



A mixed-methods assessment of engagement in wellness programs for patients with prediabetes: Factors associated with referral and participation in lifestyle wellness programs

Tainayah W. Thomas^{a,b,*}, Holly Finertie^{b,c}, Perla Sanchez^{b,c}, Luis A. Rodriguez^{b,c}, Julie Schmittiel^b

^a Stanford University School of Medicine, Department of Epidemiology and Population Health, Stanford, CA, USA

^b Kaiser Permanente Northern California, Division of Research, Oakland, CA, USA

^c Division of Research, Kaiser Permanente Northern California, 2000 Broadway, Oakland, CA 94612, USA

ARTICLE INFO

Keywords:

Diabetes prevention
Prediabetes
Engagement
Wellness programs

ABSTRACT

Objective: We assessed factors associated with engagement in lifestyle wellness programs for patients with prediabetes.

Methods: This mixed-methods study, conducted between March 2018 and April of 2021, combined a retrospective cohort study and semi-structured interviews in a Northern California cohort of patients from a randomized controlled pragmatic clinical trial aged 18–75 with body mass index ≥ 25 and at least one HbA1c between 5.7–6.4 % in the previous 3 months. Patients were assigned to a peer support, enhanced usual care, or control arm. We used generalized linear mixed models to analyze the association between clinical, demographic, and study-related factors and referral to and participation in wellness programs within 12 months. We conducted semi-structured interviews with intervention participants and analyzed them using thematic analysis. We integrated qualitative and quantitative findings using the “following a thread” method.

Results: We identified 2,164 eligible patients; 12.8% were referred to a wellness program and 7% attended a wellness program. Patients not exposed to peer support, males, and Asian-American participants had the lowest odds of participation in wellness programs. Qualitative interviews with 30 intervention participants provided contextual information on quantitative findings including the importance of physician referrals and formal recruitment, a need for social support and accountability, and matching patient needs to wellness program descriptions as facilitators of engaging in wellness programs.

Conclusion: Given the low percentage of patients with prediabetes referred to and participating in wellness programs, there is a need to develop health system strategies to improve wellness program engagement for patients at-risk for diabetes.

1. Introduction

Prediabetes is a high-risk state for developing diabetes and, in 2020, 96 million US adults had prediabetes (Centers for Disease Control and Prevention, 2022). Research has demonstrated that on an annual basis, up to 10 % of those with prediabetes developed diabetes, and that approximately 30 % of untreated patients with prediabetes developed diabetes over a three-year period (Knowler et al., 2002; Forouhi et al., Feb 2007). There is evidence that intensive behavioral interventions

such as the National Diabetes Prevention Program (NDPP) can significantly prevent or delay diabetes onset (Diabetes Prevention Program (DPP) Research Group, 2002). Additionally, research has demonstrated that lifestyle interventions including telephonic wellness coaching programs have a clinically and statistically significant positive impact on reduction in weight and progression to diabetes (Jonas et al., 2021; Jonas et al., 2021; Schmittiel et al., Feb 2017). Therefore, encouraging enrollment of patients at risk for diabetes in lifestyle wellness programs may help stem projected increases in diabetes incidence (Lin et al.,

* Corresponding author at: Stanford University School of Medicine, Department of Epidemiology and Population Health, Alway Building, Suite M121, 300 Pastuer Drive, Stanford, CA 94305, USA.

E-mail addresses: tainayah@stanford.edu (T.W. Thomas), holly.x.finertie@kp.org (H. Finertie), Perla.E.Sanchez@kp.org (P. Sanchez), Luis.A.rodriquez@kp.org (L.A. Rodriguez).

<https://doi.org/10.1016/j.pmedr.2024.102850>

Received 29 March 2024; Received in revised form 1 August 2024; Accepted 2 August 2024

Available online 7 August 2024

2211-3355/© 2024 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY-NC license (<http://creativecommons.org/licenses/by-nc/4.0/>).

2060). Unfortunately, previous research shows only 20–30 % of adults with prediabetes have documented clinician intervention to prevent diabetes (Ali et al., 2019; Karve and Prevalence, 2010; Mainous et al., 2016; Schmittiel et al., Feb 2014; Thomas et al., 2021; Zimmermann et al., Aug 2012).

The 2021 US Preventive Services Taskforce (USPSTF) screening for prediabetes and diabetes recommendation statement advises diabetes screening for adults aged 35–70 with overweight and obesity (i.e., body mass index (BMI) ≥ 25) and referral to ‘effective preventive interventions’ for patients with prediabetes (US Preventive Services Task Force et al., 2021). This is a shift from the 2015 recommendation that advised referral to ‘intensive behavioral interventions’ (i.e., NDPP) for patients with prediabetes (Siu, 2015). This broader set of effective preventive interventions includes lifestyle wellness programs associated with improvements in intermediate outcomes such as weight and pharmacologic interventions (i.e., metformin) that can delay diabetes onset. Given the significantly elevated risk among people with prediabetes, and the recent update to treatment guidelines, the objective of our study was to explore clinical and demographic factors associated with wellness program engagement among adults with prediabetes. We used mixed methods and data integration to assess the following outcomes among adults with prediabetes: (1) referral to and participation in wellness programs and clinical and demographic factors associated with these outcomes; (2) preference for, perception of, and experience with wellness programs for diabetes prevention; and (3) potential intervention targets to increase engagement in effective lifestyle wellness programs.

