

The Evidence Behind the National DPP Lifestyle Change Program

This literature review describes a subset of the studies that have examined the efficacy of the National DPP lifestyle change program. This table shows the range of health benefits—in addition to preventing type 2 diabetes—that are associated with the National DPP lifestyle change program. Each study is hyperlinked to provide access to the full study. This literature review has preserved the exact text from the studies so as not to introduce any inaccuracies to the objective, data, results, or conclusion. The table is divided into five categories:

1. Health care utilization
2. Healthy behaviors and weight loss
3. Clinical indicators
4. Chronic disease prevalence
5. Well-being

Study	Objective	Data	Results	Conclusion
Health Care Utilization				
Alva, et al. Impact Of The YMCA Of The USA Diabetes Prevention Program On Medicare Spending And Utilization , Health Affairs, 2017.	The objective of our analysis was to establish whether the Y Diabetes Prevention Program reduces health care spending and hospital admissions and prevents unnecessary emergency department (ED) visits among fee-for-service Medicare beneficiaries.	We analyzed fee-for-service Medicare claims data for the period January 2010 through December 2015 for 3,319 participating beneficiaries enrolled in Parts A and B during the intervention period.	On average, participants lost 9.5 pounds over the course of the program. Intervention participants had lower spending than members of the comparison group throughout the first six intervention quarters. The comparison group had slightly higher inpatient admission rates than the intervention group in several	Total decreases in inpatient admissions and emergency department (ED) visits were significant, with nine fewer inpatient stays and nine fewer ED visits per 1,000 participants per quarter. These results justify continued support of the model.

			<p>baseline quarters, and this difference widened during all but three of the intervention quarters.</p> <p>Similar to the case with spending, the first three intervention quarters showed significant differences in admission rates between the intervention and comparison groups ($p < 0.05$).</p> <p>In the first four intervention quarters, the ED visit rate was significantly higher in the comparison group than in the intervention group.</p>	
<p>RTI. Evaluation of the Health Care Innovation Awards, 2015</p>	<p>RTI uses two possible types of quantitative data to assess the impact of Y-USAs innovation on key outcomes. The first type includes claims data for Medicare and/or Medicaid beneficiaries, depending on the innovation's participants. The second type includes patient-level administrative and utilization data</p>	<p>We include patients who were enrolled prior to December 31, 2014, and we present Medicare claims data through December 31, 2014. The analysis uses data from the CMS Chronic Conditions Data Warehouse. The treatment group includes 1,702 participants who were enrolled for at least one quarter in Medicare fee-for-service parts A and B.</p>	<p>Analysis of currently available data shows that the innovation is associated with statistically significant reductions in Medicare spending, inpatient admissions, and ED visits during two and at most three post-innovation periods.</p> <p>For all post-intervention quarters, the weighted average quarterly reduction in spending is \$455, the reduction in the probability of having an inpatient admission is 1.1 percentage points, and the reduction in the probability of having an ED visit is 0.2 percentage points. These results</p>	<p>These effects both indicate that innovation participants were 1- to 3- percentage points less likely to be hospitalized than the comparison group.</p> <p>With the exception of the sixth post-intervention quarter, we found no statistically significant differences on ED admission rates.</p>

	Y-USA collects and submits to RTI (which we labeled “other awardee-specific data”).		are all significant at the 10 percent level. The evidence in favor of a reduction in spending is strongest in the first three quarters after enrollment. This finding is somewhat surprising because the goal of the innovation is to reduce diabetes onset, which in turn is expected to improve health and reduce expenditures in the long run, but not necessarily immediately. The source of the short-term savings, if they exist, is not clear.	
Healthy Behaviors and Weight Loss				
Ely et al. A National Effort to Prevent Type 2 Diabetes: Participant-Level Evaluation of CDC’s National Diabetes Prevention Program , Diabetes Journals, 2017.	To assess participant-level results from the first 4 years of implementation of the National Diabetes Prevention Program (National DPP), a national effort to prevent type 2 diabetes in those at risk through structured lifestyle change programs.	Descriptive analysis was performed on data from 14,747 adults enrolled in year-long type 2 diabetes prevention programs during the period February 2012 through January 2016. Data on attendance, weight, and physical activity minutes were summarized and predictors of weight loss were examined using a mixed linear model. All analyses were performed using SAS 9.3.	Participants attended a median of 14 sessions over an average of 172 days in the program (median 134 days). Overall, 35.5% achieved the 5% weight loss goal (average weight loss 4.2%, median 3.1%). Participants reported a weekly average of 152 min of physical activity (median 128 min), with 41.8% meeting the physical activity goal of 150 min per week. For every additional session attended and every 30 min of activity reported, participants lost 0.3% of body weight (P < 0.0001).	During the first 4 years, the National DPP has achieved widespread implementation of the lifestyle change program to prevent type 2 diabetes, with promising early results. Greater duration and intensity of session attendance resulted in a higher percent of body weight loss overall and for subgroups. Focusing on retention may reduce disparities and improve

