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Effectiveness Of Dietary Habits Changes And Aerobic Exercise On Constipation Relief Among Patients With Diabetes Mellitus

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Abstract:
Background: *Constipation management is still challenging among health care providers related to its complex etiology. However, 25% of patients with diabetes mellitus experience gastrointestinal problems and among them, 60% suffer from constipation, this may be directly associated with diabetic interopathy, dietary habits changes, medication and comorbidity.*
The aim of study: *to evaluate the effectiveness of dietary habits modifications and aerobic exercise on constipation relief among patients with diabetes mellitus*
Methods: *Randomized Controlled Trails (RCT) deign has been applied on participants; a purposive sample (non probability sample) for 58 participants who were randomly assigned for two groups (experimental and control) by using block randomization. Then the program which consists of dietary habits modifications and aerobic exercise has applied for four weeks (pre test – post test).*
Results: *the study result indicate improvement in constipation symptoms and highly significant difference between experimental and control group at post test (p. value = 0.00 HS).*
Conclusion: *dietary habits modification like increased dietary fibers to (25-38 g/d) and water intake (about 2L/d) in combined with aerobic exercise can relief constipation and significantly improve bowel movement for patients with diabetes mellitus.*
Recommendations:
The health care providers should focus on dietary improvement and physical activity such as aerobic exercise when dealing with diabetic patients who suffer from constipation by educating them about the role of both physical activity and dietary modification in relieving constipation
Key words: *dietary habits, aerobic exercise, constipation, diabetes mellitus*

1- INTRODUCTION:

Over the past few decades diabetes mellitus has been increased globally and became a major public health challenge. A lot of complications are associated with diabetes mellitus including gastroenteropathy which is 70% higher in patients with diabetes mellitus than in normal population and constipation represent 60% of diabetic gastroenteropathy problems (Zavaleta et al., 2021). However, half of diabetic patients who are suffering from constipation experience low quality of life and half of them find the treatment poorly effective. Several causes may lead to constipation in diabetic patients including comorbidity, dietary changes and medications, but gastroenteropathy is the most common. Generally, low fiber diet, older age, female sex, physical inactivity, fluid depletion and psychological disorders are risk factors for chronic constipation. Traditionally, constipation has been defined as less than three bowel movement weekly, in addition to symptoms such as; difficult, incomplete voiding, hard, sold stool, anorectal abstraction or need to manual stimulation to help in facilitating of defecation (; Sangnes et al., 2021 and Katsirma et al., 2021).

Constipation management is remain challenge, because of its complex etiology. Aerobic exercise may improve colonic motility and speed gastrointestinal transit. In addition for improving blood flow, exercise can positively influence gut microbiome, stool consistency and colonic functions. On the other hand, diet and hydration is essential, as high fiber diet and adequate hydration are crucial for optimizing effect of exercise on constipation. In spite of supporting evidence for the role of physical activity and dietary fibers in management of constipation, more studies should be done to clarify the role of exercise and their interaction with dietary and life style modifications (Flanczewski et al., 2024).

Gao et al., 2019 reported that the real role of exercise is still vague, therefore researcher should design more studies to investigate the effective role of exercise in management of constipation.in addition, there are inadequate high quality evidence on the efficiency of dietary interactions and more randomize control trials (RCT) using large population are needed to resolve this problem (Katsirma et al., 2021). So the current study investigates the role of combined dietary habits modification and aerobic exercise on constipation relief among diabetic patients.

2- METHODOLOGY:

2.1. Study design: Randomized Controlled Trials (RCT) Design was conducted in current study**.**

2.2. Study Sample: A non probability (purposive sample) method has been used on 58 participants who had diagnosed with DM and suffer from constipation. The sample size has determined by G-power software to reach for reliable results by deterring acceptable sample size. Group Assignment (Randomization): the participants randomly assign to two groups (expermental and control) by using block randomization.

Inclusion criteria:

- Patients with diabetes mellitus who are suffering from constipation
- Adults over 18 years old
- Adults who are able to communicate properly and have no any mental disorders.