2. Research design and methods

2.1. Study design

This study combined a retrospective cohort study and semi-structured qualitative interviews using a concurrent, non-dependent mixed method design (Schoonenboom and Johnson, 2017) whereby quantitative and qualitative data were collected in one phase between March 2018 and April of 2021. Semi-structured interviews were conducted to contextualize factors associated with participation in wellness programs for diabetes prevention in the health system, community-based, phone and online settings. We followed the Good Reporting of A Mixed Methods Study (GRAMMS) checklist to report this study (O’Cathain et al., Apr 2008).

2.2. Study population

2.2.1. Quantitative

This study used a cohort of patients from the Using Peer Support To Aid in Prevention and Treatment in Prediabetes (UPSTART) study. UPSTART design and primary results have been previously described (Heisler et al., Aug 2020; Heisler et al., Aug 2023). Eligible Kaiser Permanente Northern California (KPNC) UPSTART participants were aged 18–75 with body mass index (BMI) ≥ 25 (≥ 23 for Asian Americans) and at least one HbA1c between 5.7–6.4 % in the previous 3 months. Eligible participants were identified from monthly EHR data pulls. From each data pull, a random subset of 100 patients were invited to participate in the intervention by Recruitment stopped when adequate sample size was achieved. Those who accepted were randomized to one of two intervention arms, a peer support arm and an enhanced usual care (EUC) arm, stratified by Hispanic ethnicity and baseline HbA1c ($\leq 6\%$ or $> 6\%$). Briefly, participants in the peer support arm were assigned a peer coach and had weekly goal setting calls with their coach for six months. Participants in the EUC arm received periodic updates on available diabetes prevention and wellness programs resources. We assigned eligible patients not invited to enroll in UPSTART to the control arm.

2.2.2. Qualitative

Study participants from the UPSTART peer support and EUC arms who indicated that they were willing to be contacted for qualitative interviews during their initial study visit ($n = 76$) were contacted via email and invited to participate. Selection of participants was primarily based on reflecting the diversity (e.g., age, race/ethnicity, gender) of the overall study cohort. The selection of participants was an iterative process whereby selection criteria for subsequent interviews were modified to ensure diversity and representativeness of participants was achieved. Participants were recruited until data saturation was achieved (i.e., no additional data was expressed in new data). Participants received a \$20 gift card.

Interviews were conducted by the lead author (TT) along with a note taker (PS) and lasted up to one hour. Interviews were digitally audio recorded and a semi-structured topic guide was used to facilitate the discussions. Topics explored included experiences with prediabetes diagnosis, influences behind engagement or non-engagement in wellness programs, experiences with KPNC wellness programs or the NDPP, and preferences for diabetes prevention options. Researchers obtained verbal consent for interviews. This study was reviewed and approved by KPNC (November 20, 2018 IRB 1301009).

2.2.3. Theoretical framework

We used an ecological approach (Glanz and Rimer, 2005) to categorize intervention points for promoting health from multiple levels of influence. These levels include *individual* factors such as knowledge, attitudes and beliefs; *interpersonal* factors related to family and friends and social support; *organizational* factors such as rules, policies, regulations and structures that could constrain or promote health behaviors; *community* factors such as relationships between organizations, cultural values and norms; and *public policy* factors such as local, state and federal laws and regulations. (Glanz and Rimer, 2005).

2.2.4. Outcome measures (Quantitative)

The two primary quantitative outcomes were referrals to and participation in lifestyle wellness programs. Referrals can be recorded by providers in the internal electronic referral system or in the EHR and provided to the patient as part of their ‘after visit summary.’ Participation in lifestyle wellness programs can occur through attendance at in-person classes or through telephone-based wellness coaching services. These services do not require referrals. Patients can self-enroll by scheduling a health class through the KPNC online appointments portal. Relevant referrals and completed encounters or appointments (participation) were identified using text searches for key words related to diabetes prevention, diet/nutrition, physical activity, weight management, and wellness coaching (Appendix, Table 1). Participants with a referral within 12 months of their start date were considered to have a referral to a lifestyle wellness program. We defined 12 months as 365 days after baseline visit for those randomized to our intervention arms or 365 days after date identified as eligible for those in the control arm. Those with relevant encounters or appointments within 12 months of their start or eligibility date were considered to have participated in a lifestyle wellness program.

2.3. Statistical analysis

2.3.1. Quantitative

We presented descriptive statistics for patient-level intervention exposures, demographics, and clinical variables at baseline as proportions for categorical variables and median [IQR] for non-normally distributed continuous variables, and unadjusted proportions for each outcome by patient-level characteristic. We analyzed associations between all participant characteristics and referral to or participation in lifestyle wellness programs using generalized linear mixed models, which allowed specification of a hierarchical structure of patients nested within primary care providers (PCPs) and adjustment for unbalanced

patients clustered within provider levels. We conducted analyses using the GLIMMIX procedure in SAS 9.4 (Cary, North Carolina).

