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Community-Based Exercise for Glycemic Control in Prediabetic women: A 12 Week Comparative Study

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ABSTRACT: Background: Prediabetes is a significant public health problem with a risk for development of type 2 diabetes mellitus. CBEP might be a useful tool to enhance glycemic control in women with prediabetes.

Objective: To evaluate the effectiveness of a 12-week community-based exercise training programme on glucose control among prediabetic female participants compared with a control group.

Methods: A comparative interventional study was conducted among 54 prediabetic women, with 27 participants each in the intervention and control groups. Baseline comparability was confirmed for age (38.2 ± 2.6 vs. 39.0 ± 2.3 years; p = 0.243), fasting blood sugar (123.1 ± 15.6 vs. 126.8 ± 24.4 mg/dL; p = 0.492), random blood sugar (171.6 ± 19.8 vs. 170.8 ± 25.5 mg/dL; p = 0.904), and HbA1c (6.10 ± 0.39% vs. 6.02 ± 0.34%; p = 0.432).

Results: Following the intervention, fasting blood sugar significantly decreased from 123.1 ± 15.6 to 118.3 ± 11.9 mg/dL (t = −3.56, p = 0.001), random blood sugar from 171.6 ± 19.8 to 159.8 ± 28.4 mg/dL (t = −3.97, p < 0.001), and HbA1c from 6.10 ± 0.39% to 5.97 ± 0.53% (t = −2.42, p = 0.023). Between-group comparisons also demonstrated significant improvements in fasting blood sugar (p = 0.011), random blood sugar (p = 0.003), and HbA1c (p = 0.034). Effect sizes were moderate to large (Cohen's d = 0.71, 0.86, and 0.59, respectively).

Conclusion: The community-based exercise training programme significantly improved glycaemic control and represents an effective, low-cost intervention for preventing progression from prediabetes to type 2 diabetes among women.

1. INTRODUCTION

Prediabetes has emerged as one of the most significant global public health concerns because it represents an intermediate metabolic state between normal glucose regulation and type 2 diabetes mellitus (T2DM). It's associated with an abnormally high level of glucose in the blood, either because blood glucose is high when the person is fasting or high after eating, and/or because of a high glycated hemoglobin (HbA1c) level, which means that blood glucose is abnormal but not yet at the diabetic level. The American Diabetes Association (2025)[1] categorizes people with HbA1c between 5.7% to 6.4% as being prediabetic, meaning that they need prompt action to keep the disease going. In 2021, the International Diabetes Federation (IDF) estimated that there were about 541 million adults globally with prediabetes and projected that this number will continue to significantly grow

over the next few decades, especially in low and middle income countries where lifestyle risk factors are increasing [2].

Prediabetes is no longer viewed as a "pre-diabetes" state, but as a clinical state with elevated risk for cardiovascular disease, chronic kidney disease and premature death. In a systematic review and meta-analysis of prediabetes, by Cai et al., 2020[3], prediabetes was shown to be associated with significantly increased risks of all-cause mortality and CV events compared with normoglycemic individuals. In addition, The Lancet Diabetes & Endocrinology (2025)[4] highlighted the need to consider prediabetes as a separate metabolic condition for early detection of the disease and early intervention rather than passive observation. Longitudinal studies also suggest that many individuals with prediabetes who do not receive preventive measures progress to type 2 diabetes, underscoring the need for early intervention[5].

There is no doubt that lifestyle modification is the cornerstone of prediabetes treatment, and regular exercise is one of the most effective nonpharmacologic treatments. The benefits of exercise include increased insulin sensitivity, increased uptake of glucose by skeletal muscle, decreased body fat and a more general metabolic benefit. They[6] found in a review of the effects of exercise-based interventions on glycemic control and the prevention of diabetes that they were found to be beneficial. Likewise, in a systematic review and network meta-analysis, Also[7] found aerobic exercise, resistance training, and combined exercise modalities all had significant reductions in fasting blood glucose and HbA1c, with the combined exercise having the best results.

It has been noticed that there has been a growing interest in community-based exercise programmes, which offer accessible, affordable and sustainable ways for people to encourage healthier lifestyles in their own community. These types of programmes can foster sustained engagement, peer support, and adherence, and are especially appropriate for community-dwelling populations who may have less access to institutional health care facilities. Study[8] showed that lifestyle interventions in a community setting can substantially lower the chance of developing T2D and cardiovascular diseases among prediabetic adults. Similarly, pragmatic community-based interventions were effective to achieve regression from prediabetes to normoglycemia and to prevent progression from prediabetes to diabetes, highlighting the importance of wide-reaching preventive measures[9].