Exclusion Criteria:

- Patient with dietary restriction like patients with heart failure or kidney failure
- Patients who are unable for doing exercise for any reason
- Pregnant women
- Patients with any intestinal surgery or any abdominal physiological changes that may lead to constipation

2.3. Setting of the study:

The current study has been carried out in Diabetic and Endocrine Center in AL-Najaf City.

2.4. The study instruments

Part1: demographical and clinical data questionnaire which consists of four items: (age, sex, educational level, occupational status).

Part2**:** Constipation assessment scales which consist of two domains:

- First domain: Constipation severity questionnaire

Total score=30

0 indicate normal while 30 indicate severe constipation. The severity of constipation was classified as following

Mild: for scores of 1–5

Moderate: for scores 6–10

Severe: for scores 11–15

Very severe: for scores 16-30 (Shiba et al., 2022).

- Second domain: Bristol stool form scale: This scale is use for detecting stool consistency by offering a picture has 7 shapes for stool. The score of BSFS is ranged from (1 to 7) where shape 1 and 2 are constipated (1 is severe constipated), and (3, 4, 5) are considered normal, while (6,7) are considered diarrhea (Shokouhi et al., 2022)

2.5. The Instructional Program:

The participants in experimental group have received instructional program which consist of aerobic exercise and dietary modifications such as focusing on increasing dietary fibers to (25 g/d for women and 38g/d for men) by increasing vegetables (such as eating salad plate, and cocked veggies), eating one to two fruit per day (according to their glycemic level), consuming moderate amount of beans, eating nuts and seeds such as flax seed, chia seeds, in addition to consume fresh olive oil (extra version olive oil) to work as a stool lubricant and facilitate defecation. Moreover, the participants were educated about importance of increasing water intake (about 2L/d) with increasing dietary fibers to increase stool bulk, keeping the stool softer and reduces gases.The participants were received booklet to guide them and the researcher was staying in contact with them on phone calling.

2.6. Validity of instrument:

The questionnaire validity is needed to determine the questionnaire ability to gather the data. Face validity which can be used to complete the adopted of the questionnaire which can be specified by using the panel of experts to assess the questionnaire relevancy, clarity, and adequacy.

2.7. Reliability of the study:

Reliability has not been estimated for current study because the wexner constipation assessment scale and Bristol stool form scale are global and reliable.

2.8. Method of data collection:

Face to face interview method has been used by the researcher to gather information from participants about socio-demographic and clinical data in addition to assessing severity of constipation and consistency of stool for both study and control group.

2.9. Implication of program:

The researcher has used application of four weeks protocol to study effect of program by using pre test-post test.

2.9.1. The assessment phase:

The researcher has assessed severity of constipation for participants by using winxer constipation assessment scale in addition to assessing stool consistency by using Bristol Stool Form Scale.

2.9.2. Implementation phase:

After taking of written consent from participants. The researcher has implemented the program which consists of aerobic exercise and dietary habits modification for study group during data collection at pre-test. The researcher explains the aerobic exercise and role of them in relieving constipation. In addition, explaining of how can they doing exercise without muscle spasm or other complications. Regarding diet: the researcher has explained the role of dietary fibers in improving colonic motility in addition to improving of glucose digestion and lowering blood sugar, the researcher has also explain the types of foods which have more dietary fibers and appropriate for consuming by diabetic patients. Moreover, the researcher has also explained the importance of increasing water intake in combination with dietary fibers to promote role of dietary fibers and relive abdominal gases. In addition, the researcher explain the importance role of olive oil which can be used as stool lubricant and improve stool consistency

2.9.3. Evaluation phase:

After 4 weeks, the researcher has evaluated the effectiveness of program on constipation relieving. The post test has done on telephone calling for both study and control group

2.10. Statistical analysis:

The following statistical tests were applied to analyze and organize the data by using the Statistical Package for the Social Sciences (SPSS) version. (19), and Microsoft Excel (2010):

2.10.1. Descriptive Data Analysis:

A. Tables (Frequencies, and Percentages).
B. Statistical figures (Bar Charts).
C. Statistical mean and standard deviation.

