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Effect of Brisk Walking Exercise in Green Space on Blood Glucose Level among Children with Type 1 Diabetes Mellitus.

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Abstract: Background: Walking in green areas in hospitals are crucial to patients' health and well-being, green areas have beneficial impact on people's health and wellbeing. It is supposed that residence in green spaces nearby in combination with physical activity could lower blood glucose levels. **Purpose**: To assess the effect of brisk walking exercise in green space on blood glucose level among children with type 1 diabetes mellitus. **Setting**: Pediatric Department and Hospital Park in Shebin El kom Teaching Hospital, Menoufia Governorate. **Instruments**: Four instruments were utilized (Diabetic children's assessment, State Trait Anxiety Inventory for Children (STAIC), Sleep Disturbance Scale for Children (SDSC) and Adherence to diabetes care recommendations. **Results**: Mean score of fasting blood sugar in the study group decreased in the seventh day (106.77 ± 19.13) compared to the first day (130.37 ± 10.91). Also, there was significant improvement in the mean score of anxiety, sleep disturbance and child's adherence to care recommendation in study group compared to control group on post intervention. **Conclusion**: Children with diabetes mellitus who perform brisk walking exercise in green spaces had lower fasting blood glucose value, decreased length of hospitalization, lower level of anxiety, reduced sleep disturbance and more adherence to care recommendations. **Recommendations:** Children with type1 diabetes should make brisk walking in green areas.

Keywords`: *Blood Glucose Level, Brisk Walking Exercise, type1 diabetes.*

Introduction

Diabetes mellitus is one of the major worldwide health challenges of the 21 century. Over the previous twenty years, diabetes mellitus (DM) has emerged as a remarkable health concern that has reached worrying levels during this century. Type 1 diabetes mellitus (T1DM) is a disturbance of glucose homeostasis characterized by autoimmune destruction of the pancreatic B cells that produce insulin, which eventually results in a shortage of insulin and elevated blood sugar levels. If left untreated, insulin insufficiency causes a steadily deteriorating metabolic disturbance that might result in hunger, growing hyperglycemia and death (Weng et al., 2018).

As a result, controlling diabetes mellitus is crucial, and it is often accomplished by putting five pillars into place. It comprises instruction, pharmaceutical therapy, meal planning & nutrition therapy, blood sugar monitoring and physical activity / exercise (American Diabetes Association, 2018). Exercise is among the first actions that can be done to control blood glucose levels. Along with food intake, physical activity adapts to the body's capabilities. Furthermore, it enhances lipid metabolism, blood glucose regulation, and insulin sensitivity, which allows for a decrease in insulin dosage and an improvement in glycemic control (Gregory et al., 2019).

Meanwhile, imbalanced exercise is one of the factors that contribute to complications to diabetes mellitus. Also, irregular physical activity can harm metabolic components and lower blood vessel quality (Simarmata et al., 2021). In a literature review, Boniol et al. (2017) used mixed-effect random models to assess the impact of one extra minute of physical activity each week on changes in HbA1c and fasting blood glucose levels. The researchers discovered that exercise lowered fasting blood glucose and HbA1c levels in T1DM patients and its positive benefits were related to weekly exercise duration rather than the type of exercise.

Moreover, Nagarathna et al., 2019 mentioned that physical activity should be done for at least 30 minutes a day or 150 minutes a week at an average level. Children with DM can benefit from physical exercise by engaging in sports including swimming, cycling at a leisurely pace, jogging, and brisk walking. The Brisk Walking Exercise is one type of physical activity that helps to decrease blood sugar levels (Chan et al., 2018).

Brisk walking is a walking activity different from regular walking as the pace and frequency of steps are increased along with the employment of diverse movement. This is a quick walking exercise that takes between 15 and 30 minutes to complete but you can accomplish it gradually if you are unable to meet the time limit. In brisk walking, various steps and fundamental methods must be mastered. Stepping forward with one foot comes initially, followed by pulling one's back leg forward, relaxing in the third stage, and pushing in the fourth (Kasmad et al., 2022).

Walking in Green spaces in hospitals are significant to patients' health and well-being, particularly in pediatric hospitals where child' needs are more complex. There is evidence that green spaces improve human health and well-being, lowering stress levels, avoiding chronic illnesses, and enhancing mood (Allahyar & Kazemi, 2021). Since hospitals are unique environments that are thought to be stressful places, walking through hospital gardens is regarded as both essential and advantageous in helping patients cope with these challenging circumstances. It also has a major impact on patients' health aspects, such as lowering anxiety, stress, sleep disturbance and enhancing psychological and physical well-being which payed the child to adhere to diabetic care (Weerasuriya et al., 2019).

