Effect of Swedish massage Versus Progressive muscle relaxation on Blood Glucose Level of Children with Type 1 Diabetes Mellitus

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Abstract

Background: *Swedish massage (SM) and Progressive muscle relaxation (PMR) are special techniques that recently used in many chronic disorders as type 1 diabetes mellitus (T1DM). Both techniques have a crucial role in reducing stress that can lower blood glucose level in children with T1DM.* ***Objective****: Investigate the effect of Swedish massage versus progressive muscle relaxation on blood glucose level of children with T1DM.* ***Setting****: This study was conducted at the Outpatient diabetic clinic in the Specialized University Hospital at Smouha in Alexandria.* ***Design:*** *A quasi experimental research design was used.* ***Subjects:*** *A convenient sample of 50 diabetic children who were randomly allocated to two equal study groups (study I (SM) and study II (PMR)).* ***Tools****: Two tools were used; Socio-demographic and Medical History of Diabetic Children Interview Schedule and Blood glucose level Assessment Tool* ***Results****: Swedish massage and progressive muscle relaxation were associated with significant decreases in fasting blood glucose level, random blood glucose level and consequently HbA1C after intervention (P<0.001 for all blood glucose levels).The SM group demonstrated more decrease in fasting blood glucose level, random blood glucose level and consequently HbA1C than PMR group. Where means of HbA1C for SM and PMR were 7.88 ± 0.92 and 9.08 ± 1.08 respectively after intervention and there was a statistical significant difference (P = 0.007).* ***Conclusion:*** *Both techniques are effective to decrease blood glucose levels in diabetic children. While Swedish massage was more effective than PMR.* ***Recommendations:*** *Swedish massage and PMR techniques need to be incorporated in the care of diabetic children.*

Key words: - Swedish massage, Progressive muscle relaxation, Type 1 diabetes mellitus, Blood glucose level, Children.

Introduction

Type 1 diabetes mellitus is one of the most common endocrine and metabolic problems occurring in childhood. Type 1 diabetes mellitus (T1DM) is a chronic autoimmune disease characterized by insulin deficiency due to pancreatic β cell destruction which leads to increase blood glucose levels (hyperglycemia). Ineffective glycemic control can affect the growth and development of children and adolescents. It is usually associated with acute and chronic complications that have impact on children's quality of life (Katsarou et al., 2017; Madrigal et al., 2020).

In 2019, the International Diabetes Federation (IDF) reported that approximately

1,110,100 children are estimated to have T1DM worldwide. They reported that around 98,200 children under 15 years were diagnosed with T1DM worldwide each year (Patterson et al., 2019). The annual incidence in the United States is approximately 20 in 100,000 children. The prevalence of T1DM is highest in non-Hispanic whites followed by African Americans, Hispanics, and American Indians (Marcdante & Kliegman, 2019). The largest contribution to the total number of estimated childhood T1DM cases among Eastern Mediterranean and Middle Eastern countries comes from Egypt. It accounts for about a quarter of the region's total, 8/100 000 per year in egyptian children under the age of 15 years had T1DM (El-Ziny et al., 2014).

Stress is considered as one environmental factor contributing to the development of T1DM in children. Theoretically, the beginning of the autoimmune process could be triggered by stress and contribute to its progression. Stress results in elevated cortisol levels that may contribute to insulin resistance. Epinephrine (another hormone released during stress), inhibits also the insulin secretion and leads to an increase in the need for insulin. Stress can be controlled through behavioral intervention techniques as Swedish massage and progressive muscle relaxation which are very important to improve glycemic condition of children with T1DM (Argyropoulos et al., 2021).

Swedish massage (SM) is a relaxation technique that focuses on improving blood flow to the skin, muscle and removing tension of the muscles. It was the first systematic method of therapeutic massage based on a physiological perspective. It is built around five basic superficial strokes – effleurage (sliding or gliding), petrissage (kneading), tapotement (rhythmic tapping), friction (steady pressure) and vibration or jostling (De Omena Bomfim, 2021).