				overall program results.
DPP Research Group. The Diabetes Prevention Program (DPP): description of lifestyle intervention. (Clinical Care/Education/Nutrition) , Diabetes Care, 2002	The purpose of this manuscript is to provide a more detailed description of the lifestyle intervention protocol used in the DPP. The two major goals of the Diabetes Prevention Program (DPP) lifestyle intervention were a minimum of 7% weight loss/weight maintenance and a minimum of 150 min of physical activity similar in intensity to brisk walking.	The purpose of the present article is to provide a detailed description of the highly successful lifestyle intervention administered to 1,079 participants, which included 45% racial and ethnic minorities and resulted in a 58% reduction in the incidence rate of diabetes. Because type 2 diabetes disproportionately affects certain ethnic minorities (African Americans, Hispanic Americans, American Indians, and Asian Americans), the DPP recruited 45% of participants from these populations.	To achieve these goals, the intervention was designed to be intensive and included features such as individual case management, frequent contact over the entire trial, a structured 16-session initial core curriculum and more individualized maintenance programming, and a “toolbox” of strategies for dealing with nonadherent participants. Extensive centralized feedback, training, and support were provided to all DPP centers.	Strategies proved to be very successful, as the lifestyle intervention resulted in a 58% reduction in the incidence rate of diabetes.
Johnson et al. Can Diabetes Prevention Programmes Be Translated Effectively Into Real-World Settings and Still Deliver Improved Outcomes? A Synthesis of Evidence , Diabetes Medicine, 2013. (meta-analysis)	Randomized trials provide evidence that intensive lifestyle interventions leading to dietary and physical activity change can delay or prevent Type 2 diabetes. Translational studies have assessed the impact of	Studies were included that used a tested diabetes preventive study protocol with an adult population at risk from Type 2 diabetes.	From an initial 793 papers, 19 papers reporting 17 studies were included. Translational studies from a range of settings utilized a variety of methods. All were based on the US Diabetes Prevention Programme protocol or the Finnish Diabetes Prevention Study, with modifications that increased feasibility and access. The main outcome that was reported in	Translational studies based on the intensive diabetes prevention programmes showed that there is potential for less intensive interventions both to be feasible and to have an impact on future progression to

	interventions based on, but less intensive than, trial protocols delivered in community settings with high-risk populations. The aim of this review was to synthesize evidence from translational studies of any design to assess the impact of interventions delivered outside large randomized trials.		all studies was weight change. Weight loss, which occurred in all but one study, was greater in intervention arms than in control subjects. No consistent differences were found in blood glucose or waist circumference.	diabetes in at-risk individuals.
Sepah, Jiang, Peters. Translating the Diabetes Prevention Program Into an Online Social Network: Validation Against CDC Standards , Diabetes Education, 2014.	The purpose of this study was to evaluate the efficacy of Prevent, an online social network-based translation of the Diabetes Prevention Program (DPP) lifestyle intervention, against the Centers for Disease Control and Prevention (CDC) Diabetes Prevention and Recognition Program (DPRP) outcome standards and weight loss outcomes of other DPP translations.	Two hundred twenty participants previously diagnosed with prediabetes were recruited online and enrolled in Prevent, a DPP-based group lifestyle intervention that integrates a private online social network, weekly lessons, health coaching, and a wireless scale and pedometer. Weight and hemoglobin were assessed.	One hundred eighty-seven participants met inclusion criteria for the core program and achieved an average of 5.0% and 4.8% weight loss at 16 weeks and 12 months, respectively. They also had a 0.37% reduction in their A1C level at final measurement. One hundred forty-four of these same participants also met inclusion criteria for the post-core program and achieved an average of 5.4% and 5.2% weight loss at 16 weeks and 12 months, respectively, and a 0.40% reduction in A1C at final measurement.	Results indicate that Prevent meets CDC DPRP outcome standards for diabetes prevention programs and performs favorably to other DPP translations. Considering national initiatives to address the obesity and diabetes epidemics, online delivery platforms like Prevent offer an effective and scalable solution.
Vadheim et al. Adapted Diabetes Prevention	The purpose of this study was to assess the	In 2009, the Montana Department of Public	A total of 13 and 16 eligible adults enrolled in the on-site and the	Our findings suggest that it is feasible to