However, through these mechanisms, interaction with green areas may improve glucose balance and lower the risk of increasing blood glucose level in children. As the currently available information on these influences for children is very little, this is the first study that investigates the potential benefits of walking for thirty minutes a day for seven days in a hospital park for diabetic children's blood sugar levels, sleep status, adherence to care recommendation and anxiety levels.

Significance of the study

For children with type 1 diabetes, the variables influencing glycaemia are somewhat more complex. A limited but growing body of research suggests that walking in green areas may help adults to maintain their glucose homeostasis, Furthermore, limited researches are done in Egypt in this respect for pediatric patients having type 1 diabetes. For this reason, this study was conducted to determine the effect of brisk walking exercise in green space on blood glucose level among children with type 1 diabetes mellitus.

Operational Definitions

- **Brisk walking exercise**: In this study, it refers to rabid walking that lower blood glucose level. It includes maintain the head up and look forward, not below, relax the neck, shoulders, and back, but avoid slouching or bending forward. Then, hold the back straight while contracting abdominal muscles, maintain a straight walk while rolling foot from heel to toe and loosely swing arms, or slightly pump arms with each step.
- **Blood glucose level**: in this study, is refers to concentration of blood sugar after child fasted for at least 8 hours or overnight.

Purpose:

To determine the effect of brisk walking exercise in green space on blood glucose level among children with type 1 diabetes mellitus.

Research hypotheses:

- Children with T1DM who practise brisk walking in the park are expected to have lower level of blood glucose (study group) compared to those children who do not (control group).
- Children with T1DM who practice brisk walking in the park are expected to have lower level of anxiety compared to those children who do not.
- Children with T1DM who practice are expected to have higher adherence to diabetes care (study group) compared to those who do not (control group).

Methods

Design

Quasi-Experimental design (study and control groups) was utilized.

Setting

This research was carried out at the pediatric department and park of Shebin El Kom Teaching Hospital, Menoufia Governorate. The park area is about 2 acres of the hospital's total area and contains many ornamental plants and trees.

Sampling:

A purposive sample of 60 children was included: A simple random sample was used to assign children into study and control groups. n = ¯p (1 - ¯p) × (z1−_/2 + z1−_) 2 ÷ (p1 - p2)2 with a confidence level of 0.95 and test power 80%. Where n is the sample size, ¯p = (p1 + p2) ÷ 2, p1 = 0.50, p2 = 0.34.

Inclusion criteria

Children were included in the study according to the following criteria:

- Diagnosed with type 1 diabetes mellitus.
- Aged from 6 to 17 years.

Exclusion criteria

- Children who had other chronic illnesses, such as neurological as it may have effect on the communication and interaction with the child, cardiovascular or hypertensive problems as the exercise may have effect on hear rate.

Instruments

Four instruments were utilized to collect data in order to fulfill the purpose of the study.

Instrument one: Diabetic children's assessment.

It was created by the researcher using the relevant literature (Dadvand et al., 2018) to assess children with type 1 diabetes mellitus. It is divided into three parts:

- **Part 1: Characteristics of studied children.** It included children's age, sex, educational level, duration since diagnosed with diabetes, suffer from other diseases, Family history of diabetes, time of starting treatment and length of hospital stay.
- **Part 2: Fasting blood sugar level assessment.** It included measuring and documenting the fasting blood sugar level every morning after 8-10 hours of overnight fasting for seven days. One-Touch® Ultra® Metre ("Ultra"; Lifescan, Milpitas, CA) was used to test blood sugar at each sampling time.

Instrument Two: State Trait Anxiety Inventory for Children.

It is a self-report measure of state anxiety among children. It is adopted from Shain et al., (2020). It consists of 40 items including 20 items about "I feel…" that asking about the feeling at a particular moment in time. The rating scale of agreement is on a 3-point scale (not upset=1, upset=2, very upset=3) and reverse-worded (very calm=1, calm=2, not calm=3). The other 20 items were about person's overall level of anxiety such as I worry about making mistakes, It is difficult for me to face my problems, have trouble making up my mind,…….etc. The total score ranged from 40-120. (Low anxiety score is < 40,. Moderate anxiety ranged from 40-80. and Higher anxiety is > 80. Reliability of this tool was determined by Cronbach's co-efficiency alpha in which r = 0.95.

Instrument Three: Sleep Disturbance Scale for Children (SDSC).