Progressive muscle relaxation (PMR) is one of the best effective non-pharmacological techniques, which decreases stress in children because it influences mental and physical conditions. It can be applied by making the muscles maximally strain, and then loosening it until the muscle is relaxed. It is repeated until children acquire complete relaxation (Casman & Nurhaeni, 2018). Progressive muscle relaxation leads to regulation of autonomic nervous system activity that potentially contributes to medical management of T1DM through improving in glycosylated hemoglobin level (HbA1c) (Paschali et al., 2020).

Swedish massage and Progressive muscle relaxation had an effective role in decreasing blood glucose level in children with T1DM, so that the pediatric nurse should apply and educate care giver about Swedish massage and PMR techniques (Ismaili et al., 2018).

Aim of study

This study aimed to investigate the effect of Swedish massage versus progressive muscle relaxation on blood glucose level in children with T1DM.

Research Hypothesis:

Diabetic children who are subjected to Swedish massage exhibit low blood glucose level than those who are subjected to PMR.

Materials and Method

Design:

A quasi experimental research design was used.

Settings:

This study was conducted at the Outpatient diabetic clinic in the Specialized University Hospital at Smouha in Alexandria.

Subjects:

A convenience sampling of 50 diabetic children who fulfilled the following criteria comprised the study subjects:

Inclusion criteria:

- Diabetic children's age: 6 - 12 years.
- Children who live in Alexandria only.

- Free from other medical disorders as cardiac, renal, or any other metabolic disorder.

The subjects of the study were randomly allocated to two equal groups as follows 1st diabetic child for study group (I) then the 2nd diabetic child for study group (II):

a. **Study group (I):** Twenty-five diabetic children who received Swedish massage in addition to routine nursing care of the unit for diabetes.

b. **Study group (II)** Twenty-five diabetic children who received PMR in addition to routine nursing care of the unit for diabetes.

Tools: Two tools were used for data collection. Tool I and Tool II were developed by the researcher after review of relevant literature (Elleri et al., 2014; Hockenberry & Wilson, 2018; Marcdante & Kliegman, 2019)

Tool I: Socio-demographic and Medical History of Diabetic Children Interview Schedule:

It included two parts as follows:

Part 1: Socio-demographic characteristics of diabetic children as age, gender and birth order.

Part 2: Medical History of Diabetic Children as duration of DM, history of recent hospitalization and presence of diabetic complications.

Tool II: Blood glucose level Assessment Tool:

This tool included:

1- Fasting blood sugar.
2- Random blood sugar.
3- Glycosylated Hemoglobin (HbA1c).

Method

1. Approval from ethical research committee, Faculty of Nursing, Alexandria University was obtained.
2. An official letter from the Faculty of Nursing was sent to appropriate authorities in the Outpatient Endocrinology Unit at the Specialized University Hospital at Smouha in Alexandria. Permission to conduct the study was obtained after explanation of its aim.
3. Initially the researcher attended an extensive Swedish massage and Progressive Muscle Relaxation training program.
4. Swedish massage training program was in the department of Health Sciences, Faculty of Physical Education, Alexandria University, before data collection. The researcher got a certificate.
5. Progressive muscle relaxation training program was in the higher authority for complementary medicine of the Arab African union. The researcher got a certificate.
6. The researcher had successfully attended the two courses for a period of 4 days for each course. Total hours for each course were 24 hours (6 hours/ day).
7. Tools I and II were developed by the researcher.
8. Tools I and II were submitted to a jury of five experts in the field of pediatric nursing to assess content validity and its value was 92%.
9. Reliability of the tool 1 and the tool 2 were ascertained using Cronbach's Alpha test and its value was 0.917 which was accepted.
10. A pilot study was carried out on 5 diabetic children (10% of total sample size) in order to assess feasibility of the study and applicability of the tools. Necessary modifications were done. These children were excluded from the study subjects.
11. The researcher greeted mothers and their children, reassured them, and explained the aim of the study.
12. Tool I was applied for the two study groups at the first day of the study.
13. **A.** Tool II fasting blood glucose was monitored before breakfast each session for the two groups

    B. random blood sugar was done before and after intervention for the two study groups in each session during the 3 months.

