Reducing the Progression of Prediabetes to Diabetes Through Diet, Exercise, and Education in Prediabetic 30-40 year olds in the U.S. Compared to Those Receiving No Intervention

Group Members: Amy, Matthew, Mohammed, Abigail, Jessica, and Lily

Evidence Tables

Evidence Table A: Significance of Health Issue

Why is DIABETES a significant public health issue?		
Author(s), Year	**Research Method**	**Findings Relevant to Selecting Health Issue**

Zhang, HJ., Feng, J., Zhang, XT. et al. Age at type 2 diabetes diagnosis and the risk of mortality among US population. Sci Rep 14, 29155 (2024). https://doi.org/10.1038/s41598-024-80790-8	**Study Method**
	- **Retrospective cohort analysis** using nationally representative U.S. data (NHANES linked with mortality data). Statistical models adjusted for demographics and comorbidities.
	
	Data Collected
	- Age at type 2 diabetes diagnosis
	- Mortality outcomes (all-cause and cardiovascular mortality)
	- Demographic and clinical variables (sex, race, BMI, smoking status)
	
	Outcomes Examined
	- All-cause mortality risk
	- Cardiovascular mortality risk
	- Mortality hazard ratios by age of diabetes onset (<40, 40–59, ≥60 years)
	
	Purpose
		Prevalence among younger population
		- In recent decades, **diabetes within the younger population** has become **much more common**
		  - Diabetes **prevalence of approximately 4–5% among individuals aged 18–44** in the U.S.
		  - Due to growth of obesity rates and changes in lifestyle behaviors
		  - **Early-onset diabetes** (diagnosed earlier than 40 years old) is **more aggressive, with poorer outcomes and** a **higher** relative **risk of complications and death**
		Higher risk of complications
		- There's a **bidirectional relationship between type 2 diabetes and cardiovascular disease**, leading to vascular damage and inflammatory responses that further increase the risk of cardiovascular disease
		  - When the age at diagnosis was assessed (< 40 vs. ≥60), it was found that **younger age categories were associated with an increased risk of both all-cause and CVD mortality**

	- Investigate how age at diagnosis of type 2 diabetes influences subsequent risk of mortality in the U.S. population **Overall** - Early-onset type 2 diabetes (before age 40) linked to significantly higher risks of both all-cause and cardiovascular mortality compared to diagnosis at age ≥60 This article highlights the aggressive nature of early-onset diabetes, as well as increased risk of mortality amongst the younger population.	

Gwira, J., Fryar, C., & Gu, Q. (2021). *Key findings Data from the National Health and Nutrition Examination Survey*. https://www.cdc.gov/nchs/data/databriefs/db516.pdf	**Study Method**
	- Analysis of cross-sectional data from the U.S. National Health and Nutrition Examination Survey (NHANES)
	- Data collected during 2017–March 2020
	- Nationally representative sampling of non-institutionalized U.S. population
	
	Data Collected
	- Blood glucose levels and A1c percentages to identify diagnosed and undiagnosed diabetes
	- Demographic variables (age, sex, race)
	- Self-reported history of diabetes diagnosis
	
	Outcomes Examined
	- Prevalence of diagnosed and undiagnosed diabetes among U.S. adults
		Delays in Diagnosis
		- From August 2021-2023, the **prevalence of undiagnosed diabetes in U.S. adults was approximately 4.5% (15,070,000 adults)**
		    - Results in a **missed window of opportunity for patients to prevent progression** to diabetes
		    - By the time the patient receives diagnosis, diabetes-associated complications have already been present for an extended period of time
		    - Highlights how prediabetes is often asymptomatic

	- Comparisons in diabetes prevalence based on age, sex, and race/ethnicity **Purpose** - To provide national estimates of diabetes prevalence, including undiagnosed cases, across different demographics in the U.S. **Overall** - **Reflects the notable burden in younger populations**, with a higher prevalence observed among non-white individuals. These **findings highlight the importance of early detection** and prevention efforts, even in younger age groups.	