It is adopted from Shahid et al., (2012). It consists of 26 items related to clinical screening. It is used to evaluate sleep disturbances in children. It also estimates the quantity and timing of sleep. The items are rated on a five point Likert scale ranging from 1 for "never," to 5 for "always (daily)." The total score ranged from 26-130 in which the higher scores indicated more sleep disturbances (low sleep disturbance <45, Moderate sleep disturbance ranged from 45-90 and high sleep disturbance is >90). Reliability of the instrument was determined by Cronbach's co-efficiency alpha in which r = 0.79.

Instrument four: Adherence to diabetes care recommendations.

It is adopted from Kyokunzire & Matovu (2018). It includes three subscales: diet adherence, insulin adherence and blood glucose monitoring adherence. Each subscale consists of five questions that is rated on four responses: never (1), sometimes (2), most of the times (3), and always (4). The subjects who responded by 1 and 2 were scored by zero points, and others who responded by 3 and 4 were scored by one point. The total score was calculated as follows: The subjects who achieved 80% of the score (12 out of 15 points) were considered to be "adherent" to the care recommendations. Meanwhile, subjects who achieve score < 80% (less than 12 points) were considered to be "not adherent" to the care recommendations. Reliability of this instrument was determined by Cronbach's co-efficiency alpha in which r = 0.88.

Validity

Three pediatric nursing professors and two professors of pediatrics made up the jury experts that reviewed the four instruments to ensure their validity and make any necessary modifications. The modifications were made to ensure that instruments were thorough and pertinent.

Pilot study

A pilot study was carried out on 6 children (10% of the sample) before the data collection to test the feasibility and applicability of the instruments. No changes were done. The pilot study was not included in the study sample.

Ethical considerations

Approval of the Ethical Research Committee, Faculty of Nursing at Menoufia University was obtained on January 2023 (code: 923). The researcher introduced herself to each child or family member participating in the study and explained the purpose of the study and methods of data collection. A written consent was obtained from parents of children regarding their acceptance to share in the study. They were assured of the anonymity of the study. Patients' privacy and data confidentiality were respected.

Procedure:

- A letter was submitted from the dean of the Faculty of Nursing, Menoufia University to the director Shebin El Kom Teaching hospital including the purpose of the study and methods of data collection
- Data gathering took place throughout eight months period starting from the beginning of February 2023 until the end of Septmber 2023.
- Both study and control group subjects were assessed upon admission to obtain baseline data including characteristics of studied children using instrument one part 1. Then, fasting blood sugar using instrument one part two. Assessment of anxiety, sleep disturbance, and adherence to diabetes care was done using instrument two, three and four.
- Children in the control group only received routine hospital care included measures to control of glucose level, anxiety and fatigue symptoms, , increase medication compliance, decrease adverse effects of treatment, teach patients about (nutrition, effects and side effects, exercise, blood glucose monitoring techniques).
- Children in the study group received the same hospital care. Brisk walking was planned one hour after meals to avoid hypoglycemia.
- Children in the study group were encouraged to select shoes with thick, flexible soles, firm heels, and appropriate arch support. Also, they were encouraged to wear comfortable clothes that are suitable for weather.
- The researcher showed the study participants how to perform brisk walking exercise, and then each child in the study group performed the exercise in hospital park, 30 minuts per day for seven day. Children were divided into 3 groups. Every group engaged in the exercise of brisk walking in Hospital Park from 3.00 pm to 4.30 pm daily for 7 days.
- The exercise session consisted of 2 cycles of exercise in Hospital Park. Each cycle included walking for 15 minutes followed by a 5-minutes rest period.
- Firstly, the researcher encouraged children to change their technique, increase the duration gradually, and begin by working on their gait and walking slowly for five minutes to warm up. Then practice brisk walking technique for 10 minutes.
- Measurements of blood glucose were performed before the beginning of exercise, throughout the rest interval, and after the exercise was completed. When the subject's blood glucose dropped below 60 mg/dL during exercise, the subjects was given 5–30 gm of carbohydrates and after five to fifteen minutes, the blood glucose was measured again. Until the blood glucose level was greater than 70 mg/dL, exercise was not resumed. (Gao et al., 2017).
- Patients' fasting blood sugar was evaluated daily for seven days using instrument one part 2.
- After the end of the seven days, the researcher reassessed children for

sleep disturbance, anxiety, adherence to diabetes care recommendations level.