C. Glycosylated Hemoglobin (HbA1c) was calculated at the beginning of collection of data for the two groups.

13. **For study group (I):** a. Swedish massage was done in quiet room with appropriate temperature and light at 9 a.m.

    b. The researcher advised children to take off their clothes except panties and lie in supine position.

    c. The researcher did the massage for diabetic children twice per week for 30 minutes per session for three months.

    d. At the beginning of the massage the researcher applied the lavender Jonson oil for lubrication, spread it over the surface, warm the surface layer of tissue and reflexively create a smooth relaxing flow and rhythm for the application of the stroke.

    e. The first process of implementation of Swedish massage was **Effleurage** in which the researcher did long, firm gliding strokes with the whole hand or thumbs. The strokes trace the outer contours of the body.

    f. The second process was **Petrissage,** where the researcher lifted, rolled, grasped, stretched, and compressed or squeezed the underlying tissue of abdomen, back, arm, and leg of child.

    g. The third process was **Tapotement.** In this process the researcher did a rhythmic percussion, most frequently administered with the edge of her hand, a cupped hand or the tips of the fingers.

    h. The fourth process was **Friction** in which the researcher did a deep and circular movement near joints and other bony areas such as rib cage in front and backbones in the back.

    j. The last process of Swedish massage was **Vibration,** where the researcher made shaking, quivering, trembling, or rocking movements with the fingers, or full hand to all body parts from the front and from the back.

    k. Finally the researcher advised the children to put on their clothes.

14. **The Progressive muscle technique (PMR)** exercise was performed by children in study group (II) under supervision of the researcher in the following manner:

a. Progressive muscle relaxation technique started at 9 a.m twice per week for 30 minutes per session for three months.
b. Progressive Muscle relaxation technique was done by advising the children to lie down or sit down on the bed and take deep breaths before the beginning of PMR technique.
c. The researcher advised the child not to strain or overly tense the muscles, which systematically included in PMR technique. Just creating a little tension is sufficient to cultivate greater awareness of tension in the body and the relaxation that occurs when contracted muscles are released.
d. If any of the exercises caused discomfort or cramping, eased up, stopped or skipped this body part to prevent exacerbation in any pre-existing injury or cause pain.
e. Researcher advised the child to avoid holding the breath while tensing up muscles as this can cause stress in the body.
f. Synchronized the breath with movements in the body by breathed in while creating tension and breathe out when releasing the tension. This rhythmic pattern of breathing and movement can enhance the feeling of relaxation throughout the body and helped calm the mind.
g. During the PMR technique, diabetic children contracted active muscles for 5 seconds and then released of the same muscles for 30 seconds.
h. The sequence used by children in study group (II) under supervision of the researcher was done as follows: - Fists – Clenched both fists and hold. Biceps – Bended elbows and tensed biceps muscles. Triceps – Straighten arms and tensed muscles in back of arms. Forehead – Wrinkled forehead in a frown and hold. Eyes – Closed eyes tightly and hold. Jaw – Gently clenched

jaw, Tongue – Press against roof of mouth and hold. Lips – Press together and hold. Neck – Gently press neck back and hold. Then bring head forward to chest and hold. Shoulders – Shrugged shoulders as high as he can and hold stomach out as much as possible and hold. Lower back – Gently arched up. Buttocks – Tighten muscles in buttocks and hold. Thighs – Tensed by lifting legs off floor and hold. Calves – Press toes downward, as if burying them in sand, and finally Shins and ankles – Bended feet toward head and hold.

15. Glycosylated Hemoglobin (HbA1c) was calculated after three months using tool two at the end of collection of data for the two groups.

Ethical considerations:

- Informed written consent was obtained from diabetic children's caregivers for their participation in the study after explaining the aim of the study.
- The right to refuse to participate or withdraw from the study at any time was assured.
- The privacy of children was ascertained.
- Confidentiality of data was maintained.