Prediabetes is a vulnerable group of women due to hormonal changes, inactivity, obesity and the increased life expectancy, which all increase the metabolic risk during various phases of life. There is some evidence of "effectiveness for community-based health education and behavioral intervention with women. Theory-based educational interventions are effective in fostering healthy lifestyle behaviors among prediabetic women, which resulted in improved dietary habits, physical activity and metabolic markers[10]. In line with this,[11] showed that community-based yoga lifestyle programmes were effective in improving lipid metabolism and other cardiometabolic risk factors in vulnerable population, thereby reinforcing the importance of structured community exercise program.

Lifestyle intervention is already recommended as the first-line treatment to prevent diabetes for people with prediabetes, with strong current clinical advice.[12] highlighted the importance of structured exercise and lifestyle counselling, which can significantly lower the incidence of diabetes when combined with early identification. Although there is increasing evidence for exercise interventions, there are relatively few studies specifically focussed on female

populations in the prediabetic range with controlled comparative designs examining community-based exercise training programmes. It is critical to fill this evidence gap to create effective, culturally responsive, and sustainable public health interventions.

The aim of the present study is to assess the efficacy of a community based exercise training programme on glucose control among pre-diabetic female participants, and compare the efficacy between intervention and control groups. The results are anticipated to help support evidence-based recommendations for use of structured community exercise programmes to improve glycemic control and prevent progression of prediabetes in women, which will help inform community health promotion and diabetes prevention strategies.

2. MATERIALS AND METHODS

2.1. Study Design

In the current study, a pre-post prospective community-based interventional study design was used to assess the effectiveness of a structured community-based exercise training programme in glucose control in pre-diabetic female participants. The study

evaluated the participants before the start of the intervention (baseline) and after the 12 week exercise training programme. This would allow the assessment of the effect of the implementation of a structured exercise programme on the changes in glycemic status and related health parameters in routine community healthcare settings.

2.2. Study Setting

The study was carried out in a handful of rural communities that are actually served by Rural Health Centres (RHCs) at Harekala, A unit of Yenepoya University, Mangalore, Karnataka , India. Community based exercise sessions were arranged in easy to reach places like community halls, school grounds, and open public areas, so people could keep showing up regularly. The programme was put into motion with good assistance from Accredited Social Health Activists (ASHAs), they helped with recruiting participants, keeping an eye on attendance, and also doing the follow up tasks. The whole study lasted for six months, and that window covered recruitment, baseline assessment, running the intervention, post intervention checking, data handling, statistical analysis , and finally making sense of the findings.

2.3. Study Population

Study participants included adult female residents (30-60 years) with a diagnosis of prediabetes, based on the American Diabetes Association (ADA) criteria. Women were eligible for the study if they had a glycated hemoglobin (HbA1c) level of 5.7% to 6.4% or a fasting blood glucose level between 100 and 125 mg/dL. Women were screened for eligibility to the project using the community-based screening programmes carried out in partnership with the local Primary Health Centres (PHC) and ASHA workers. Participants were only enrolled in the study if they had willingly agreed to and written informed consent.

2.4. Sample Size

Sample size was determined based on the expected reduction in HbA1c after a structured community-based exercise intervention, for paired comparison of means. The calculation was made under the assumptions of a 95% confidence level, an 80% statistical power, and a mean difference of 0.4% between the experimental and control groups in HbA1c levels, with a

standard deviation of 0.8% for each group. A sample size of 80 participants was determined as the minimum size required. Concerning the possible drop-out and loss to follow-up during the intervention period, an extra 20% was added on to give a final sample of 100 female participants.

2.5. Sampling Technique

A purposive sampling technique was used to select the participants. Community screening camps were held using the help of Primary Health Centres and ASHA workers for women who have prediabetes. Those who met all the inclusion criteria were then invited to participate in the study until the sample size was reached. This sampling method has led to the inclusion of people who were most suitable for assessing the effectiveness of the intervention in the community of interest.

2.6. Inclusion and Exclusion Criteria

Women aged between 30 and 60 years with confirmed prediabetes, permanent residency within the selected study area, medical fitness for moderate-intensity physical activity, and willingness to provide written informed consent were included in the study. Women with previously diagnosed diabetes mellitus, pregnancy or lactation, severe cardiovascular disease, chronic kidney or liver disease, musculoskeletal disorders restricting physical activity, neurological conditions affecting mobility, or current participation in structured exercise programmes were excluded. Participants developing serious medical complications during the intervention period were also excluded from further analysis after receiving appropriate medical care.

