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RESEARCH ARTICLE

Effect of active static stretching on glycemia in type 2 diabetes

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Abstract

Background: Type 2 diabetes Mellitus (T2DM) is a chronic disease whose prevalence is increasing worldwide. It is characterized by insulin resistance in insulin-dependent tissues (e.g. skeletal muscle, adipose tissue). Despite new evidence that stretching may aid in glycemic control, this form of physical exercise remains underutilized in the therapy of T2DM. **Objective:** The objective of this study was to evaluate the effects of active static stretching on the glycemia of individuals with T2DM. **Methods:** Twenty-nine volunteers participated in the study, divided into 3 randomly assigned groups: 30-second stretching group (GA30) with 10 participants; 45-second stretching group (GA45) with 10 participants; control group (CG) with 9 participants. **Results:** Analysis of the intervention groups versus the control group showed that the intervention groups GA30 and GA45 had a significant milligrams per deciliter (mg/dl) reduction in glycemia compared to the control group (control Δ-7.9mg/dl, GA30 Δ12.7mg/dl and GA45 Δ18.5mg/dl >0.001) and between intervention groups (GA30 and control Δ 20.5mg/dl, P 0.002), GA45 and control (Δ 26.4mg/dl, P 0.001). There was no difference between the intervention groups. The results suggest that, regardless of the application time, active static stretching reduces glycemia in individuals with T2DM. In an analysis divided into 4 stages (1st and 2nd weeks, 3rd and 4th weeks, 5th and 6th weeks, and 7th and 8th weeks), the results obtained from the glycemic difference before and after each two weeks were as follows: GA30 pre and post (1st ≠ 17.4 mg/dl, 2nd ≠ 5.8 mg/dl, 3rd ≠ 14.5 mg/dl, and 4th ≠ 8.9 mg/dl), GA45 pre and post (1st ≠ 18.1 mg/dl, 2nd ≠ 17.0 mg/dl, 3rd ≠ 19.2 mg/dl, and 4th ≠ 20.0 mg/dl), and CG pre and post (1st ≠ -10.4 mg/dl, 2nd ≠ -3.7 mg/dl, 3rd ≠ -11.4 mg/dl, and 4th ≠ -11.7 mg/dl). **Conclusion:** This interaction between the two-factor period (Group and Period) did not have a significant effect. Finally, a descriptive analysis of pre- and post-intervention glucose behavior showed the variability of glycemia during the period. Thus, active static stretching significantly reduces acute and chronic glycemia in individuals with T2DM compared to control.

Keywords: Type 2 diabetes Mellitus; exercise; active static stretching.

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BACKGROUND

Diabetes is one of the fastest-growing diseases in the world. According to the latest update from the International Diabetes Federation (IDF) in 2021, there were 573 million people between the ages of 20 and 79 living with diabetes worldwide. During the same period, there were about 6.7 million deaths caused by the disease (IDF, 2021). Projections indicate that by 2030, there will be 643 million people with diabetes worldwide (IDF, 2021). The majority of those affected by the disease have type 2 diabetes, which means they have type 2 diabetes Mellitus (DM2). This represents 90% of all cases of diabetes mellitus. The main causes of DM2 development are obesity and physical inactivity[1]. It is not surprising, therefore, that regular physical exercise is a necessary component for controlling the disease[2-4].

Physical exercise is a relevant tool in the glycemic control of DM2, minimizing the risks of complications, and reducing the severity of any existing complications[3,4]. Life-style changes with the inclusion of physical exercise are considered a non-pharmacological way of treatment to reduce glycemic dysregulation in DM2[5,6]. Despite the relevance of physical exercise for the treatment of DM2[7,8] many individuals with the disease have difficulties in exercising (especially more intensively). This is because the disease can seriously compromise the musculoskeletal system, but even in the most severe conditions, exercise is necessary[9].

Stretching exercise is a physical activity that can be adapted without coordination demands and is of low cost, making it practicable anywhere. In addition, stretching can be practiced by individuals with any physical and functional profile, even in extreme cases such as amputees. It has been shown that this form of exercise can also help with glycemic control[10-18]. The objective of this study was to determine whether active static stretching would reduce the blood glucose levels of diabetic individuals and whether different time protocols would have an influence on the outcome. We used two time protocols, with three sets of 45 seconds expected to have a greater and more positive glycemic response than three to four sets of 30 seconds. However, the vast majority of studies show that the use of the 3 to 4 sets of 30 seconds protocol, which is more commonly used in works related to response and improvement in flexibility.

METHODS

The research is a longitudinal study using a quantitative experimental methodology in humans, focused on the clinical and physical health area, analyzing the cause and effect of stretching with the independent variable and blood glucose levels as the dependent variable.

Participant selection criteria

The inclusion criteria for this study were living in the eastern region of São Paulo, being diabetic, having physical and functional conditions to exercise, not practicing any type of physical exercise in the last 5 months prior to the study, and having blood glucose levels below 300 mg/dL. As exclusion criteria, the following were observed for the study living outside the eastern region of São Paulo, not being diabetic, practicing regular physical exercise for 5 months, being in the gestational period, being physically and functionally incapacitated to exercise, having uncontrolled blood glucose levels above 300 mg/dL, having osteopenia and osteoporosis, mental deficiency, foot ulcers, and limb amputations.

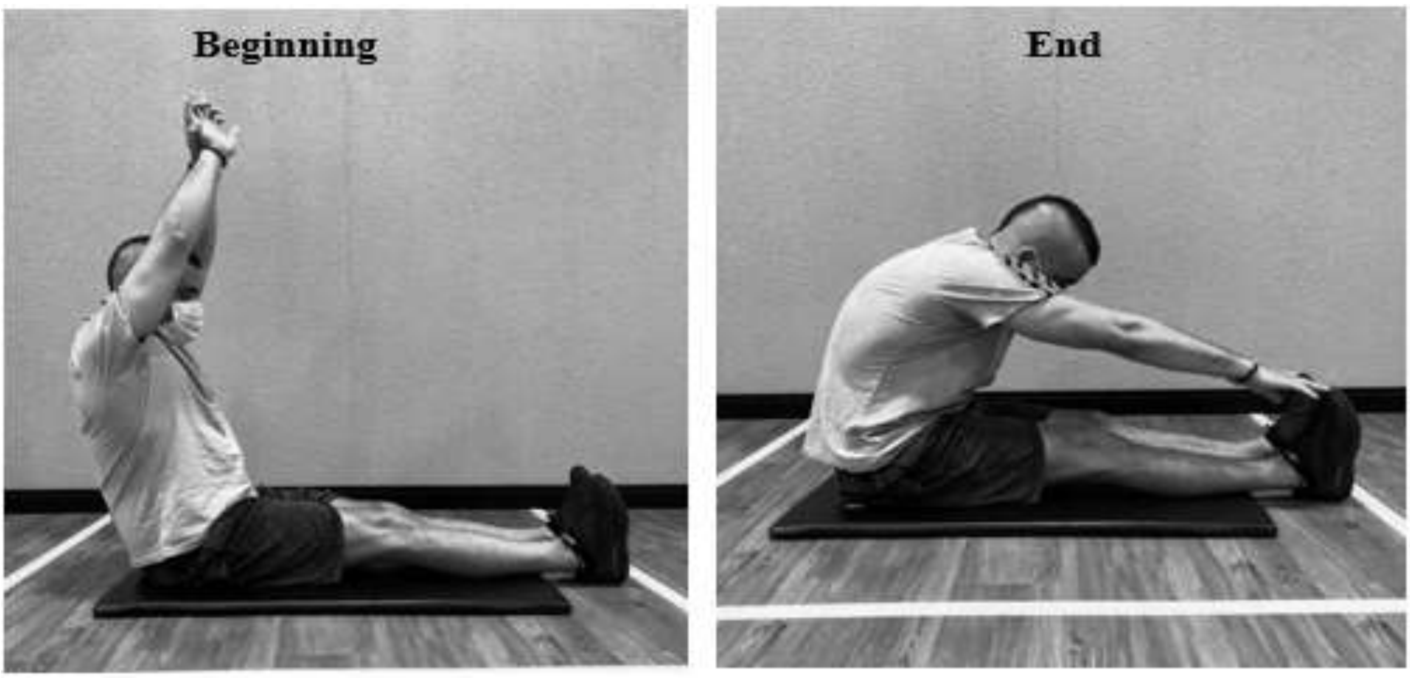
According to the sample calculation, the study included 29 participants of both sexes (7 men) with a mean age of 61.5 ± 6.6 years, randomized into 3 groups: 10 participants in the 30-second stretching group, 10 participants in the 45-second stretching group, and 9 participants in the control group. The two intervention groups received assistance, meaning all participants were in the same location for stretching interventions and data collection, while the control group did not receive any physical or verbal orientation. The mean time of diabetes diagnosis was 9.4 ± 4.0 years.