<p>Program Lifestyle Intervention Can Be Effectively Delivered Through Telehealth, Diabetes Education, 2010.</p>	<p>feasibility of delivering an adapted group-based version of the Diabetes Prevention Program's (DPP) lifestyle intervention through telehealth video conferencing.</p>	<p>Health and Human Services in collaboration with Holy Rosary Healthcare implemented the DPP lifestyle intervention, which was provided to an on-site group in 1 community and simultaneously through telehealth to a second group in a remote frontier community. Participants obtained medical clearance from their primary care physician and were eligible if they were overweight and had 1 or more of the following risk factors: prediabetes, impaired glucose tolerance/impaired fasting glucose (IGT/IFG), a history of gestational diabetes (GDM) or the delivery of an infant >9 pounds, hypertension, or dyslipidemia.</p>	<p>telehealth program, and 13 (100%) and 14 (88%) participants completed the 16-week program, respectively. Both the on-site and telehealth groups achieved high levels of weekly physical activity and there were no significant differences between groups. Over 45% of on-site and telehealth participants achieved the 7% weight loss goal with the average weight loss per participant greater than 6.4 kg in both groups.</p>	<p>deliver an adapted group-based DPP lifestyle intervention through telehealth resulting in weight loss outcomes similar to the original DPP.</p>
<p>Vadheim et al. Telehealth Delivery of the Diabetes Prevention Program to Rural Communities, Translational Behavioral Medicine, 2017.</p>	<p>The purpose of this study was to compare participation, monitoring of diet and physical activity, and weight loss in participants receiving</p>	<p>From 2008 through 2015, 894 participants were enrolled in the program (29% at telehealth sites). The mean age of participants was</p>	<p>There were no statistically significant differences in number of intervention sessions attended by the telehealth or on-site participants. There were no statistically significant differences in the mean weight loss or reduction in BMI between the</p>	<p>Our findings suggest that participants receiving the DPP through telehealth have similar rates of participation and achieve similar weight</p>

	the intervention on-site and those participating virtually through telehealth.	51.7 years and 84% were female.	telehealth and the on-site groups. There also were no statistically significant differences in the percentage of telehealth or on-site participants who achieved $\geq 5\%$ weight loss (56 vs. 57%) or the 7% weight loss goal (38 vs. 41%).	loss as participants attending the program on-site.
Ciemics et al. Intent-to-Treat Analysis of a Simultaneous Multisite Telehealth Diabetes Prevention Program , BMJ Open Diabetes Research & Care, 2018.	Determine the effectiveness of a 16-week modified diabetes prevention program (DPP) administered simultaneously to multiple rural communities from a single urban site, as compared with a similar face-to-face intervention. A 12-week intervention was evaluated to consider minimization of staff costs in communities where resources are limited.	A prospective cohort study compared DPP interventions implemented in rural (via telehealth technology) and urban (face-to-face) communities using an intent-to-treat analysis. Primary outcome measures included 5% and 7% body weight loss. Logistic regression analyses were used to determine predictors of intervention success and included a variable for treatment effect.	The 16-week urban and rural interventions were comparable; 33.5% and 34.6% of participants lost 7% body weight, respectively; 50% and 47% lost 5% ($p=0.22$). Participants who were male (OR=2.41; 95% CI 1.32 to 4.40), had lower baseline body mass index (OR=1.03; 95% CI 1.01 to 1.07), attended more sessions (OR=1.33; 95% CI 1.11 to 1.58), and more frequently reported (OR=3.84; 95% CI 1.05 to 14.13) and met daily fat gram (OR=4.26; 95% CI 1.7 to 10.6) and weekly activity goals (OR=2.46; 95% CI 1.06 to 5.71) were more likely to meet their 7% weight loss goal. Predictors of meeting weight loss goals were similar for participants enrolled in the 12-week intervention.	Using telehealth technology to administer a modified DPP to multiple rural communities simultaneously demonstrated weight loss results comparable to those in a face-to-face intervention. Given the limitation of resources, linking rural areas to urban centers using telemedicine may increase access to much needed services to prevent or delay progression to diabetes.
Sepah, Jiang, & Peters. Long-term Outcomes of a Web-based Diabetes Prevention Program: 2-year Results of a Single-Arm Longitudinal Study , Journal of Medical Internet Research, 2015.	The objective of this study was to conduct a 2-year follow-up on participants in the Internet-based Prevent diabetes prevention program pilot study,	Participants underwent a 16-week weight loss intervention and an ongoing weight maintenance intervention. As part of the program, participants	Participants previously diagnosed with prediabetes ($n=220$) were originally enrolled in the pilot study. A subset of participants ($n=187$) met Centers for Disease Control and Prevention (CDC) criteria for starting the program (starters), and a further	Users of the Prevent program experienced significant reductions in body weight and A1c that are maintained after 2 years. Contrary to the expected