Statistical analysis:

- The collected data were coded and entered in special format to be suitable for computer feeding.
- Following data entry, checking and verification process were carried out in order to avoid any errors.
- Data were analyzed using the statistical package for social science SPSS (version 20).
- The following statistical analysis measures were used:
  - **Descriptive statistical measures,** included numbers, percentages of Arithmetic mean and Standard deviation.
  - **Statistical analysis tests,** which included Chi square, ANOVA test, Fisher Exact and Monte Carlo test.
  - **Significance** of the obtained results was judged at the 5% level.

Results:

Table (1) illustrates socio-demographic characteristics of diabetic children. It revealed that 52% of each of diabetic children who received SM and those who received PMR were females. The highest percentage of each of the diabetic children who received SM and PMR groups were in the age group from 10 to 12 years (44% and 52% respectively). Regarding the child birth order, the highest percentage was for the first and second birth order in the family for Swedish massage and PMR groups (60%- 92% respectively).

Medical history of diabetic children is shown in **table (2)**. It was clear from this table that the highest percentage of SM group (56%) was within the duration of DM from less than one to 2 years. The highest percentage in PMR group (40%) was within the duration of 3 to 4 years. The majority of SM group (92%), while nearly three quarters (72%) of PMR group were previously admitted to the hospital. The most common diabetic complications in study group I (SM) and study group II (PMR) were hyperglycemia (100% and 96%, respectively) and lack of concentration (68% and 40% respectively).

Table (3) presents that comparison between SM and PMR groups regarding means of fasting blood glucose level before breakfast. It was clear that the mean of fasting blood glucose level of Swedish massage group at the end of 12th week was less than those at the end of first week, where means were 106.28 ± 15.43 and 166.5 ± 42.62 respectively. There was highly statistically significant difference between all weeks of the study (P1 <0.001). The mean of fasting blood glucose level of PMR group at the end of 12th week (133.28 ± 11.05) was less than those at the end of first week (142.16 ± 26.30). There was highly statistically significant difference between all the weeks of the study (P1 <0.001). It

was noticed from the same table that mean fasting blood glucose level of Swedish massage group at the end of 12th week (106.28 ± 15.43) was less than those in PMR group at the same week (133.28 ± 11.05).There was a statistical significant difference between both groups (P2= 0.001).

Comparison between SM and PMR groups related to means of random blood sugar level before and after each session is highlighted in **Table (4).** It revealed from the table that mean of random blood sugar after 24th session in SM group (150.08 ± 19.72) was less than those before the first session (264.7 ± 82.01). There was a statistical significant difference between all of the study weeks (P1 <0.001). This table shows that the mean of random blood sugar after 24th session in PMR group (218.72 ± 46.59) was less than those before the first session (248.52 ± 35.54). There was a statistical significant difference between all the study weeks (P1 <0.001). It revealed from the same table that mean of random blood sugar level at the end of 12th week of the study in SM group (150.08 ± 19.72) was less than those in PMR group (218.72 ± 46.59) at the same week. There was a statistical significant difference between both groups (P2 <0.001).

Table (5) shows comparison between SM and PMR groups regarding means of HbA1c. It was noticed that the mean of HbA1c in the SM group at the end of the 12th week (7.88 ± 0.92) was less than those at the beginning of the study (9.74 ± 1.11). There was a statistical significant difference (P0<0.001). This table shows also that the mean of HbA1c in PMR group at the end of the 12th week (9.08 ± 1.08) was less than those at the beginning of the study (9.74 ± 1.12). There was a statistical significant difference (P0 <0.001). It was obvious from this table that mean at the 12th week of the study in SM group (7.88 ± 0.92) was less than those in PMR (9.08 ± 1.08). There was a statistical significant difference (P = 0.007).

Discussion

Diabetes mellitus is the most common chronic metabolic disease in childhood. Children with T1DM more frequently experience stress compared with other children. Stress response activates sympathetic nervous system that may enhance cortisol release, increase insulin resistance and elevate blood glucose level (Nygren, 2015). So, it is important to apply complementary medicine as Swedish massage and progressive muscle relaxation (PMR) techniques, which helped in relieving stress in addition to routine care of diabetic children as, insulin injection, diet management, and exercise. (Anna et al., 2018).