2.3.2. Qualitative

Interview recordings were transcribed verbatim and transcripts were checked for accuracy by comparing the original recording to the transcript (PS). To analyze qualitative interview data, we used Braun and Clarke's six phases of thematic analysis. (Braun and Clarke, 2012) First, we read and reread transcribed data to gain familiarity with the data and the lead author made notes to highlight topics of interest as well as reviewed notes from the note taker (Phase 1). Next, the research team used the highlighted topics from transcripts as well as topics from the interview guide to develop initial codes. (Braun and Clarke, 2012) Team members then independently applied codes to the transcripts and used team discussions to define, add, remove, or modify codes until consensus was reached and the final codes were applied to all transcripts (Phase 2). In Phase 3, we assessed initial relationships between codes to develop themes including mapping clusters of codes to identify larger data patterns. (Braun and Clarke, 2012) In Phase 4, we reviewed these initial themes in relation to the broader dataset and codebook to ensure alignment between initial themes and the data. As part of a directed content analysis approach, we also mapped initial themes to the social ecological model. Next, we named, organized, and defined themes and transcripts were reviewed to identify illustrative quotes (Phase 5). (Braun and Clarke, 2012) Finally, we organized a narrative of themes based on the social ecological model (Phase 6).

2.3.3. Data integration

This study utilized both qualitative and quantitative methods to obtain complementary information contextualizing quantitative results with qualitative data. The lead and senior authors employed the "following a thread" (O'Cathain et al., 2010) method to integrate qualitative and quantitative findings by conducting preliminary analyses of each component to identify key findings and then identifying questions to explore further (O'Cathain et al., 2010), focusing data integration on quantitative findings that highlighted sub-group differences in program participation. We then selected one question, "what factors may explain intervention exposure, gender, and race differences in program participation?" from the quantitative findings and followed it across the qualitative component.

3. Results

3.1. Quantitative

We identified 2,164 patients for analyses and patient characteristics are reported in Table 1. Fig. 1 summarizes unadjusted proportions of patients who were referred to or participated in wellness counseling services by patient characteristics and intervention exposure. Overall, 12.8 % of patients had a referral to a wellness program and 7 % participated in a wellness program. While referrals were not required for participation, 60.3 % of patients with a referral participated in a wellness program, compared to 39.7 % of patients without a referral.

In adjusted models (Table 2), patients with prediabetes exposed to the peer support arm had significantly higher odds of referral to wellness programs compared to those not exposed to peer or wellness program information/interventions [AOR: 2.25, 95 % CI: 1.11, 4.59]. Both the peer support [AOR: 3.09, 95 % CI: 1.46, 6.51] and EUC [AOR: 3.10, 95 % CI: 1.43, 6.74] arms had significantly higher odds of participating in wellness counseling programs, compared to those with no exposure to interventions.

Female patients had higher odds compared to male patients for both referrals [AOR: 1.50, 95 % CI: 1.11, 2.01] and participation [AOR: 1.99, 95 % CI: 1.35, 2.91]. Asian American/HI/PI patients had lower odds of participation in wellness programs compared to White patients [AOR: 0.55, 95 % CI: 0.31, 0.99]. Participants with a HbA1c \geq 6 % had higher

Table 1

Distribution of Baseline Characteristics for KPNC UPSTART Eligible Participants, 2018–2021.

Characteristic	Quantitative Participants (N=2,164)	Qualitative Participants (N=30)
Intervention Arm, N (%)		
Peer support	53 (2.5)	14 (46.7)
Enhanced usual care	52 (2.4)	16 (53.3)
Not exposed to peer or enhanced usual care interventions	2,059 (95.1)	0 (0)
Demographics		
Age, years, median [IQR]	58 [48–66]	59.8 [55–67]
Sex, N (%)		
Female	1,171 (54.1)	18 (60.0)
Male	993 (45.9)	12 (40.0)
Race/Ethnicity, N (%)		
African American	801 (37.0)	11 (36.7)
Asian American/HI/PI	404 (18.7)	6 (20.0)
Hispanic	204 (9.4)	<5 (3.3)
Multiracial, or Other	99 (4.6)	<5 (3.3)
White	656 (30.3)	12 (40.0)
Clinical		
HbA1c, N (%)		
<6.0 %	1,447 (66.9)	20 (66.7)
\geq 6.0 %	717 (33.1)	10 (33.3)
BMI, kg/m ² , N (%)		
Overweight ^a	927 (42.8)	13 (43.3)
Obese ^b	1,237 (57.2)	17 (56.7)

Abbreviations: IQR, interquartile range; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); HI/PI, Hawaiian Islander/Pacific Islander.

^a Overweight BMI 25–29.9 kg/m², or 23–27.4 among Asian American, Native Hawaiian, or Pacific Islander participants.

^b Obese BMI \geq 30 kg/m², or \geq 27.5 among Asian American, Native Hawaiian, or Pacific Islander participant.

odds of referral to a wellness program compared to participants with a HbA1c < 6 % [AOR: 1.51, 95 % CI: 1.14, 2.00] and participants with obesity had higher odds compared to patients who were overweight [AOR: 1.79, 95 % CI: 1.32, 2.43].

