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Article

Effectiveness of Exercise and Diet on Quality of Life among Adults with Uncontrolled Type 2 Diabetes Mellitus in Eket, Nigeria

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Abstract: Purpose: This study evaluated the effect of exercise and diet on quality of life (QoL) among adults with uncontrolled type 2 diabetes mellitus (T2DM) in Eket Nigeria. Methods: In a four-arm randomized controlled trial,153 patients were allocated to: combined exercise and diet (n = 38), exercise-only (n =38), diet-only (n = 38), or control (n = 39) group. Interventions were delivered over 6 months. All patients were allowed to access their usual diabetes care. QoL was assessed at baseline and at follow-up. Within-group changes were analysed using the Wilcoxon signed-rank test, while between group differences were assessed using the Kruskal-Wallis H test with Bonferonni-adjusted post hoc comparisons. Effect sizes were calculated using standardized test statistics (r) and epsilon-squared (ε2). P-values < 0.05 were considered statistically significant. Results: The mean age, HbA1c and baseline BMI of the patients were 50 ± 15 years, 7.9 ± 1.5% and 23.88 ± 5.75 Kg/m2 respectively, and 62.7% of patients were females. At 6 months, QoL improved significantly in the exercise and diet (z = -4.910, p < 0.001, r = 0.80), exercise-only (z = -2.560, p = 0.010, r = 0.42), and diet-only groups (z = -3,022, p =0.003, r = 0.49). Between-group differences were significant (H(3) = 33.42, p < 0.001, ε2 = 0.204), with the combined exercise and diet intervention demonstrating the greatest clinically meaningful improvement. Conclusion: The QoL findings support integrated lifestyle intervention as an effective and clinically meaningful strategy for managing T2DM.

Keywords: Type 2 diabetes mellitus; Quality of life; Exercise intervention; Dietary intervention; Randomized controlled trial.

Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by sustained hyperglycaemia observed globally with no age, gender, racial or socioeconomic barriers [1]. Type 2 diabetes mellitus (T2DM) accounts for about 90-95% of diabetes cases worldwide and is linked with serious complications including cardiovascular disease, nephropathy, neuropathy, retinopathy, stroke, and limb amputation [1-2]. Beyond these medical complications, T2DM also negatively affects health-related quality of life (HRQoL), influencing the physical, emotional, and social well-being of affected individuals [3]. The burden of diabetes continues to rise globally, especially in low- and middle-income countries such as Nigeria, where challenges such as poverty, poor healthcare infrastructure, inadequate health data, and limited access to quality healthcare complicate disease management. In Nigeria,

diabetes prevalence among adults aged 20-69 years is estimated at 5.77%, with rates as high as 9.8% reported in the South-South region [4]. Many individuals remain poorly controlled despite advances in treatment, increasing their risk of complications and poor quality of life [5].

Management of T2DM involves both drug therapy and lifestyle modification, particularly exercise and dietary intervention. Regular physical activity improves insulin sensitivity and glucose uptake, while healthy dietary practices contribute to better blood sugar control [6-7]. Educational interventions that improve self-management and patient understanding of diabetes have also been associated with better outcomes [8]. Traditionally, diabetes management has focused mainly on clinical outcomes such as glycosylated haemoglobin (HbA1c), blood glucose levels, blood pressure, and complication rates. However, increasing attention is now being given to patient-centred outcomes such as quality of life (QoL), treatment satisfaction, psychological well-being, and self-management practices [9]. Lifestyle interventions may also improve QoL independently of glycaemic outcomes, with exercise shown to improve mood and reduce anxiety, and healthy diets linked with better mental well-being [10-11]. Despite these benefits, adherence to lifestyle interventions in developing countries remains poor due to financial limitations, inadequate counselling, cultural barriers, and lack of structured programmes [12].

Although many studies have shown that lifestyle modification improves glycaemic control, evidence regarding its effect on QoL among individuals with uncontrolled T2DM remains inconsistent. Some studies reported significant improvements following exercise interventions, while others found limited or non-significant effects [13-15]. Systematic reviews have also reported conflicting findings due to differences in study populations, intervention types, follow-up duration, and outcome measures [16]. Conversely, dietary interventions and their impact on QoL remain underexplored.

A notable limitation of previous research is the widespread use of generic QoL tools such as the Short Form-36 (SF-36), which may not adequately capture diabetes-specific concerns. Diabetes-specific instruments such as the Audit of Diabetes Dependent Quality of Life (ADDQoL) [17-18] have been shown to provide more accurate assessments because they are less influenced by comorbid conditions [19]. This study was justified by the growing burden of uncontrolled T2DM in Nigeria, the poor QoL experienced by affected individuals, and the limited local evidence on the combined effects of exercise and dietary interventions. The study aimed to evaluate the effect of exercise and diet on QoL among adults with uncontrolled T2DM in Eket, Nigeria, using the diabetes-specific ADDQoL-19 instrument.

Methodology

Study Design

This study was a four-arm prospective, longitudinal, randomized controlled study with a 6-month patient follow-up.