2.10.2. Inferential Data Analysis:

A. Chi square test
B. Mann-Whitney U tests:
C. Wilcoxon Signed Ranks
D. Kruskal-Wallis H test

3- RESULTS:

Table (1): Distributions of the Study Sample According to the Socio Demographic Characteristics (N=58; 29 for each of the Study and Control Groups)

Demographic Data	Rating and Intervals	Study Group		Control Group	
		Freq.	%	Freq.	%
Age (years)	<= 30	1	3.40	1	3.40
	31 - 40	2	6.90	2	6.90
	41 - 50	9	31.00	7	24.10
	51 - 60	11	37.90	7	24.10
	61+	6	20.70	12	41.40

Sex	Male	7	24.10	10	34.50
	Female	22	75.90	19	65.50
Education level	Un able to read	3	10.30	8	27.60
	Read and write	10	34.50	5	17.20
	Primary school	13	44.80	10	34.50
	Intermediate school	3	10.30	2	6.90
	Secondary school	0	0.00	3	10.30
	Institute, college or postgraduate	0	0.00	1	3.40
Occupation status	Own worker or self-employed	4	13.80	2	6.90
	Government employer	2	6.90	3	10.30
	Housewife	16	55.20	17	58.60
	Retired	2	6.90	3	10.30
	Jobless	5	17.20	3	10.30
	Disable	0	0.00	1	3.40

Table (1) represents the socio-demographic distribution of the study and control groups. The study's results indicate that most of the study group's participants (37.9%) are within (51 - 60) years old, female (75.9%), primary school (44.8%) and housewives (55.2%). While for control group, the study results show that majority of control group participants are more than 61 years old (41.4%), female (65.5%), primary school (34.5%) and housewives (58.6%)

Table (2): Distributions of the Study Sample According to the Clinical Data (N=58; 29 for each of the Study and Control Groups)

Clinical data	Rating and Intervals	Study Group		Control Group	
		Freq.	%	Freq.	%
Past Medical History	None	14	48.30	11	37.90
	HTN	11	37.90	11	37.90
	Asthma	0	0.00	1	3.40
	Hyperthyroidism	0	0.00	1	3.40
	Coronary artery disease CAD	2	6.90	0	0.00
	HTN + Hypothyroidism	1	3.40	1	3.40
	HTN + Chronic kidney diseases	1	3.40	0	0.00
	HTN + Coronary artery disease CAD	0	0.00	2	6.90
	HTN + Cardiovascular diseases CVD	0	0.00	1	3.40
	HTN + Cardiomegaly	0	0.00	1	3.40
Past surgical history	None	14	48.30	18	62.10
	C\S	7	24.10	4	13.80
	Hernia	0	0.00	1	3.40
	Cholecystectomy	1	3.40	1	3.40
	Hemorrhoidectomy	0	0.00	1	3.40
	Left kidney removal	0	0.00	1	3.40
	Appendectomy	1	3.40	1	3.40
	Thyroidectomy	2	6.90	0	0.00
	Cardiac catheterization	1	3.40	0	0.00
	Cystectomy	1	3.40	0	0.00
	C/S + Hernia	0	0.00	1	3.40

	C/S + Hemorrhoidectomy	0	0.00	1	3.40
	C/S + Thyroidectomy	1	3.40	0	0.00
	C/S + Appendectomy	1	3.40	0	0.00
Smoking	Not smoker	21	72.40	15	51.70
	Active smoker	1	3.40	5	17.20
	Passive smoker	5	17.20	5	17.20
	Past smoker	2	6.90	4	13.80
Type of diabetes mellitus	One	14	48.30	8	27.60
	Two	15	51.70	21	72.40
Medication use	Not used	27	93.10	26	89.70
	Anti-acid	2	6.90	3	10.30
Body mass index	Normal	6	20.70	7	24.10
	Overweight	18	62.10	16	55.20
	Obese	5	17.20	6	20.70