The study was approved by the Human Research Ethics Committee of the School of Arts, Sciences, and Humanities at the University of São Paulo (EACH-USP) under the CAAE number 37570720.5.0000.5390. All participants agreed to participate in the study[19] and signed the informed consent form, attesting to their awareness of all experimental procedures adopted in the study, and agreed to attend the agreed location for the experiment and data collection.

For this study, an Accu-Chek Performa® glucose meter from was used, as well as a weight scale, measuring tape, stopwatch, cotton, and 70% alcohol. Participants were instructed to maintain their usual diet and wear comfortable clothing suitable for physical activity. To avoid data alterations, participants were instructed not to engage in any physical activity for 8 weeks (2 months), except for the stretching interventions of the study. Data collection was conducted starting at 9:00 AM and immediately after the end of the intervention at 10:15 AM, during which data collection and training were performed for all three groups, with all 29 participants having their data collected between 9:00 AM and 10:15 AM. In total, 58 data collections were performed on the intervention day, 174 data collections in the week, and a total of 1.392 data collections in the 8 weeks, both before and after the interventions of all groups. The proposed stretching intensity in the present study was "light", ranging between 2 and 3 on the Borg scale. Data analysis was performed using R-Studio 4.0.3 software, and sample calculations were performed using G-Power 3.1 software. Data collections were conducted twice for each intervention (pre and post) during the 8 weeks for all groups.

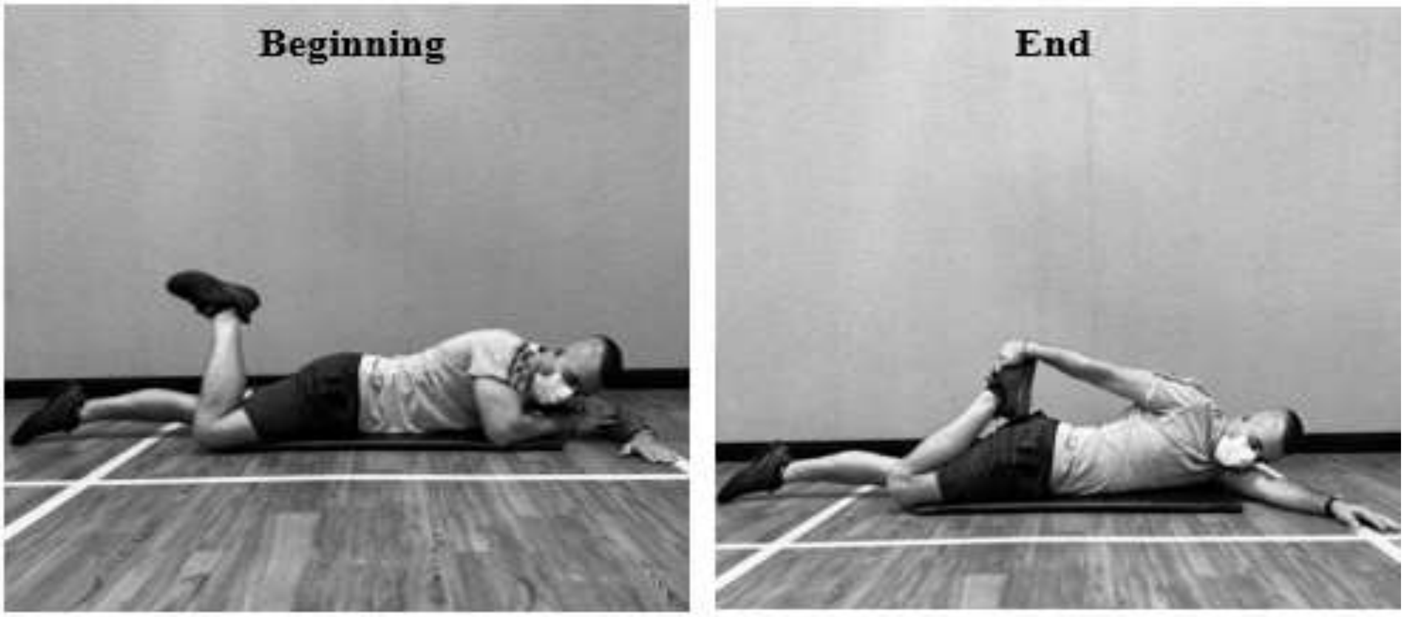
Description of the 8 (eight) exercises:

Figure 1. Hamstring stretch



a) Initial position, the participant seated on the floor with legs together and extended;
b) Final position, flex the body forward (hip flexion) towards the feet, keeping the legs extended.

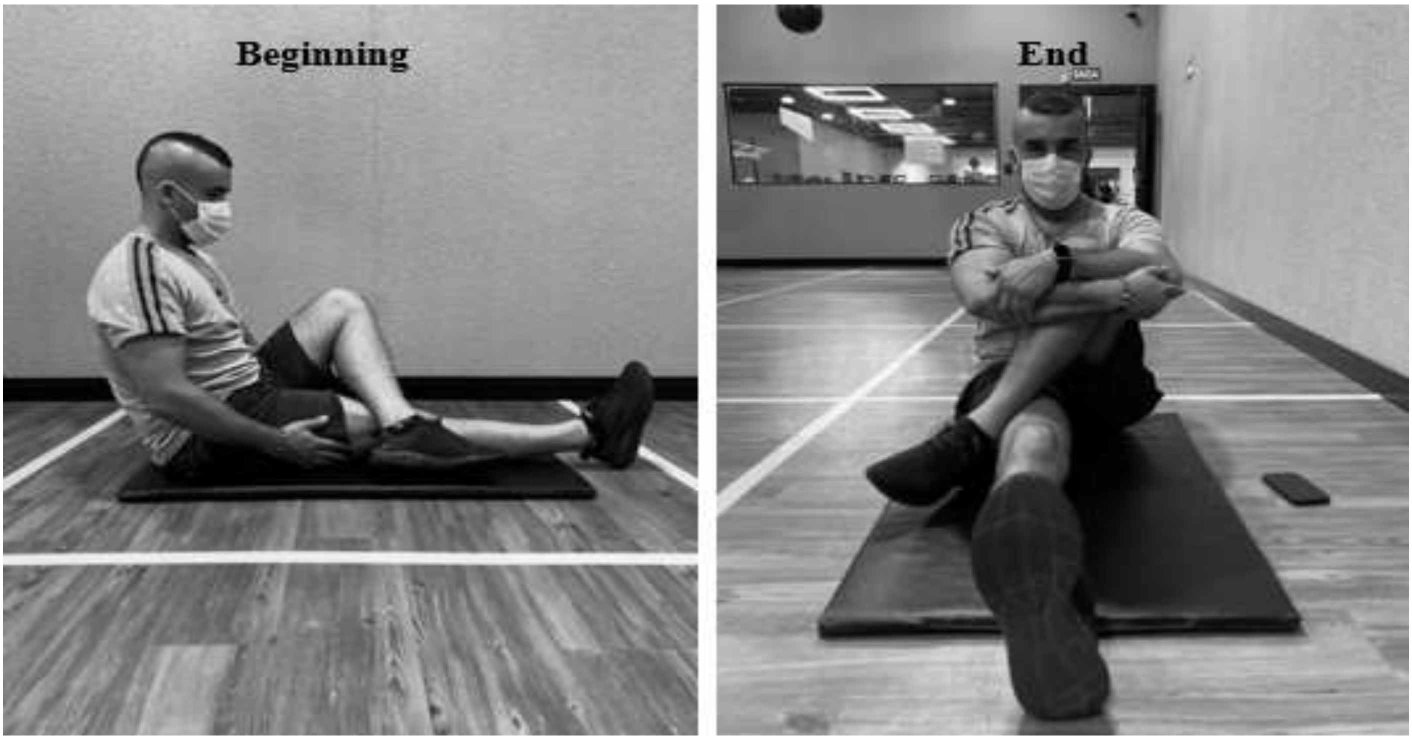
Figure 2. Hip flexors and knee extensors stretching (quadriceps)



