

## How Effective is Swedish Massage on Blood Glucose Level in Children with Diabetes Mellitus?

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Received: 10 Jan. 2011; Received in revised form: 3 Feb. 2011; Accepted: 20 Feb. 2011

**Abstract-** This study was conducted to determine the effect of Swedish massage on blood glucose level in children with diabetes mellitus (DM). It was prospective randomized controlled trial study that conducted on 36 children, 6-12 years old with DM, recruited from a hospital in Qom City, Iran. The children were randomly assigned to intervention and control groups. Swedish massage was performed 15 minutes, 3 times a week, for 3 months in intervention group. The blood glucose levels were evaluated immediately after every session of massage in two groups. The mean ages of children in the intervention (n=18) and control (n=18) groups were 9.05±1.55 and 9.83±2.03 years respectively. There was statistically no significant difference in blood glucose levels before intervention between two groups ( $P=0.586$ ), but the blood glucose levels were lower significantly in intervention group in comparison with control group after intervention ( $P<0.0001$ ). Addition of Swedish massage to daily routines; exercise, diet and medication regimens, is an effective intervention to reduce blood glucose level in diabetic children.

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*Acta Medica Iranica*, 2011; 49(9): 592-597.

**Keywords:** Blood glucose; Diabetes Mellitus; Massage; Child

### Introduction

Diabetes mellitus (DM) is one of the most common severe chronic childhood diseases with a variable incidence among different ethnic groups; from 0.7/100000 per year in Karachi-Pakistan to about 40/100000 per year in Finland. The incidence of DM is rapidly increasing and shows a trend toward earlier age of onset. The increasingly prolonged survival of the diabetic child is associated with an increasing prevalence of complications (retinopathy, neuropathy). These long term complications are related to glycemic control. A good metabolic control is having a profound influence on reducing the incidence and the severity of certain complications (1). However achieving good control can be difficult for many individuals because the delicate hormonal balance that controls glucose homeostasis is disrupted by the disease, before diagnosis and easily upset by physical and psychological stress after diagnosis even if the person is on diabetes treatment (2).

Because of the chronic nature of diabetes many people turn to complementary therapies (CT) to assist them to cope and control the disease (2) Leese *et al.* surveyed people with diabetes attending a diabetic outpatient clinic in the UK and found 17% were using CT (3). A similar survey in Canada found 25% of people with diabetes used CT (4). The main therapies used were nutritional and spiritual therapies, herbs, massage and meditation (5). More than 1000 years ago, diabetes was treated in various societies with relaxation, massage, opium, and moderate exercise, as well as dietary alternations (6).

There are 5 forms of massage therapy. The first is traditional European or Swedish, the most common form of massage in the United States. The focus is on relaxation and improved blood circulation through muscle massage (7,8).

Swedish massage was developed in 1914 by Per Henrik Ling; this method is considered one of the first scientific approaches to massage, aiming specifically to affect the circulatory, lymphatic, and nervous systems.

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Long, gliding strokes (referred to as friction) are used to enhance blood and lymph flow; kneading (called petrissage) is used to relax muscle tension; and tapping, cupping, and hacking movements (called tapotement) are used to stimulate nerves. (9)

It has been shown that there are significant correlations between poor metabolic control and depressive symptoms, and a high level of anxiety (1). Massage has been shown to decrease anxiety in a variety of patient populations, including people with diabetes. These stress reducing benefits of massage have raised the possibility that massage may be of benefit to people with diabetes by inducing the relaxation response, thereby controlling the counter-regulatory stress hormones and permitting the body to use insulin more effectively (9-14).

Cortisol is a stress hormone associated with the sympathetic response of the autonomic nervous system (15,16). Massage therapy (MT) is expected to reduce cortisol levels, a finding that would be consistent with facilitating a parasympathetic response of the autonomic nervous system (16-18). So massage has continued to be found useful for lowering blood glucose levels (11,12). This study was conducted to determine the effect of Swedish massage on blood glucose level in children with DM.