	specifically examining the effects on body weight and A1c, which are risk factors for diabetes development.	received a wireless scale, which was used to collect body weight data on an ongoing basis. Participants also received A1c test kits at baseline, 0.5 year, 1 year, and 2-year time points.	subset (n=155) met CDC criteria for completing the program (completers) and were both included in analyses. Program starters lost an average of 4.7% (SD 0.4) of baseline body weight after 1 year and 4.2% (SD 0.8) after 2 years, and reduced A1c by mean 0.38% (SD 0.07) after 1 year and 0.43% (SD 0.08) after 2 years. Program completers lost mean 4.9% (SD 0.5) of baseline body weight after 1 year and 4.3% (SD 0.8) after 2 years, and reduced A1c by 0.40% (SD 0.07) after 1 year and 0.46% (SD 0.08) after 2 years. For both groups, neither 2-year weight loss nor A1c results were significantly different from 1-year results.	progression from prediabetes to diabetes over time, average A1c levels continued to show an average regression from within the prediabetic range (5.7%-6.4%) initially to the normal range (<5.7%) after 2 years. Further investigation is warranted to test digital therapeutics as a scalable solution to address national diabetes and cardiovascular disease prevention efforts.
Sepah et al. Engagement and Outcomes in a Digital Diabetes Prevention Program: 3-year Update , Emerging Technologies, Pharmacology and Therapeutics, 2017.	This study's objective was to examine clinical outcomes up to 3 years post-baseline and the relationship between program engagement and clinical outcomes in a digital DPP.	In a single-arm, non-randomized trial, 220 patients previously diagnosed with prediabetes were enrolled in the Omada Health Program, a commercially available, 16-week DPP-based weight loss intervention followed by an ongoing weight maintenance intervention. Changes in body weight and A1c were assessed annually.	Participants were socioeconomically diverse (62% women, 50.2% non-Hispanic white, 51.7% college educated or higher). From baseline to 3 years, those participants who completed four or more lessons and nine or more lessons achieved significant sustained weight loss (-3.0% and -2.9%, respectively) and an absolute reduction in A1c (-0.31 and -0.33, respectively) with an average remission from the prediabetes range to the normal glycemic range. Factor analysis of engagement metrics during the first year revealed	This study demonstrates significant long-term reductions in body weight and A1c in a digital DPP and identifies patterns of program engagement that predict weight loss.

		Relationships between program engagement during the first year and clinical outcomes across 3 years were examined.	two underlying dimensions, one comprising lesson completion and health behavior tracking consistency, and the other comprising website logins and group participation. When these two factors were used to predict weight loss, only the logins and group participation factor was a significant predictor of weight loss at 16 weeks and 1 year.	
Wilson et al. Evaluation of a Digital Behavioral Counseling Program for Reducing Risk Factors for Chronic Disease in a Workforce , JOEM, 2017.	To evaluate a digitally delivered, intensive behavioral counseling program for a workforce at risk for obesity-related chronic disease	Employees were offered a digital health program modeled after the diabetes prevention program (DPP). Annual workforce health assessments were used to examine changes in chronic disease risk factors between participants (n = 634) relative to a matched comparison group (n = 1268).	: Overall, employees were gaining an average of 3.5 pounds annually before program inception. Program engagement was positive; 83% completed the majority of the curriculum and 31% lost at least 5% of their starting weight. Compared with non-participating peers, participants demonstrated reduced weight, improved fasting blood glucose, and improved nutritional intake after a year.	The digital health program was effective for engaging employees in health behavior change. Digital options facilitate widespread implementation.
Moin et al. Women Veterans' Experience With a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice , Journal of Medical Internet Research, 2015.	Our primary objective was to qualitatively explore women veterans' early experiences with a Web-based DPP intervention. Our secondary objective was to estimate weight	We conducted and analyzed semistructured interviews and collected data on weight change, participation, and engagement. A total of 17 women veterans with prediabetes from a Midwest VA Women's	Participants perceived the DPP program as an appealing way of initiating lifestyle changes and made them feel accountable in achieving their daily goals. The online program was convenient because it could be accessed at any time, and many found that it integrated well into daily life. However, some did not like	Women veterans' early experiences with a Web-based DPP intervention were generally positive. Accountability and convenience were key enabling factors for participation and