The present study results showed that means of fasting blood glucose level (Table 3), random blood glucose level (Table 4) and HbA1c blood glucose level (Table 5) for SM and PMR at the end of 12th week were less than those at the end of first week. The difference was highly statistically significant. Field (2019) supported the present study as he reported that implementing massage was more effective to children and adolescents with chronic disease as T1DM. The blood glucose levels were significantly lower in the SM group by the end of the three months period of application of massage . Talakoub et al. (2010) results were congruent with the current study. He reported that application of PMR in children was more effective in decreasing blood glucose levels at the end of the study period.

The results related to positive effect of SM and PMR at the end of 12th week of the study may be related to the fact that children became more relaxed at the end of the study than at the beginning. They became more familiar with techniques. It is due to body release a lot of endorphins throughout the study period which can calm the central nervous system so that reduce blood glucose levels with progression in sessions (Purba et al., 2019). Rodríguez-

Mansilla et al. (2017) agreed with the current study and reported that effect of SM and PMR techniques became more effective after the fourth session because the children became more relaxed.

The findings related to positive effect of SM and PMR on blood glucose levels could be explained in the light of the fact that SM and PMR techniques stimulate hypothalamus to decrease action of sympathetic nervous system and increase action of parasympathetic. These actions lead to decrease stress hormones as cortisol and glucagon, which consequently decrease blood glucose level (Purba et al., 2019). These results may be due to that around one half of children in SM group and more than half in PMR group were at age group 10-12 years (Table 1). According to Piaget cognitive developmental theory at this age, children became able to think and connect between actions in logical manner. So that they feel comfortable to connect between application of SM or PMR and sense of relaxation, which lead to decrease blood glucose level. Moreover these results may be contributed to the role of mothers in children's life. Mothers are considered as the corner stone related to children. Children may be compliance with SM and PMR techniques that lead to decrease blood glucose levels because in this time they became more attached to their mothers and got great attention from them.

The findings could be explained by the fact that children in school age became more interested in using technology. So that, they were interested in watching videos that the researcher sent to them about SM and PMR techniques. Children became more curious and be stimulated to come to sessions of techniques, which produced effective results at the end of study period. Moreover, Kashaninia et al. (2015) reported that Swedish massage is easy to apply, free from risk, non-invasive, and relatively inexpensive which makes it the most common complementary medicine used in nursing. It may be another cause for commitment to techniques and decreased blood glucose levels at the end of the study due to easiness, safety, and cost- effective of techniques in decreasing and stabilizing blood glucose level, which made mothers more motivated to complete all sessions for their children. Elagamy et al. (2020) and Magor et al. (2014) supported the current study and cited that PMR technique is the easiest technique to be learned and administered to children, inexpensive, available at any time, self-induced by children, and had no side effects.

Although SM and PMR techniques had positive effect in reducing blood glucose levels. Swedish massage technique was more effective than PMR technique in reducing blood glucose level in diabetic children. Where means of fasting blood glucose level (Table 3), random blood glucose level (Table 4), and consequently HbA1c blood glucose level (Table 5) in SM group were less than those in PMR group throughout the study period. There were statistically significant differences between both groups at the end of the 12th week. These results are supported by Ghazavi et al. (2008) and Sajedi et al. (2011) who study the effect of massage therapy and muscle relaxation on blood glucose levels in diabetic children. They reported that Swedish massage technique is more effective than progressive muscle relaxation technique in decreasing the blood glucose level. These results could be contributed to that the researcher in SM technique had active role to touch children, while in PMR technique the researcher just gave instructions and motivated the children to carry it out by themselves. Touch had an important effect to help children reach state of deep relaxation that leads to decrease blood glucose levels than effect of instructions and motivation in PMR group. In addition, the role of the child in SM technique is passive role, while in PMR technique the child had an active role. He must do the technique correctly and effectively with complete attention to reach the state of deep relaxation. Children in this age may not be able to follow a lot of instructions and keep attention for a long period of time.