Statistical analysis

After data collection was finished, statistical analysis was carried out with the SPSS programme (version 20.0). Descriptive statistics, which are percentages and frequencies (N, %) were calculated. The means and standard deviation, t-test were used for quantitative data. Chi-square ($\chi 2$) was used for qualitative data. A statistical significant difference was considered if P<.05. A highly statistical significant difference is considered if P<.01. A very highly statistical significant difference is considered if P<.001 (Washington et al., 2020)

Table 1 shows distribution of study and control groups according to their characteristics through the study period. It was obvious that children with diabetes aged between 6 to 8 years in study group were 50.0 % and 46.7% in control. Their mean age was 9.90 ± 2.99 VS 9.80 ± 2.67 respectively. In addition, less than half of children in study and control groups diagnosed with diabetes since less than 3 years (46.7%). No statistically significant differences were found between children in the study and control groups at 5% level of statistical significance.

Table 2 clarifies mean and standard deviation of the length of hospitalization of diabetic children in study and control groups. The study group experienced a shorter average hospital stay than the control group. The study group mean and standard deviation of hospitalization was 5.77 ± 0.77 compared to 7.80 ± 1.30 in the control group. Consequently, there was a very highly statistically significant difference at the 1‰ level of statistical significance.

Table 3 clarifies mean of fasting blood sugar scores among study and control groups. It showed highly statistically significant differences in fasting blood sugar between the study and control groups from the second to the seventh day (P ≤ 0.01 & <0.05). Regarding the study group patients, it was clear that the mean of fasting blood sugar decreased in the seventh day (106.77 ± 19.13) compared to the first day (130.37 ± 10.91). Therefore, there were very highly statistically significant differences between all days (P ≤ 0.001).

Table 4 shows mean and standard deviation of anxiety and sleep disturbance among study and control groups. In relation to total anxiety score, it illustrated that there was decrease in the mean anxiety score for study group in post intervention than pre intervention (39.67 ± 17.66 VS 59.37 ± 26.68). In addition, there were highly statistically significant differences in anxiety score between the study and control groups on posttest. Regarding the total sleep disturbance score, there was decrease in sleep disturbance score for the study group on post intervention 41.67 ± 19.71 compared to 77.30 ± 25.18 on pre intervention. Moreover, there were very highly statistically significant differences in sleep disturbance scores between the study and control groups on post intervention.

Table 5 indicates mean and standard deviation of adherence to care recommendations between the study and control groups. The findings revealed that the mean score for child's adherence to insulin in the study group improved on post intervention than pre intervention (4.13 ± 1.10 VS 2.40 ± 0.93 respectively). In addition, the child's adherence to diet in the study group was 4.57 ± 2.56 on post intervention compared to 2.37 ± 0.99 on pre intervention. Moreover, the child's adherence to blood glucose monitoring in the study group was 4.27 ± 1.70 on post intervention compared to 2.47 ± 1.14 on pre intervention. Furthermore, there were very highly statically significant improvement (p<0.001) in the total score of child's adherence to care recommendation in study group compared to control group on posttest.

Figure 1 illustrates comparison between level of anxiety among the study and control groups on pre and post intervention. The results showed that 76.7% of the study group's children exhibited lower levels of anxiety after the intervention than they had before (76.7% VS 30.0%). On the other hand, it was evident that less than half of the children in the control group (46.7%) showed moderate anxiety levels on the pre- and post-test.

Figure 2 illustrates comparison between sleep disturbance in the study and control groups on pre and post intervention. This figure pointed out that more than half of the children in the study group experienced less sleep disturbances after the intervention than they did before (56.7% VS 13.3%). On the contrary, it was evident that over 50% of the children in the control group experienced moderate sleep disturbances in both the pre- and post-tests (60.0% & 56.7%, respectively).

Figure 3 reflects comparison between child's adherence to care recommendations in the study and control groups on pre and post intervention. This figure indicated that nearly three quarters of children in the study group adhered to care recommendation on post intervention compared to pre intervention (73.3% VS 10.0%). On the other hand, it was obvious that the majority (86.7%) of children in the control group did not adhere to care recommendation in posttest and pretest.

Table 6 shows a very highly statistical significant positive correlation between total scores of anxiety and sleep disturbances in the study group, (P < 0.001). On the other hand, there was no statistical significant difference between total scores of anxiety and sleep disturbance in the control group (P>.05).