	loss, participation, and engagement to provide context for our qualitative findings.	Health Clinic were eligible to participate; 15 completed interviews.	the logging aspect and some found it to be too impersonal. Participants logged in a mean 76 times, posted a mean 46 group messages, and sent a mean 20.5 private messages to the health coach over 16 weeks. Participants lost 5.24% of baseline weight, and 82% (14/17) of participants completed at least 9 of 16 core modules.	engagement. A Web-based DPP intervention appears to be a promising means of translating the DPP for women veterans with prediabetes.
Clinical Indicators				
Ackermann et al. Translating the Diabetes Prevention Program Into the Community. The DEPLOY Pilot Study , American Journal of Preventive Medicine, 2008. PDF	The Diabetes Prevention Program (DPP) found that an intensive lifestyle intervention can reduce the development of diabetes by more than half in adults with prediabetes, but there is little information about the feasibility of offering such an intervention in community settings. This study evaluated the delivery of a group-based DPP lifestyle intervention in partnership with the YMCA.	This pilot cluster-randomized trial was designed to compare group-based DPP lifestyle intervention delivery by the YMCA to brief counseling alone (control) in adults who attended a diabetes risk-screening event at one of two semi-urban YMCA facilities and who had a BMI ≥ 24 kg/m ² , ≥ 2 diabetes risk factors, and a random capillary blood glucose of 110-199 mg/dL. Multivariate regression was used to compare between-group differences in changes in body weight, blood pressures, HbA1c, total	Among 92 participants, controls were more often women (61% vs 50%) and of nonwhite race (29% vs 7%). After 6 months, body weight decreased by 6.0% (95% CI=4.7, 7.3) in intervention participants and 2.0% (95% CI=0.6, 3.3) in controls ($p < 0.001$; difference between groups). Intervention participants also had greater changes in total cholesterol (-22 mg/dL vs +6 mg/dL controls; $p < 0.001$). These differences were sustained after 12 months, and adjustment for differences in race and gender did not alter these findings. With only two matched YMCA sites, it was not possible to adjust for potential clustering by site.	The YMCA may be a promising channel for wide-scale dissemination of a low-cost approach to lifestyle diabetes prevention.

		cholesterol, and HDL-cholesterol after 6 and 12 months.		
Mudaliar et al. Cardiometabolic Risk Factor Changes Observed in Diabetes Prevention Programs in US Settings: A Systematic Review and Meta-analysis , 2016.	The Diabetes Prevention Program (DPP) study showed that weight loss in high-risk adults lowered diabetes incidence and cardiovascular disease risk. No prior analyses have aggregated weight and cardiometabolic risk factor changes observed in studies implementing DPP interventions in nonresearch settings in the United States.	In this systematic review and meta-analysis, we pooled data from studies in the United States implementing DPP lifestyle modification programs (focused on modest [5%–7%] weight loss through ≥150 min of moderate physical activity per week and restriction of fat intake) in clinical, community, and online settings. We reported aggregated pre- and post-intervention weight and cardiometabolic risk factor changes (fasting blood glucose [FBG], glycosylated hemoglobin [HbA1c], systolic or diastolic blood pressure [SBP/DBP], total [TC] or HDL-cholesterol).	We reported aggregated pre- and post-intervention weight and cardiometabolic risk factor changes (fasting blood glucose [FBG], glycosylated hemoglobin [HbA1c], systolic or diastolic blood pressure [SBP/DBP], total [TC] or HDL-cholesterol). Mean absolute changes observed were: weight -3.77 kg (95% CI: -4.55; -2.99), HbA1c -0.21% (-0.29; -0.13), FBG -2.40 mg/dL (-3.59; -1.21), SBP -4.29 mmHg (-5.73, -2.84), DBP -2.56 mmHg (-3.40, 1.71), HDL +0.85 mg/dL (-0.10, 1.60), and TC -5.34 mg/dL (-9.72, -0.97). Programs with a maintenance component achieved greater reductions in weight (additional -1.66kg) and FBG (additional -3.14 mg/dl). We found that even with these modifications, the programs were still associated with favorable changes in weight, blood pressure, cholesterol and blood sugar.	DPP lifestyle modification programs achieved clinically meaningful weight and cardiometabolic health improvements. Together, these data suggest that additional value is gained from these programs, reinforcing that they are likely very cost-effective.
Pronk. Structured Diet and Physical Activity Programmes Provide Strong Evidence of Effectiveness for	This systematic review to assess the effectiveness of	Fifty-three studies met the inclusion criteria and described 66 programmes.	Fifty-three studies met the inclusion criteria and described 66 programmes. Compared to usual care, combined diet and physical	This study provides evidence for clinicians to consider referral of patients at high risk of