3.2. Qualitative

Based on our recruitment strategy, 66 participants from the peer support and EUC arms were invited to participate in semi-structured interviews. Thirty participants (45 % response rate) completed semi-structured interviews. The mean patient age for the interview participants was 59 years, 60 % were women, 57 % had a BMI \geq 30, 33 % had a HbA1c between 6–6.4 %, and 40 % were White (Table 1). Themes and illustrative quotes are provided in Table 3.

Theme 1: Matching perceived needs to program description [individual].

"That level of specificity and that kind of particular context that really spoke to me as this is a program— it's for you [...] a pre-diabetic person, and this will help you put off the diabetes."

Participants had the most experience with KPNC wellness classes (50 %) followed by structured weight programs (40 %, namely, Weight Watchers). Participants were most interested in enrolling in the NDPP (60 %), followed by KPNC wellness classes (40 %). Participants liked the NDPP's explicit focus on diabetes prevention. If a participant believed that a program was a good match for their needs, they stated that they were more likely to try it. There were three main reasons that participants cited for trying a program: accountability, information about prediabetes, and avoiding diabetes.

Many patients stated that prior to the research's study outreach, they did not initially understand why a prediabetes program would meet their needs. For example, one participant said, *"I've heard the term pre-diabetes. I don't think I really understood what it meant [...]"*. This made

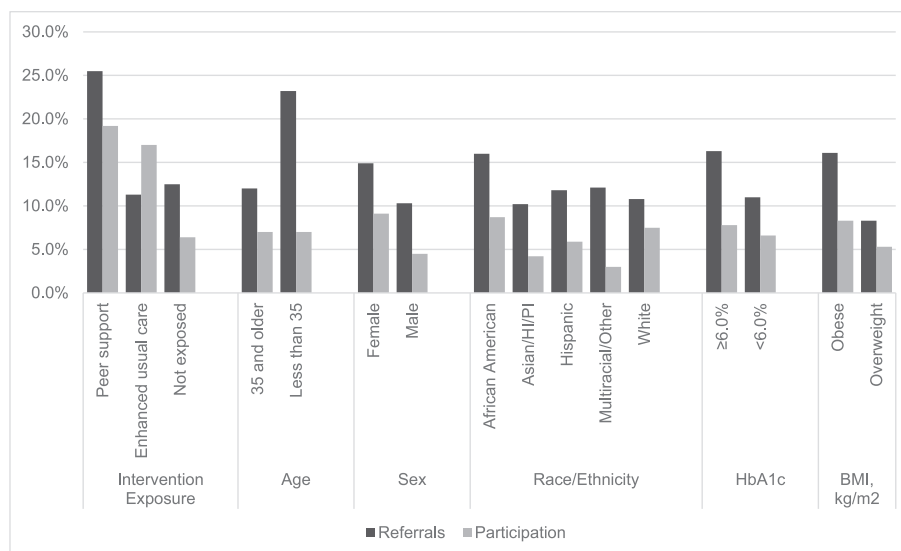


Fig. 1. Proportion of KPNC UPSTART Eligible Participants with a Referral to or Participation in Wellness Counseling by their Baseline Characteristics, 2018–2021. BMI, body mass index (calculated as weight in kilograms divided by height in meters squared; HI/PI, Hawaiian Islander/Pacific Islander. ^a Overweight BMI 25–29.9 kg/m², or 23–27.4 among Asian American, Native Hawaiian, or Pacific Islander participants. ^b Obese BMI ≥30 kg/m², or ≥ 27.5 among Asian American, Native Hawaiian, or Pacific Islander participants.

Table 2

Association between Referrals to and Participation in Wellness Counseling and Baseline Characteristics among KPNC UPSTART Eligible Participants using-Multilevel Mixed Models, 2018–2021.

	Referrals, AOR (95 %CI)	Participation, AOR (95 %CI)
Fixed Effects		
Intervention Exposure		
Peer support	2.25 (1.11, 4.59)	3.09 (1.46, 6.51)
Enhanced usual care	0.91 (0.36, 2.27)	3.10 (1.43, 6.74)
Not exposed to peer or enhanced usual care interventions	1 [Reference]	1 [Reference]
Age		
35 and older	0.50 (0.32, 0.80)	0.97 (0.49, 1.96)
Less than 35	1 [Reference]	1 [Reference]
Sex		
Female	1.50 (1.11, 2.02)	1.99 (1.35, 2.91)
Male	1 [Reference]	1 [Reference]
Race/Ethnicity		
African American	1.35 (0.95, 1.91)	1.02 (0.68, 1.53)
Asian American/HI/PI	0.92 (0.59, 1.42)	0.55 (0.31, 0.99)
Hispanic	0.82 (0.48, 1.40)	0.63 (0.32, 1.23)
Multiracial/Other	0.99 (0.49, 1.99)	0.37 (0.11, 1.25)
White	1 [Reference]	1 [Reference]
HbA1c		
≥6.0 %	1.51 (1.14, 2.00)	1.21 (0.84, 1.73)
<6.0 %	1 [Reference]	1 [Reference]
BMI, kg/m ²		
Obese ^a	1.79 (1.32, 2.43)	1.37 (0.94, 1.99)
Overweight ^b	1 [Reference]	1 [Reference]

Multilevel models accounted for PCP-level variability (random effect) and were adjusted by baseline characteristics (fixed effects): intervention exposure, age, sex, race/ethnicity, HbA1c, and BMI.