CDC. (2024, May 22). *Nerve Damage*. Diabetes. https://www.cdc.gov/diabetes/diabetes-complications/diabetes-and-nerve-damage.html
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CDC. (2024, May 13). *Vision Loss and Diabetes*. Diabetes. https://www.cdc.gov/diabetes/diabetes-complications/diabetes-and-vision-loss.html
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	Study Method
	- Educational webpage compiling evidence from prior scientific research and public health data
	- Summarizes scientific understanding and clinical guidance
	
	Data Collected
	- Prior research, including epidemiological statistics, and clinical findings from previous studies
	
	Outcomes Examined
	- **Types of diabetic neuropathy**
	    - Peripheral neuropathy
	    - Autonomic neuropathy
	    - Proximal neuropathy
		Diabetic neuropathy
		- Extended periods of hyperglycemia can lead to nerve damage in the extremities
		    - Common symptoms include: tingling, “pins and needles” sensation, and numbness
		        - Numbness increases one’s risk of acquiring an infection due to wounds or ulcers that go unnoticed
		
		Diabetic retinopathy
		- Prolonged and poorly-controlled diabetes damages the neurovasculature of the retina
		    - Blood vessels weaken and form small pouches that eventually begin to leak, leading to swelling and blurred vision

Centers for Disease Control and Prevention. (2024, May 22). *Chronic Kidney Disease*. Diabetes. https://www.cdc.gov/diabetes/diabetes-complications/diabetes-and-chronic-kidney-disease.html	- **Consequences of untreated nerve damage**
	    - foot ulcers, amputations
	Purpose
	- To educate the public about how diabetes contributes to neuropathy, the different types of neuropathy one may experience, and strategies to mitigate progression of these symptoms**.**
	
	Overall
	- Nerve damage is a common, serious complication of diabetes that results from extensive high blood sugar causing damage to one's nerves and small blood vessels
		- If advanced, new, fragile blood vessels form and bleed, which causes vision loss
		
		- Diabetic retinopathy is the leading cause of blindness in working-age adults
		
		Diabetic nephropathy (chronic kidney disease)
		- Damage to renal vessels and nephrons lead to reduced ability to filter waste
		    - Chronic kidney disease can progress to stage 5, at which point dialysis will be necessary several times weekly
		
		Overall these diabetes-related complications, such as neuropathy, retinopathy, and nephropathy, can cause a significant amount of damage. This can lead to impairment of one's activities of daily living and therefore negatively impact their quality of life.

Parker, E. D., Lin, J., Mahoney, T., Ume, N., Yang, G., Gabbay, R. A., ElSayed, N. A., & Bannuru, R. R. (2024)	This is a **Retrospective, Population-Based, Economic Modeling Study → classified as Descriptive Study**
	● Combined the demographics of the U.S. population in 2022 with diabetes prevalence, from national survey data, epidemiological data, health care cost data, and economic data → made a **Cost of Diabetes Economic Model to estimate the economic burden at both the population and per capita levels**
	● **Purpose**: Highlight the economic burden of diagnosed diabetes by estimating the **direct medical costs** (e.g., hospital care, medications) and **indirect costs** (e.g., productivity loss, premature mortality) associated with diabetes
		1. **Massive Economic Burden**
		● The total cost of **diagnosed diabetes** in the U.S. in 2022 was **$412.9 billion**, consisting of:
		    ○ $306.6 billion in direct medical costs
		    ○ $106.3 billion in indirect costs (productivity loss, disability, and premature death)
		● Diabetes is responsible for **1 in 4 healthcare dollars spent in the U.S.**
		● People with diabetes incur **2.6x higher medical expenditures t**han those without diabetes (average: $19,736/year)