Study Setting

The study protocol was approved by the Health Research Ethics Committee of the Akwa Ibom State Ministry of Health with assigned number AKHREC/15/08/25/346. Patients were recruited from two secondary and two primary healthcare facilities located in Eket, Akwa Ibom State, South-South geopolitical zone of Nigeria.

Inclusion/Exclusion Criteria

Patients with T2DM who fulfilled the recruitment criteria were identified and included in this study. The inclusion criteria were T2DM patients who: provided a signed written informed consent to participate in the study and abide by the rules of the study, were available to participate in the study for 6 months, were not less than 18 years of age, had HbA1c of 6.5% and above, and were on stable antidiabetic therapy for at least 3 months.

Exclusion criteria were T2DM patients who: had severe diabetes complications, had cognitive impairment or psychiatric illness affecting participation, had physical disabilities limiting participation, were pregnant or breast-feeding, and were less than 18 years.

Sample Size Determination

Following a sample size power calculation using G*Power software [20] based on the procedures described by Faul et al. [21] and Kang [22], a sample size of at least 133 was required. To ensure sufficient statistical power and account for 'lost to follow-up' during the study, a target sample size of 153 patients was recruited. This sample size was considered adequate to detect a clinically significant difference in QoL scores between groups.

Sampling Technique

A consecutive sampling method was used to recruit eligible patients for this study until the required sample size was achieved.

Randomization and Allocation Concealment

Patients were assigned unique identity numbers to conceal their identity and each participant was numbered from 1 to 153. A randomization sequence was generated by the research coordinator who did not take part in the allocation process, using IBM SPSS Statistics software [23]. Block randomization with block sizes of 4 was implemented to ensure balanced allocation across the four groups in a 1:1:1:1 ratio. Patients were grouped into blocks and a random number was generated for each participant. Cases were sorted in each block based on the random numbers and group assignments were allocated in equal proportions within each block.

The assignments were moved into numbered, opaque, sealed envelopes, with each envelope containing single group allocation printed on identical paper [24]. During enrolment, the envelopes were opened sequentially after eligibility of the participant is confirmed. The envelopes were prepared by a pharmacy technician who was part of the research team but did not partake in the recruitment process.

Since the total sample size of 153 was not evenly divisible by the four groups, the randomization process resulted in approximately equal groups (38-39 patients per group) and the final participant was allocated using simple randomization.

Intervention Description

Patients in Intervention Group 1 (IG1) received a combined exercise and diet training, patients in Intervention Group 2 (IG2) received exercise-only training, while patients in Intervention Group 3 (IG3) received diet-only training. Patients in the Control Group (CG) received no intervention. All patients were allowed to receive usual diabetes care, which included routine hospital visits on appointment, prescription of medicines, routine laboratory tests, prescription refills, consultations with the doctors and referrals. The usual care was offered with minimal or no counselling sessions to educate patients on their conditions or enlighten on diabetes self-management. The interventions were administered after recruitment and allocation by the research assistants. Intervention modules were prepared in the form of pamphlets, and handed over to each patient after training. The patients were supervised on a daily basis for two weeks before once weekly follow-up.

The Exercise Intervention (Exercise Module)

The exercise module consisted of compulsory 150 minutes of aerobic exercise with optional two to three times strength and stretching exercises per week and optional light activity for at least three minutes for every half hour after prolonged sitting [25].

The Dietary Intervention (Diet Module)

The diet module involved the plate method of dietary modification, with half plate of non-starchy vegetables, one quarter plate of lean protein, one quarter plate of carbohydrate foods and water or unsweetened tea or unsweetened coffee [25].

Duration of Intervention

The intervention lasted for a total of 6 months (24 weeks), with a once weekly follow-up visits by experienced and trained community canvassers to monitor adherence and progress. Follow-up visits took place at patients' homes or during clinic appointments. The visits were also augmented with reminders through phone calls, text messages and WhatsApp groups. Patients were issued follow-up cards with their unique identification numbers marked on the cards. The cards were marked at the end of every week as evidence of adherence to their intervention training. Patients were considered lost to follow-up if they could not be reached after three consecutive contact attempts.

Outcome Measures

The primary outcome was QoL which was assessed using the validated ADDQoL-19 instrument [17-18], while the secondary outcome was body mass index (BMI).

Data Collection Tools

The instruments used in data collection included Clover A1c Self HbA1c Analyzer for HbA1c measurement, structured questionnaire for socio-demographic and clinical data, and the validated ADDQoL-19 for measuring QoL.

The Study Instrument

The ADDQoL-19 instrument used in this study has been validated in several countries including China, Malaysia, Norway, Singapore, Lithuania, and Portugal [17, 26-30]. The questionnaire contains two overview items and 19 domain-specific items. The overview items assess general quality of life and diabetes-dependent quality of life. General QoL is rated from +3 (excellent) to -3 (extremely poor), while Diabetes-dependent QoL evaluates how life would differ without diabetes on a scale from -3 (very much better) to +1 (worse).