Abbreviations: AOR, Adjusted Odds Ratio; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); PCP, Primary Care Provider;

Bold indicates significant fixed (p < 0.05).

^a Overweight BMI 25–29.9 kg/m², or 23–27.4 among Asian American, Native Hawaiian, or Pacific Islander participants.

^b Obese BMI ≥30 kg/m², or ≥ 27.5 among Asian American, Native Hawaiian, or Pacific Islander participants.

classes and programs specifically referencing prediabetes attractive to these participants as it was an opportunity to learn more about the condition. Participants were also interested in avoiding progression to diabetes as many had a family history of diabetes and had seen first-hand its potential complications. Therefore, programs that offered diabetes prevention specifically were attractive to these participants.

Theme 2: Importance of physician referrals, and formal recruitment outreach, and discussion of prediabetes [interpersonal; organizational].

“My doctor recommended it, and so it seemed like a good idea at the time.”

All qualitative interviewees were study participants in the peer support or EUC arm. As such, they were recruited into the larger intervention via a mailed letter inviting them into the study, which included their PCPs’ recommendation for participation. Most participants cited the outreach letter and its explicit reference of their PCPs’ support as a factor for enrolling. Furthermore, most participants who had experience with a KPNC wellness class cited their PCPs recommendation and referral as a key reason they decided to enroll. Some participants also mentioned enrolling in other wellness programs due to clinic-based outreach, including phone calls and mailed letters, that invited their participation.

Alternatively, many participants mentioned being unaware of having prediabetes; either their providers had not explicitly discussed their laboratory results with them, or they shared the results but did not explain their value was in the prediabetes range. These participants learned of their prediabetes status during intervention outreach.

3.3. Data integration

Quantitatively, we found that participants with no exposure to our interventions, men, and Asian American participants had lower odds of program participation. We also found that participants in the peer support arm had the highest unadjusted proportion of participation in wellness programs compared to all other subgroups. As part of our data integration strategy, we utilized the qualitative dataset to explore these findings and found the following contextual factors influencing program participation for subgroups: 1) social support, accountability, and shared knowledge by peer coaches (intervention exposure); 2) lack of interest in weight loss and group programs for men (gender); and 3)

Table 3
Qualitative Themes, Data Integration Contextual Factors, and Illustrative Quotes Recorded from Interviews with KPNC Peer Support and EUC participants, 2018–2021.

Theme	Social Ecological Domain(s)	Illustrative Quotes	Data Integration Contextual Factors	Data Integration Illustrative Quotes
Matching perceived needs to program description	Individual	<p>“I got a diagnosis from my doctor. And I started looking through classes at Kaiser and asking her, “What can I do to get some help with it?” I’m one of the kind of people that I need a help, a prompt, a coach.” [Peer, Black, woman]</p> <p>“It’s something as simple as just making it that explicitly related to me and my own health condition.” [Peer, Asian American, woman]</p> <p>“Well, I had decided to participate when I— my family has a history of diabetes. And I’m trying to be conscious of my weight and conscious of things that I do and my eating habits. So, I want to be part of things that will give something to my tool kit in order to enhance my life so that I can have longevity.” [EUC, Black, woman]</p> <p>“I found it very helpful to have another person who had shared her experiences and validated my struggles, and just was really great to have somebody to get new ideas from and to get motivation from. It’s just sometimes taking your goal and having accountability and somebody to talk to about it can help keep you focused on it. So that was a great benefit.” [Peer, White, woman]</p>	<p>Lack of interest in weight loss and group programs for men (gender)</p> <p>Differences in perceived need for programs based on perceived risk (race)</p> <p>Social support, accountability, and shared knowledge by peer coaches (intervention exposure)</p>	<p>“My weight is [...] where it should be. Weight Watchers isn’t going to help me to lose, what, 3 lb? I’m not overweight. So, I have no interest in going to a class like Weight Watchers because I don’t have any weight to lose.” [EUC, Black, man]</p> <p>“if it’s somebody who’s as well educated as myself, I would say, “You may not get very much, but you might enjoy the interaction with a coach” [Peer, Asian American, woman]</p> <p>“And I found out that I do better in a group setting to keep it up as opposed to trying to do it on my own. [...] We [participant and coach] both attended a weight management class together. That was fun. [...] It was something that my coach suggested. And then we decided— she was interested in weight reduction and weight management as well. So, she decided to go as well.” [Peer, Black, woman]</p>
Importance of physician referrals, formal recruitment outreach, and discussion of prediabetes	Interpersonal/ Organizational	<p>“Well, I’ve received an invitation from study members and they indicated that my doctor thought that it would be worthwhile for me [...]. And so I trust them, so yeah, I’d do it.” [EUC, Black, woman]</p> <p>“Again, my A1C score was below the threshold of being designated diabetes. I was in that— that’s why I was invited to be part of the program. And so I thought the timing of it was excellent. It was like, “This number is really close to the line. It doesn’t take much for you to go into that category. So we’d like you to participate.” I thought that was great outreach on Kaiser’s part. I thought the timing was excellent.” [Peer, White, man]</p> <p>“Well, once my physician had pointed out to me that I was in the prediabetes range, she recommended initially that I take part in some of the pre-diabetes courses that Kaiser already offers. So I followed her advice, and I attended a three-hour session that was facilitated by a dietician to just learn more about what is type 2 diabetes. What are some changes I could be making to diet and to exercise to help kind of hold off on worsening my condition...” [Peer, Asian American, woman]</p> <p>“Oddly enough, my doctor never really discussed it with me. It wasn’t until you guys contacted me that I discovered.” [Peer, White, man]</p> <p>“[...] But when my doctor told me I was on the borderline, so I’m like, “Mm-mm, borderline, I’m on it. I’m going to stay on it or get off.” [...] Moderator: Did you discuss your risk for diabetes and what that meant with your doctor or anybody at your clinic kind of at any point? [...] No. I don’t remember her mentioning it at all. She just said I was on the borderline.” [Peer, Black, woman]</p>		