a) Starting position, the participant lies on their stomach (prone position) and bends their left knee, placing the ankle close to the buttocks;

b) Finishing position, the left hand holds the foot and pulls the heel towards the buttocks.

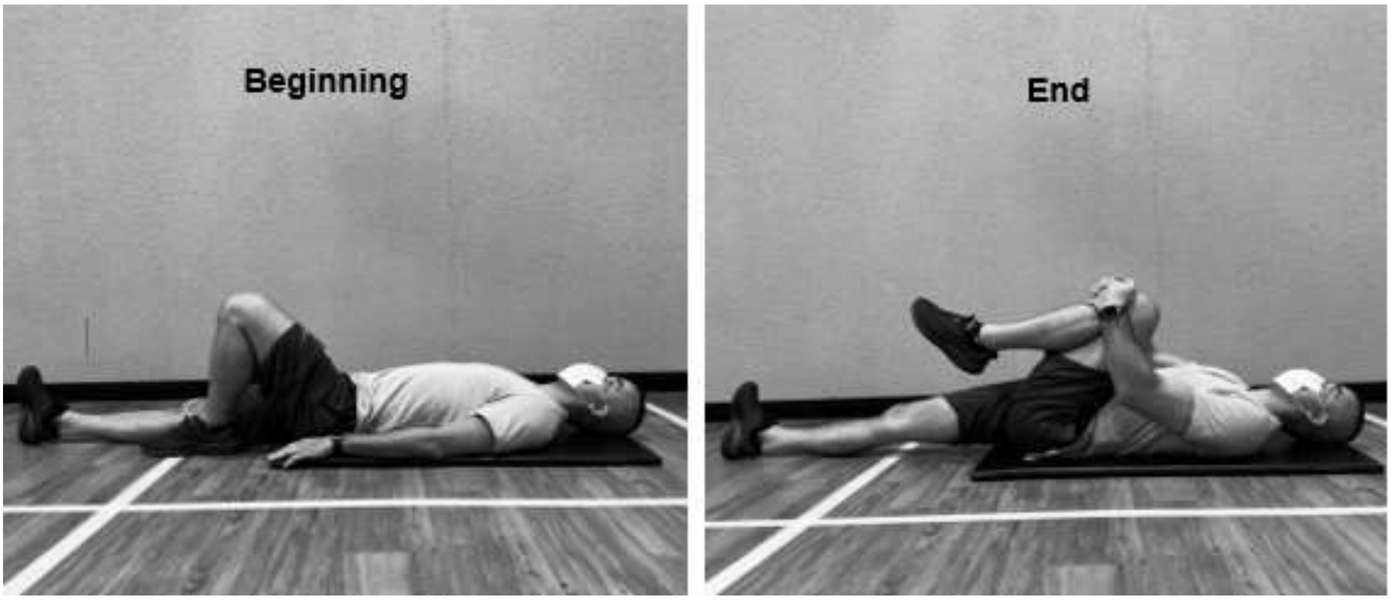
Figure 3. Hip external rotator stretch (gluteus)



a) Starting position, with the participant seated on the floor, with the left leg extended, flex the right leg over the extended left leg, resting the foot on the ground;

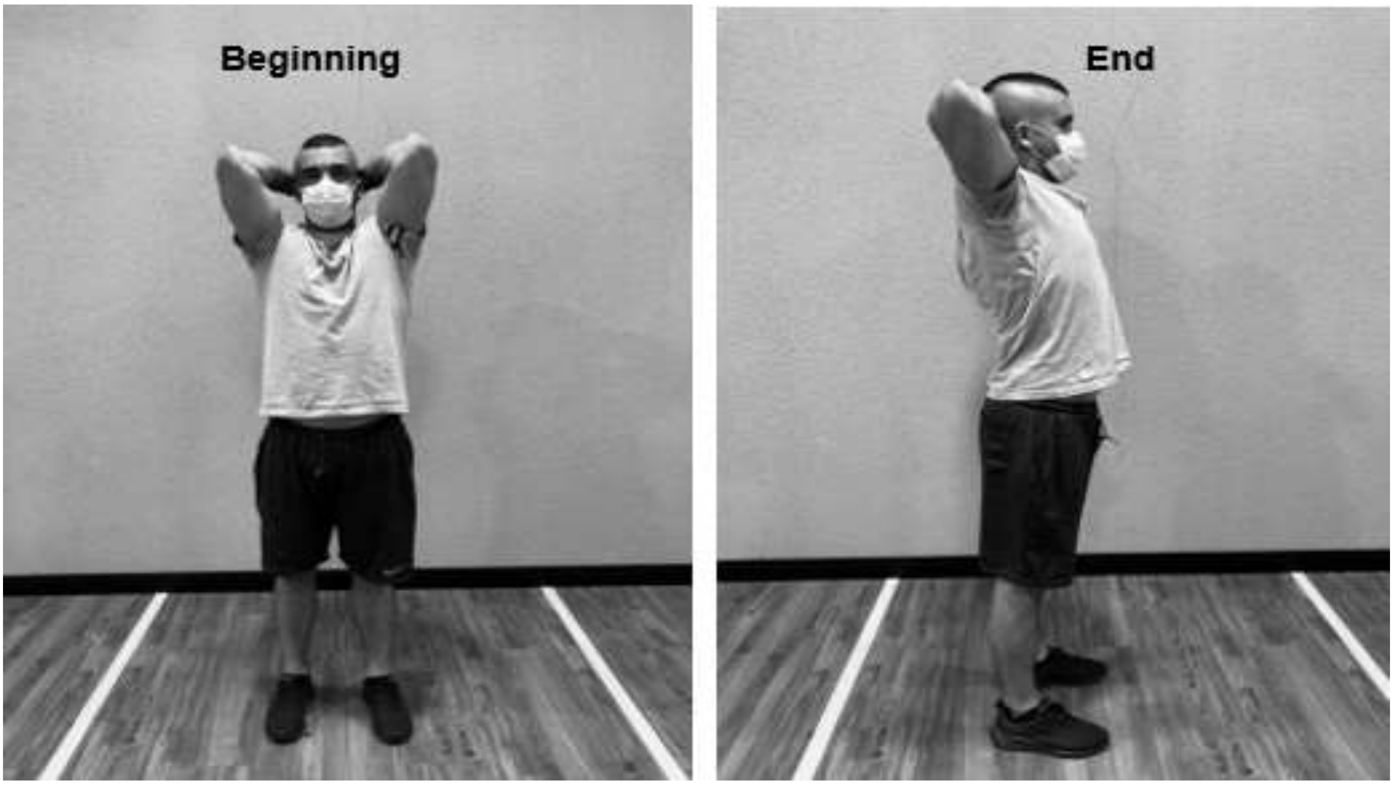
b) Final position, using the arms and hands, hold or hug the right knee and pull it towards the body.