	● **Data sources used** (both state-level & national level) ○ National health surveys ○ Insurance claims (ex. Medicare standard analytic files) ○ Hospital data ● Used an **attributable risk fraction** approach to isolate costs directly due to diabetes Overall provides critical estimates of disease burden, which can inform public health policy, resource allocation, and economic planning related to diabetes care and prevention.	Therefore, preventing diabetes by targeting prediabetes would significantly reduce BOTH personal and system-level economic burdens 2. **Delayed Action ⇒ Rising Per Capita Cost** (average cost of medical care per person is going up over time) a. Even after accounting for inflation and how common diabetes is, the **average yearly cost to treat one person with diabetes went up** from **$11,619 in 2017** to **$12,022 in 2022** (increased by 3.5%) b. Especially true for for inpatient hospital stays and prescription medications i. Between 2017 and 2022, the average cost per capita for insulin went up by 20%, and the cost for other diabetes medications went up by 25% Therefore, intervening during prediabetes can help flatten this upward cost trend. Each person with diabetes now costs more in medical care and treatment than they did five years ago. This shows that the longer we delay intervention efforts, the more expensive diabetes becomes for everyone.
Alouki, K., Delisle, H., Bermúdez-Tamayo, C., & Johri, M. (2016)	This is a **Systematic Review** based on 20 studies from peer-reviewed sources containing both national-level and international data that targeted: 1. **High-risk adults** (prediabetes, obesity, impaired glucose tolerance, or a history of gestational diabetes) 2. **Economic evaluations** that looked at cost and health outcomes 3. **Cost per quality-adjusted life year** (weighs length and quality of life)	1. **Type 2 diabetes (T2D) is largely preventable, especially in the prediabetes stage** ● Lifestyle interventions at the prediabetes stage have proved successful at reducing the incidence of T2D by 28.5% to 58%, in China, India, Finland, and the United States ● Weight control is key to the prevention and management of diabetes independent of dietary composition (obesity is a major risk factor)

	4. **National healthcare systems** ● Extracted data included population characteristics, intervention details, modeling methods, outcomes, and sensitivity analyses ● **Purpose**: Evaluate the cost-effectiveness of lifestyle interventions (diet, physical activity, or both) for the prevention of type 2 diabetes and obesity in high-risk adult populations → found to be supported by 15/20 studies Overall, provided strong, evidence-based support for the idea that diabetes is a significant public health issue that requires early intervention, especially during the prediabetes stage	2. **Lifestyle interventions are cost-effective** ● Out of the 20 studies reviewed, most concluded that lifestyle interventions (diet, exercise, or both) were cost-effective or even cost-saving in preventing type 2 diabetes ● Cost per QALY (Quality-Adjusted Life Year) gained was generally below accepted thresholds, meaning these intervention programs provided good value for money 3. **Interventions were most effective when applied to high-risk populations**, such as people with: ● Prediabetes ● Obesity ● Impaired glucose tolerance

Evidence Table B: Specific Priority Group

Which group(s) is a priority or target population and why? (Mat & Moe)		
Author(s), Year	**Research Method**	**Findings Relevant to Selecting Priority Group**

Kaptoge, S., Seshasai, S., Sun, L., Walker, M., Bolton, T., Spackman, S., Ataklte, F., Willeit, P., Bell, S., Burgess, S., Pennells, L., Altay, S., Assmann, G., Ben-Shlomo, Y., Best, L., Björkelund, C., Blazer, D., Brenner, H., Brunner, E., & Dagenais, G. (2023)	Study Method: This study examines data from 2 large **prospective cohort studies**, the first set of data coming from the Emerging Risk Factors Collaboration (data obtained studying 96 cohorts from 1961-2020) & the second from the UK Biobank (data obtained from 2006 through 2020). Five age groups across 19 different countries and 23 million person-years were analyzed in this study and this includes individuals: ● Aged ≥30 years diagnosed with type 2 diabetes ● Organized into age at diagnosis groups: 30-39, 40-49, 50-59, 60-69, & ≥70. ● Excluded diagnoses before age 30 to reduce the inclusion of type 1 diabetics Data collected also included: ● **Exposures** i.e. Individual characteristics (age, sex, smoking, history of CVD), diabetes status, and **Outcomes** i.e. cause-specific and all-cause mortality Purpose: ● To provide an estimation as to how age at diagnosis of diabetes is associated with all-cause mortality, cause-specific mortality, and reductions in life expectancy Overall: This study provided quality evidence that an earlier diagnosis is linked to higher mortality risks thus supporting the value of early intervention to delay diabetes progression.	1. **Every decade of earlier diagnosis** of diabetes was associated with about three to four years of **lower life expectancy** - Hazard ratios were calculated for each age group and the younger the age the higher the ratio that was observed - For ages 30-39 the HR was 2.69 and for ages 40-49 the HR was 2.26, this indicates that our priority group had the highest risk of death as compared individuals their age without diabetes 2. Substantial reduction of mortality risk was observed after adjusting for glycemic markers - The study demonstrates that a significant portion of the increased mortality in patients diagnosed at a younger age is due to poor blood sugar control - This finding suggests that the risk is potentially preventable with increased efforts in early detection and better management of glucose levels