Table (1): Distribution of study and control groups according to their Characteristics through the study period (n=60)

Characteristics	Study group (n=30)		Control group (n=30)		Statistical test	P –value
	No	%	No	%		
Age						
6-9 years	15	50.0%	14	46.7%	X2 = 0.34ns	0.84
10-13 years	11	36.7%	13	43.3%		
14-17 years	4	13.3%	3	10.0%		
Mean ±SD	9.90 ± 2.99		9.80 ± 2.67		t = 0.14ns	0.89
Sex						
Male	16	53.3%	17	56.7%	X2= 0.60 ns	0.30
Female	14	46.7%	13	43.3%		
Education level						
Primary	22	73.3%	22	73.3%	X^2=0.29 ns	0.83
Preparatory	5	16.7%	6	20.0%		
Secondary	3	10.0%	2	6.7%		
Duration since diagnosed with diabetes						
1-3 years	14	46.7%	14	46.7%	X^2=0.90 ns	0.85
4-6 years	11	36.7%	13	43.3%		
>6years	5	16.6%	3	10.0%		
Suffer from other diseases						
No	30	100%	30	100%	X^2 = a	-
Yes	0	0.0%	0	0.0%		
Family history of diabetes						
No	8	26.7%	6	20.0%	X2 = 0.37 ns	0.38
Yes	22	73.3%	24	80.0%		
Time of starting treatment						
≤5 years	18	60.0%	21	70.0%	X2 = 0.66 ns	0.29
>5years	12	40.0%	9	30.0%		

NB: *ns = not significant p<0.05,*= significant (p≤.05), ** = highly significant (p≤0.01). a= No statistics are computed because data is a constant.*

Table (2): Mean and Standard Deviation of the Length of Hospitalization of Children in the Study and Control Groups (n=60).

Length of hospitalization/ day	Study no=30	Control no=30	t-test	P –value
Mean ± SD	5.77 ± 0.77	7.80 ± 1.30	7.37***	0.00

Table (3): Mean of Fasting Blood Sugar Scores among the Study and Control Groups (n=60).

Variable	Days	Study group (n=30) Mean ±SD	Control group (n=30) Mean ±SD	t-test	P –value
Fasting blood sugar	**1st day**	130.37 ± 10.91	130.0 ± 9.20	0.14ns	0.89
	2nd day	122.5 ± 13.33	129.47 ± 10.35	2.25*	0.03
	3rd day	119.27 ±13.07	127.80 ± 12.42	2.59*	0.01
	4th day	118.43 ± 13.52	127.80 ±14.93	2.55*	0.01
	5th day	113.43 ± 14.10	124.07 ± 15.78	2.75**	0.008
	6th day	108.77 ± 17.30	122.40 ± 16.65	3.11**	0.003
	7th day	106.77 ± 19.13	122.73 ± 18.28	3.30**	0.002
	Anova test P-value	9.28*** 0.00	1.50 ns 0.18		

NB: ns = not significant (p> 0.05),*= significant (p≤0.05), ** = highly significant (<0.01). ***= Very highly significance (<0.001

Table (4): Mean and Standard Deviation of Anxiety and Sleep Disturbances among Study and Control Groups (n=60).

Variables	Study group	Control group	t-test	P -value
	Mean ± SD	M ± SD		
Anxiety				
Pre intervention	59.37 ± 26.68	59.37 ± 26.68	2.79**	0.008
Post intervention	39.67 ± 17.66	57.03 ± 29.18		
Paired t test	4.45***	1.32 ns		
p-value	0.00	0.20		
Sleep Disturbance				
Pre intervention	77.30 ± 25.18	76.13 ± 23.95	5.89***	0.00
Post intervention	41.67 ± 19.71	74.47 ± 23.24		
Paired ttest	9.50***	1.41 ns		
P-value	0.00	0.17		

NB: *ns = not significant (p> 0.05) ,*= significant (p≤0.05), ** = highly significant (0.01). ***= Very highly significance*

Table (5): Mean and Standard Deviation of Adherence to Care Recommendation between the Study and Control Groups (n=60).