Each of the 19 domain-specific items has two parts: the first measures the impact of diabetes on that area of life from -3 (maximum negative impact) to +1 (positive impact), while the second measures the importance of the domain from 3 (very important) to 0 (not at all important). The impact and importance scores are multiplied to obtain a weighted impact (WI) score ranging from -9 to +3. Average Weighted Impact (AWI) scores are calculated by dividing the total weighted impact scores by the number of applicable domains. Domains with a "not applicable" response option are excluded from analysis if they are not applicable for a respondent. AWI scores are calculated only when no more than six responses are missing. The ADDQoL questionnaire was used with permission and licence from Prof. Clare Bradley of Health Psychology Research Ltd, U.K. [18], under licence number CB1473, and took approximately 20–30 minutes to complete.

Data Collection Procedure

Baseline data were collected before randomization. Follow-up assessments were conducted at the end of the intervention period. The ADDQoL-19 was administered as a self-completed questionnaire. Patients who required assistance received standardized clarifications from trained research assistants using a predefined clarification guide. Clarifications explained item wordings and response options without involving interpretation of questions or direction of patient responses. The trained research assistants were blind to the group allocations of the patients interviewed.

Data Analysis

Collected data were analysed using the IBM SPSS Statistics [23]. An intention-to-treat approach was utilized in the analysis, and multiple imputations with five imputations under the fully conditional specification method was used for missing data. Descriptive data was summarized as mean, standard deviation, frequencies, median and interquartile range where applicable. Test for normality was carried out using skewness and kurtosis values, Shapiro-Wilk test, Normal Q-Q Plots and histograms. Chi square test or Fisher's exact was conducted to compare proportions.

Within-group variations were analysed using Wilcoxon signed-rank test while between group differences were analysed by computing change scores and performing Mann-Whitney U test for two independent groups and Kruskal-Wallis H test for more than two independent groups. Post hoc analysis with Bonferonni adjustment was performed for multiple comparisons [31]. Results of between-group analysis and post-hoc pairwise comparisons across five imputed datasets were pooled using Fisher's method. The effect size for between-group differences was calculated using epsilon-squared (ε^2) [32], while the effect sizes for pairwise comparisons and within-group differences were calculated using the standardized test statistic ($r = Z/\sqrt{N}$) [33]. P values <0.05 were considered statistically significant.

Results

A total of 275 patients were screened between February and September, 2025, out of which 153 were included in the study and were randomized (see the flow chart in Figure 1).

The patients' ages ranged from 24 to 80 years, with a mean age of 50 ± 15 years. The mean HbA1c level was 7.9% ± 1.5%, and females constituted 62.7% of the study participants. All variables when compared at baseline showed no significant differences across groups, with the exception of "location recruited" (Table 1).

Analysis of the effects of the interventions on General QoL, Diabetes-dependent QoL and domains of QoL showed a significant improvement in Diabetes-dependent QoL in all intervention groups and a significant improvement in 9 domains of QoL, 3 domains of QoL and 2 domains of QoL in IG1, IG2 and IG3 respectively, when compared with the CG (Tables 2, 3, and 4).

Within-group AWI analysis showed significant differences in IG1 with median scores increasing from -3.10 to -2.50 post intervention, IG2 with median scores decreasing from -2.60 to -2.65 post intervention, and IG3 with median scores decreasing from -2.60 to -2.70 post intervention, while the CG showed no statistically significant difference with median scores of -2.60 versus -2.80. The between-group AWI analysis showed a statistically significant difference in AWI change scores across the groups ($H(3) = 33.42$, $p < .001$, $\varepsilon^2 = 0.20$), confirmed by Fisher's method ($\chi^2(10) = 69.08$, $p < .001$, $\varepsilon^2 = 0.20$). Significant pairwise differences were observed between IG1 (mean rank = 107.34) and IG2 (mean rank = 68.58), IG1 and IG3 (mean rank = 75.21), IG1 and CG (mean rank = 49.74), and IG3 and CG. Complete results are presented in Table 5.

Within-group BMI change score analysis showed significant reductions in IG1 from 22.78 Kg/m^2 to 22.50 Kg/m^2 post intervention and IG2 from 22.92 Kg/m^2 to 22.82 Kg/m^2 post intervention. No statistically significant differences were observed in IG3 with median scores of 23.04 Kg/m^2 versus 23.69 Kg/m^2, and CG with 22.00 Kg/m^2 versus 22.16 Kg/m^2. The between-group BMI analysis revealed statistically significant differences in BMI change scores across the groups ($H(3) = 20.03$, $p < .001$, $\varepsilon^2 = 0.20$), confirmed by Fisher's method ($\chi^2(10) = 69.08$, $p < .001$, $\varepsilon^2 = 0.11$). Significant pairwise differences were observed between IG1 (mean rank = 98.81) and IG3 (mean rank = 68.76), IG1 and CG (mean rank = 52.37), and IG2 (mean rank = 80.36) and CG (Table 5).

