in behavioral interventions among adults at high risk for type 2 diabetes. Similar to our findings, in these studies better retention is consistently associated with older age (14,18–25). Some studies have also found that retention is lower among racial/ethnic minorities or immigrants (25–27), although these findings are less consistent across studies (24). Future research should seek to identify barriers and facilitators for retention among participants who are younger and/or racial/ethnic minorities.

Although we found that in-person enrollment in the National DPP lifestyle change program was approximately four times greater for women compared with men, we did not observe differences in retention by sex. We hypothesize that this lack of difference may result because the men and women who choose to participate in the National DPP lifestyle change program are different from men and women in the general population and share characteristics that make them more likely to continue to participate in disease prevention programs. Similarly, two literature reviews have not found consistent associations between sex and retention (14,24).

Importantly, a participant’s success with weight loss and physical activity, especially early on, was a key predictor of retention. Of note, mean percent weight loss was less predictive of retention after ~25 weeks (i.e., some of the different weight loss group plots crossed [Fig. 3A]). We hypothesize that some highly successful participants may leave the program at this point because they feel they have lost enough weight. Our results are consistent with the well-established finding from weight loss trials that early weight loss is a strong predictor of retention (28), suggesting that “early nonresponders” to weight loss could receive adaptive interventions to improve their outcomes. In one review, three studies found that more physical activity was a predictor of retention, while the remaining five studies did not find an association (24). Importantly, retention is not only predictive of good outcomes; our results show that early good outcomes (i.e., weight loss and physical activity) can predict further program retention.

These predictors of retention represent opportunities for program improvement. An increased focus on early successes in weight loss and physical activity might be considered for the curriculum and emphasized by coaches. Furthermore, programs and coaches might target their early retention efforts on participants who are struggling to find early successes. Several additional retention strategies have been proposed in the literature, including health care provider referrals (29), nonmonetary incentives (29), partner enrollment (30), and recruiting participants who are ready to change behavior (11). In addition, Venditti et al. (31) found that many participant barriers can be successfully addressed through behavioral problem-solving approaches that lifestyle change coaches can be trained to use.

A strength of our study is that it is one of the largest analyses of retention in a chronic disease prevention program. We studied the records of >40,000 individuals, and the follow-up time captured was up to 1 year, which is longer than many studies of weight loss or chronic disease prevention. Furthermore, we were able to capture data from all in-person CDC-recognized program delivery organizations, thus presenting a broad picture of much of the National DPP to date. In addition, our predictive modeling was able to demonstrate that several variables were independent predictors of retention.

Study limitations included that we were only able to examine retention for a limited number of variables. Because the CDC's DPRP data set is derived from a recognition program rather than a public health surveillance system, it contains a limited range of variables and is lacking information on psychological, sociological, or behavioral characteristics, with the exception of self-reported physical activity. Such variables may play an important role in retention. Reviews have concluded (14,24) that retention is more closely associated with psychological and behavioral variables than with demographic variables. For example, retention in behavioral change programs has been associated with factors such as partner enrollment in the study, perceived stress, self-efficacy, marital status, financial incentives, smoking status, depression, education, or employment (14,19,22,32–38). The DPRP database does not include these variables, and therefore, we were unable to examine how they were related to retention. Such variables will likely need to be assessed in other research studies, since the CDC recognition program must minimize the data collection burden it imposes on program delivery organizations.

A further limitation is that we were unable to address how enrollment and retention are related to poverty and social determinants associated with diabetes-related disparities. Future research might use databases such as the American Community Survey and Social Vulnerability Index (https://svi.cdc.gov) to examine how the community environment is related to the geographic location of lifestyle change programs and to enrollment and retention in these programs.

Another important limitation relates to the fact that CDC-recognized organizations are allowed multiple enrollments in the DPRP. Thus, organizations that are not on a successful course can withdraw from the DPRP and then reapply for recognition once programmatic issues have been addressed. When this occurs, the organization is not allowed to carry over to their new enrollment any classes that were ongoing at the time of withdrawal. For this reason, if any session records for these participants have already been submitted, they appear

in this analysis as participants who left the program early. In these instances, we have no way to determine whether the organization allowed the participants to complete the program or whether the participants chose to discontinue their attendance. Anecdotally, we are aware that some of these participants do continue attending sessions, which suggests that our results may somewhat underestimate overall retention.