Table (2) demonstrates the clinical variables of the study and control groups. The study results show that majority of study participants (48.3%) has no co-morbidity, followed by hypertension (37.9%), have no past surgical history (48.3%), not smoker (72.4), have not used medication that likely to be risk factor for constipation (93.1%) and majority of them (62.1) are overweight. While majority of control group participants are; have no morbidity and hypertension was in the same portion (37.9%), no surgical history (62.1), not smokers (51.7), have not used medication that likely to be risk factor for constipation (89.7%) and overweight (55.2%)

Table (3): Distributions of the Study Sample According to Dietary Habits and level of exercise and the Differentials between the Study and Control Groups at pre-test (N=58; 29 for each of the Study and Control Groups)

Dietary Data	Rating and Intervals	Study Group		Control Group		Significance
		Freq.	%	Freq.	%	
Fluid Intake	Adequate (> 2500 ml/24 h)	11	37.90	9	31.00	X2 = 0.305 p. value = 0.581 NS
	Inadequate (< 2500 ml/ 24 h)	18	62.10	20	69.00	
Taking a high Fibers food	I usually eat divers, healthy food daily	6	20.70	3	10.30	X2 =2.029 p. value = 0.363 NS
	I eat like these food but not daily	10	34.50	8	27.60	
	I usually doesn't eat whole grains or nuts and avoid fruit eating	13	44.80	18	62.10	
level of exercise	No exercise	27	93.10	24	82.80	X2 =2.376 p. value = 0.305 NS
	Occasionally, light exercise (Once or twice every one to two weeks)	0	0.00	2	6.90	
	Regular exercise and training (3 to 7 times per week)	2	6.90	3	10.30	

***X*²** = Chi square, **S.D.** = Standard Deviation, ***p.* value**= Probability value, **NS**= No Significant, **Freq**= frequency, **df**= degree of freedom, **HS**= High Significant

Study results according to table (3) demonstrates: majority of study participants (62.1%) have inadequate fluid intake (> 2500 ml/24 h), have not eating a high fiber foods in their usual diet routine (44.8) and majority of them (93.1) have not doing exercise. While regarding control group majority of participants (69%) have inadequate fluid intake, low fiber diet (62.1) and having no

exercise (82.8%).A non significant difference was detected in each dietary habits and level of activity between study and control groups.

Table (4): Distributions of the Study Sample According to Dietary Habit and level of exercise, and the Differentials between the Study and Control Groups at post test (N=58; 29 for each of the Study and Control Groups)

Dietary Data	Rating and Intervals	Study Group		Control Group		Significance
		Freq.	%	Freq.	%	
Fluid Intake	Adequate (> 2500 ml/24 h)	28	96.60	5	17.20	X2 = 37.190 p. value = 0.00 HS
	Inadequate (< 2500 ml/ 24 h)	1	3.40	24	82.80	
Taking a high Fibers food	I usually eat divers, healthy food daily	26	89.70	3	10.30	X2 = 39.241 p. value = 0.00 HS
	I eat like these food but not daily	3	10.30	6	20.70	
	I usually doesn't eat whole grains or nuts and avoid fruit eating	0	0.00	20	69.00	
level of exercise	No exercise	11	37.90	24	82.80	X2 = 12.197 p. value = 0.002 HS
	Occasionally, light exercise (Once or twice every one to two weeks)	3	10.30	1	3.40	
	Regular exercise and training (3 to 7 times per week)	15	51.70	4	13.80	

***X*²** = Chi square, **S.D.** = Standard Deviation, ***p.* value=** Probability value, **NS**= No Significant, **Freq**= frequency, **df**= degree of freedom, **HS**= High Significant