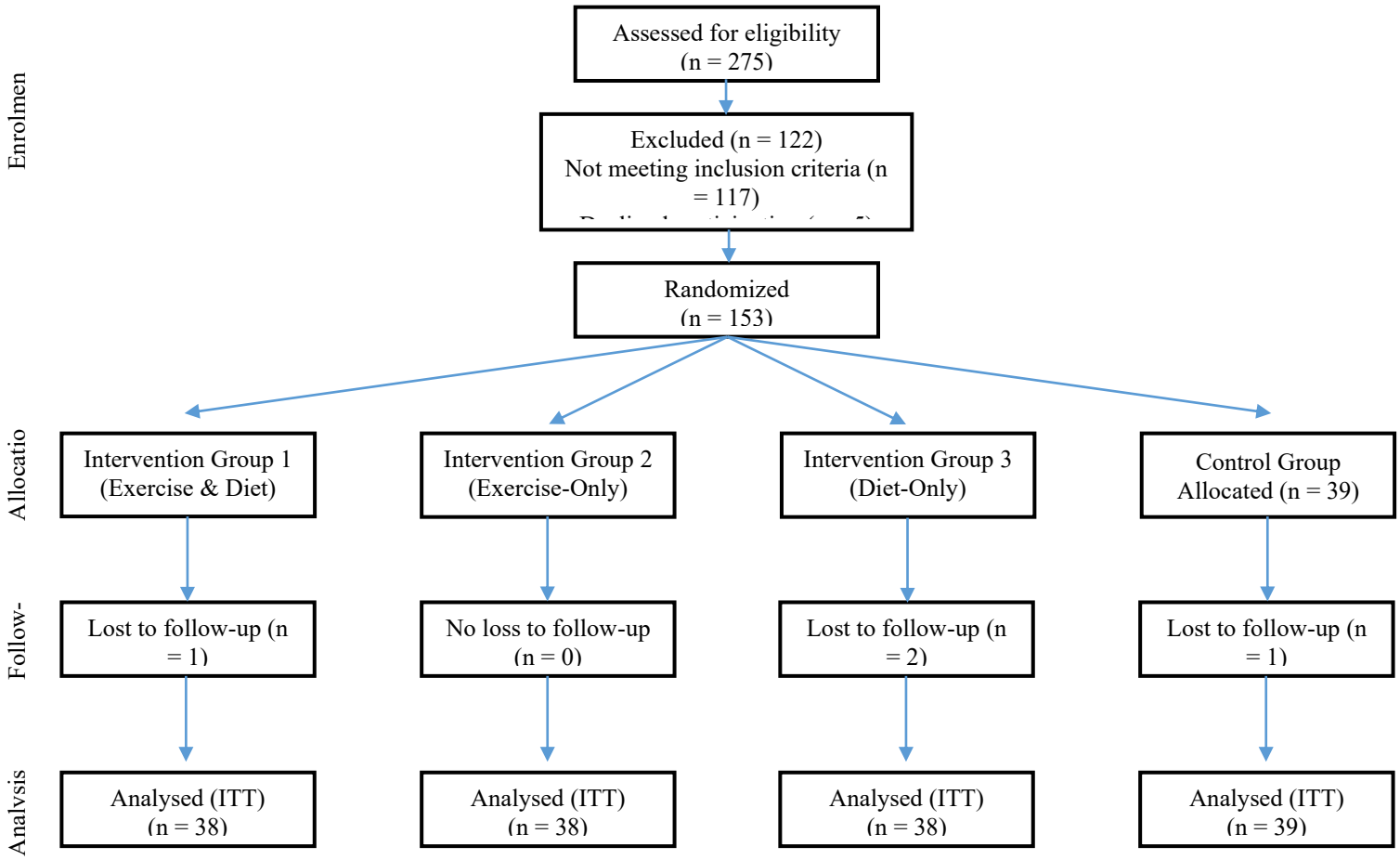

Figure 1. Flow Diagram of Participant Progression through the Study.

Table 1. The Distributions of the Socio-Demographic and Clinical Characteristics of Patients Across Groups.

	IGI (n=38) Exercise & Diet mean (SD)	IG2 (n=38) Exercise mean (SD)	IG3 (n=38) Diet mean (SD)	CG (n=39) Control mean (SD)	Overall (n=153) mean (SD)	p value
HbA1c (%)	8.0 (1.2)	7.7 (1.6)	8.0 (1.7)	7.9 (1.3)	7.9 (1.5)	0.372
Weight (Kg)	60.5 (13.0)	62.4 (10.7)	59.0 (13.6)	61.1 (12.0)	60.8 (12.3)	0.546
BMI (Kg/m2)	23.82 (6.28)	23.80 (4.97)	24.27 (6.27)	23.47 (5.56)	23.83 (5.74)	0.939
	n (percent)	**n (percent)**	**n (percent)**	**n (percent)**	**n (percent)**	
Gender						0.839
Male	12 (31.6)	14 (36.8)	15 (39.5)	16 (41.0)	57 (37.3)	
Female	26 (68.4)	24 (63.2)	23 (60.5)	23 (59.0)	96 (62.7)	
Age (years)						0.407
18 – 40	16 (42.1)	10 (26.3)	12 (31.6)	12 (30.8)	50 (32.7)	
41 – 60	15 (39.5)	16 (42.1)	21 (55.3)	17 (43.6)	69 (45.1)	
>60	7 (18.4)	12 (31.6)	5 (13.1)	10 (25.6)	34 (22.2)	
Marital status						0.155
Single	3 (7.9)	0 (0.0)	5 (13.2)	1 (2.6)	9 (5.9)	
Married	24 (63.2)	29 (76.3)	22 (57.9)	32 (82.1)	107 (69.9)	
Separated	2 (5.3)	0 (0.0)	1 (2.6)	0 (0.0)	3 (2.0)	
Widowed	9 (23.6)	8 (21.1)	8 (21.0)	6 (15.3)	31 (20.3)	
Divorced	0 (0.0)	1 (2.6)	2 (5.3)	0 (0.0)	3 (2.0)	
Education level						0.205
None	4 (10.5)	0 (0.0)	2 (5.3)	2 (5.1)	8 (5.2)	
Primary	7 (18.4)	19 (50.0)	17 (44.7)	13 (33.3)	56 (36.6)	
Secondary	21 (55.3)	16 (42.1)	15 (39.5)	17 (43.6)	69 (45.1)	
Tertiary	6 (15.8)	2 (5.3)	4 (10.5)	6 (15.4)	18 (11.8)	
Vocational/Technical	0 (0.0)	1 (2.6)	0 (0.0)	1 (2.6)	2 (1.3)	
Facility recruited						0.021
Primary facility	15 (39.5)	15 (39.5)	15 (39.5)	15 (38.5)	60 (39.2)	
Secondary facility	23 (60.5)	23 (60.5)	23 (60.5)	24 (61.5)	93 (60.8)	