## Materials and Methods

### Subjects

Following ethical approval from the ethics committee of the University of Social Welfare and Rehabilitation Sciences (USWR), a prospective, randomized, controlled trial study was conducted in 2009, at the Clinic of Kamkar-Arabnia Hospital, Qom City, Iran. Inclusion criteria were age between 6-12 years, diagnosis of DM type I (based on medical file), and parents & children cooperation. Exclusion criteria were skin disease, osteopathy, malignancy in spinal cord, drug consumption (except for DM), and severe sensorial or movement disorders. Forty eight patients were assessed for eligibility. Six patients were excluded because of not meeting inclusion criteria and six other patients refused to participate. All parents received documented information about the aims and plans of the research, and were asked to sign consent forms; those not willing to participate would be provided with services as usual. Finally 36 patients with DM enrolled in this study. The subjects were randomly assigned to intervention and control groups on the basis of random number table.

### Protocol

We focused on forms of MT that are concordant with the traditional Swedish styles of massage; Swedish massage is performed on a table or special massage chair with oil and systematically starts and finishes in the following manner. The first process is stroking (effleurage), which consists of long, firm gliding strokes usually done with the whole hand or thumbs. The strokes trace the outer contours of the body. The second is kneading (petrissage), which is the process of working on specific muscle groups by rhythmically lifting, rolling, kneading, or squeezing them. Third is friction. The therapist uses circular strokes often moving opposite to the muscle fibers to reach the deeper muscles and for connective tissues such as tendons. Fourth is percussion (tapotement), which uses gentle, rhythmic, and drumming motions. Finally the therapist uses vibration. To do this the massage therapist rapidly relaxes and contracts his or her own muscles, which transmits the vibrations to whatever part of the body is being touched. A gentler technique is called jostling and is used on the arms and legs. The therapist gently shakes the arms back and forth to relax them. A trained massage therapist will usually start with stroking and then move on to kneading and friction on any areas that seem especially tense or sore. Percussion is used to relax the large back muscles. Vibration and jostling are used throughout the massage, especially on the arms and legs (7-9,19).

For the purposes of this study, MT is performed by the manual manipulation of soft tissue by a person other than the recipient. A nurse was trained to Swedish massage by one of the experienced physiotherapists at USWR. Then she trained the parents. Next, the intervention group was given Swedish massage by trained parents with supervision of that nurse.

Massage was implemented in quiet rooms with appropriate temperature (20-24°C), and light at 8 am. The parents were asked not to change their children's daily routines such as: exercise, diet and medication regimens.

The children took off their clothes and were positioned on a suitable bed in supine position and were massaged from arms, neck and head and then progressed to the torso, feet, and legs. The patient then lied prone, and the legs, hip and back were massaged. Massage lotion was applied to minimize friction on the skin. The children received massage for 15 minutes, three times a week for three months (totally = 540 minutes) and blood glucose level was measured right after every MT session by glucometre. The children did not receive any

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interventions in control group but they had daily routines such as: exercise, diet and medication regimens and their blood glucose levels were measured at 8:30 am, three times a week, for three months by glucometer in the hospital for comparison with the blood glucose levels of children in intervention group.

### Measurements

Data was collected by glucometre with glucomen brand name, scale, tape-measure and demographic questionnaire.

Demographic questionnaire included 13 questions: age, gender, height, weight, children and their parents' educations, the parents' job, duration of diabetes and diabetes medication, type and doses of insulin, and family history of diabetes. The demographic questions were developed by the researchers in Persian (Farsi) language. To establish the validity of questions, using content validity method; evaluation of questionnaire by 10 faculty members of nursing and medicine that were experienced.

The patients' weights were measured without shoes and with comfortable clothes by standard scale. Their heights were measured as they stood in front of a wall without shoes and their heel, shoulders and buttock touched the wall; the highest level of the head was determined on the wall and was measured by tape.

To assess reliability of the glucometre instrument, the blood samples of 20 individuals were sent to test to Kamkar hospital laboratory. At the same time one drop of the same blood samples were tested by glucometre. Then reliability of two measurements was determined and confirmed by pearson correlation coefficient.

### Data analysis

The analyses were used in this study were: (a) linear mixed model to determine the effect of massage on the blood glucose level after baseline measurement in follow up; If the F-test of linear mixed model was

significant, pairwise comparisons among all times is performed by bonferroni post hoc test. (b) Independent t-test was used to compare baseline blood glucose levels and quantitative demographic variables in two groups. (c) Chi-square and fisher's exact test were used to compare the categorical demographic variables in two groups. (d) K-S test was used to assessing normality of variables. Although we measured blood glucose level 36 times after baseline, because of the small sample size, we analyzed 12 measurements; the mean of 3 successive measurements. SPSS version 16 was used to statistical analysis of data. A  $P \leq 0.05$  was considered statistically significant.