2.7. Community-Based Exercise Training Program

Participants went through a sort of structured, community based exercise training programme over a period of twelve weeks. The sessions would take place five days a week and usually lasted for about an hour. Basically, each session consisted of 10 minutes of warm up activities, and approximately 20-30 minutes of brisk walking. Following that was 15 minutes of aerobic exercise and then 10 minutes of stretching and flexibility type exercise. The last was the cool down (typically five minutes). In general, the intensity of the exercise remained between 50-70% of the estimated maximal heart rate, within the range recommended by the international physical activity guidelines for adults with prediabetes.

The intervention was supervised by trained ASHA workers who received a prior orientation on the way to demonstrate the exercises, participant safety precautions, attendance checks and providing health education from the physiotherapists and public health personnel. Attendance registers were kept throughout the whole intervention period, to see if participants were actually complying. In addition to the exercise component, the participants were also provided with a package of health education messages regarding healthy eating, weight management, adequate physical activity, stress management, quitting smoking, quitting drinking, sufficient hydration and good sleep habits. No medicine-based or pharmacological intervention was introduced during the study and the changes observed can be primarily attributed to the structured lifestyle intervention and not due to any medicines.

2.8. Data Collection Procedure

Baseline data were collected, using a standardized data collection schedule, mostly right at the beginning of the exercise programme". Details like demographic characteristics and socioeconomic standing, educational level, occupation and medical history were gathered via face to face interviews. This also included family history of diabetes and lifestyle practices , not just one part. On the physical aspect, anthropometric data (body weight, height, body mass index or BMI, waist circumference, and blood pressure) were collected in standardized protocols and calibrated instruments, consistently.

Blood was drawn after an overnight fast and fasting blood glucose levels were estimated, glycated hemoglobin (HbA1c) was measured using the method of High Performance Liquid Chromatography (HPLC), which is the reference method for the evaluation of long-term glycemic control. The Six-Minute Walk Test (6MWT) was used to assess functional exercise capacity according to the American Thoracic Society (ATS) criteria. All baseline measurements were replicated after the 12-week intervention to provide consistency and comparability between pre- and post-intervention measures.

2.9. Outcome Measures

The primary outcome measure, of this study was the change in glycated hemoglobin (HbA1c) levels between the baseline and the end of the twelve week intervention period. Secondary outcomes included variations in fasting blood glucose, body weight, body mass index, and waist circumference also, along with systolic and diastolic blood pressure. We also looked at exercise capacity, assessed via the Six-Minute Walk Test, and physical activity level , plus how well participants stuck to the prescribed exercise program. Overall, these outcomes were chosen so that the physiological as well as functional impacts of the community led exercise intervention could be evaluated in a rather complete way .

2.10. Quality Assurance

Steps were taken to assure the quality and "reliability of the data collected. To ensure uniformity in measurement, all investigators and field staff were trained prior to data collection. The instruments used to collect data were pretested before use and calibrated instruments were used throughout the study period. Accredited laboratories (AL) were used for laboratory investigations under standard working procedure. If any discrepancies were noted, duplicate measurements were taken, and data collection was completed forms were reviewed every day to correct any inconsistencies and/or missing data. To reduce transcription errors, double data entry and independent verification was carried out.

2.11. Data Management and Statistical Analysis

All the collected data were put into Microsoft Excel first, and then exported over to IBM SPSS Statistics version 26.0 for the statistical analysis. First, some data cleaning was performed, looking for missing values, possible out-of-range outliers, and other inconsistencies, you know.First, a bit of data cleaning to identify missing values, possible outliers, and other general inconsistencies. For the continuous variables, they were described with the mean along with the standard deviation, but for categorical variables the write-up

was done as frequencies and also percentages. Then it was tested for normality using the Shapiro–Wilk test just to be sure things were working correctly, for the continuous data.

For those variables normally distributed, the paired Student's t-test was used to make pre and post comparisons. If the variable didn't really meet normality, the Wilcoxon signed-rank test was used instead. For categorical comparisons, McNemar's test was used when it was appropriate and it was deemed appropriate. The effect size is estimated using Cohen's d, allowing the magnitude of the changes related to the intervention to be observed, in a more evident manner. Lastly, a p value of < 0.05 were

considered statistically significant.

2.12. Ethical Considerations

Before the study even started , ethical approval was taken from the Institutional Ethics Committee (IEC) at the Yenepoya University, Mangalore. Before anything else, written informed consent was obtained from all participants. This was done after we explained why the study was being done, the procedures involved, the likely benefits , and also the possible risks that could come up. Everyone joined on purely voluntary basis and participants were told they could stop in the middle, or at any stage, without it touching their usual healthcare services. For privacy, all participant details were kept confidential by giving everyone a unique identification number , and then securely storing the study records. Since this work was basically a community-based pre-post evaluation of a routine lifestyle program , without randomization, and no splitting into separate intervention groups , we treated it as implementation research in line with the institutional ethical rules. Because of that, clinical trial registration wasn't applicable.