Gopalan, A., Mishra, P., Alexeeff, S. E., Blatchins, M. A., Kim, E., Man, A., Karter, A. J., & Grant, R. W. (2020)	Study Method: This study is a retrospective, longitudinal cohort study utilizing data collected from January 1st 2010 to December 31st 2016. The information was sourced from the Kaiser Permanente Northern California EHR. The 32,137 individuals chosen were ages 21-64 who had received a clinical diagnosis of type 2 diabetes or the addition of it to their EHR problem list within 3 months of their A1c result. They were divided into 2 groups, younger-onset (age 21-44) and mid-age-onset (age 45-64). Data collected: - Demographics (age, sex, race/ethnicity etc.) - Clinical Info (A1c, BMI, hypertension, hyperlipidemia, heart disease, renal disease etc.) - Care utilization (PCP encounters, missed appointments, online portal use) - Behaviors (exercise routines, smoking status) Outcomes examined: - Primarily, glycemic control at year 1 (achieving HgbA1c <7%) - Additional outcomes: blood pressure control, weight loss, weekly exercise etc. Purpose: - The general purpose of the study was to compare glycemic control and initial care between adults with younger onset and mid-age onset of type 2 diabetes. Overall:	1. Younger Adults diagnosed with T2D had higher initial HgbA1c values - In younger adults (21-44) the mean value was 8.9% vs. 8.4% in older adults. This supports the need for a more aggressive approach in this population. - They also had lower odds of achieving the desired outcome of HgbA1c < 7% at the year 1 benchmark 2. Younger Adults face significant barriers in achieving glycemic control - They were found to have less in-person contact (due to preference of the online patient portal) with their PCP's and lower adherence to metformin during year 1 - The study also acknowledges the greater association between poor glycemic control and various factors such as depression, greater stress and time constraints due to work and family demands As a result, preventing or delaying the progression of prediabetes into diabetes in the younger adult population is critical. They face more challenges in achieving desired outcomes in comparison to those diagnosed at an older age.

	- This study highlights the important fact that adults diagnosed with diabetes at a younger age face considerable challenges in early glycemic control. It further points to the necessity of focused and adaptive efforts to improve these outcomes.	
Yang, W., Wu, Y., Chen, Y., Chen, S., Gao, X., Wu, S., & Sun, L. (2024) - Moe	**Study Design**: Prospective Population-Based Cohort Study **Population:** 12,424 adults with prediabetes (**mean age 52.7**; SD of 16.8; 68% of participants between **36-69 years old**) including ages 30–50. **Data Collected:** - Demographics (age, sex, income, education) - Lifestyle (diet, exercise, smoking, alcohol) - Clinical/lab (FBG, BMI, cholesterol, BP) **Assessment:** - Physical activity categorized into (low: <600, moderate: 600-3000, high: ≥3000 based on Metabolic equivalence of task (MET-min/week) - Follow-up duration: 3.6 years **Outcomes Examined:** - Incident T2D - Changes in fasting blood glucose (FBG) **Purpose:** To assess whether different levels of physical activity in prediabetic individuals affect the likelihood of developing T2D.	**Low physical activity was highly prevalent and significantly associated with increased diabetes risk:** • 66% of the cohort (between age 36-69) had low physical activity, reflecting a poor health behavior pattern • Those with low activity had 43% higher risk of developing T2D compared to those with moderate activity. → This supports the low levels of protective behavior among the priority group (age 30-50). **Increased diabetes risk in inactive individuals** • T2D incidence was highest among those with low activity: 55.83/1,000 person-years vs. 35.14 (moderate) and 39.61 (high). • Moderate activity reduced T2D risk by 43% (HR = 0.57); high activity reduced risk by 24% (HR = 0.76). →This further demonstrates that insufficient physical activity increases disease risk. **Physical activity improves glycemic control** • Low activity group had an average FBG increase of +0.20 mmol/L, while the moderate group decreased by −0.27 mmol/L. This shows that physical inactivity is linked to worsening glycemic trends in this group. **Issue is increasing in this age group:** • Global prediabetes expected to affect 1 billion by 2045; early onset is becoming more common