Variables	Study group X ± SD	Control group X ± SD	t test	P -value
Insulin adherence				
Pre intervention	2.40 ± 0.93	2.57 ± 1.17	6.13***	0.00
Post intervention	4.13 ± 1.10	2.43 ± 1.04		
Paired ttest	5.72***	1.28 ns		
Pvalue	0.00	0.21		
Diet adherence				
Pre intervention	2.37 ± 0.99	2.67 ± 0.99	3.85***	0.00
Post intervention	4.57 ± 2.56	2.76 ± 0.88		
Paired ttest	4.67***	1.40 ns		
p-value	0.00	0.20		
Glucose monitoring adherence				
Pre intervention	2.47 ± 1.14	2.57 ± 1.14	4.002***	0.00
Post intervention	4.27 ± 1.70	2.73 ± 1.23		
Paired ttest	4.60***	1.98 ns		
Pre intervention	0.00	0.07		
Total adherence to care recommendations				
Pre intervention	7.23 ± 2.86	7.80 ± 2.80	3.95***	0.00
Post intervention	12.97 ± 3.67	8.60 ± 4.81		
Paired ttest	6.55***	1.02 ns		
-P value	0.00	0.32		

NB: *ns = not significant (p> 0.05) ,*= significant (p≤0.05), ** = highly significant (0.01). ***= Very highly significance*

Figure (1): Comparison between level of anxiety among the study and control groups on pre and post intervention

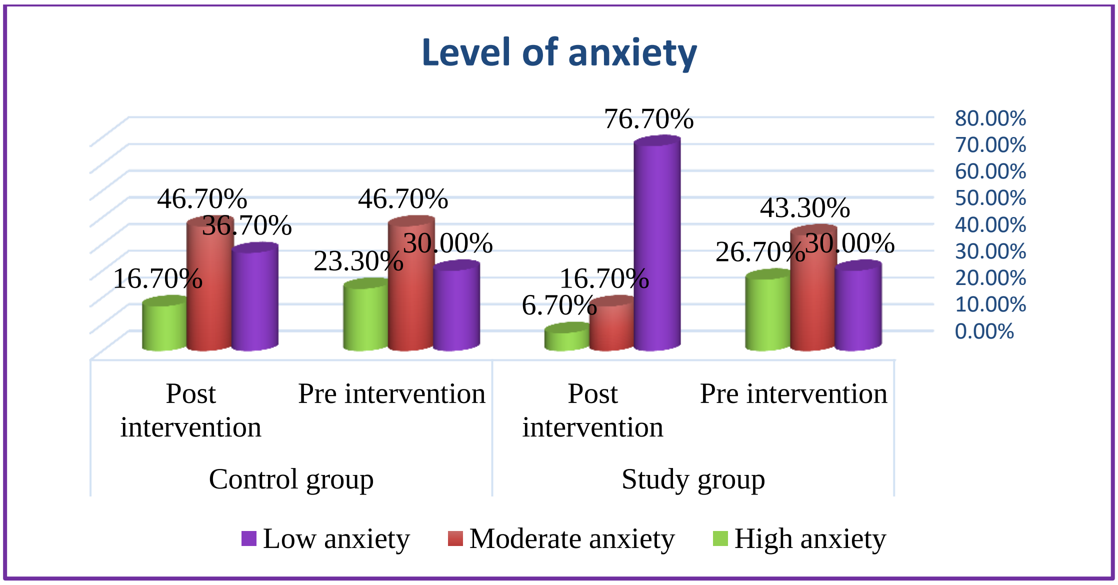

Figure (2): Comparison between sleep disturbance in the study and control groups on pre and post intervention