From the ongoing discussion, it can be noted that integrating complementary medicines as Swedish massage and progressive muscle relaxation techniques to routine nursing care are considered one of the nursing priorities for diabetic children. Swedish massage and PMR enhance children's physiological parameters related to blood glucose levels (fasting, random, and consequently HbA1c). Therefore, nurses in diabetic unit have a more meaningful and active role in teaching as well as implementing the complementary medicines including Swedish massage and progressive muscle relaxation and could integrated them in children's plan of care.

Conclusion:

Based upon the findings of the current study, diabetic children who received SM or PMR techniques had positive effect on reducing blood glucose levels (fasting, random and consequently HbA1c). There were highly statistically significant differences at the end of 12th week of the study in SM and PMR groups related to blood glucose level.

Diabetic children who were subjected to Swedish massage had more positive effect in decreasing blood glucose levels (fasting, random and consequently HbA1c) than those who were subjected to Progressive Muscle Relaxation with statistically significant differences.

Recommendations:

- Inservice training program should be provided for all nurses working in diabetic units as regards SM and PMR techniques and its benefits for diabetic children.
- Swedish massage and PMR techniques need to be incorporated in the care of diabetic children.
- Nurses should be able to use telehealth and telenursing in nursing care, follow up and compliance with SM and PMR for diabetic children.
- Nurses have an important role in educating mothers about the importance of both techniques and its effectiveness on their children health status and how to apply them effectively.
- Simplified booklet and CD with videos about SM and PMR techniques and its application should be available for nurses and mothers in diabetic units.

Table (1) Percentage distribution of socio-demographic characteristics of diabetic children

	Socio-demographic Characteristics of Diabetic Children:	SM (Study I) (n = 25)		PMR (Study II) (n = 25)	
		No.	%	No.	%
1	**Gender**				
	Male	12	48.0	12	48.0
	Female	13	52.0	13	52.0
2	**Child's age (years)**				
	6 –	10	40.0	1	4.0
	8–	4	16.0	11	44.0
	10–12	11	44.0	13	52.0
	Mean ± SD.	8.76 ± 2.39		9.80 ± 1.47	
3	**Birth order of the child:**				
	1–	15	60.0	23	92.0
	3–	9	36.0	2	8.0
	5 and more	1	4.0	0	0.0

SD: Standard deviation

Table (2) Percentage distribution of medical history of diabetic children

	Medical history of diabetic children	SM (n = 25) (Study I)		PMR (n = 25) (Study II)	
		No.	%	No.	%
1	**Duration of DM (Years)**				
	<1-	14	56.0	7	28.0
	3-	5	20.0	10	40.0
	5 and ≥6	6	24.0	8	32.0
	Mean ± SD.	2.65 ± 1.68		3.72 ± 1.67	
2	**Previous hospital admission**				
	Yes	**23**	**92.0**	**18**	**72.0**
	No	2	8.0	7	28.0
3	**Presence of diabetic complications #**				
	Hypoglycemia	11	44.0	3	12.0
	Hyperglycemia	25	100.0	24	96.0
	Infections	2	8.0	0	0.0
	Lack of concentration	17	68.0	10	40.0

SD: Standard deviation **# More than one answer**

Table (3): Comparison between Swedish massage and Progressive muscle relaxation groups regarding means of fasting blood glucose level before breakfast