<p>Type 2 diabetes Prevention and Improvement of Cardiometabolic Health. Evidence Based Medicine, 2016.</p>	<p>diet and physical activity promotion programmes was used by the Community Preventive Services Task Force (CPSTF) to guide its recommendations for diabetes prevention and to identify gaps in research.</p>	<p>Outcomes included T2DM incidence, body weight change, fasting blood glucose levels and changes in other cardiometabolic health factors.</p>	<p>activity promotion programmes were associated with significant reductions in T2DM incidence, body weight, fasting blood glucose level and improved other cardiometabolic health factors including systolic blood pressure, diastolic blood pressure and total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol and triglyceride levels. More intensive programmes were more effective.</p>	<p>T2DM into structured community-based programmes designed to provide a threshold dose of diet and physical activity programming to reduce risk of T2DM diagnosis and improvement of cardiometabolic health. Successful efforts to do so will require efficient processes for diagnosis of high-risk prediabetes, referral systems to clearly defined and accredited programmes and coverage of the costs of these services.</p>
<p>McTigue et al. Using the Internet to Translate an Evidence-Based Lifestyle Intervention Into Practice, Telemedicine Journal and E-Health, 2009.</p>	<p>Despite evidence-based recommendations for addressing obesity in the clinical setting, lifestyle interventions are lacking in practice. The objective of this study was to translate an evidence-based lifestyle program into the clinical setting by</p>	<p>We enrolled 50 patients from a large academic general internal practice into a pilot program between November 16, 2006 and February 11, 2007.</p>	<p>Participants were primarily female (76%), with an average age of 51.94 (standard deviation [SD] 10.82), and BMI of 36.43 (SD 6.78). At 12 months of enrollment, 50% of participants had logged in within 30 days. On average, completers (n = 45) lost 4.79 (SD 8.55) kg. Systolic blood pressure dropped 7.33 (SD 11.36) mm Hg, and diastolic blood pressure changed minimally (+0.44 mm Hg; SD 9.27).</p>	<p>An Internet-based lifestyle intervention may overcome significant barriers to preventive counseling and facilitate the incorporation of evidence-based lifestyle interventions into primary care.</p>