differences in perceived need for programs based on perceived risk (race).

Qualitative study participants were interested in social support relating to diabetes prevention health behaviors and social opportunities to attend wellness programs with others. Some participants in the peer support arm mentioned attending wellness classes and engaging in physical activity with their peer coaches (pre-pandemic) and greatly enjoying those opportunities. Many EUC participants mentioned that they were disappointed that they were not randomized to the peer support arm and thereby having a peer coach who would provide accountability and support. Many EUC participants cited that receiving information on existing programs was not enough to encourage them to enroll in wellness programs.

Across participants, there were two categories of reasons for not participating in a program: no knowledge of the program and no perceived need of program. Men were more likely to report no

experience with a program, no interest in enrolling in a program and no perceived need for a program. Although all participants had an overweight or obese BMI, almost all male participants stated that they had never participated in a weight management program because they did not feel the need to lose weight. Additionally, male participants were more likely to mention not wanting to attend group sessions and a desire to work on wellness goals alone.

While Asian American participants had the lowest interest in and experience with wellness programs, Black participants had the greatest interest in and experience with wellness programs. Asian American participants tended to be more knowledgeable about diabetes prevention in general which may be one reason that they were not interested in enrolling in informational types of diabetes prevention programs. Black participants were more likely to mention a family history of diabetes specifically as a motivator for wanting to avoid diabetes and enrolling in diabetes prevention programs.

These contextual findings align with and provide an additional context for our qualitative themes. Our gender- and race-based data integration findings support theme 1, matching perceived needs to program description. Male participants' lack of interest in weight management, the importance of family history as a motivator for Black participants, and a lack of perceived need for diabetes prevention information for Asian patients suggest the importance of aligning patient motivations with program goals. Furthermore, our data integration findings highlight the importance of accountability and social support as a facilitator for wellness program engagement supporting theme 1 and matching patients who desire accountability and social support with peer coaching programs.

4. Discussion

In a sample of 2,164 patients with prediabetes and overweight/obesity, we found that only 12.8 % of patients had a referral to a wellness program and only 7 % of participants attended a wellness program. Patients not exposed to peer support, male patients, and Asian American participants had the lowest odds of participation in wellness programs. Qualitative interviews provided contextual information on our quantitative findings including the importance of physician referrals to programs and formal recruitment outreach, a need for social support and accountability, and the value of matching perceived patient needs to wellness program descriptions as facilitators of engaging in wellness programs.

These findings align with previous research highlighting low referrals to and engagement in diabetes prevention wellness programs and factors associated with wellness program engagement. In Chambers et al.'s study of patient characteristics associated with engagement in the NDPP, researchers found that among 31,524 patients eligible to participate in the NDPP, 89.6 % were not referred to the NDPP, and of those referred, 77 % were never placed in a class or were placed and never attended a class. Referrals and engagement were lower in men than women, in younger compared to older adults, and in patients receiving Medicaid than other patients (Chambers et al., Dec 2019). Referral and engagement were higher in patients with higher BMIs (Chambers et al., Dec 2019). In a qualitative study of 35 women and clinicians, Baucom et al. identified patient-related barriers to enrollment and retention in the NDPP including lack of program alignment with patient goals and mismatched program expectations (Baucom et al., 2021). Taken together, our studies highlight factors associated with wellness program engagement and patient identified barriers to program enrollment. Our study also extends these findings from only the NDPP to other effective behavioral interventions, consistent with recently updated clinical guidelines.