Figure 4. Hip and spine extensor stretch (gluteus, multifidus, and iliocostalis)



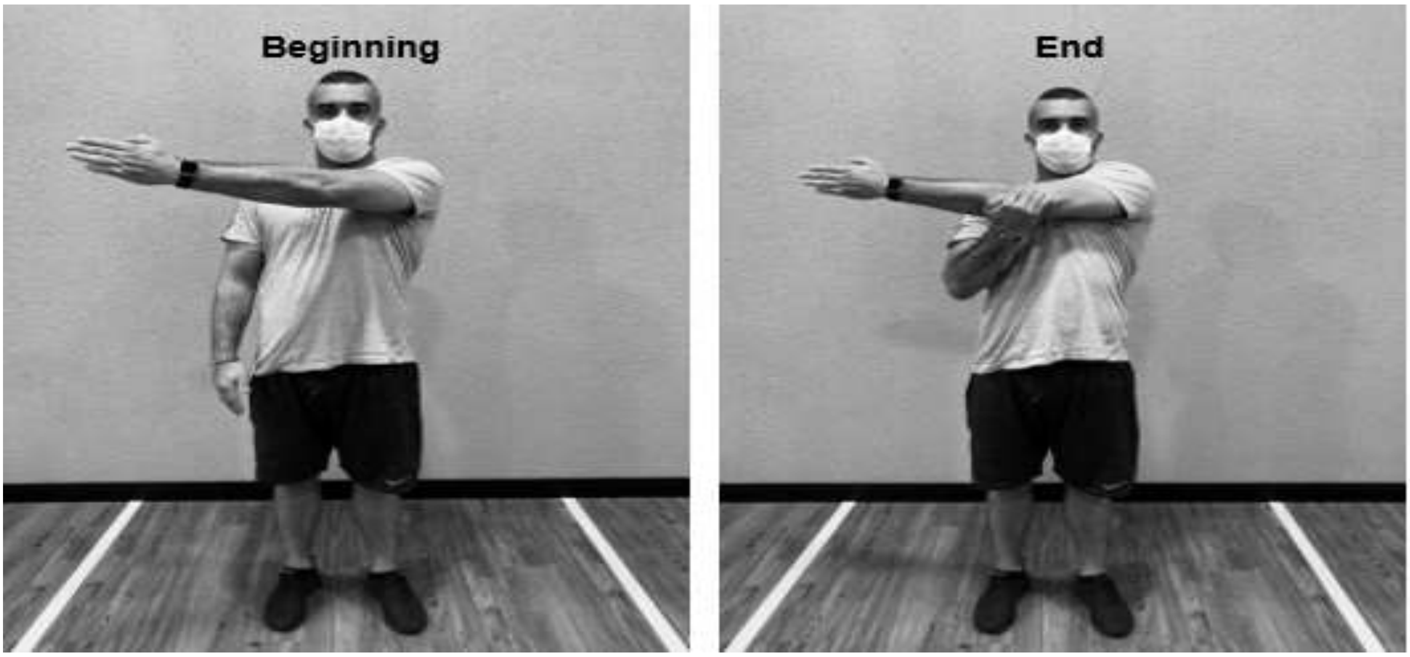
a) Starting position, the participant will be lying on their back (supine position) with the left knee flexed and the right leg extended on the ground in direct contact;
b) Final position, with the help of the hands, the participant will hold the left knee and pull it towards the chest.

Figure 5. Shoulder flexor and chest stretch (anterior deltoid and pectoral)



a) Starting position, the participant standing or sitting, interlaces their hands behind their head;
b) Final position, after interlacing the hands behind the head, perform a backward projection of the elbows.

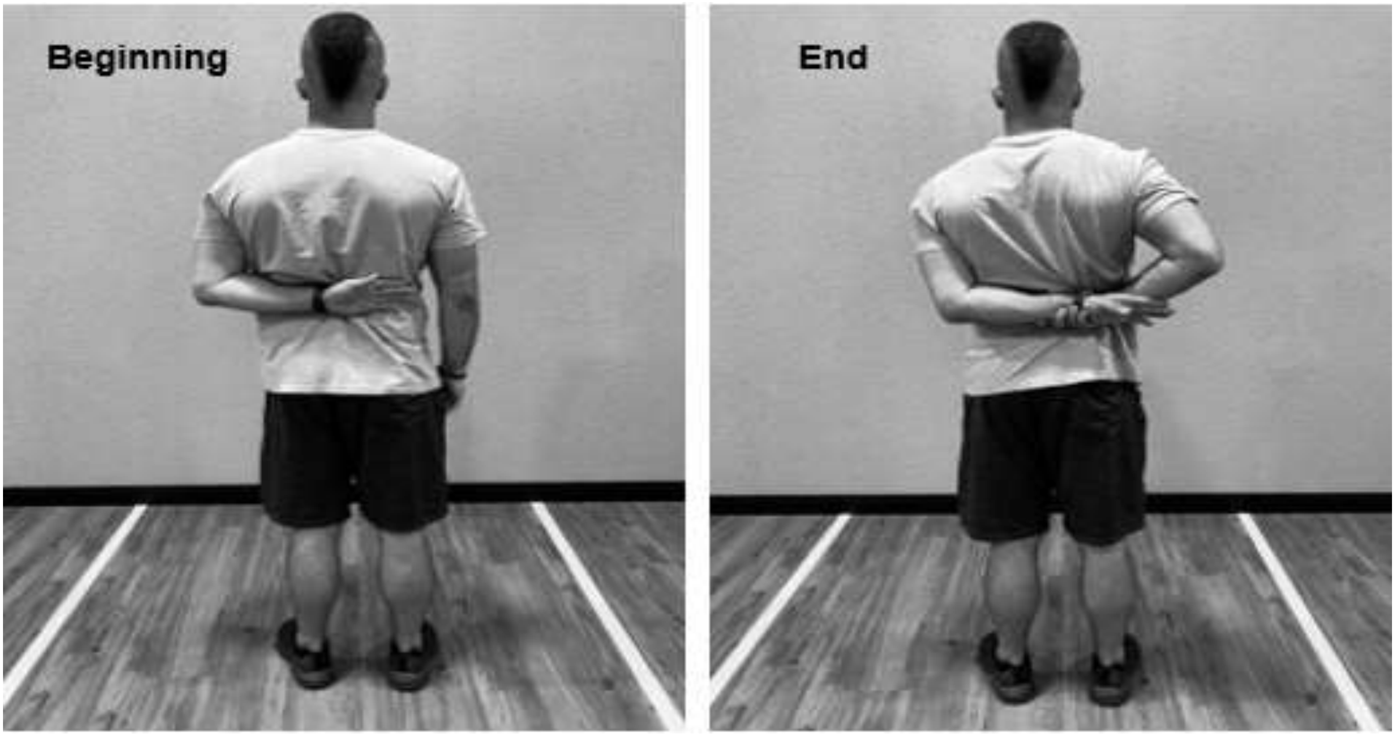
Figure 6. Shoulder adductor stretch (posterior portion of the deltoid)



a) Starting position, participant seated or standing, will cross the extended left arm in front of the body;

b) Final position, with the right hand supporting the left elbow, pull it towards the right side.