The study results show that majority of study participants (96.6%) having adequate fluid intake, (89.7%) having high fiber foods in their daily eating routine and majority of them (51.7) doing regular exercise (3-7 times per week). While regarding control group, majority of participants (82.8%) was having inadequate fluid intake, have not eating high fiber foods in their daily eating routine (69%) and have no exercise (82.8%). The study results demonstrate highly significant difference between study and control groups after applying the interventional program which mean improvement in dietary habits and level of activity among study participants

Table (5): Comparing the severity of constipation between the experimental Group and Control Groups at pre test (N=58; 29 for each of the Study and Control Groups)

Groups	Levels	Freq.	%	Mean Rank	Mann-Whitney U	p.value
Study Group	Moderate	3	10.3	29.84	410.50	0.88 NS
	Severe	11	37.9			
	Very Severe	15	51.7			
	Total	29	100.0			
Control Group	Mild	1	3.4	29.16		
	Moderate	4	13.8			
	Severe	9	31.0			
	Very Severe	15	51.7			
	Total	29	100.0			

***p.* value=** Probability value, **NS**= No Significant, **Freq.**= frequency, %= Percent , **HS**= High

Table (5) shows that majority of study and control participants having very severe constipation and in the same percentage (51.7%). Followed by sever constipation (37.9%) for study participants and (31%) for control. And there is no significant difference between study group and control group

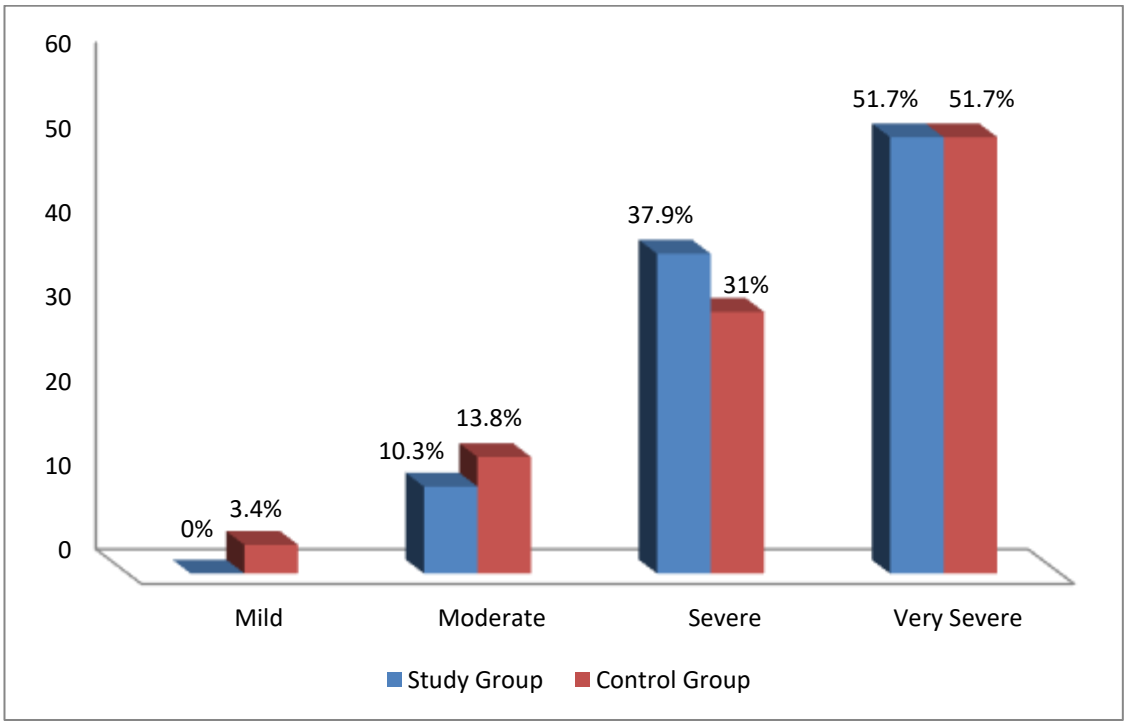

Figure (2): illustrate the Comparison between the severity of constipation between the Study Group and Control Group before Applying the Interventional Program