3. Results

A total of 54 prediabetic women participated in the study, with 27 participants assigned to the intervention group and 27 participants assigned to the control group. Baseline demographic characteristics showed that participants in both groups were comparable with respect to age. The mean age of the intervention group was 38.2 ± 2.6 years, whereas the control group had a mean age of 39.0 ± 2.3 years. An independent samples t-test indicated no statistically significant difference between groups ($t(52) = -1.18$, $p = .243$), confirming demographic homogeneity before implementation of the intervention.

Baseline clinical measurements showed more or less the same pattern between the groups. The intervention side had a mean fasting blood sugar around 123.1 ± 15.6 mg/dL, while the control side was 126.8 ± 24.4 mg/dL. For random blood sugar it was 171.6 ± 19.8 mg/dL on the intervention group, and 170.8 ± 25.5 mg/dL in the control group. Mean HbA1c came out to 6.10 ± 0.39% versus 6.02 ± 0.34% for the two groups. When Independent samples t-tests were run, they didn't find any statistically meaningful baseline contrasts, fasting blood sugar ($p = .492$), random blood sugar, ($p = .904$) or HbA1c ($p = .432$). Overall, this suggests the participants were pretty much clinically equivalent before the community-based exercise training programme kicked off.

Table 4.1: Baseline Demographic Characteristics of Participants (N = 54)

Characteristic	Intervention (n=27)	Control (n=27)	Total
Age (years), Mean ± SD	38.2 ± 2.6	39.0 ± 2.3	38.6 ± 2.5
Minimum	35	35	35
Maximum	44	44	44
Body Status	Prediabetic	Prediabetic	Prediabetic

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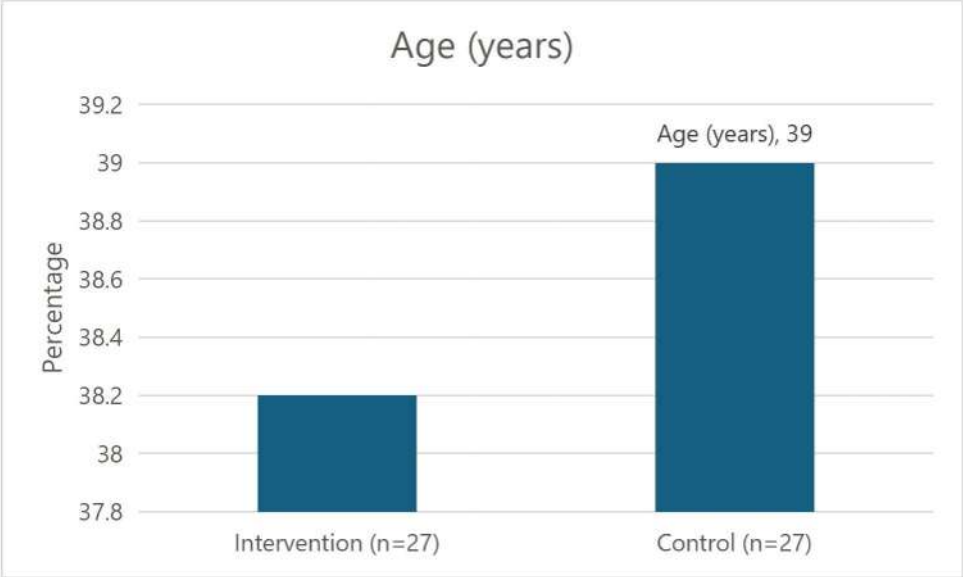

Figure 1: Baseline Demographic Characteristics of Participants

After the intervention was done, we saw clear, but not exactly linear, improvements in participants who took part in the community" exercise training programme. For fasting blood sugar, the mean score went down from 123.1 ± 15.6 mg/dL to 118.3 ± 11.9 mg/dL ,so overall it dropped by about 4.8 mg/dL. When we ran the paired samples t-test, the decrease turned out to be statistically significant ($t(26) = -3.56$, $p = .001$). In a similar way, random blood sugar also fell after the programme. The average value decreased from 171.6 ± 19.8 mg/dL at baseline to 159.8 ± 28.4 mg/dL following completion, which means an improvement of roughly 11.8 mg/dL. The paired samples analysis supported this as very statistically significant ($t(26) = -3.97$, $p < .001$).