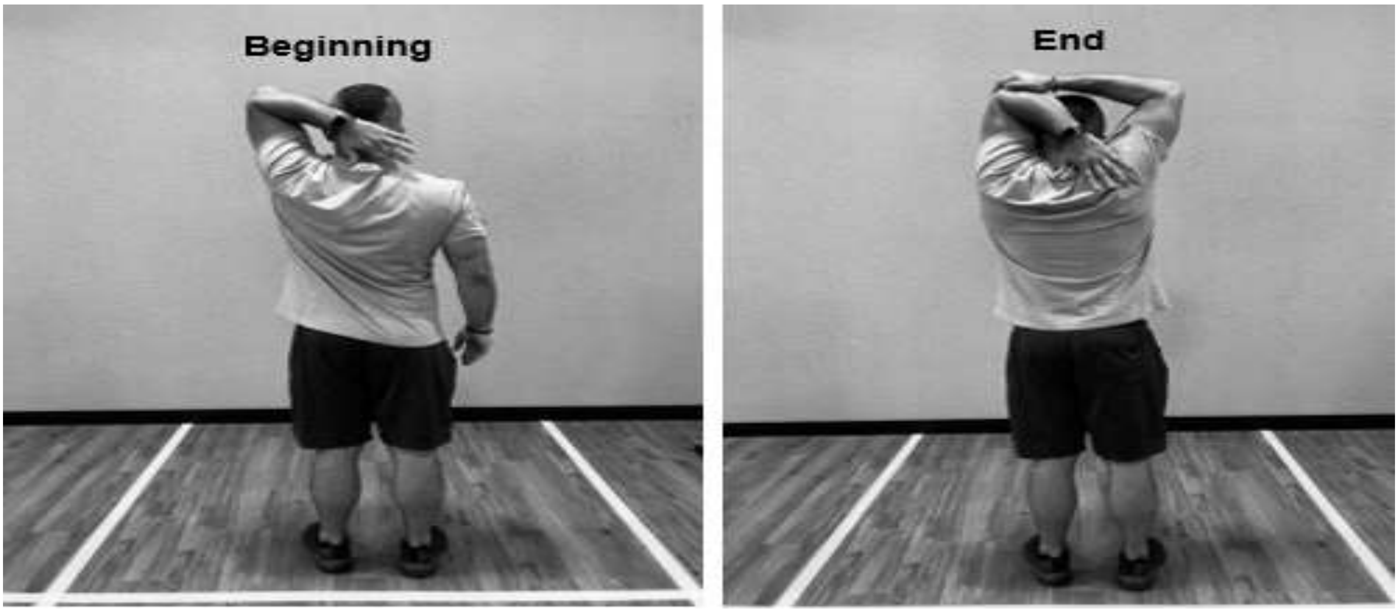
Figure 7. Shoulder flexor stretch (deltoid)



a) Starting position, with the participant standing and the left arm behind the body with the elbow at a 90-degree angle;

b) Final position, with the right hand behind the body, hold the left forearm or elbow and pull it towards the middle of the back.

Figure 8. The stretching of the elbow extensors (brachial triceps) is observed



a) Initial position, the participant may be seated or standing, raise the left arm and flex it behind the head, with the left hand on the left spine or scapula;
b) Final position, with the help of the right hand, support the left elbow and pull it to the right side.

RESULTS

The overall results of the study are divided into Tables 2 and 3, and every two weeks within the two-month period in Table 4 and Figure 1. The individual and daily behavior of blood glucose levels for the three groups are shown in Figures 3, 4, and 5. After 8 weeks of stretching exercises, the results showed a significant difference between the intervention and control groups, as shown in Table 2. However, when comparing group versus group, we analyzed the time protocols to determine if there were significant differences between intervention groups. Table 3 showed no significant difference.

Table 1. Anthropometric characteristics of the 30-second stretching group (GA30), 45-second stretching group (GA45), and control group (CG)

Participants	GA30 (n=10)	GA45 (n=10)	CG (n=09)
Age (years)	60,0 ± 10,2 (years)	59,5 ± 6,3	52,7 ± 5,6
Weight (kg)	75,0 ± 24,2 kg	73,4 ± 15,7	79,3 ± 20,5
Height (cm)	161,8 ± 8,1cm	161,4 ± 5,7	167,6 ± 11,4
Body mass index (BMI)	28,2±7,1 kg/m^2	27,9±4,5 kg/m^2	27,9±4,7 kg/m^2
Duration of diabetes (years)	8,3 ± 3,4 anos	8,7 ± 3,0	8,1 ± 2,4
Subjective perception of exertion (SPE).	2,6±1,9	1,7 ± 1,2	N/A

Note*: Mean ± standard deviation values.

Table 1 shows the characteristics, basis of the study participants, number of participants, and average age for each group, weight, height, body mass index, average duration of diabetes, and average intensity of training.

Table 2. Capillary blood glucose values (mg/dL) of the control group (CG), 30-second stretching group (GA30), and 45-second stretching group (GA45)

	Mean		**Delta Difference**	**Anova Test**
	Pre	**Post**	**Δ**	**P- Value**
Control	188,1 mg/dl	196,0 mg/dl	7,9	< 0,001
GA30	176,6 mg/dl	163,9 mg/dl	-12,7	Standard deviation
GA45	168,9 mg/dl	150,4 mg/dl	-18,5	1.891276

Notes*: Based on the one-way ANOVA Table, we can conclude that there are differences between the protocol groups (p-value < 0.05). The result of Table 2 (ANOVA test) showed a significant reduction in glucose levels between the intervention groups versus the control group (GA30, GA45, and Control).

Based on the one-way ANOVA Table, we can conclude that there are differences between the protocol groups (p-value < 0.05). The result of Table 2 (ANOVA test) showed a significant reduction in glucose levels between the intervention groups versus the control group (GA30, GA45, and Control).

Table 3. Comparison of glucose Δ values between intervention and control groups and between intervention groups

	Δ	**P-value**
GA30-Control	20,5 mg/dl	0,002
GA45-Control	26,4 mg/dl	0,001
GA45-GA30	5,8 mg/dl	0,38

Notes*: Tukey test for comparing the mean Δ between two groups.

In Table 3, the difference between the intervention and control groups is reaffirmed. However, when comparing the intervention group GA45 versus GA30, there is no significant reduction in glucose levels. The results of Table 3 show that it does not matter whether diabetic individuals stretch for 30 or 45 seconds.

It was also observed the behavior of glucose throughout the period every two weeks, as shown in Table 4 and Figure 1, as well as its daily behavior for each group, as demonstrated in Tables 10, 11, and 12.

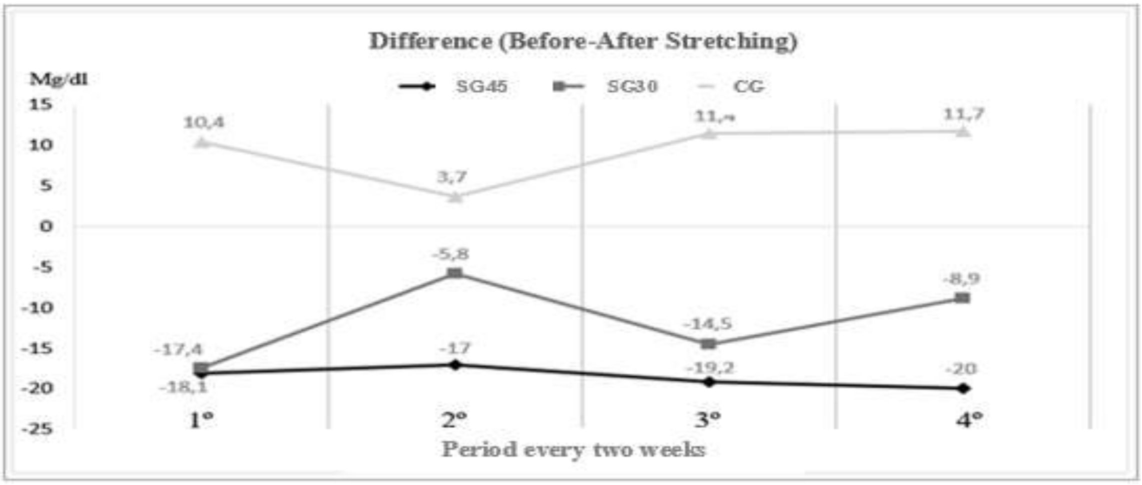
Table 4. Analysis of capillary glycemic difference every two weeks, for the 30-second stretching group (GA30), 45-second stretching group (GA45), and control group (CG).