Finally, because we restricted our analyses to data collected from in-person programs, we could not conclude whether retention was associated with the same variables in online, distance learning, or combination programs. We plan to explore retention in these programs in future analyses.

In conclusion, many CDC-recognized organizations delivering the National DPP lifestyle change program are successful in retaining participants, but key opportunities exist for increasing retention. These opportunities relate to improving retention after particular sessions (e.g., between sessions 1 and 2), participant characteristics (e.g., age and race/ethnicity), and participant behaviors (e.g., weekly physical activity). In our future research, we plan to focus on these high-impact opportunities in order to develop strategies for improved retention, thus increasing the number of individuals who prevent or delay the development of type 2 diabetes.

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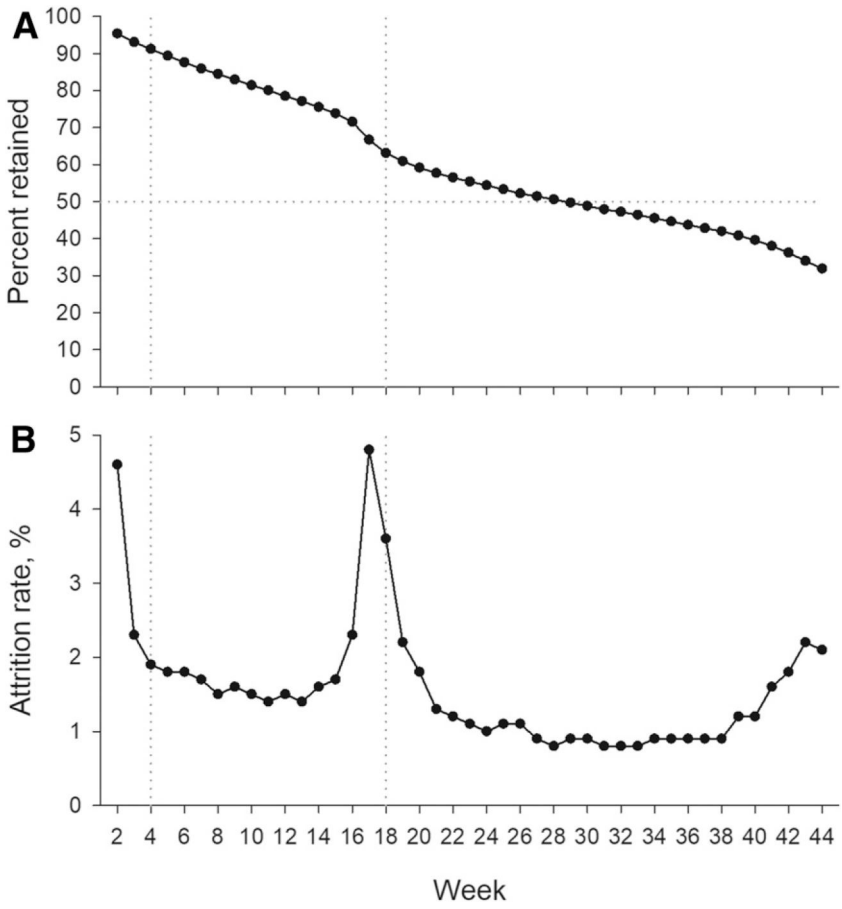

Figure 1—.
Overall retention (*A*) and attrition (*B*) among participants in the National DPP lifestyle change program.