We found that at the individual level there is a need for education of prediabetes risk. Patient-provider communication regarding diabetes screening results along with brief education on the meaning of a prediabetes diagnosis and diabetes risk could address the individual level factor of lacking prediabetes risk knowledge. At the interpersonal level, our findings suggest a need for increased physician referrals to wellness programs and social support for diabetes prevention since those with physician referrals and peer support were more likely to participate in wellness programs. Peer support interventions could be one mechanism to address this need. For example, the only difference in our qualitative findings between the peer support and EUC arm was that peer support participants mentioned going to wellness programs with their peer coach and EUC participants mentioned enrolling in the intervention because they were interested in social support and accountability. Primary care-based interventions utilizing peer support from fellow patients may be a low-cost strategy to sustainably and effectively improve health behaviors and engagement in prevention programs. One mechanism for how our peer support intervention increased the likelihood of program referral and participation in effective behavioral interventions is through the social opportunity afforded by having a peer

coach who provided information on classes and programs and was willing to attend with them. Furthermore, combining participants' motivation by family history of diabetes and their desire for social support, greater access to family or household-based diabetes prevention programs may be needed. At the organizational level, our findings suggest a need for tools that support alignment of patient needs to wellness program objectives, improved referral systems and availability of programs, and increased patient outreach with information on resumed in-person wellness classes. Additionally, identifying and inviting patients with a family history of diabetes to these programs may be one strategy to increase engagement. At the community level, broader outreach is needed to provide education on diabetes prevention strategies.

Our study has limitations. First, it is a single health system study. Second, all our qualitative participants were willing to be randomized and participate in a diabetes prevention intervention; therefore, their perspectives may not reflect those of the general population at-risk for diabetes. Lastly, the COVID-19 pandemic limited primary care visits and referrals and participation options for wellness programs, potentially reducing the number of patients referred and who participated in diabetes prevention and wellness programs. However, patients can self-enroll in many KPNC wellness programs, many of which were offered virtually during the pandemic, thereby still providing access to wellness programs.

5. Conclusions

We found low rates of referrals and participation in diabetes prevention wellness programs among adults at high risk for diabetes, and that engagement in diabetes prevention wellness programs is affected by lack of prediabetes and wellness program knowledge, low physician referrals, and a need to match patient needs and goals to program goals. These findings will assist in much-needed efforts to develop multilevel strategies to improve wellness program engagement for patients at-risk for diabetes.

Funding

This research was funded by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) grant 1R18DK113403-01. Support was also provided by the Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development Service. Drs. Thomas and Rodriguez received funding from The Permanente Medical Group (TPMG) Delivery Science Fellowship Program and the National Institute of Diabetes and Digestive and Kidney Diseases grant T32DK11668401. Dr. Schmittiel received additional support from the NIDDK-funded Health Delivery Systems Center for Diabetes Translational Research (1P30DK902924). This work was also partially supported by supported through a National Institute on Minority Health and Health Disparities Administrative Supplement Award 3R01MD016738-03S1 (Dr. Thomas) and a National Institute of Diabetes and Digestive and Kidney Diseases and Administrative Supplement Award R18DK122372-04S1 (Dr. Rodriguez).

CRedit authorship contribution statement

Tainayah W. Thomas: Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Holly Finertie:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Perla Sanchez:** Writing – review & editing, Project administration, Investigation, Formal analysis, Data curation. **Luis A. Rodriguez:** Writing – review & editing, Investigation, Conceptualization. **Julie Schmittiel:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Appendix

Table 1. Key words used to identify lifestyle-related wellness counseling referrals and participation within KPNC EHR, 2018-2021.

Category	Key Words
Diabetes prevention and management	Dbtes Dia Diet DM Hgba1c Impaired fastin
Diet/nutrition	Carb Cooking Eat Food Meal Nutrition Plant RD Vegetarian
Physical activity	Dance Exercise Fitness Physical active Physical activity Pilates Yoga Zumba
Weight management	Bmi Mwlm Mwm Obese Obesity Obsty Overweight Weight Wght Wgt Wht Wl Wlm Wt
Wellness coaching	Coach Education Wellness
Other	Cardiovascular Health Healthy Salud Viva bien

References

Ali MK, McKeever Bullard K, Imperatore G, et al. Reach and Use of Diabetes Prevention Services in the United States, 2016-2017. *JAMA Netw Open*. May 3 2019;2(5): e193160. doi:10.1001/jamanetworkopen.2019.3160.

Baucom, K.J.W., Pershing, M.L., Dwenger, K.M., Karasawa, M., Cohan, J.N., Ozanne, E. M., 2021. Barriers and facilitators to enrollment and retention in the national diabetes prevention program: perspectives of women and clinicians within a health system. *Women’s Health Reports* 2 (1), 133–141. <https://doi.org/10.1089/whr.2020.0102>.

Braun V, Clarke V. *Thematic analysis*. American Psychological Association; 2012:57-71. Centers for Disease Control and Prevention. National Diabetes Statistics Report website. Accessed 28 October 2022, <https://www.cdc.gov/diabetes/data/statistics-report/index.html>.

Chambers, E.C., Gonzalez, J.S., Marquez, M.E., Parsons, A., Rehm, C.D., Dec 2019. The reach of an urban hospital system-based diabetes prevention program: patient engagement and weight loss characteristics. *Diabetes Educ*. 45 (6), 616–628. <https://doi.org/10.1177/0145721719880503>.

Diabetes Prevention Program (DPP) Research Group. The Diabetes Prevention Program (DPP): description of lifestyle intervention. *Diabetes Care*. Dec 2002;25(12):2165-71. doi:10.2337/diacare.25.12.2165.