Level of fasting blood glucose before breakfast	SM (n = 25) (Study I)		PMR (n = 25) (Study II)		$^{F1}p_2$
	Mean ± SD.	Mean ± SD.	Mean ± SD.	Mean ± SD.	
1st Week	**1st Session**	**2nd Session**	**1st Session**	**2nd Session**	0.028*
	195.8 ± 80.52	166.5 ± 42.62	136.56 ± 15.84	142.16 ± 26.30	
2nd Weeks	**3rd Session**	**4th Session**	**3rd Session**	**4th Session**	0.057
	154.2 ± 49.73	154.8 ± 47.20	137.96 ± 17.78	129.64 ± 30.15	
3rd Weeks	**5th Session**	**6th Session**	**5th Session**	**6th Session**	0.442
	152.44 ± 47.80	135.48 ± 44.73	138.52 ± 22.64	147.44 ± 23.33	
4th Weeks	**7th Session**	**8th Session**	**7th Session**	**8th Session**	0.995
	146.92 ± 47.41	139.92 ± 43.25	142.80 ± 17.58	140.88 ± 19.52	
5th Weeks	**9th Session**	**10th Session**	**9th Session**	**10th Session**	0.442
	133.44 ± 51.68	132.20 ± 37.40	144.36 ± 12.48	142.24 ± 17.92	
6th Weeks	**11th Session**	**12th Session**	**11th Session**	**12th Session**	0.102
	142.0 ± 53.75	123.48 ± 29.92	145.96 ± 22.47	139.32 ± 21.28	
7th Weeks	**13th Session**	**14th Session**	**13th Session**	**14th Session**	0.078
	130.96 ± 28.34	121.64 ± 28.45	139.16 ± 14.16	138.48 ± 15.23	
8th Weeks	**15th Session**	**16th Session**	**15th Session**	**16th Session**	0.036*
	120.68 ± 25.59	126.72 ± 20.69	143.60 ± 18.44	144.60 ± 19.15	
9th Weeks	**17th Session**	**18th Session**	**17th Session**	**18th Session**	0.003*
	123.96 ± 22.77	117.40 ± 24.52	138.88 ± 19.18	138.28 ± 14.95	
10th Weeks	**19th Session**	**20th Session**	**19th Session**	**20th Session**	0.002*
	117.76 ± 19.99	115.32 ± 22.88	137.56 ± 14.41	137.48 ± 15.27	
11th Weeks	**21th Session**	**22th Session**	**21th Session**	**22th Session**	0.073
	121.48 ± 26.10	116.60 ± 14.89	136.88 ± 15.78	132.60 ± 12.60	
12th Weeks	**23th Session**	**24th Session**	**23th Session**	**24th Session**	0.001*
	106.60 ± 18.26	106.28 ± 15.43	135.20 ± 14.05	133.28 ± 11.05	
$^{F2}p_1$	<0.001*		<0.001*		

SD: **Standard deviation**

F1: **F for One way ANOVA test**, Pairwise comparison bet. each 2 groups was done using **Post Hoc Test, (Tukey)**

F2: F test (ANOVA) with repeated measures, Sig. bet. periods was done using **Post Hoc Test (adjusted Bonferroni)**

p_2: p value for comparing between SM and PMR groups in second session

p_1: p value for comparing between the studied weeks in each session in each group *: Statistically significant at $p \leq 0.05$

Table (4): Comparison between Swedish massage and Progressive muscle relaxation groups related to means of random blood sugar level before and after each session