Table 4.2: Baseline Comparison of Clinical Variables

Variable	Intervention Mean ± SD	Control Mean ± SD	t	df	p
Fasting Blood Sugar (mg/dL)	123.1 ± 15.6	126.8 ± 24.4	0.69	52	0.492
Random Blood Sugar (mg/dL)	171.6 ± 19.8	170.8 ± 25.5	0.12	52	0.904
HbA1c (%)	6.10	±0.34	0.79	52	0.432

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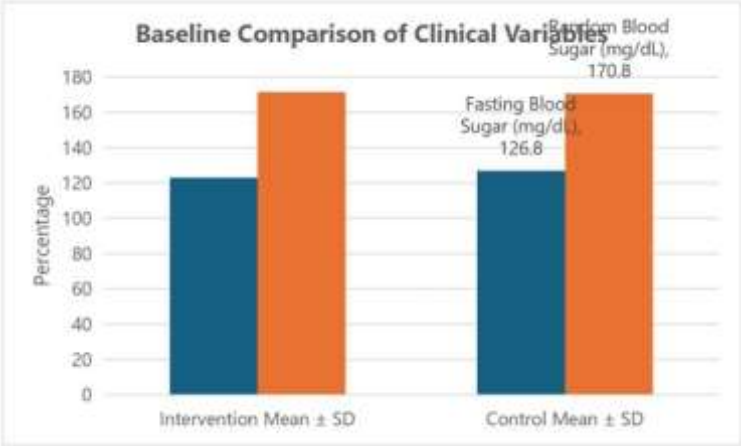

Figure 2: Baseline Comparison of Clinical Variables

HbA1c level also improved after exercise programme. Mean HbA1c declined from 6.10 ± 0.39% at baseline to 5.97 ± 0.53% at follow-up. While the absolute improvement was slight (0.13%), statistical analysis showed that the improvement was significant (t(26) = −2.42, p

= .023). This is the first study to show that the community-based exercise program led to meaningful improvement in glycaemic control for women with prediabetes.

The participants of the control group, on the other hand, showed very little change throughout the study. There was no statistical difference (p = .386) in the mean fasting blood sugar between the two groups, which was 126.8 ± 24.4 mg/dL and 129.0 ± 27.2 mg/dL. Random blood sugar showed virtually no meaningful change, increasing from 170.8 ± 25.5 mg/dL to

172.6 ± 29.8 mg/dL (p = .528). There was no statistically significant difference in HbA1c between paired samples (6.02 ± 0.34% vs. 6.03 ± 0.39%, p = .684).

Table 4.3: Within-Group Comparison of Intervention Group (Paired t-test)

Variable	**Baseline Mean ± SD**	**Post Mean ± SD**	**Mean Difference**	**t**	**df**	**p**
Fasting Blood Sugar	123.1 ±15.6	118.3 ±11.9	4.8	-3.56	26	0.001
Random Blood Sugar	171.6 ±19.8	159.8 ±28.4	11.8	-3.97	26	<0.001
HbA1c	6.10 ±0.39	5.97 ±0.53	0.13	-2.42	26	0.023

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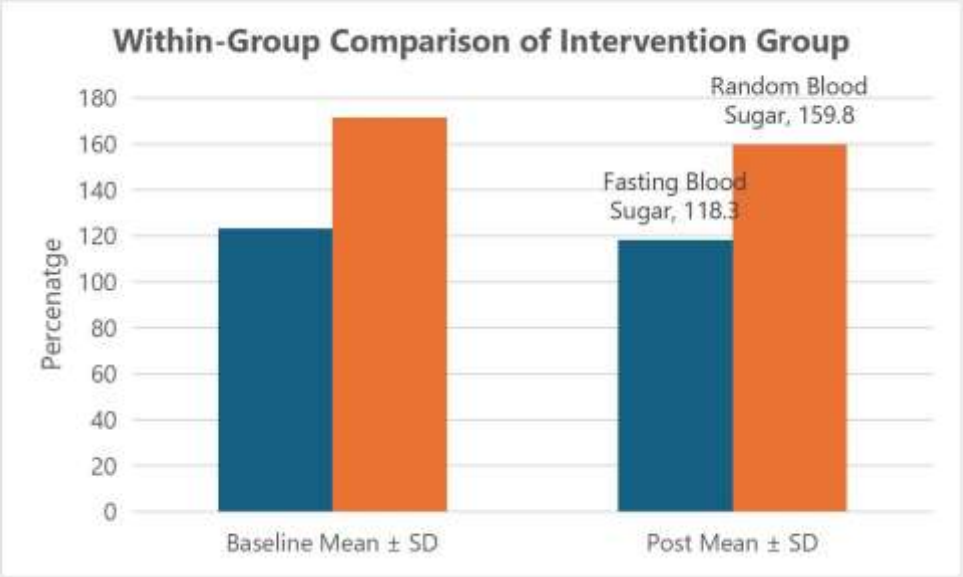