Forouhi, N.G., Luan, J., Hennings, S., Wareham, N.J., Feb 2007. Incidence of Type 2 diabetes in England and its association with baseline impaired fasting glucose: the Ely study 1990–2000. *Diabet. Med.* 24 (2), 200–207. <https://doi.org/10.1111/j.1464-5491.2007.02068.x>.

Glanz K, Rimer B. *Theory at a glance: a guide for health promotion practice* (Second Edition). 2005:52.

- Heisler, M., Kullgren, J., Richardson, C., et al., Aug 2020. Study protocol: Using peer support to aid in prevention and treatment in prediabetes (UPSTART). *Contemp. Clin. Trials* 95, 106048. <https://doi.org/10.1016/j.cct.2020.106048>.
- Heisler, M., Dyer, W.T., Finertie, H., et al., Aug 2023. Using peer support to prevent diabetes: results of a pragmatic RCT. *Am. J. Prev. Med.* 65 (2), 239–250. <https://doi.org/10.1016/j.amepre.2023.02.015>.
- Jonas, D.E., Crotty, K., Yun, J.D.Y., et al., 2021. Screening for prediabetes and type 2 diabetes: updated evidence report and systematic review for the US preventive services task force. *J. Am. Med. Assoc.* 326 (8), 744–760. <https://doi.org/10.1001/jama.2021.10403>.
- Jonas DE, Crotty K, Yun JDY, et al. *Screening for Prediabetes and Type 2 Diabetes Mellitus: An Evidence Review for the U.S. Preventive Services Task Force*. Vol. Evidence Synthesis, No. 207. Agency for Healthcare Research and Quality (US); 2021. AHRQ publication 21-05276-EF-1.
- Karve A, Hayward RA. Prevalence, diagnosis, and treatment of impaired fasting glucose and impaired glucose tolerance in nondiabetic U.S. adults. *Diabetes Care*. Nov 2010; 33(11):2355-9. doi:10.2337/dc09-1957.
- Knowler, W.C., Barrett-Connor, E., Fowler, S.E., et al., 2002. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N. Engl. J. Med.* 346 (6), 393–403. <https://doi.org/10.1056/NEJMoa012512>.
- Lin J, Thompson TJ, Cheng YJ, et al. Projection of the future diabetes burden in the United States through 2060. *Popul Health Metr.* Jun 15 2018;16(1):9. doi:10.1186/s12963-018-0166-4.
- Mainous 3rd, A.G., Tanner, R.J., Baker, R., 2016. Prediabetes diagnosis and treatment in primary care. *J. Am. Board Fam. Med.* Mar-Apr 29 (2), 283–285. <https://doi.org/10.3122/jabfm.2016.02.150252>.
- O’Cathain A, Murphy E, Nicholl J. Three techniques for integrating data in mixed methods studies. *Bmj.* Sep 17 2010;341:c4587. doi:10.1136/bmj.c4587.
- O’Cathain, A., Murphy, E., Nicholl, J., Apr 2008. The quality of mixed methods studies in health services research. *J. Health Serv. Res. Policy* 13 (2), 92–98. <https://doi.org/10.1258/jhsrp.2007.007074>.
- Schmittiel, J.A., Adams, S.R., Segal, J., et al., Feb 2014. Novel use and utility of integrated electronic health records to assess rates of prediabetes recognition and treatment: brief report from an integrated electronic health records pilot study. *Diabetes Care* 37 (2), 565–568. <https://doi.org/10.2337/dc13-1223>.
- Schmittiel, J.A., Adams, S.R., Goler, N., et al., Feb 2017. The impact of telephonic wellness coaching on weight loss: a “Natural Experiments for Translation in Diabetes (NEXT-D)” study. *Obesity (Silver Spring)* 25 (2), 352–356. <https://doi.org/10.1002/oby.21723>.
- Schoonenboom, J., Johnson, R.B., 2017. How to Construct a Mixed Methods Research Design. *Kolner Z Soz Sozpsychol.* 69 (Suppl 2), 107–131. <https://doi.org/10.1007/s11577-017-0454-1>.
- Siu, A.L., 2015. Screening for abnormal blood glucose and type 2 diabetes mellitus: U.S. preventive services task force recommendation statement. *Ann. Intern. Med.* 163 (11), 861–868. <https://doi.org/10.7326/m15-2345>.
- Thomas TW, Golin C, Samuel-Hodge CD, Kirkman MS, Golden SD, Lightfoot AF. Race and gender differences in abnormal blood glucose screening and clinician response to prediabetes: A mixed-methods assessment. *Prev Med.* 2021; 148: 106587. doi: 10.1016/j.ypmed.2021.106587.
- US Preventive Services Task Force, Davidson, K.W., Barry, M.J., et al., 2021. Screening for Prediabetes and Type 2 Diabetes: US Preventive Services Task Force Recommendation Statement. *J. Am. Med. Assoc.* 326 (8), 736–743. <https://doi.org/10.1001/jama.2021.12531>.
- Zimmermann, L.J., Thompson, J.A., Persell, S.D., Aug 2012. Electronic health record identification of prediabetes and an assessment of unmet counselling needs. *J. Eval. Clin. Pract.* 18 (4), 861–865. <https://doi.org/10.1111/j.1365-2753.2011.01703.x>.