Table 2. Quality of Life among Patients with Uncontrolled T2DM and its Outcome on General QoL, Diabetes-dependent QoL and Domains of QoL on Introduction of a Combined Exercise and Diet Training.

	Exercise and Diet Group (n=38)			Control Group (n=39)			
Overview Items and Domains	**Median WI Score (IQR) at baseline**	**Median WI Score (IQR) at endpoint**	**p-value within group (Wilcoxon signed-rank)**	**Median WI Score (IQR) at baseline**	**Median WI Score (IQR) at endpoint**	**p-value within group (Wilcoxon signed-rank)**	**p-value between groups (Mann-Whitney U)**
General QoL	0.00 (2.00)	0.00 (1.50)	0.564	0.00 (2.00)	0.00 (2.00)	0.157	0.102
Diabetes-dependent QoL	-1.00 (2.00)	0.00 (1.00)	<0.001	-1.00 (2.00)	-1.00 (2.00)	0.074	0.031
Leisure	-2.00 (4.00)	-2.00 (3.00)	0.004	-2.00 (4.00)	-2.00 (3.25)	0.796	0.002
Work	-6.00 (3.00)	-3.00 (3.00)	<0.001	-3.00 (5.00)	-3.00 (5.00)	0.829	<0.001
Journeys	-3.00 (4.00)	-3.00 (4.00)	0.334	-0.50 (3.00)	-1.00 (3.00)	0.364	0.296
Holidays	-2.50 (3.75)	-2.00 (4.00)	0.046	-2.00 (3.50)	-2.00 (3.00)	0.453	0.373
Physicality	-3.00 (5.00)	-2.00 (3.00)	0.002	-2.50 (6.00)	-3.00 (6.00)	0.670	0.003
Family life	-6.00 (6.00)	-3.00 (6.00)	<0.001	0.00 (3.50)	-3.00 (4.50)	0.179	<0.001
Friendship and social life	0.00 (4.00)	-2.00 (4.00)	0.068	0.00 (3.25)	-2.00 (3.25)	0.087	0.008
Personal relationship	-3.00 (4.00)	-2.00 (4.00)	0.204	-2.00 (3.00)	-2.00 (4.00)	0.221	0.071
Sex life	-4.00 (4.00)	-3.00 (6.00)	0.031	-3.00 (7.50)	-3.00 (5.50)	0.013	0.782
Physical appearance	-4.00 (6.00)	-3.00 (4.00)	0.001	-2.00 (4.50)	-3.00 (4.00)	0.509	0.044
Self confidence	-4.00 (5.00)	-3.00 (4.00)	0.105	-2.00 (3.00)	-2.00 (3.25)	0.439	0.280
Motivation	-3.00 (4.00)	-3.00 (4.00)	0.577	-2.00 (4.00)	-2.00 (4.00)	0.168	0.770
Reactions of other people	-2.00 (2.50)	-2.00 (3.00)	0.005	-1.00 (3.00)	-1.50 (3.00)	0.718	0.004
Feelings about the future	-4.00 (5.50)	-2.00 (3.00)	<0.001	-3.00 (4.50)	-3.00 (4.00)	0.503	<0.001
Financial situation	-3.00 (6.00)	-3.00 (6.00)	0.044	-4.00 (3.00)	-6.00 (3.00)	0.031	0.848
Living conditions	-3.00 (6.00)	-3.00 (6.00)	0.773	-4.00 (3.25)	-4.00 (3.00)	0.670	0.773
Dependence on others	0.00 (2.00)	-1.00 (2.00)	0.187	-1.00 (3.00)	-1.50 (3.00)	0.559	0.096
Freedom to eat	-4.00 (3.50)	-2.00 (3.50)	<0.001	-3.50 (4.00)	-4.00 (3.25)	0.131	<0.001
Freedom to drink	-2.00 (4.00)	-2.00 (4.00)	0.099	-2.00 (3.25)	-2.00 (1.25)	0.835	0.120

Table 3. Quality of Life among Patients with Uncontrolled T2DM and its Outcome on General QoL, Diabetes-dependent QoL and Domains of QoL on Introduction of Exercise-Only Training.