Table (6): Comparing the severity of constipation between the experimental Group and Control Groupat post test:

Groups	Levels	Freq.	%	Mean Rank	Mann-Whitney U	Sig.
Study Group	Normal	7	24.1	16.5	43.0	0.00 HS
	Mild	19	65.5			
	Moderate	1	3.4			
	Severe	1	3.4			
	Very Severe	1	3.4			
Control Group	Mild	1	3.4	42.5		
	Moderate	5	17.2			
	Severe	9	31.0			
	Very Severe	14	48.3			

***p.* value=** Probability value, **NS**= No Significant, **Freq.**= frequency, %= Percent , **HS**= High Significant

Table (4-6): Comparing the severity of constipation between the experimental Group and Control Group after Applying the Interventional Program,

Majority of participants in experimental group (65.5%) have mild constipation while majority of participants in control group (48.3%) have very severe constipation. The results are showing highly significant deference in severity of constipation between study group and control group after applying the interventional program, which mean that instructional program was highly effective in relieving constipation.

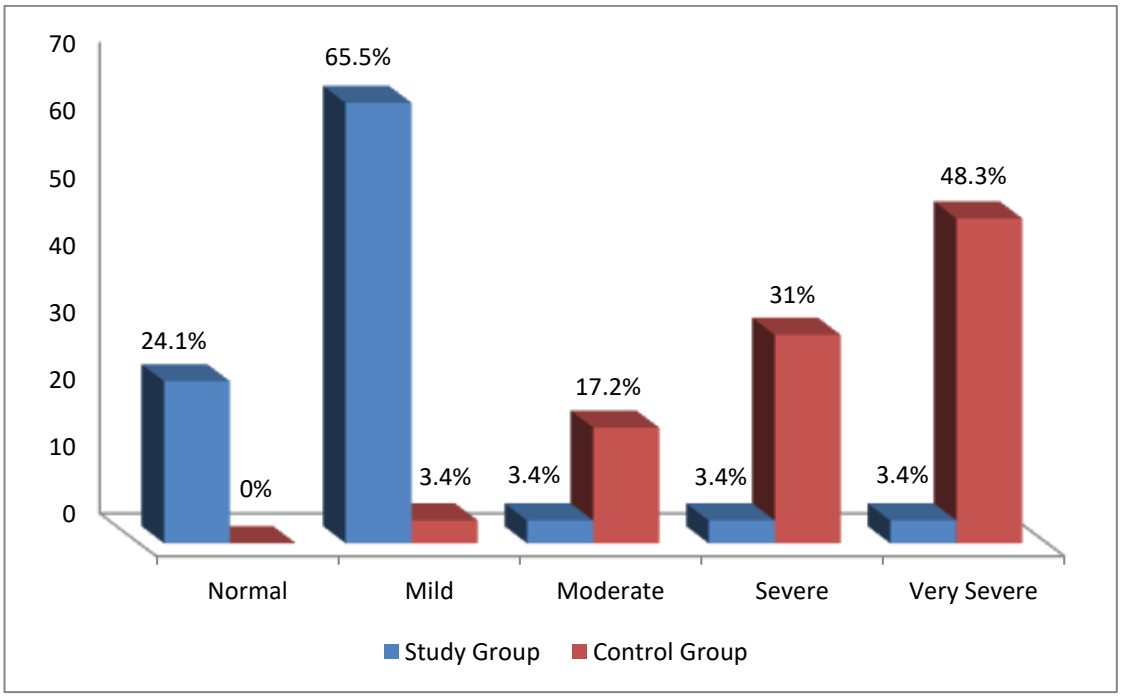

Figure (3): illustrate the Comparison between the severity of constipation between the Study Group and Control Group after Applying the Interventional Program

4- DISCUSSION:

The study results indicate that there is highly significant difference between experimental and control group after applying instructional program where majority of participants in experimental group was having mild constipation(65.5%)followed by normal (24.1), while majority of participants in control group was having very severe constipation degree(48.3), followed by severe (31%). This mainly means that interventional program which consist of dietary habits modifications and aerobic exercise was effective in relieving constipation among patients with diabetes mellitus. This results agreed with results of Ragab et al., 2021 on "effect of educational program about dietary and physical activity on functional constipation for elderly people at assiut geriatric clubs" which reported significant difference between pre and post interventional program, which mean that instructional program which consist of education about improvement of dietary habits and physical activity was effective in management of constipation.