Group	Period	Pre mg/dl	Post mg/dl	Difference
G30	1º	186,0±56,5	168,5±54,0	-17,4 mg/dl
G30	2º	162,7±44,6	156,8±41,2	-5,8 mg/dl
G30	3º	178,4±45,6	163,9±48,7	-14,5 mg/dl
G30	4º	178,4±47,3	169,5±47,9	-8,9 mg/dl
G45	1º	175,2±58,6	157,1±60,2	-18,1 mg/dl
G45	2º	168,4±47,6	151,4±44,6	-17,0 mg/dl
G45	3º	161,8±49,1	142,6±49,5	-19,2 mg/dl
G45	4º	174,0±51,3	154,0±48,5	-20,0 mg/dl
Control	1º	170,5±59,1	180,9±57,6	10,4 mg/dl
Control	2º	186,2±71,3	189,9±75,7	3,7 mg/dl
Control	3º	179,2±61,7	190,5±60,6	11,4 mg/dl
Control	4º	183,4±61,4	195,1±61,0	11,7 mg/dl

Note*: Groups GA30, GA45, and CG, mean ± standard deviation.

Table 4 presents the glycemic data of the groups over the period in a more descriptive way, with pre- and post-glycemic means every two weeks for the 30-second stretching group, 45-second stretching group, and control group, complemented by a cleaner view in Graph 1 showing the behavior of glucose during the period.

Figure 1. Analysis of capillary glycemia (Group vs. Period) (mg/dl), timeline every two weeks for the 30-second stretching group (SG30), 45-second stretching group (SG 45), and control group (CG) over the period of two weeks



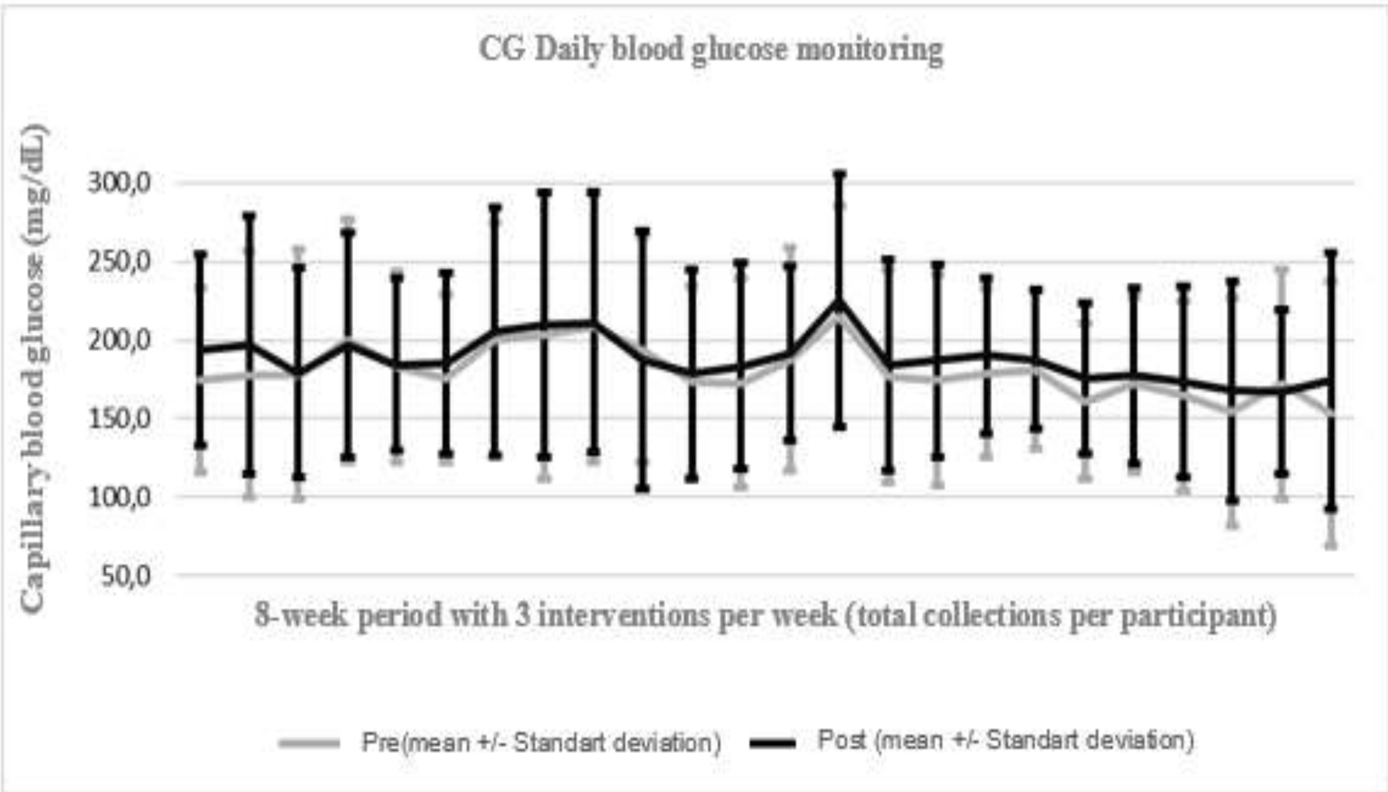
Over the weeks, the group with the 45-second intervention (G45) obtained a higher average difference in the 4th week per period, compared to the other groups.

Table 5. Analysis of capillary glycemia (mg/dl) between two factors, Group x Period, of pre- and post-intervention difference.

Factors	Statistics F	P value
Group	45,9	<0,001
Period	0,3	0,814
Group x Period	1,2	0,332