	Exercise-Only Group (n=38)			Control Group (n=39)			
Overview Items and Domains	**Median WI Score (IQR) at baseline**	**Median WI Score (IQR) at endpoint**	**p-value within group (Wilcoxon signed-rank)**	**Median WI Score (IQR) at baseline**	**Median WI Score (IQR) at endpoint**	**p-value within group (Wilcoxon signed-rank)**	**p-value between groups (Mann-Whitney U)**
General QoL	0.00 (2.00)	0.00 (1.25)	0.705	0.00 (2.00)	0.00 (2.00)	0.157	0.198
Diabetes-dependent QoL	-1.00 (2.00)	-1.00 (1.00)	0.007	-1.00 (2.00)	-1.00 (2.00)	0.074	0.769
Leisure	-2.00 (4.00)	-2.00 (4.00)	0.083	-2.00 (4.00)	-2.00 (3.25)	0.796	0.083
Work	-4.00 (4.00)	-3.00 (2.00)	0.002	-3.00 (5.00)	-3.00 (5.00)	0.829	0.009
Journeys	0.00 (4.00)	0.00 (3.00)	0.739	-0.50 (3.00)	-1.00 (3.00)	0.364	0.875
Holidays	-2.50 (2.25)	-2.00 (2.00)	0.354	-2.00 (3.50)	-2.00 (3.00)	0.453	0.684
Physicality	-3.00 (2.75)	-2.00 (3.00)	0.001	-2.50 (6.00)	-3.00 (6.00)	0.670	0.001
Family life	0.00 (6.00)	-2.00 (3.00)	0.386	0.00 (3.50)	-3.00 (4.50)	0.179	0.099
Friendship and social life	0.00 (2.00)	0.00 (2.00)	0.785	0.00 (3.25)	-2.00 (3.25)	0.087	0.116
Personal relationship	-2.00 (3.00)	-2.00 (3.00)	0.386	-2.00 (3.00)	-2.00 (4.00)	0.221	0.368
Sex life	-4.00 (4.00)	-3.00 (5.25)	0.011	-3.00 (7.50)	-3.00 (5.50)	0.013	0.910
Physical appearance	-3.00 (4.00)	-3.00 (2.00)	0.094	-2.00 (4.50)	-3.00 (4.00)	0.509	0.587
Self confidence	-2.00 (4.00)	-2.00 (4.00)	0.059	-2.00 (3.00)	-2.00 (3.25)	0.439	0.712
Motivation	-2.00 (3.00)	-2.00 (3.00)	1.000	-2.00 (4.00)	-2.00 (4.00)	0.168	0.245
Reactions of other people	-2.00 (3.00)	-2.00 (3.00)	0.248	-1.00 (3.00)	-1.50 (3.00)	0.718	0.197
Feelings about the future	-4.00 (4.00)	-3.00 (3.00)	0.002	-3.00 (4.50)	-3.00 (4.00)	0.503	0.017
Financial situation	-6.00 (3.00)	-6.00 (3.00)	0.006	-4.00 (3.00)	-6.00 (3.00)	0.031	0.909
Living conditions	-4.00 (4.00)	-4.00 (3.25)	0.857	-4.00 (3.25)	-4.00 (3.00)	0.670	0.683
Dependence on others	-2.00 (2.00)	-2.00 (3.00)	0.405	-1.00 (3.00)	-1.50 (3.00)	0.559	0.251
Freedom to eat	-4.00 (4.00)	-4.00 (4.00)	0.227	-3.50 (4.00)	-4.00 (3.25)	0.131	0.454
Freedom to drink	-2.00 (3.00)	-2.00 (2.00)	0.295	-2.00 (3.25)	-2.00 (1.25)	0.835	0.510

Table 4. Quality of Life among Patients with Uncontrolled T2DM and its Outcome on General QoL, Diabetes-dependent QoL and Domains of QoL on Introduction of Diet-Only Training.