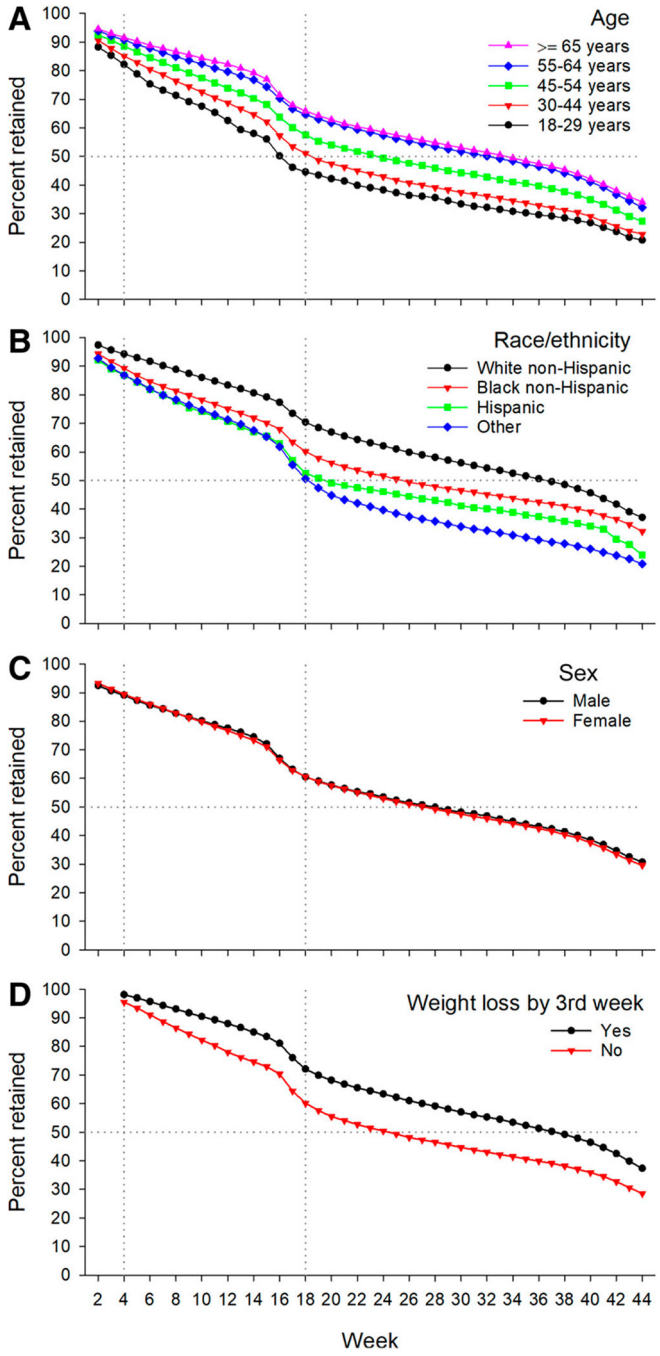

Figure 2—.

Percent retained by week in the National DPP lifestyle change program, stratified by selected time-invariant variables: age (*A*), race/ethnicity (*B*), sex (*C*), and weight loss by the 3rd week (*D*).

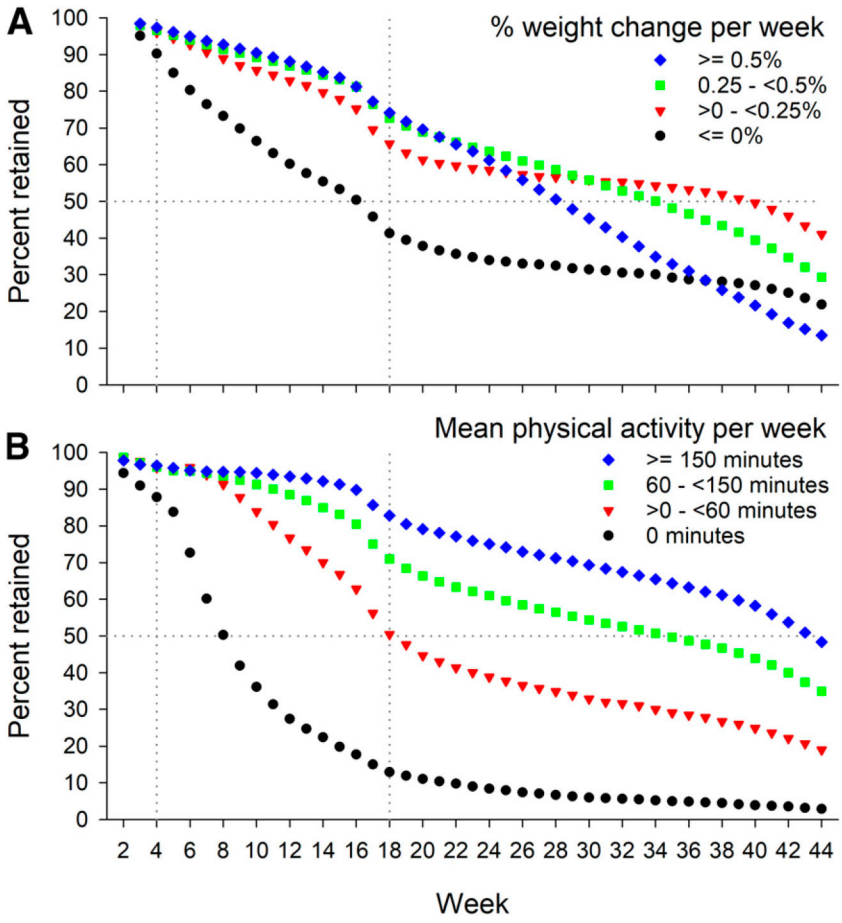

Figure 3—.