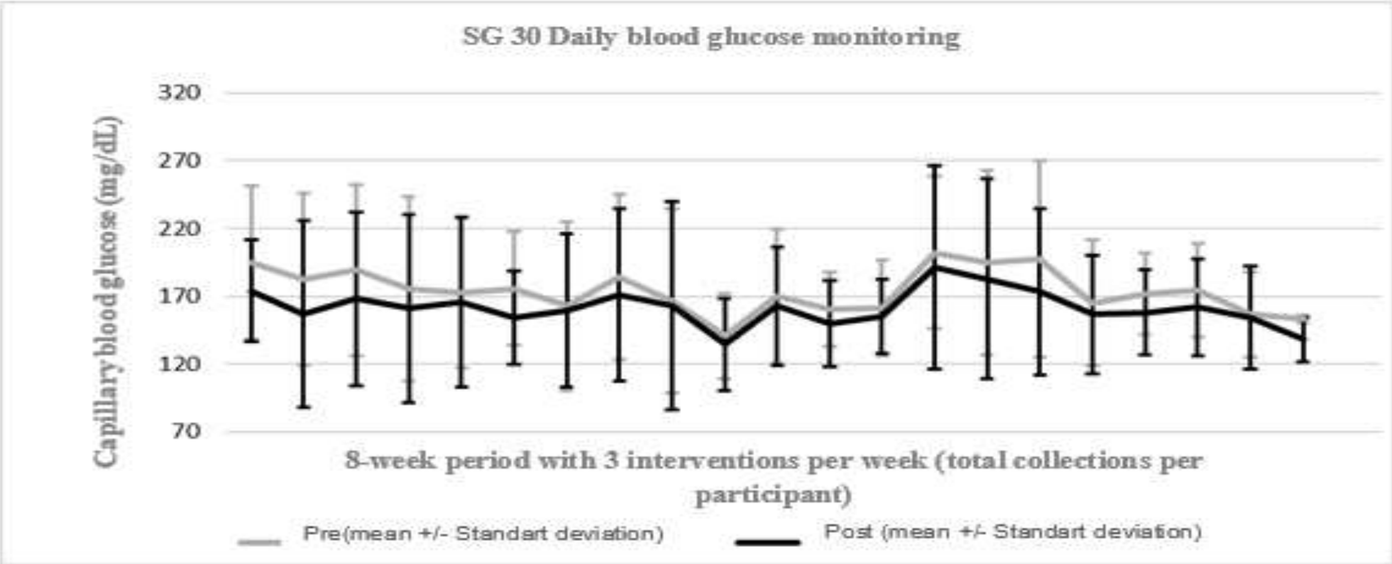
Two-factor ANOVA (Group and Period) for the pre- and post-intervention glucose difference showed that there was a significant effect of the Group factor (p value <0.05), but the period and the interaction between the two factors (Group x Period) showed no significant effect (p value >0.05). The basic descriptive analysis of glucose behavior in the daily period of 8 weeks for all participants.

Figure 2. Daily analysis of capillary glycemic collection (mg/dl), 3 times a week during the 8-week period, pre and post the intervention schedule for the control group (CG), with a mean of 432 collections, with mean ± standard deviation



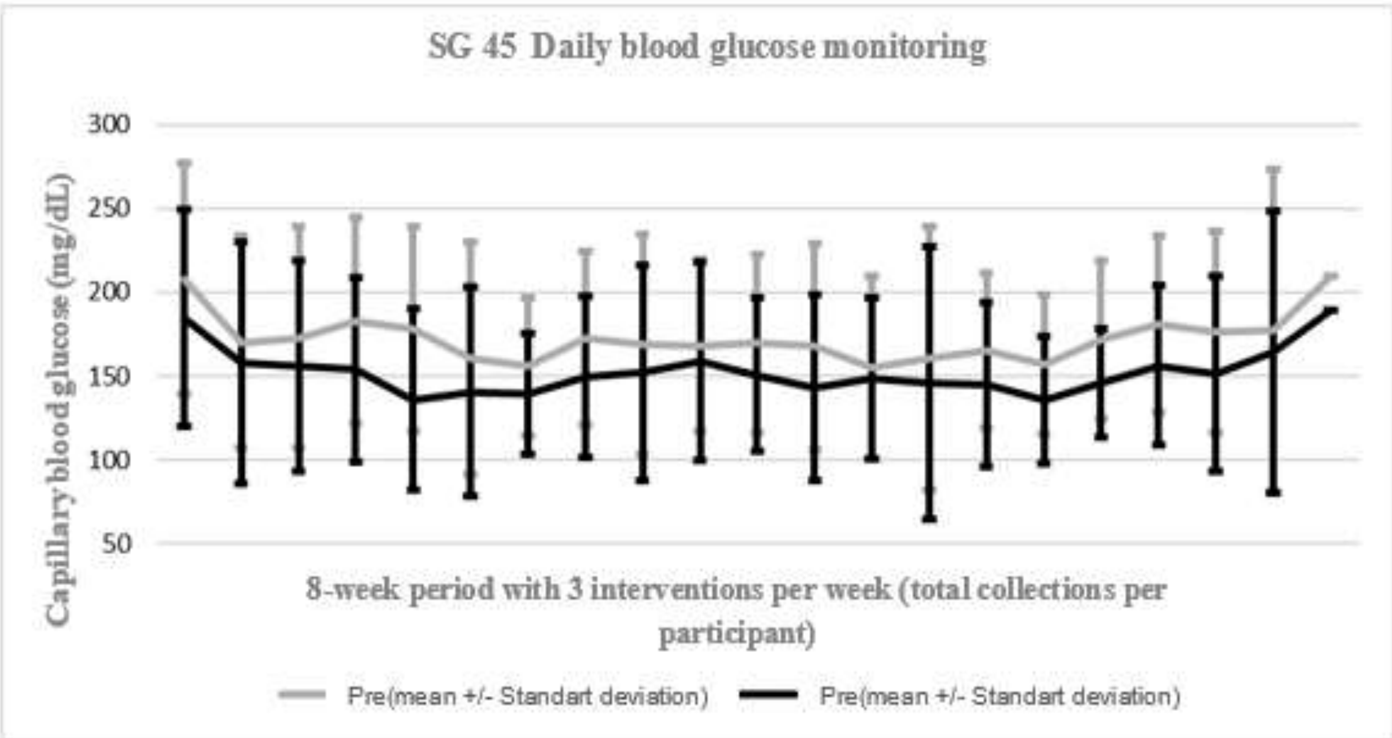
The Figure 2 represents a behavioral mean of pre- and post-intervention daily collections and standard deviation of the control group.

Figure 3. Daily analysis of capillary blood glucose collection (mg/dl), 3 times a week for an 8-week period, pre- and post-intervention of the 30-second stretching group (SG 30), with an average of 480 collections, with mean ± standard deviation



The Figure 3 represents a behavioral mean of pre- and post-intervention daily collections and standard deviation of the 30-second intervention group.

Figure 4. Daily analysis of capillary blood glucose collection (mg/dl), 3 times a week for an 8-week period, pre- and post-intervention of the 30-second stretching group (SG30), with an average of 480 collections, with mean ± standard deviation.



The Figure 4 represents a behavioral mean of pre- and post-intervention daily collections and standard deviation of the 45-second intervention group.

DISCUSSION

The main finding of this study was that active static stretching promotes a reduction in blood glucose levels in individuals with T2DM, both acutely and over an 8-week intervention period. Contrary to our initial hypothesis, time was not a determining factor in this effect. Previous studies have also demonstrated a positive effect of stretching on blood glucose levels in patients with T2DM[3,7,11,13,16-18].

A study conducted by Arnold, Joke, and David (2011) analyzed the effects of stretching with pre-intervention food intake on glycemic behavior. Twenty-two pre-diabetic and type 2 diabetic participants were acutely analyzed and compared two hours after their routine meals, after consuming 355 ml of fruit juice (43g of carbohydrates). After 30 minutes, they performed the protocol with 4 sets of 30 seconds of tension with 15 seconds of rest for 30 seconds to change the segment, totaling 40 minutes of stretching exercise interventions, with one group stretching and the control group simulating the exercise, with collections being performed at three moments: pre-intervention, 20 minutes after the start, and at the end of the training[2].

Following the same line more recent studies by are similar but have some discrepancies. Study follows the closest model of in an acute way, using the variable of food intake, two hours after their routine meals, and ingestion of 355 ml fruit juice (43g of carbohydrate). However, their protocol time is different from Arnold's, with 45 seconds of tension and 15 seconds of rest, with 30 seconds to switch follow-up[2,16,18].

Aimed to compare the two types of stretching (passive vs. active) to determine which one had a better benefit for reducing blood glucose levels in diabetics through capillary collection[16]. The study recruited 20 participants, all with type 2 diabetes, divided into two groups, one for passive stretching and the other for active stretching. The intervention was acute and lasted for 40 minutes, and both groups showed significant reduction in blood glucose levels. However, when compared to each other, the passive group obtained better results. Regardless of the time protocol, passive stretching was superior to active stretching. In the present study, active stretching was standardized, and there was no significant difference between groups in the chronic model.