	Diet-Only Group (n=38)			Control Group (n=39)			
Overview Items and Domains	**Median WI Score (IQR) at baseline**	**Median WI Score (IQR) at endpoint**	**p-value within group (Wilcoxon signed-rank)**	**Median WI Score (IQR) at baseline**	**Median WI Score (IQR) at endpoint**	**p-value within group (Wilcoxon signed-rank)**	**p-value between groups (Mann-Whitney U)**
General QoL	0.00 (2.00)	0.00 (2.00)	0.603	0.00 (2.00)	0.00 (2.00)	0.157	0.084
Diabetes-dependent QoL	-1.00 (2.00)	-1.00 (1.00)	0.002	-1.00 (2.00)	-1.00 (2.00)	0.074	0.410
Leisure	-2.00 (4.00)	-2.00 (4.00)	1.000	-2.00 (4.00)	-2.00 (3.25)	0.796	0.528
Work	-3.00 (6.00)	-3.00 (6.00)	0.021	-3.00 (5.00)	-3.00 (5.00)	0.829	0.055
Journeys	-1.00 (4.00)	-2.00 (4.00)	0.746	-0.50 (3.00)	-1.00 (3.00)	0.364	0.723
Holidays	-2.00 (4.00)	-2.00 (3.50)	0.516	-2.00 (3.50)	-2.00 (3.00)	0.453	0.630
Physicality	-3.00 (6.00)	-3.00 (5.50)	0.356	-2.50 (6.00)	-3.00 (6.00)	0.670	0.327
Family life	-1.00 (6.00)	-3.00 (6.00)	0.605	0.00 (3.50)	-3.00 (4.50)	0.179	0.298
Friendship and social life	0.00 (2.00)	0.00 (3.75)	0.010	0.00 (3.25)	-2.00 (3.25)	0.087	0.562
Personal relationship	-2.50 (4.00)	-3.00 (6.00)	0.149	-2.00 (3.00)	-2.00 (4.00)	0.221	0.739
Sex life	-4.00 (3.00)	-3.00 (4.00)	0.799	-3.00 (7.50)	-3.00 (5.50)	0.013	0.138
Physical appearance	-3.00 (5.00)	-3.00 (2.00)	0.037	-2.00 (4.50)	-3.00 (4.00)	0.509	0.335
Self confidence	-2.00 (4.00)	-2.00 (3.75)	0.705	-2.00 (3.00)	-2.00 (3.25)	0.439	0.558
Motivation	-2.00 (3.00)	-2.00 (3.00)	0.102	-2.00 (4.00)	-2.00 (4.00)	0.168	0.946
Reactions of other people	-1.50 (3.75)	-1.00 (3.00)	0.165	-1.00 (3.00)	-1.50 (3.00)	0.718	0.056
Feelings about the future	-4.00 (4.75)	-3.00 (5.75)	0.001	-3.00 (4.50)	-3.00 (4.00)	0.503	0.011
Financial situation	-5.00 (3.00)	-6.00 (3.00)	0.003	-4.00 (3.00)	-6.00 (3.00)	0.031	0.596
Living conditions	-6.00 (2.75)	-6.00 (3.00)	1.000	-4.00 (3.25)	-4.00 (3.00)	0.670	0.732
Dependence on others	-2.00 (3.75)	-2.00 (3.75)	0.063	-1.00 (3.00)	-1.50 (3.00)	0.559	0.035
Freedom to eat	-4.00 (4.00)	-2.50 (3.00)	<0.001	-3.50 (4.00)	-4.00 (3.25)	0.131	<0.001
Freedom to drink	-2.50 (2.00)	-2.00 (2.00)	0.018	-2.00 (3.25)	-2.00 (1.25)	0.835	0.097

Table 5. Pooled Within-Group, Between-Group, and Post Hoc Pairwise Comparisons of AWI and BMI (m = 5 imputations).

Analysis Type	Comparison	Statistic	p-value	Effect Size	Interpretation
AWI					
Within-group (Wilcoxon)	IG1 (Pre vs. Post)	Z = -4.910	<0.001	r = 0.80	Large
	IG2 (Pre vs. Post)	Z = -2.560	0.010	r = 0.42	Moderate
	IG3 (Pre vs. Post)	Z = -3.022	0.003	r = 0.49	Moderate-Large
	CG (Pre vs. Post)	Z = -0.293	0.769	r = 0.05	Negligible
Between-group (Kruskal-Wallis)	All groups	H(3) = 33.42	<0.001	ε2 = 0.204	Large
Post hoc (Dunn-Bonferroni)	IG1 vs. IG2	Z = 3.866	<0.001	r = 0.31	Medium
	IG1 vs. IG3	Z = 3.032	<0.001	r = 0.25	Small-Medium
	IG1 vs. CG	Z = 5.646	<0.001	r = 0.46	Medium-Large
	IG2 vs. IG3	Z = -0.834	1.000	r = 0.07	Negligible
	IG2 vs. CG	Z = 1.755	0.850	r = 0.14	Small
	IG3 vs. CG	Z = 2.595	0.005	r = 0.21	Small-Medium
BMI					
Within-group (Wilcoxon)	IG1 (Pre vs. Post)	Z = -3.850	<0.001	r = 0.62	Large
	IG2 (Pre vs. Post)	Z = -3.227	0.001	r = 0.52	Large
	IG3 (Pre vs. Post)	Z = -0.834	0.404	r = 0.14	Small
	CG (Pre vs. Post)	Z = -1.298	0.194	r = 0.21	Small-Moderate
Between-group (Kruskal-Wallis)	All groups	H(3) = 20.03	<0.001	ε2 = 0.114	Moderate-Large
Post hoc (Dunn-Bonferroni)	IG1 vs. IG2	Z = 1.567	0.970	r = 0.13	Small
	IG1 vs. IG3	Z = 2.686	<0.001	r = 0.22	Small-Medium
	IG1 vs. CG	Z = 4.327	< 0.001	r = 0.35	Medium
	IG2 vs. IG3	Z = 1.119	1.000	r = 0.09	Small
	IG2 vs. CG	Z = 2.748	<0.001	r = 0.22	Small-Medium
	IG3 vs. CG	Z = 1.624	0.910	r = 0.13	Small