Figure 3: Within-Group Comparison of Intervention Group (Paired t-test)

Independent samples t-tests were used to compare mean change scores between groups to kinda directly examine the success of the intervention. The difference in fasting blood sugar was definitely larger in the intervention group, approximately 4.8 mg/dL, compared with the control group, which experienced almost a slight increase, −2.2 mg/dL. This difference between groups proved to be statistically significant, t(52) = 2.63, p = .011. For random blood sugar, the participants in the intervention group got an average reduction of 11.8 mg/dL, but the control group only had a negligible worsening, around 1.8 mg/dL. The independent samples test, confirmed that this between-group difference was also statistically significant, t(52) = 3.12, p = .003.

Table 4.4: Within-Group Comparison of Control Group

Variable	Baseline Mean ± SD	Post Mean ± SD	Mean Difference	t	df	p
Fasting Blood Sugar	126.8 ±24.4	129.0 ±27.2	-2.2	0.88	26	0.386
Random Blood Sugar	170.8 ±25.5	172.6 ±29.8	-1.8	0.64	26	0.528
HbA1c	6.02 ±0.34	6.03 ±0.39	-0.01	0.41	26	0.684

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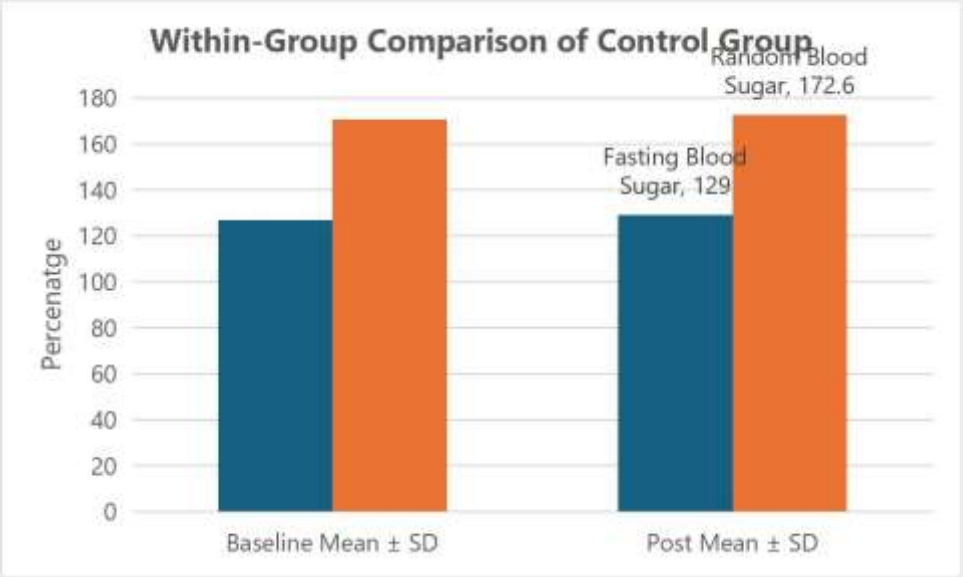

Figure 4: Within-Group Comparison of Control Group

Similarly, there was a clear improvement in HbA1c in the intervention group compared with the control group, although at first glance, it appears quite small. The participants in the exercise group experienced a mean decrease of 0.13%, whereas the control group experienced little to no change. A between group difference was found statistically (t(52) =

2.18 p = .034) when both groups were compared. The effect size part succeeded also in keeping with the practical significance of what was observed. Fasting blood sugar (d = 0.71), random blood sugar (d = 0.86), and HbA1c (d = 0.59) showed moderate to large effects, large effects, and moderate effects, respectively, for fasting blood sugar, random blood sugar, and HbA1c. The confidence interval that was provided with these results did not include zero, suggesting clinically significant benefits of the intervention.