	adapting it for delivery via the Internet.			
Chronic Disease Prevalence				
Knowler et al. 10-year Follow-Up of Diabetes Incidence and Weight Loss in the Diabetes Prevention Program Outcomes Study , Lancet, 2009.	In the 2.8 years of the Diabetes Prevention Program (DPP) randomised clinical trial, diabetes incidence in high-risk adults was reduced by 58% with intensive lifestyle intervention and by 31% with metformin, compared with placebo. We investigated the persistence of these effects in the long term.	All active DPP participants were eligible for continued follow-up. 2766 of 3150 (88%) enrolled for a median additional follow-up of 5.7 years (IQR 5.5-5.8). 910 participants were from the lifestyle, 924 from the metformin, and 932 were from the original placebo groups. On the basis of the benefits from the intensive lifestyle intervention in the DPP, all three groups were offered group-implemented lifestyle intervention. Metformin treatment was continued in the original metformin group (850 mg twice daily as tolerated), with participants unmasked to assignment, and the original lifestyle intervention group was offered additional lifestyle support. The	During the 10.0-year (IQR 9.0-10.5) follow-up since randomisation to DPP, the original lifestyle group lost, then partly regained weight. The modest weight loss with metformin was maintained. Diabetes incidence rates during the DPP were 4.8 cases per 100 person-years (95% CI 4.1-5.7) in the intensive lifestyle intervention group, 7.8 (6.8-8.8) in the metformin group, and 11.0 (9.8-12.3) in the placebo group. Diabetes incidence rates in this follow-up study were similar between treatment groups: 5.9 per 100 person-years (5.1-6.8) for lifestyle, 4.9 (4.2-5.7) for metformin, and 5.6 (4.8-6.5) for placebo. Diabetes incidence in the 10 years since DPP randomisation was reduced by 34% (24-42) in the lifestyle group and 18% (7-28) in the metformin group compared with placebo.	During follow-up after DPP, incidences in the former placebo and metformin groups fell to equal those in the former lifestyle group, but the cumulative incidence of diabetes remained lowest in the lifestyle group. Prevention or delay of diabetes with lifestyle intervention or metformin can persist for at least 10 years.

		primary outcome was development of diabetes according to American Diabetes Association criteria. Analysis was by intention-to-treat. This study is registered with ClinicalTrials.gov, number NCT00038727.		
DPP Research Group. Long-term Effects of Lifestyle Intervention or Metformin on Diabetes Development and Microvascular Complications Over 15-year Follow-Up: The Diabetes Prevention Program Outcomes Study , Lancet Diabetes Endocrinology, 2015.	Effective prevention is needed to combat the worldwide epidemic of type 2 diabetes. We investigated the long-term extent of beneficial effects of lifestyle intervention and metformin on diabetes prevention, originally shown during the 3-year Diabetes Prevention Program (DPP), and assessed whether these interventions reduced diabetes-associated microvascular complications.	The DPP (1996-2001) was a randomised trial comparing an intensive lifestyle intervention or masked metformin with placebo in a cohort selected to be at very high risk of developing diabetes. All participants were offered lifestyle training at the end of the DPP. 2776 (88%) of the surviving DPP cohort were followed up in the DPP Outcomes Study (DPPOS, Sept 1, 2002, to Jan 2, 2014) and analysed by intention to treat on the basis of their original DPP assignment. During DPPOS, the original lifestyle intervention group was offered lifestyle reinforcement semi-annually and the	During a mean follow-up of 15 years, diabetes incidence was reduced by 27% in the lifestyle intervention group (hazard ratio 0.73, 95% CI 0.65-0.83; p<0.0001) and by 18% in the metformin group (0.82, 0.72-0.93; p=0.001), compared with the placebo group, with declining between-group differences over time. At year 15, the cumulative incidences of diabetes were 55% in the lifestyle group, 56% in the metformin group, and 62% in the placebo group. The prevalences at the end of the study of the aggregate microvascular outcome were not significantly different between the treatment groups in the total cohort (placebo 12.4%, 95% CI 11.1-13.8; metformin 13.0%, 11.7-14.5; lifestyle intervention 11.3%, 10.1-12.7). However, in women (n=1887) the lifestyle intervention was associated with a lower prevalence (8.7%, 95% CI 7.4-10.2) than in the placebo	Lifestyle intervention or metformin significantly reduced diabetes development over 15 years. There were no overall differences in the aggregate microvascular outcome between treatment groups; however, those who did not develop diabetes had a lower prevalence of microvascular complications than those who did develop diabetes. This result supports the importance of diabetes prevention.