Random blood sugar	SM (n = 25) (Study I)				PMR (n = 25) (Study II)				$^{F1}p_2$
	Before	After	Before	After	Before	After	Before	After	
	Mean ±SD.	Mean ±SD.	Mean ±SD.	Mean ±SD.	Mean ±SD.	Mean ±SD.	Mean ±SD.	Mean ±SD.	
1st Week	1st Session		2nd Session		1st Session		2nd Session		0.084
	264.7 ± 82.01	243.2 ± 71.21	227.1 ± 59.17	213.5 ± 59.15	248.52 ± 35.54	240.76 ± 34.35	253.60 ± 34.63	242.32 ± 31.33	
2nd Weeks	3rd Session		4th Session		3rd Session		4th Session		<0.001*
	202.20 ± 51.50	182.0 ± 43.10	203.40 ± 43.83	183.60 ± 37.79	246.80 ± 27.58	236.44 ± 32.37	248.84 ± 24.40	238.36 ± 27.82	
3rd Weeks	5th Session		6th Session		5th Session		6th Session		<0.001*
	212.32 ± 47.28	188.0 ± 48.66	213.08 ± 40.29	188.04 ± 35.38	244.04 ± 29.14	231.76 ± 31.33	248.52 ± 26.12	237.12 ± 26.14	
4th Weeks	7th Session		8th Session		7th Session		8th Session		<0.001*
	208.72 ± 32.0	181.96 ± 28.60	206.28 ± 39.28	179.20 ± 37.40	246.88 ± 18.84	238.04 ± 19.39	247.24 ± 18.32	236.72 ± 19.24	
5th Weeks	9th Session		10th Session		9th Session		10th Session		<0.001*
	198.96 ± 50.11	171.84 ± 43.29	207.96 ± 47.89	180.12 ± 45.18	240.0 ± 24.09	232.84 ± 23.20	238.80 ± 19.89	229.28 ± 20.82	
6th Weeks	11th Session		12th Session		11th Session		12th Session		<0.001*
	208.44 ± 35.92	177.0 ± 29.88	209.0 ± 46.80	180.08 ± 41.07	241.52 ± 19.88	232.32 ± 19.73	240.20 ± 21.14	229.76 ± 21.18	
7th Weeks	13th Session		14th Session		13th Session		14th Session		<0.001*
	210.68 ± 37.40	179.24 ± 33.81	217.72 ± 28.43	183.80 ± 23.06	237.56 ± 23.97	226.16 ± 25.29	238.08 ± 21.17	229.44 ± 21.99	
8th Weeks	15th Session		16th Session		15th Session		16th Session		0.001*
	202.36 ± 29.28	173.12 ± 24.42	208.40 ± 42.09	178.12 ± 41.93	242.12 ± 24.59	232.44 ± 25.79	234.32 ± 25.02	224.68 ± 26.73	
9th Weeks	17th Session		18th Session		17th Session		18h Session		<0.001*
	196.88 ± 34.70	167.52 ± 33.37	209.32 ± 17.52	174.36 ± 19.66	239.56 ± 21.06	229.84 ± 20.95	238.60 ± 22.33	228.48 ± 24.02	
10th Weeks	19th Session		20th Session		19th Session		20th Session		<0.001*
	192.24 ± 38.56	158.44 ± 33.58	196.32 ± 21.59	165.40 ± 18.45	243.44 ± 23.74	232.16 ± 22.51	244.0 ± 22.04	235.40 ± 22.29	
11th Weeks	21th Session		22th Session		21th Session		22th Session		<0.001*
	187.64 ± 29.50	157.84 ± 27.69	195.04 ± 26.22	156.40 ± 25.99	239.96 ± 20.05	228.64 ± 20.44	254.48 ± 65.91	231.40 ± 22.66	
12th Weeks	23th Session		24th Session		23th Session		24th Session		<0.001*
	189.48 ± 20.35	151.32 ± 18.90	189.64 ± 19.28	150.08 ± 19.72	240.60 ± 21.46	228.92 ± 20.52	238.60 ± 23.11	218.72 ± 46.59	
$^{F2}p_1$	<0.001*				<0.001*				

F1: **F for One way ANOVA test**, Pairwise comparison bet. each 2 groups was done using **Post Hoc Test, (Tukey)**
F2: F test (ANOVA) with repeated measures, Sig. bet. periods was done using **Post Hoc Test** (**adjusted Bonferroni)**
P_2: p value for comparing between SM and PMR groups in second session **(after)**
p_1: p value for comparing between the studied weeks in each session in each group
*: Statistically significant at $p \leq 0.05$

Table (5): Comparison between Swedish massage and Progressive muscle relaxation groups regarding means of glycosylated haemoglobin level (HbA1c)

Glycosylated Haemoglobin (HbA1c)	SM (n = 25) (StudyI)	PMR (n = 25) (Study II)	^{F1}p
Value at the beginning of the first week of the study Mean ± SD.	9.74 ± 1.11	9.74 ± 1.12	1.000
Value at the end of 12th week of the study Mean ± SD	7.88 ± 0.92	9.08 ± 1.08	0.007*
$^{F2}p_0$	**<0.001***	**<0.001***	

F1: **F for One way ANOVA test**, Pairwise comparison bet. each 2 groups was done using **Post Hoc Test, (Tukey)**
F2: F test (ANOVA) with repeated measures, Sig. bet. periods was done using **Post Hoc Test** (**adjusted Bonferroni)**
p: p value for comparing between the studied groups
p_0: p value for comparing between **beginning** and **end value**
*: Statistically significant at $p \leq 0.05$

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