		• Age-stratified analysis showed stronger risk association between physical activity level and risk of T2D in younger adults (under 60), including the 30–50 range (P = 0.02). →This highlights that physical activity is most protective against T2D in younger adults (like those age 30-50), which supports targeting 30–50-year-old prediabetic for physical activity intervention before age reduces the responsiveness to lifestyle changes. **Behavior change is effective even before metabolic syndrome develops:** • High activity reduced T2D risk significantly in participants without metabolic syndrome (P for interaction < 0.001). → This shows that early behavioral interventions in younger, less metabolically impaired adults are impactful. **Conclusion:** Adults aged 30–50 with prediabetes are a priority population because they demonstrate low levels of protective behavior (physical activity) and are experiencing an increasing pattern of earlier diabetes onset. The study supports implementing early interventions such as exercise to slow or prevent progression to T2D in this high-risk group.

Nguyen, Q. M., Xu, J.-H. ., Chen, W., Srinivasan, S. R., & Berenson, G. S. (2012). -Moe	**Study Design:** Prospective longitudinal cohort study **Participants:** 2,603 Black and White young adults (aged 18–50 at follow-up), originally	**Higher Disease Incidence in Ages 30–50:** • Diabetes incidence increased sharply with age: 7.7% at ages 30–39 and 8.6% at ages 40–50 compared to 1.6% at 18–29.

	normoglycemic, followed over 16 years in the community-based Bogalusa Heart Study. **Data Collected:** Baseline demographics (race, sex, parental diabetes), BMI, blood pressure, glucose, insulin, HOMA-IR, lipid profile (TG/HDL-C), and incidence of type 2 diabetes. **Outcomes Examined:** Incidence of type 2 diabetes by age group (18–29, 30–39, 40–50), racial/ethnic differences, parental diabetes history, and predictive value of baseline cardiometabolic risk factors. **Purpose:** To assess how early health risks can predict when someone might develop T2D and to find out which risk factors matter most at different ages.	• Per 1,000 person-years: 4.3 (age 30–39), 3.9 (40–50), vs. 1.6 (18–29). →These numbers clearly demonstrate a much higher burden of disease in 30–50-year-olds compared to their younger counterparts. **Race-Based and Sex-Based Disparities Among 30–50 Age Group:** • Black individuals especially Black women were disproportionately affected. • Incidence in Blacks: 7.1% vs. 4.8% in Whites; Black females: 7.2%, White females: 4.7% ($p < 0.05$). • This suggests added vulnerability in minority adults aged 30–50. →The disparities within the 30-50 age group warrants focused preventive efforts to reduce inequities in T2D outcomes. **Key Modifiable Risk Factors Identified:** • In 30–50-year-olds, the strongest predictors of developing diabetes were modifiable: high BMI, elevated glucose, and abnormal TG/HDL-C ratio. • These risk factors can be potentially targeted with diet, exercise, and education interventions. →These are modifiable lifestyle related risks common in the target age range, making this group ideal for behavior change based intervention. Thus, supporting the effectiveness and relevance of early lifestyle interventions who are still in modifiable

		stages of risk. **Conclusion:** Adults aged 30–50 are a high-incidence, high-risk group for type 2 diabetes with identifiable and modifiable risk factors. The study strongly supports early preventive interventions in this priority population to prevent progression to diabetes.

Evidence Table C: Specific Health Behavior

Which behavior(s) needs to be addressed to Diabetes*? (Abigail and Lily)*		
Author(s), Year	**Research Method**	**Findings Relevant to Selecting Health Behavior**
Yau, J. W., Thor, S. M., & Ramadas, A. (2020).	A scoping review was conducted to identify and map existing nutritional strategies studied in adults with prediabetes. ● The aim was to provide a comprehensive overview, not to evaluate the efficacy of specific interventions. ● The protocol was guided by the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews). What studies were included? ● Studies with adults aged ≥18 years with prediabetes, defined per ADA guidelines: ○ Impaired fasting glucose (IFG)	● More than 50% of reported interventions resulted in significant improvements in plasma glucose, serum insulin, serum lipid profile, body mass index and body weight. ● Eight studies (57.1%) recorded statistically significant improvements in reducing progression to diabetes or reversing prediabetes. ● A high-protein diet found complete remission of prediabetes in the high-protein group. ● Curcumin was found to improve β-cells function and insulin resistance with few adverse effects. Foods that specifically helped with glucose levels:

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Impaired glucose tolerance (IGT)
Elevated HbA1c

Followed Studies that included nutritional interventions:

Energy intake
Macronutrient or micronutrient intake
Consumption of specific foods/food groups
Overall dietary patterns

Where were the studies found?