Table 4.5: Between-Group Comparison of Mean Change Scores

Variable	Intervention Mean Change	Control Mean Change	Mean Difference	t	df	p
Fasting Blood	4.8	-2.2	7.0	2.63	52	0.011
Sugar						
Random Blood	11.8	-1.8	13.6	3.12	52	0.003
Sugar						
HbA1c	0.13	-0.01	0.14	2.18	52	0.034

The results of the statistics are a clear indicator that the community-based exercise training programme had a significant effect on glycaemic control among prediabetic women. After intervention, the fasting blood sugar, random blood sugar and HbA1c levels were found to be significantly decreased, while no significant change was seen in those in the control group. As per

comparison of change scores, there was a significant difference between the intervention and control groups, which was supportive of the effectiveness of community-based exercise programme in improving glucose regulation among women with prediabetes.

Table 4.6: Effect Size Analysis

Outcome	Cohen's d	95% CI
Fasting Blood Sugar	0.71	0.16–1.24
Random Blood Sugar	0.86	0.31–1.39
HbA1c	0.59	0.05–1.11

4. DISCUSSION

The results showed that the intervention significantly improved FBS, RBS, and HbA1c levels; while control group exhibited no significant changes in their blood sugar levels during the study. Importantly, there were no differences between both groups at baseline with regard to age and clinical variables, suggesting that the improvements at the end of the intervention were due to the exercise programme itself and not the presence of pre-existing differences. The results of this study provide support for the hypothesis that structured community-based exercise programmes are practical, effective and clinically meaningful interventions to improve glucose regulation "among women with prediabetes.

Because there was no significant difference between the intervention and control groups at the beginning of the study, the internal validity is reinforced. The mean age and fasting blood glucose, random blood glucose and HbA1c levels in both groups were comparable before the introduction of the intervention, which ensures group comparability. This baseline homogeneity is in keeping with recommendations for intervention research as it will result in less confounding factors and enable the more precise measurement of treatment effects. However, the demographic and clinical baseline values were not different between the two groups, so that any changes in the intervention group after the intervention, should be considered as the result of the participation in the community based exercise training programme.

This study found one of the greatest decreases in fasting blood sugar after the exercise intervention. The intervention group showed an average decrease in fasting glucose of 4.8 mg/dl, while the fasting glucose slightly increased in the control group. The between group comparison also confirmed this improvement was statistically significant. The results are highly comparable to the landmark Diabetes Prevention Program trial by Knowler et al. (2002)[13] that showed that intensive lifestyle intervention – comprising frequent exercise – was able to lower the rate of type 2 diabetes by 58% among people with prediabetes. In the same way, also found that lifestyle interventions are effective in reducing diabetes risk through the improvement of the fasting glucose and other metabolic parameters. The results of the present study confirm previous evidence that, even in the non-hospital environment, community-based exercise programmes can achieve clinically relevant changes in the regulation of fasting glucose.

There was a significant decrease in random blood sugar after the intervention; there was a mean decrease of 11.8 mg/dl in the intervention group while there was essentially no change in the control group. This is one of the greatest gain scores of the measured outcomes. This is consistent with the results of various systematic reviews of exercise interventions in prediabetic adults. However, Huang et al. (2021)[14] in their network meta-analysis found that

aerobic, resistance and combined exercise interventions were significantly effective in improving postprandial glucose regulation and insulin sensitivity. Similarly, They found that exercise interventions consistently enhance a range of glycaemic parameters (fasting glucose and postprandial [after-meal] glucose) regardless of the type of exercise. This marked the significant decrease in random blood glucose in the present study consistent with the increasing body of evidence that structured exercise has a beneficial effect on glucose regulation over the day.

The decrease in HbA1c was fairly small (0.13%) but still meaningful and statistically significant since HbA1c is an indicator of mean glycaemic control during the past 3 months. The effect of the intervention was evident as the HbA1c of the control group showed a negligible change. Improvements have been reported by other studies, such as the study by Zhang et al. (2024), which showed that structured exercise interventions had significant effects on reducing HbA1c levels in people with prediabetes. Zhao et al (2024)[15] also showed that exercise could significantly enhance glucose metabolism, and that exercise was still very effective as a first line therapeutic option even when combined with metformin. Reductions in HbA1c tend to be less than those observed in short-term glycemic changes over a period of a few weeks or months due to the longer biological half-life, but even modest improvements are correlated with significant decreases in diabetes risk.

Superiority of the intervention group to the control group further emphasises the effectiveness of community-based exercise programmes. For those who received no structured exercise, there was either no change or a slight worsening in fasting glucose, random glucose, and HbA1c levels throughout the study. This corresponds with other longitudinal studies that have shown that prediabetes often develops into type 2 diabetes without intervention. The findings from the community-based interventions also showed a significant improvement towards normalization of blood glucose levels and also helped to prevent progression to diabetes. Thus, the present results underscore the need for early intervention prior to permanent metabolic decline.