Conducted a similar acute intervention study with 50 participants with T2DM, divided into two groups: an intervention group with passive static stretching and a control group with simulated stretching. The protocol involved 4 sets of 30 seconds of tension with 30 seconds of rest between muscle groups and 9 exercises. Both groups were subjected to 20 minutes of stretching, with blood glucose levels being collected after 20 minutes and 1 hour after the intervention, concluded that there was a significant reduction in blood glucose levels both 20 minutes and 1 hour after the intervention, which remained low compared to the simulated stretching group. The conclusion was that passive static stretching is an effective intervention for T2DM[18].

Based on your statement, it seems that the present study differs from the previous studies in several aspects. Firstly, the intervention was performed in a chronic manner to evaluate the long-term effect on glycemic control. Secondly, the protocol of time for SG 30 was similar to the previous studies, but the present study had an additional time variable (SG45). Thirdly, the number of series and duration of each series in the present study were different from the previous studies. Fourthly, the present study had a larger sample size than, but smaller than with all participants being diabetic. Lastly, the variable of food intake was not used, and the control group did not receive any instructions to avoid possible changes(2,16,18).

Studies have shown that 20 minutes of stretching are sufficient to reduce blood glucose levels. Two other studies have argued that even with food interference after stretching, blood glucose levels still show a significant reduction(2,16,18).

When comparing the results of the three authors mentioned, there is variation, but with the focus on blood glucose levels. In the present study, we evaluated all diabetic participants acutely and chronically (Table 2, 4 and 5). Unlike the others, we performed active stretching with two time protocols, 30 and 45 seconds, and a control group without any guidance.

The results of the 8 weeks of active static stretching intervention in this study showed significant differences in both intervention groups compared to the control group. Additionally, a comparison between the two intervention groups was performed, which showed no significant differences between them. Both intervention variables were standardized in execution - the participants performed the stretches themselves using a perceived exertion scale to maintain equal intensity. In contrast, passive stretching involved the therapist assisting with the movement, which could result in differences in intensity due to therapist fatigue.

It was not requested or recommended to the participants in the present study to consume any specific type of food or follow a specific diet. They were only asked to maintain their regular diet. However, based on the results, it would be interesting to include a nutritional intervention along with the exercise intervention in future studies. The sample size of the present study and the average number of participants in the combined studies were considered considerable through the sample size calculation.

Two studies presented similarities when comparing chronic effects between active static stretching and passive static stretching, along with functional capacity testing, with 50 participants, all of whom had type 2 diabetes. The study lasted for 12 weeks, with activities conducted three times a week, and the functional capacity test was performed before and after this period. This test consisted of a 6-minute walk, with the distance covered in meters being quantified(15,16).

In the stretching interventions, participants were divided into 3 groups, with 20 in the active static stretching group, 20 in the passive static stretching group, and 10 in the control group. Before and after the 12-week interventions, blood samples were taken for the glycated hemoglobin test, which reflects the average glucose behavior over a period of time. To collect capillary glucose, participants drank 250 ml of water with 75g of sugar, two hours before the intervention, and glucose was collected again at the end of the first session and after 12 weeks following the last intervention.

The results of the study showed significance in glycated hemoglobin levels in the intervention groups, with no difference in the control group. As for the acute analysis of glucose collected in the first session before and after, there was no significance between any of the groups. However, chronically, the first pre-collection compared to the last after the interventions showed significance in the intervention groups when compared to the control group. However, there was no difference when compared between the intervention groups. The result of the functional capacity test performed at the end, compared to the initial result, showed that both active and passive stretching improved the functional capacity of the participants, and there was no difference in the control group[15].

Another result, when compared to the present study, was more comprehensive; they conducted hemoglobin A1c and functional capacity tests, but did not measure flexibility or control the participants' diet. There were some limitations in the study, such as not being able to perform the hemoglobin A1c test because a medical order was required, and due to the pandemic, it was not possible to measure flexibility at the participants' request. However, daily data collection was carried out in all training sessions[15].

According to table 4 and figure 1, there was a fluctuation in blood glucose levels throughout the period, with analyses performed every two weeks within the 8-week intervention period showing no significant changes over time within each group, only significant differences between groups.

Stretching is growing in research, and some researchers have started to compare the glycemic response of stretching with other modalities[7].

The study compared two different modalities, passive static stretching versus weight training, with 51 participants with type 2 diabetes mellitus divided into two groups and analyzed in only one training session. Capillary blood glucose measurements were taken at three points: fasting, 2 hours after a meal, and immediately after exercise. The intervention in the study lasted 60 minutes for both groups, and it concluded that there was no significant difference between the groups, meaning that both the stretching and weight training groups experienced a reduction in blood glucose levels, reinforcing the benefits of stretching as an initial physical activity for diabetics. In comparison to the present study, it was shown that stretching has significant benefits for type 2 diabetics both acutely and chronically. Another study suggests that initially, even in the absence or inability to perform other modalities, stretching is beneficial[7].

The study compared the difference between aerobic training versus neuroproprioceptive facilitation stretching. The study included 40 participants divided into two groups. Within the study, they performed 12 weeks, three times a week, each session totaling 30 minutes of aerobic training (treadmill) at 60% of maximum heart rate, and neuroproprioceptive facilitation stretching for lower and upper limbs with a protocol of 30 seconds of tension followed by 30 seconds of rest between sets[17].

The validation of the study was through pre- and post-intervention HbA1c, and it was concluded that there was no significant difference between the groups, meaning that the benefits of glucose reduction were the same. The present study worked with light to moderate intensity as a reference to the Borg Rating of Perceived Exertion (RPE) test, which showed that stretching at a light intensity has significant results in reducing blood glucose levels. Although the results presented showed no difference between the protocols, blood glucose levels still decreased, demonstrating that even at higher intensity, such as with neuroproprioceptive facilitation stretching, it is possible to obtain glucose reduction[17].

The study conducted passive static stretching interventions with 15 participants, all of whom had type 2 diabetes, for 8 weeks[13]. The chronic behavior of passive stretching on blood glucose was analyzed. When compared to the present study, we followed the same intervention composed of an 8-week period, all diabetic participants, with the control group receiving no guidance, the GA30 protocol and exercises were followed according to their study, but with one less set, from 4 sets to 3 sets. Park did not measure blood glucose, but rather glycated hemoglobin collected pre and post-intervention, which had significant results.

Compared to the study a larger number of participants were obtained and an additional time variable (GA45) was added. The time variable (GA45) was used to determine whether a longer period would be more significant than the standard period (GA30), and the results showed no significant difference in blood glucose. Both studies did not measure flexibility, only blood glucose, focused on glycated hemoglobin. Active static stretching exercises provide metabolic benefits in terms of blood glucose as well as locomotor benefits, improving flexibility and mobility. According to the literature, keeping individuals with type 2 diabetes physically active is necessary to minimize complications caused by the disease, providing greater longevity[13].

This evidence is reinforced in the study which shows that the more active a person with diabetes is, the less likely they are to experience complications compared to sedentary individuals, resulting in lower drug consumption and greater physical activity. Comparing the base work with the literature, it is possible to affirm that regardless, active static stretching promotes glycemic reduction benefits for the population with type 2 diabetes. Based on the exposed and comparisons, the study allows for validation of the work executed[6].

CONCLUSION

This study concluded that active static stretching was efficient in reducing glycemia both acutely and chronically. Within the statistical analysis performed, both intervention groups, GA30 and GA45, showed significant reductions compared to the CG, and there was no difference between intervention groups.

Conflict of Interest: The authors declare no conflict of interest.

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