Databases searched: Ovid MEDLINE, PubMed, Embase, Scopus, CINAHL, and PsycINFO
Search period: 2010 to 2020

Studies chosen

In the end, 298 full-text articles were reviewed for eligibility and final inclusion was 95 studies.

Data Extraction and Organization

A standardized Google Sheets-based template was used.
variables included:

Country
Study design
Duration
Population characteristics
Mean age
Intervention and control details
Outcomes measured

Main findings

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Whole grains [were] superior to refined grains, with the most notable benefits being better glucose- and insulin-related parameters.
Soy protein enhanced glucose levels, BMI and insulin parameters.
Kimchi showed improvement at post intervention in glucose metabolism and BMI.
Pistachio demonstrated positive correlations with glucose and insulin related parameters.
Vinegar enhanced insulin sensitivity, insulin resistance, glucose metabolism.
All [seven studies] found a preponderance towards healthy eating such as reduced daily caloric, fat and alcohol intake as well as increased fiber consumption.

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	○ Studies were categorized by setting, focus of intervention and type of outcome assessed Data Analysis ● Findings were thematically grouped based on the type of nutritional strategy and outcomes.	
Tseng, T. S., Lin, W. T., Gonzalez, G. V., Kao, Y. H., Chen, L. S., & Lin, H. Y. (2021)	● A narrative literature review that synthesizes existing research examining the link between sugar-sweetened beverage intake and DM Type II. ● Selected peer-reviewed literature included epidemiologic cohort studies, meta-analyses, experimental/clinical trials, observational studies, and biochemical studies. ● Extracted data from the above studies includes measurements of sugar-sweetened beverage intake (frequency, volume, and sugar content), patient outcomes (DM type II incidence, glycemic control markers, inflammation), and patient characteristics. ● Authors examine the direct effects of sugar-sweetened beverage intake (such as fructose's impact on liver metabolism and insulin resistance) along with indirect effects via weight gain and obesity. ● Authors reviewed how sugar-sweetened beverage consumption affects individuals with DM type II in regards to disease management.	● Showed strong and consistent evidence that sugar-sweetened beverage consumption increases the risk of DM Type II. Large-scale prospective cohort studies showed that regular consumption significantly increased the risk of developing DM Type II, even independent of obesity. For example, one study showed that each additional daily serving of a sugar-sweetened drink increased the risk of DM Type II by 18%. ● Showed that sugar-sweetened beverages lead to weight gain and obesity, which are major risk factors for DM Type II. However, after adjusting for body weight it was seen that sugar-sweetened beverages independently raised DM type II risk through mechanisms like insulin-resistance. ● Saw that sugar-sweetened beverages, especially those high in fructose, promotes several metabolic mechanisms including hepatic insulin resistance, increased de novo lipogenesis (fat formation in liver), inflammation, and elevated triglycerides. These pathways are believed to directly contribute to the development of DM type II, even in individuals without obesity. ● Some studies showed that high sugar-sweetened beverage intake was associated with increased levels of CRP, showing an increase in inflammation which plays a critical role in pathogenesis of insulin resistance and DM. ● Sugar-sweetened beverages do not promote satiety leading to excess calorie consumption and subsequent weight gain.