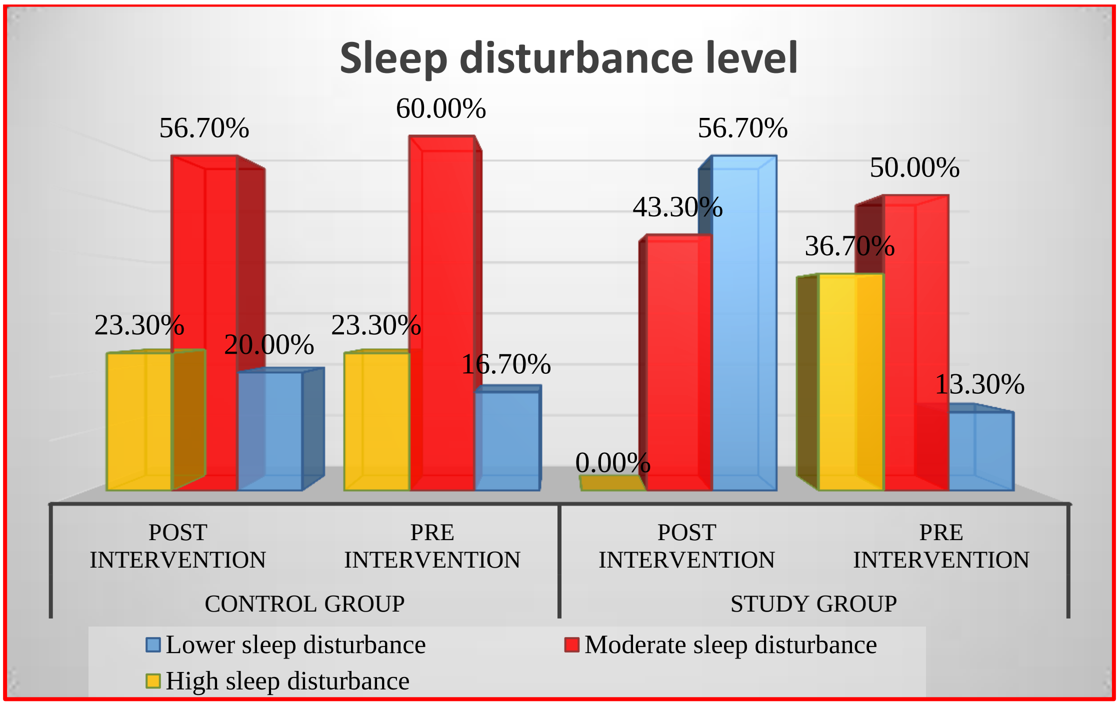

Figure (3): Comparison between child's adherence to care recommendations in the study and control groups on pre and post intervention

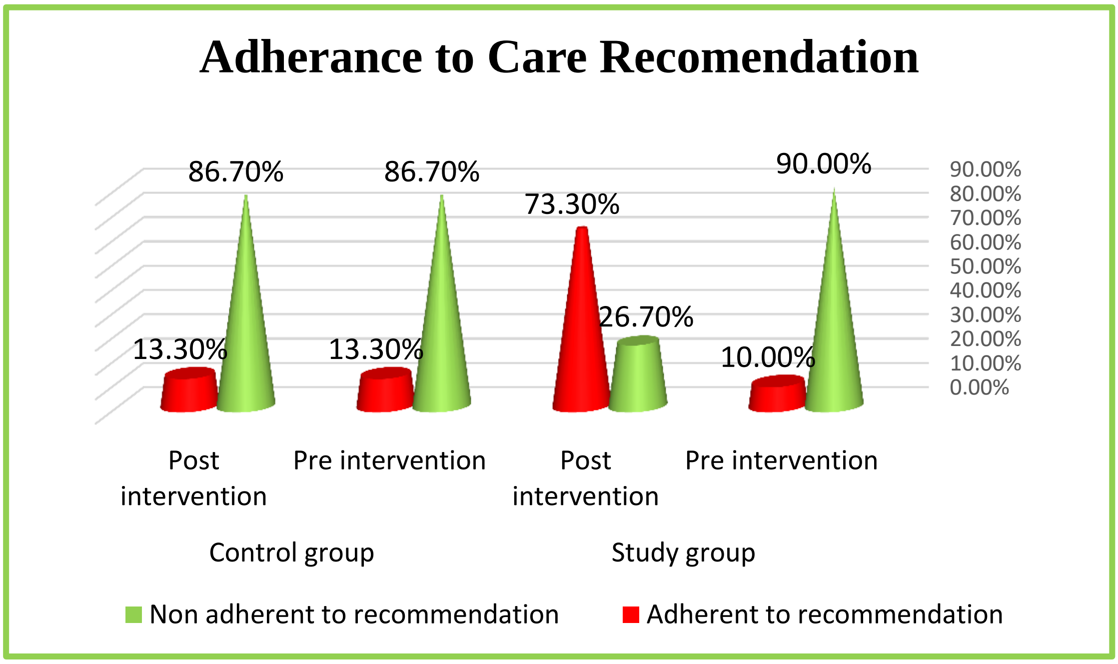

Table (6): Pearson Correlation between Total Scores of Anxiety and Sleep Disturbances in The Study And Control Groups (n=60).

Variables	Total score sleep disturbance			
	Study group		Control group	
	R	p. value	R	p. value
Total score of anxiety	0.42***	0.00	0.16ns	0.22

Discussion:

Globally, diabetes mellitus is the primary cause of disease and mortality and the earliest stage in the development of diabetes is childhood. Childhood may be seen as an opportunity for behavioral and environmental interventions designed to address the risk factors of these diseases and prevent them from developing later in life. There has been a consistent and quick rise in the number of people living in cities, where access to the outdoors is frequently restricted, along with the prevalence of diabetes worldwide. (Dadvand et al., 2018)

In relation to mean scores of level of fasting blood sugar scores in the study and control groups, the finding showed that, the mean of fasting blood sugar for study group decreased in the seventh day compared to first day in the study group. This finding came in agreement with Liao et al., `(2019) who mentioned that there was a substantial correlation founded between living near more greenery and lowering blood glucose levels in mothers.