Shi et al (2024) of " Prevalence, risk factors, impact and management of constipation among adults in Urumqi, China: a cross-sectional survey " which reported that consuming certain diet and increasing water intake were linked to decrease severity of constipation. Yurtdaş et al (2020) have reported significant difference between moderately active to active participants in compared to physically inactive. In addition they reported that increasing water and fiber intake significantly decrease likelihood of constipation in compared to low fiber and water intake ($p < 0.05$). Liu et al (2022) in their cross-sectional study on "association between overall dietary quality and constipation in American adults" have reported that dietary adjustment is an effective strategy of relieving constipation symptom and decreases severity of constipation. The study reported that consumption of fruits, whole grains, beans, vegetables and high fatty acid food are essential in managing constipation.

Flanczewski et al, (2024) have reported that light to moderate aerobic exercise can relief constipation by improving colonic motility and gut microbiota. In addition, they reported importance of combination between exercise and adequate fluid and fiber intake for better results. In addition, the current study results indicates significant improvement in stool consistency of study group in compared to control group ($p= 0.00$). This results are similar to results of Lai et al (2023) in their a double-blinded randomized placebo trial on "Effects of dietary fibers or probiotics on functional constipation symptoms and roles of gut microbiota" they reported that Bristol stool form scale finding significantly improved among interventional groups after consuming supplementary fibers(all $P < 0.001$) while no change reported in placebo group ($P = 0.170$). Chen et al., (2022) in their "study Prevalence and Risk Factors of Functional Constipation According to the Rome

Criteria in China: A Systematic Review and Meta-Analysis" reported that prevalence of constipation is higher among physically inactive participants (16.7% (95% CI: 8.8–29.3) in compared to physically active (9.1% (95% CI: 5.5–14.6); OR= 1.97 (95% CI: 1.14–3.43). In addition they reported that low prevalence of constipation among participant who consuming high fiber diet like whole grain and vegetable in compared to participants who consuming low fiber diet.
These results disagree with results of Silveira et al., (2021) on "Prevalence of constipation in adults with obesity class II and III and associated factors" where they reported that there were no significant association between consumption of high fiber diet and constipation. While study results of Safarvanadeh et al., 2025 on "Fluid intake, fiber consumption, and physical activity related to constipation among elderly, which one is more important? A cross-sectional study in Iran" has reported that physical activity is more effective in relieving constipation in compare with increasing fiber foods and fluid intake. In addition the study reported negative association between dietary fiber and constipation management. However, Li et al., (2021) in their study " Effect of Physical Activity on the Association between Dietary Fiber and Constipation: Evidence from the National Health and Nutrition Examination Survey 2005-2010" has reported that increasing dietary intake improve stool consistency for physically active participants but has no effect for those who are physically inactive.

5- CONCLUSION:

According to current study result, dietary modification and aerobic exercise program is effective in management of constipation in patients with diabetes mellitus, increasing dietary fibers and water intake in combined with aerobic exercise can effectively improve bowel movement and stool consistency.

6- Recommendations:

The health care providers should be focusing on dietary improvement for diabetic patients who suffering from constipation by educate them about the role of dietary fibers, how fibers can affect bowel motion and which foods are considered high in fibers and suitable for patients with diabetes mellitus. Educate the patients about importance of increasing water intake in combination with increasing dietary fibers and supporting their education by booklet to guide them for proper dietary habits**.** Educate the patients about role of physical activity in management of constipation and who aerobic exercise can relief their symptoms

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