AWI = Average Weighted Impact; BMI = Body Mass Index

Discussion

The combined exercise and diet intervention demonstrated a very large improvement in QoL, with an effect size (r) of 0.80, while exercise-only and diet-only groups indicated moderate improvements, and no improvement was observed in the control group. The between-group difference indicated a large effect size ($\varepsilon^2 = 0.204$), showing the significant influence of the interventions on QoL in this study. The combined exercise and diet intervention was associated with improvements in several domains of life including physical capabilities, leisure activities, work life, family life, holidays, friendships and social life, reactions of other people, feelings about the future and appearance, as well as improvements in overall diabetes-specific QoL. The results are supported by a community-based intervention study conducted in India, which reported that a structured lifestyle program with combined behavioural changes and dietary modification education improved HRQoL significantly in adults with T2DM after a 12-month follow-up [34].

Furthermore, another randomized controlled trial reported that a significant improvement in HRQoL indicated by changes in physical component summary and Beck Depression Inventory II scores was observed in individuals with T2DM following intensive lifestyle intervention (diet and physical activity) [35]. This improvement was more pronounced in the physical component of QoL, and this reinforces the effectiveness of structured lifestyle approaches in diabetes care. The comparable effects observed in this study between exercise-only and diet-only interventions are also consistent with

evidence from studies where exercise interventions have been reported to significantly improve QoL and perceived well-being, even in the absence of dietary modification [36-38].

The BMI findings in this study demonstrated significant reductions in the patients who received combined exercise and diet intervention (r = 0.62) and those who received exercise-only intervention (r = 0.52), but not in those who received diet-only intervention. There was a moderate between-group variations in BMI (ε^2 = 0.114), with pairwise comparisons revealing that both the combined exercise and diet, and exercise-only interventions were superior when compared to the control group. These results suggest that exercise was a key driver of BMI reduction in this study, and this aligns with findings from other studies [39].

Sigal *et al*. demonstrated that structured aerobic and resistance physical activity markedly reduces adiposity in adults with T2DM, which is consistently applicable across diverse populations, including low-resource settings [39]. Other studies demonstrated modest and variable changes in BMI or limited changes in anthropometric measures despite significant improvements in self-management behaviours [40-41]. These indicate that behavioural changes do not always lead to weight reduction and dietary modification alone often do not translate to substantial weight loss without intensive monitoring and adherence support.

This finding also aligns partially with other existing literature in terms of the effect of dietary intervention. The Look AHEAD trial reported significant weight loss among individuals with T2DM following combined lifestyle interventions, with dietary adherence identified as a key determinant of the magnitude of weight loss [42]. The absence of significant BMI reduction among patients who received diet-only intervention in this study may reflect challenges in strict adherence to dietary intervention, cultural dietary practices and limited access to recommended foods.

Studies utilizing general QoL instruments have reported mixed results following lifestyle modifications among patients with T2DM [13-15] which calls for caution in the interpretation of the results and creates the need for future studies with diabetes-specific QoL instruments.

A key finding in this study is the demonstration of QoL improvement which occurred independent of BMI reduction. The patients who received diet-only intervention had their QoL improved significantly without a significant reduction of their BMI, showing that perceived health improvements, increased health awareness and symptom relief may have all influenced QoL gains. Global evidence showing that psychological and functional benefits often precede measurable weight loss has been reported [35]. Thus, interventions that do not produce significant weight loss may still result to improved patient-reported outcomes.

The findings in this study have crucial implications for the management of T2DM in Nigeria and similar settings. Management of T2DM with combined lifestyle interventions should be prioritized. With the evidence of this study, combined exercise and dietary intervention produces the greatest overall benefit for patients. Exercise-based interventions are particularly useful in the reduction of BMI, and may be more feasible to implement at community level, whereas dietary interventions require cultural adaptation to improve adherence and effectiveness. Where resources are limited, single exercise or diet interventions may be valuable alternatives. The increasing burden of T2DM in Africa, and especially in Nigeria calls for scalable, low-cost, community-based lifestyle programmes that integrate both physical activity and dietary education in the non-pharmacological management of the condition, which complements pharmacological management [43]. The major strength of this study is the multi-arm approach, which allows for direct comparisons of the combined and single interventions within the same study population.

Limitations

The lack of significant BMI differences in patients who received diet-only intervention highlights potential limitations due to intervention adherence and duration, which are common challenges in Nigeria settings. Efforts were made to eliminate bias by intensifying follow-up on a day-to-day basis through recruitment and utilization of community canvassers, follow-up cards and notification of patients that inability to adhere to the study guidelines would result to removal from the

study. Non-compliance to diabetes usual hospital care was not controlled for. Furthermore, QoL was assessed using self-reported measures, which may be influenced by subjective perceptions.

Conclusion

Combined exercise and dietary intervention over 6 months produced the greatest improvement in QoL and significant reductions BMI among adults with uncontrolled T2DM within the study population. Exercise emerged as a major determinant of weight reduction, while improvements in QoL were observed even in the absence of substantial BMI changes. Future studies should assess the long-term sustainability, cost-effectiveness, and scalability of exercise and diet training programmes, as well as compare specific dietary and exercise interventions among patients with T2DM.

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