## Results

### Background variables

A total of 36 children were enrolled in this study: 18 children in each group. There were 7 (38.9%) and 11(61.1%) females in control and intervention groups respectively ( $P=0.182$ ).

Table 1 summarizes the demographic characteristics of 2 groups. There were no significant differences in age, weight, height, DM duration, medication duration, and insulin doses (NPH & regular) between 2 groups.

There were also no significant differences in occupations of mothers ( $P=0.104$ ) and fathers ( $P=0.97$ ), educations of mothers ( $P=1$ ), fathers ( $P=1$ ) and patients ( $P=1$ ), and family history of DM ( $P=1$ ) between 2 groups by fishers' exact test.

### Blood glucose levels

The mean of baseline blood glucose levels in intervention and control groups were  $207.9 \pm 70.5$ ,  $195.9 \pm 54.6$  respectively before intervention. There was no significant difference in the mean of baseline blood glucose levels between 2 groups by Independent test ( $P=0.568$ ).

**Table 1.** Demographic characteristics (quantitative) in two groups\*

	Intervention (n=18)	Control (n=18)	P
Age (year)	9.0 ±1.5	9.8 ±2.0	0.206
Weight (kg)	26.7 ±5.3	30.7±6.5	0.052
Height (cm)	129.7±8.4	126.8 ±33.0	0.342
DM duration (month)	21.6 ±13.2	27.7 ±19.6	0.278
Medication duration(month)	20.8 ±12.2	27.6 ±19.4	0.225
NPH doses (IU)	30.0 ± 5.8	32.8 ±7.0	0.198
Regular doses (IU)	14.4 ± 3.2	16.0 ±4.2	0.226

\* values are expressed as mean ±SD

**Table 2.** Repeated measurements of blood glucose levels (BGLs) in the two groups\*

Time of measurements	baseline	first	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>
Intervention group BGLs	207.9± 70.5	200.3 ±61.7	187.2±58.6	174.6±58.3	171.6±46.1	167.2±42.8	159.2±41.9	153.2±41.6
Control group BGLs	195.9± 54.6	198.6±55.9	209.4±56.4	189.2±46.9	190.7±47.9	193.8±47.2	187.8±46.8	196± 60.5

**Be continue Table 2.**

Time of measurements	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	11 <sup>th</sup>	12 <sup>th</sup>	Mixed ANOVA
Intervention group BGLs	146.7±38	137.9±36	134.8±32	128.8±29.2	116.9±28.8	**
Control group BGLs	193.8±49.1	193.9±53.6	190.7±58.1	195.1±51.3	191.2±50.5	

\*Values are expressed as mean ± SD.

\*\*The effect of group and time were statistically significant;  $P, 0.05$ .

Linear mixed model (with first-order autoregressive covariance matrix and random effect subject) yielded a significant time, group, baseline blood glucose level, time and group interaction effect ( $P<0.05$ ). This indicated that intervention was effective in reducing blood glucose level. Bonferooni post hoc test indicated that blood glucose levels didn't change at successive sessions in control group but there were significant differences between responses at almost of pairwise sessions except a few sessions in intervention group (Table 2).

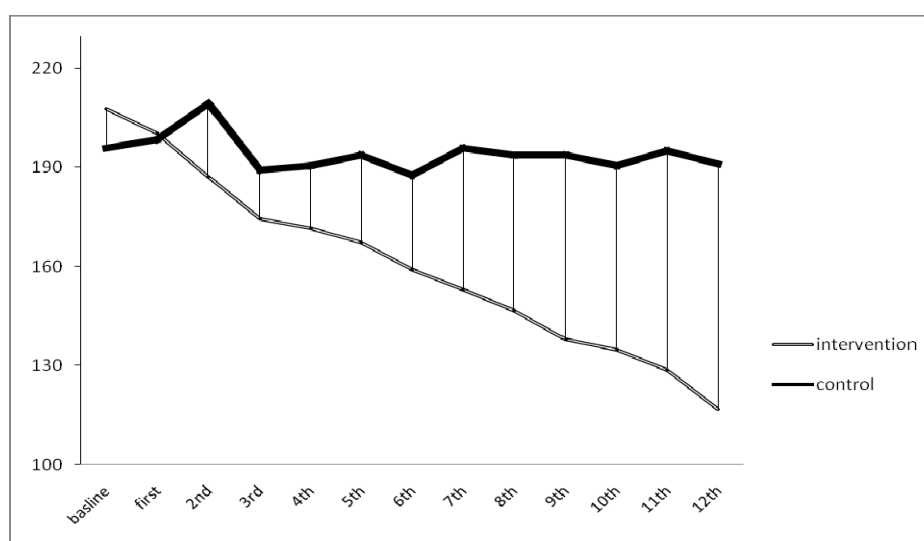
Also as it is shown in figure 1, the means of blood glucose levels in intervention group is descending, but there is no significance changes in control group.