		● Also examined sugar-sweetened beverage consumption in individuals already diagnosed with DM type II. Showed that many individuals with DM Type II continue to consume sugar-sweetened beverages. Some cross-sectional studies showed that patients with higher sugar-sweetened beverage intake had poorer glycemic control (higher A1C levels).
Wang, Y., Li, H., Yang, D., Wang, M., Han, Y., & Wang, H. (2023)	A systematic review and meta-analysis was conducted to evaluate the effects of aerobic exercise in patients with prediabetes. What studies were included ● Included RCTs involving individuals with prediabetes (IGT, IFG, HbA1c 5.7–6.4%), without age/gender limits. ● Intervention in studies: Supervised aerobic exercise; Control: No exercise (blank controls). ● Excluded studies if patients had diabetes, CVD, pregnancy, musculoskeletal conditions, or hypoglycemic/lipid-lowering medication use. Where were studies found ● Databases searched: PubMed, Embase, Web of Science, Cochrane Library (through Jan 7, 2023). Studies Chosen ● 10 RCTs, 815 participants with mean age 56.1 years. ● Aerobic interventions: dance, treadmill, walking, HIIT (65% HRmax median).	Effects of aerobic exercises in prediabetes patients: a systematic review and meta-analysis ● Participants had an average age of 56 and exercised 3–4 times per week using aerobic methods such as walking, treadmill use, or aerobic dance ● Interventions led to statistically significant improvements in key metabolic markers: ○ BMI reduced by 1.44 kg/m² ○ Fasting blood glucose decreased by 0.51 mmol/L ○ 2-hour post-load glucose decreased by 0.76 mmol/L ○ HbA1c reduced by 0.34% ● Interventions solely focused on aerobic exercise have been found to reduce the risk of Type 2 diabetes by 46% ● Studies included had variable durations, but longer-term programs tended to show greater benefits ● The article highlights the importance of regular aerobic exercise as a low-cost, non-pharmacological intervention for diabetes prevention ● Findings support implementation of structured exercise programs in prediabetic populations as a public health strategy

	Data Extraction ● Author, region, sample size, demographics, exercise type/intensity/frequency/duration, and outcomes. Analysis ● Egger’s test used to assess publication bias.	
Phillips, E., Rahman, R., & Mattfeldt-Beman, M. (2018)	● Qualitative cross sectional correlational study examining the relationship between diabetes knowledge, glycemic control, and associated health conditions. ● 17 hospital patients between the ages of 18-75 years old with DM type II and a recent (within 3 month) A1C. ● Participants were given the Michigan Diabetes Knowledge Test to assess diabetes knowledge and provide information about their diabetes self-care habits, previous diabetes education, and diabetes-related secondary health conditions. ● For analysis, the test computed mean Michigan Diabetes Knowledge Test scores vs A1C levels. Also compared the Michigan Diabetes Knowledge Test scores vs cases of retinopathy. Both comparisons used p-values to evaluate the statistical significance.	● Participants with higher Michigan Diabetes Knowledge Test scores, and thereby better DM knowledge, tended to have better glycemic control (lower A1C). This result was statistically significant ($P<0.05$), suggesting a meaningful link between diabetes knowledge and glycemic control. ● Patients with retinopathy had significantly lower Michigan Diabetes Knowledge Test scores compared to those without retinopathy. P-value was 0.03 which indicates a strong association between poor DM knowledge and presence of retinopathy. ● Shows that patients with higher DM knowledge/education have better health outcomes.

Shirvani, T., Javadivala, Z., Azimi, S., Shaghaghi, A., Fathifar, Z., Bhalla, H. D. R., Abdekhoda, M., & Nadrian, H. (2021).	• Systematic review and meta-analysis to evaluate the effectiveness of community-based educational interventions in preventing DM type II. • Measured effectiveness of community based educational interventions at preventing DM type II based on their impact on risk parameters including incidence of DM, fasting blood glucose, A1C, BMI, waist circumference, and blood pressure • Comprehensive search across multiple databases including PubMed, Embase, Scopus, ProQuest, CINAHL, and Cochrane Library in addition to other literature and reference lists • Included 19 studies that examined implemented community-based educational interventions aimed at preventing DM type II and reported relevant outcomes. 10 of those studies were meta-analysis with a total of 16,106 participants.	• Community interventions reduced risk of DM type II by 46%. This had a relative risk of 0.54 and a p value of $p < 0.001$. • Community interventions were associated with an average reduction of fasting blood glucose of 0.33mmol/L with a p value of $p < 0.0001$ and an average reduction of A1C of 0.15% with a p value of $p < 0.0001$. • Community interventions were associated with a mean reduction of BMI of 0.47 kg/m^2 and a mean reduction of waist circumference of 0.66cm. • Improvement in the above risk factors were observed in both short term, 6 months or less, and long term, greater than 6 months, interventions. This suggests that both long term and short term interventions are effective. • Interventions grounded in behavioral/educational theory were more effective than those without a theoretical framework, with a 48% reduction in fasting glucose. • Overall, community based educational interventions saw significantly reduced incidence of DM type II along with improving glycemic control and body composition.

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