In addition, the current finding were in the same line with Yang et al., (2019) who clarified that a lower frequency of diabetes mellitus is linked to higher residential greenness. Diabetes and green space lower body mass index and air pollution levels. Also, Dadvand et al., (2018) found that decreased fasting blood glucose levels were linked to longer stays in green areas, especially natural green spaces.

Moreover, the current result was consistent with Lee et al., (2017) who conducted a research and found that there was a positive correlation between green space and blood sugar. Furthermore, Marson et al., (2016) indicated that children who are in green areas are more likely to engage in moderate-to-intense physical activity. Also, exercise has been shown to improve glucose homeostasis. This could be attributed to the effect of children's exposure to green area and brisk walking in hospital garden

Concerning length of hospitalization, the present study found that the diabetic children exposure to green space with brisk walking exercise had a beneficial impact on the length of hospital stay for children. Patients in the study group had shorter duration of hospitalization than patients in the control group. This result was in the line with Mascherek et al., (2022) who mentioned that increased greenness was correlated with a decrease in the duration of hospitalization. This could be due to spending some time in green park with brisk walking exercise aids in lowering fasting blood glucose value and improving of child's health outcomes, which may be responsible for the shorter duration of hospitalization among children in the study group subjects.

Concerning mean and standard deviation of anxiety and sleep disturbances among study and control groups, there was decrease in the mean anxiety score for study group post intervention than pre intervention. This result came in agreement with de la Osa et al., (2023) who stated that there was a correlation between reduced anxiety symptoms and more green space exposure. However, exposure to green areas is expected to improve child's mental wellness. In addition, the current result was in the same line with Lee & Yoon (2023) who mentioned that the findings offer strong evidence that natural environment have a beneficial impact on anxiety.

Moreover, the current finding came in agreement with Gascon et al., (2018) who found that green areas might have a protective effect on mental health, including anxiety and sadness. This could be related to getting some exercise in a natural setting, like brisk walk in the park, which can improve prosocial behavior and foster more social interaction. Furthermore, it provides more opportunities for play, which allows for the practice and development of appropriate social attitudes and behaviors. Additionally, green areas have been linked to higher levels of physical activity, which has been shown to have a protective impact against anxiety and aid in improving mood, decreasing stress and recovery from mental exhaustion. Time spent in natural environments aids in regaining direct focus and overcoming mental exhaustion and stress.

Regarding sleep disturbance, the current study revealed that there was decrease in sleep disturbance score for study group on post intervention compared to pre intervention. This finding was consistent with Qu et al., (2023) who suggested that the quality of sleep is positively correlated with the health of the living environment. Also, Ma et al., (2023) mentioned that walking outside in green spaces helps to feel less depressed and increases degree of awareness and quality sleep.

In addition, the current result was in agreement with Mayne et al., (2021) who indicated that better sleep timing was correlated with increased exposure to green areas and natural environment. Moreover, Xie et al., (2020) illustrated the important impact of green space on human health by showing a substantial positive correlation between improved sleep quality and higher residential greenness. This might be due to brisk walking in green garden and exposure to natural environment that helps to more relaxation, decrease anxiety, stress and tension that could enhance the sleep quality, duration and reduce sleep disturbance.

For child's adherence to care recommendation in the study and control groups on pre and post intervention, child's adherence to insulin, diet and blood glucose monitoring improved on post intervention than pre intervention in study group. This finding was in the same line with Scavarda et al., (2023) who revealed that social isolation emerges as a barrier to lifestyle modifications and self-care activities connected to blood sugar monitoring. The respondents' environment, both physical and social, appears to have a greater impact on their ability to engage in diet recommendation, exercise, and blood sugar monitoring. This could be attributed to time spent in green space with brisk walking in the garden that helped to decrease anxiety level, stress, sleep disturbance and improve social interaction, mood & sleep quality which had appositive effect on overall health outcomes and recovery, all of this payed the patient to be more adherent to care recommendation.

Conclusion:

Children with type 1 diabetes who are exposed to green spaces and and conducted brisk walking in green areas demonstrated lower fasting blood glucose value, decrease length of hospitalization. Also, it contributed to decrees level of anxiety, sleep disturbance and improve adherence to care recommendation.

Recommendations: `

- Children with type1 diabetes should make brisk walking in green areas
- This study can be replicated on large probability sampling to ensure the generalizability of results.

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