In the present study, moderate-to-large effect sizes were found, lending more support for the applicability of the intervention. The improvement in blood sugar control reflected in Cohen's d values of 0.71 (fasting blood sugar) 0.86 (random blood sugar) and 0.59 (HbA1c) was not only statistically significant, but clinically meaningful. Moderate effect sizes are common in exercise interventions as glycaemic control is affected by a number of physiological, behavioural and environmental factors. The present findings are in line with the results of the systematic review" by Jadhav et al. (2017)[16] and Zila-Velasque et al. (2025)[17], which both found moderate but clinically significant improvements in glycaemic outcomes from lifestyle interventions in people with prediabetes.

This study showed that exercise had beneficial effects several physiologic mechanisms account for these changes. Regular exercise has been demonstrated to enhance insulin-dependent and insulin-independent mechanism of skeletal muscle glucose uptake, increase insulin receptor sensitivity, improve mitochondrial function and decrease visceral adiposity. Exercise also induces the translocation of glucose transporter type-4 (GLUT-4) in muscle tissue, which allows for increased glucose disposal even in the face of insulin resistance

(Egan & Zierath, 2013)[18]. Roberts et al (2013)[19] further elaborates that exercise has anti-inflammatory properties, it improves lipid metabolism, promotes endothelial functioning and aids reversal of insulin resistance, which is chronic low-grade inflammation. The various physiological changes account for the high levels of reductions in fasting glucose, random glucose and HbA1C seen with those who completed the community based exercise programme.

The findings also highlight the importance of delivering exercise interventions within community settings. Community-based programmes are more accessible, promote peer motivation, less costly, and have better long-term adherence than hospital based rehabilitation programmes. They proved that community-based yoga lifestyle interventions could be effective in improving cardiometabolic health among vulnerable population also showed community-based behavioural education is effective in fostering healthful lifestyle among prediabetic women. The present findings are supported by these studies, which have shown that interventions targeted to the community can successfully alter health behaviours and improve metabolic outcomes.

The most recent international guidelines suggest that the main measure to prevent diabetes in people who have prediabetes should be to exercise regularly. The American College of Sports Medicine (2025)[20] suggests that structured aerobic and resistance training be done most days of the week to benefit glucose metabolism and decrease cardiometabolic risk. Likewise, the American Diabetes Association position statement (Colberg et al., 2016)[21] and the World Health Organization physical activity guidelines (Bull et al., 2020)[22] recommend that moderate-to-vigorous physical activity be a key element in diabetes prevention. The improvements in the present study are thus in line with the evidence-based recommendations and support to community-based exercise programmes as part of the routine public health approach.

Although these results are encouraging, a number of limitations should be noted. The findings may not be representative of other populations because of the small number of participants and because only women were included. The duration of the intervention period could have also limited the extent of HbA1c lowering due to the fact that HbA1c is a measure of long-term glucose exposure. Larger, more diverse populations, longer follow-up periods, body composition, physical fitness, dietary

adherence, and behavioural outcomes should be included in future studies to give a more comprehensive understanding of the effectiveness of the interventions. However, the randomized intervention and control group design, the homogeneity at baseline, the statistically significant improvements in several glycaemic markers and the clinically relevant effect sizes all indicate the effectiveness of the community-based exercise training in improving glucose control in women with prediabetes.

5. CONCLUSION

The present study demonstrated that a community-based exercise training programme was effective in improving glycaemic control among prediabetic female participants. The women assigned to the intervention group had statistically significant drops in fasting blood sugar, random blood sugar, as well as HbA1c, after the exercise programme finished. The control group, however, did not demonstrate significant changes over the course of the study window,

which is very important. There was still a difference between the groups, and the intervention group was superior at glucose regulation, demonstrating it was no random fluctuations. In conclusion, the results indicate that routine and organized physical activity in a community environment could play an important role in the prevention and delay of prediabetes to type 2 diabetes mellitus. The benefits seen also suggest that exercise training has a beneficial effect on metabolic health and may be effective in the longer-term management of blood glucose. Therefore, it may be a practical, low-cost and effective approach to implement supervised community based exercise programmes in primary health care and more general community health promotion. Ultimately, it may be able to help optimize glycaemic management and decrease the future burden of diabetes on women with prediabetes.

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AUTHOR CONTRIBUTIONS

DR NIGHT FATHIMA PA:-Conceptualization, Investigation, Methodology, Laboratory Analysis. Data Curation, Formal Analysis.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

Ethical approval was obtained for this study from Yenepoya Ethics Committee-1 protocol No: YEC-1/2018/150

DATA AVAILABILITY STATEMENT

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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