Percent retained by week in the National DPP lifestyle change program, stratified by selected time-variant variables: mean percent weight change per week (*A*) and mean physical activity minutes per week (*B*).

Table 1–

Retention in CDC's National DPP lifestyle change program, stratified by various factors at weeks 4 and 18

Variable	Week 4				Week 18			
	Number retained	Percent retained	Difference from referent category (95% CI)	*P* *	Number retained	Percent retained	Difference from referent category (95% CI)	*P* *
Age (years)								
18–29	856	85.3	7.4 (5.2, 9.6)	<0.001	461	45.9	21.7 (18.5, 24.9)	<0.001
30–44	5,237	87.8	4.8 (3.9, 5.8)	<0.001	3,187	53.4	14.2 (12.7, 15.7)	<0.001
45–54	8,599	90.7	2.0 (1.3, 2.8)	<0.001	5,711	60.2	7.4 (6.1, 8.7)	<0.001
55–64	11,093	92.3	0.4 (−0.2, 1.1)	0.219	8.021	66.7	0.9 (−0.3, 2.1)	0.123
≥65 (referent)	11,794	92.7			8,607	67.6		
Race/ethnicity								
Other	7,940	86.8	7.4 (6.7, 8.2)	<0.001	4,627	50.6	19.9 (18.7, 21.1)	<0.001
Hispanic	3,088	86.9	7.3 (6.2, 8.5)	<0.001	1,870	52.6	17.9 (16.1, 19.6)	<0.001
Non-Hispanic black	5,357	89.3	5.0 (4.1, 5.8)	<0.001	3,631	60.5	10.0 (8.6, 11.4)	<0.001
Non-Hispanic white (referent)	21,194	94.2			15,859	70.5		
Sex								
Male	7,483	90.6	0.7 (0.0, 1.4)	0.046	5,197	63.0	0.1 (−1.0, 1.3)	0.808
Female (referent)	30,096	91.3			20,790	63.1		
Test for prediabetes								
Risk test only	12,437	90.6	0.8 (0.3, 1.4)	0.004	8,412	61.3	2.6 (1.7, 3.6)	<0.001
Glucose test/GDM (referent)	25,142	91.5			17,575	64.0		
BMI at session one (kg/m^2)								
24–29.9	9,489	91.1	0.1 (−0.5, 0.8)	0.663	6,715	64.5	−1.9 (−2.9, −0.8)	<0.001
≥30 (referent)	28,090	91.2			19,272	62.6		
Weight loss by 3rd week								
No	6,840	95.5	2.6 (2.1, 3.1)	<0.001	4,349	60.7	11.4 (10.2, 12.7)	<0.001
Yes (referent)	24,051	98.1			17,687	72.2		

Variable	Week 4				Week 18			
	Number retained	Percent retained	Difference from referent category (95% CI)	*P* *	Number retained	Percent retained	Difference from referent category (95% CI)	*P* *
Weight loss per week (%)								
≤0	7,331	90.2	7.1 (6.4, 7.8)	<0.001	2,370	41.0	32.9 (31.3, 34.5)	<0.001
>0 to <0.25	5,913	96.3	1.0 (0.5, 1.6)	<0.001	8,965	66.2	7.7 (6.4, 9.0)	<0.001
0.25 to <0.5	9,181	96.7	0.6 (0.2, 1.1)	0.003	9,486	72.9	1.1 (−0.2, 2.3)	0.109
≥0.5 (referent)	14,477	97.3			5,104	73.9		
Mean physical activity per week (min)								
0	21,111	87.8	8.6 (7.9, 9.4)	<0.001	764	12.8	70.0 (68.8, 71.1)	<0.001
>0 to <60	6,727	95.8	0.5 (−0.2, 1.3)	0.191	5,652	56.1	26.7 (25.4, 27.9)	<0.001
60 to <150	6,421	96.1	0.3 (−0.5, 1.1)	0.467	11,755	74.8	7.9 (6.9, 8.9)	<0.001
≥150 (referent)	3,320	96.4			7,816	82.8		

* Computed using the Wald test.