## Discussion

The results of this study demonstrated that MT (in type of Swedish massage) is effective to reduce blood glucose level in diabetic children.

MT effects can be divided into *single-dose* and *multiple-dose*. Single-dose effects include MT's influence on psychological or physiological states that are transient in nature. Multiple-dose effects are restricted to MT's influence on variables that are considered to be more enduring, or that would likely be influenced only by a series of MT sessions performed over a period of time (19). In this study, we used multiple-dose to benefit its continuing influences.

The potential benefits of multiple-dose MT can be further classified to affective, physiological or behavioral in nature. Affective refers to effects most closely associated with the recipients' feelings and emotions (such as anxiety). Physiological effects are those concerned with recipients' vital organismic processes including muscle tone and blood glucose level.

**Figure 1.** Trends of blood glucose level changes in two groups.

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*Behavioral* effects are those related to the recipients' observable responses to their environment; such as relaxation (19). It's seemed that our subjects benefited from all of these effects.

Beider and Moyer showed that generally massage therapy has resulted in lower anxiety and stress hormones and improve clinical course in diabetic children (20). In our study may be, MT was effective through reduction of anxiety and stress hormones.

Hernandez *et al.* (21) also assessed massage effect on blood pressure, stress hormones secreted from salivary glands and depression. They showed that massage reduces blood pressure ( $P<0.05$ ), anxiety ( $P<0.001$ ), depression ( $P<0.01$ ) and stress hormones (cortisol) secreted from salivary glands ( $P<0.05$ ). On the other hand Dunn showed that there were no statistically significant differences in the physiological stress indicators following massage therapy (22).

Doctors at Duke University Medical Center have observed small but significant improvements in glycemic control in type 2 diabetics given stress management training. They proposed that cost-effective stress management training programs include muscle relaxation, when administered in a group setting, might benefit patients with type 2 diabetes in the long-run by building on traditional practices used for improving glucose levels (23).

Surwit *et al.* also suggested that stress management (include muscle relaxation) can be a meaningful addition to a comprehensive treatment program for patients with type 2 diabetes, because stress is associated with the release of counterregulatory hormones and energy mobilization, often resulting in elevated glucose levels. In addition, stress can disrupt diabetes control indirectly through effects on diet, exercise, and other self-care behaviors (24). Jablon *et al.* showed that muscle relaxation was effective on fasting blood glucose level reduction ( $P<0.0001$ ), 2 hours blood glucose ( $P<0.0001$ ) and stress ( $P<0.0001$ ) (25).

May be massage is more effective than relaxation on blood glucose level in DM. In one study, twenty-four children with diabetes were assigned to receive either massage therapy or relaxation therapy. One-half of the parents were asked to massage their children for 20 minutes before bedtime for 30 consecutive nights, and the other half were asked to conduct progressive muscle relaxation each night for the same time period. The effects in the massage group were decreased parental and child anxiety. Over a 30-day period, the mean blood glucose decreased from 159 to 118 mg/dL in the massage group. (26)

In conclusion, addition of Swedish massage as a complementary treatment to daily routines; exercise, diet and medication regimens, is an effective intervention to reduce blood glucose level in diabetic children. Considering that parents continue to explore and utilize all the health care options for their children and Swedish massage is cost-effective, easy and available, so it is essential to be taught to mothers and caregivers for better metabolic control in diabetic children.

## Acknowledgements

This research was supported by the University of Social Welfare and Rehabilitation Sciences (USWR). We would like to acknowledge Elham Mahmoudi, patients and their parents for their sincere cooperation.

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