		metformin group received unmasked metformin. The primary outcomes were the development of diabetes and the prevalence of microvascular disease. For the assessment of microvascular disease, we used an aggregate microvascular outcome, composed of nephropathy, retinopathy, and neuropathy.	(11.0%, 9.6-12.6) and metformin (11.2%, 9.7-12.9) groups, with reductions in the lifestyle intervention group of 21% (p=0.03) compared with placebo and 22% (p=0.02) compared with metformin. Compared with participants who developed diabetes, those who did not develop diabetes had a 28% lower prevalence of microvascular complications (relative risk 0.72, 95% CI 0.63-0.83; p<0.0001).	
Well-Being				
Ackermann et al. Changes in Health State Utilities With Changes in Body Mass in the Diabetes Prevention Program , Obesity (Silver Spring), 2009	Health utilities are measures of health-related quality of life (HRQL) used in cost-effectiveness research. We evaluated whether changes in body weight were associated with changes in health utilities in the Diabetes Prevention Program (DPP) and whether associations differed by treatment assignment (lifestyle intervention, metformin, placebo) or	We constructed physical (PCS-36) and mental component summary (MCS-36) subscales and short-form-6D (SF-6D) health utility index for all DPP participants completing a baseline 36-item short form (SF-36) HRQL assessment (N = 3,064). We used linear regression to test associations between changes in body weight and changes in HRQL indicators, while adjusting	Overall differences in HRQL between treatment groups were highly statistically significant but clinically small after 1 year. In multivariable models, weight change was independently associated with change in SF-6D score (increase of 0.007 for every 5 kg weight loss; P < 0.001), but treatment effects independent of weight loss were not. We found no significant interaction between baseline obesity severity and changes in SF-6D with changes in body weight. However, increases in physical function (PCS-36) with weight loss were greater in persons with higher baseline obesity severity.	In summary, improvements in HRQL are associated with weight loss but not with other effects of obesity treatments that are unrelated to weight loss. Although improvements in the SF-6D did not exceed commonly reported thresholds for a minimally important difference (0.04), these changes, if causal, could still have a significant impact on

	baseline obesity severity.	for other demographic and behavioral variables.		clinical cost-effectiveness estimates if sustained over multiple years.
Florez et al. Impact of Lifestyle Intervention and Metformin on Health-Related Quality of Life: the Diabetes Prevention Program Randomized Trial , Journal of General Internal Medicine, 2012.	Adults at high risk for diabetes may have reduced health-related quality of life (HRQoL). To assess changes in HRQoL after interventions aimed at diabetes risk reduction.	A randomized clinical trial, the Diabetes Prevention Program, was conducted in 27 centers in the United States, in 3,234 non-diabetic persons with elevated fasting and post-load plasma glucose, mean age 51 years, mean BMI 34 Kg/m ² ; 68 % women, and 45 % members of minority groups. Participants who experienced weight gain had significant worsening on the same HRQoL specific domains when compared to those that had treatment-related (ILS or MET) weight loss. No benefits with ILS or MET were observed in the MCS score.	After a mean follow-up of 3.2 years, there were significant improvements in the SF-6D (+0.008, p = 0.04) and PCS (+1.57, p < 0.0001) scores in ILS but not in MET participants (+0.002 and +0.15, respectively, p = 0.6) compared to the PLB group. ILS participants showed improvements in general health (+3.2, p < 0.001), physical function (+3.6, p < 0.001), bodily pain (+1.9, p = 0.01), and vitality (+2.1, p = 0.01) domain scores. Treatment effects remained significant after adjusting sequentially for baseline demographic factors, and for medical and psychological comorbidities. Increased physical activity and weight reduction mediated these ILS treatment effects. Participants who experienced weight gain had significant worsening on the same HRQoL specific domains when compared to those that had treatment-related (ILS or MET) weight loss. No benefits with ILS or MET were observed in the MCS score.	Overweight/obese adults at high risk for diabetes show small improvement in most physical HRQoL and vitality scores through the weight loss and increased physical activity achieved with an ILS intervention.
Castro Sweet et al. Outcomes of a Digital Health	To examine the outcomes of a Medicare	People at risk for diabetes enrolled in a program	A total of 501 participants enrolled; 92% completed at least nine of 16	This Medicare population

<p>Program With Human Coaching for Diabetes Risk Reduction in a Medicare Population, Journal of Aging and Health, 2017.</p>	<p>population who participated in a program combining digital health with human coaching for diabetes risk reduction.</p>	<p>combining digital health with human coaching. Participation and health outcomes were examined at 16 weeks and 6 and 12 months.</p>	<p>core lessons. Participants averaged 19 of 31 possible opportunities for weekly program engagement. At 12 months, participants lost 7.5% (SD = 7.8%) of initial body weight; among participants with clinical data, glucose control improved (glycosylated hemoglobin [HbA1c] change = -0.14%, p = .001) and total cholesterol decreased (-7.08 mg/dL, p = .008). Self-reported well-being, depression, and self-care improved (p < .0001).</p>	<p>demonstrated sustained program engagement and improved weight, health, and well-being. The findings support digital programs with human coaching for reducing chronic disease risk among older adults.</p>
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