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The Effect of Massage on Diabetes and its Complications: A Systematic Review

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Abstract

Objectives: Massage therapy has been used since ancient times for many diseases. This systematic review aimed to evaluate the effectiveness of massage therapy on the symptoms and complications of diabetes mellitus (DM).

Methods: Three electronic databases including PubMed, Google Scholar, and Scopus were searched from January 1, 2000 to May 13, 2018 using relevant keywords, followed by identifying all relevant randomized controlled trials. The study design, interventions, controls, primary outcome measures, follow-up, and main results were extracted and methodological quality was evaluated using the Jadad Scale by two authors independently.

Results: Significant results were obtained, including a decrease in blood glucose, hemoglobin A1c (HbA1c) levels while an improvement in neuropathic pain and diabetic foot ulcer in the related articles.

Conclusions: From this review, massage therapy can affect the clinical and laboratory symptoms and complications of the DM. However, various conditions such as the quality and quantity of pressure and duration, as well as the number of sessions, the type of massage, and the psychophysical state of patients can change the results of massage therapy.

Keywords: Dalk, Diabetes, Massage, Persian traditional medicine, Ziabites

Introduction

According to the report of the World Health Organization, although diabetes mellitus (DM) has been known from 3000 years ago and various therapies have been experienced in this respect, it was the fourth cause of death in non-communicable diseases in 2016 (1,2).

Many countries have used massage therapy from ancient times, including Babylonia, Assyria, Iran, India, China, Egypt, Syria, Greece, America, Australia, Africa, and Europe. It can be found in Egyptian papyrus (1700 BC), Chinese medical book (2700 BC), the writings of Hippocrates (357-460 BC), as well as Avicenna and Ambroise Paré in the 10th century and 16th century AD (3-5).

Some studies (6, 7) about diabetes and Iranian traditional medicine reported that *Ziabites* (DM in Iranian traditional medicine) is treated by herbal therapy and sometimes with moderate Dalk (massage).

Over the last few decades, the non-drug treatment of diabetes has received special attention (8,9). For example, 80% of people in developing countries use complementary/alternative medicine. This trend in diabetics is 2.5 times more than non-diabetics (10,11). In recent years, the beneficial effect of massage therapy has been confirmed for some diseases such as arthritis, fibromyalgia, hypertension, asthma, multiple sclerosis, and breast cancer (12) while the effect of massage on DM has been categorized in the lowest documented group in the review article by Ng and Cohen (13). There is only one systematic review for the effectiveness of massage on the DM in the latest two decades which has unclarified conclusions (14). After 2 decades, the role of massage therapy on DM remains unknown. Accordingly, this systematic review sought to find if a massage has any effect on the treatment and complications of the DM compared to current treatments.

Methods

Two independent researchers searched PubMed, Google Scholar, and Scopus databases from January 1, 2000, to May 13, 2018.

The search terms were “massage”, “Dalak”, and “Dalk,” that were combined with other terms including “diabetes mellitus”, “ziabites”, “blood glucose”, “DM complications”, “hyperglycemia”, “T2DM”, and “T1DM” by using Boolean operators in the title and abstract based on the MESH/

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subject. The English and Persian articles were used in this study and the methodological quality of all included randomized controlled trials (RCTs) was assessed by using the Jadad Scale. In addition, the studies were independently selected and assessed by two investigators (D.B. and M.A) using the Jadad scale. Duplicate studies were excluded using Mendeley software as well. Further, irrelevant studies were excluded after accessing the title and abstract, followed by excluding some other studies after accessing to all contents of the studies. According to PICO (patient, intervention, comparison, and outcome) criteria, the included literature must be an RCT that evaluates the effect of any type of massage on signs, symptoms, or the complications of the DM (type 1 or type 2) compared with placebo or standard treatment with Jadad scale ranging from 3 to 5. The outcomes compromise clinical changes, laboratory tests, and the quality of life evaluation.

In the present study, the exclusion criteria were studies with uncertain statistical information and vague results, as well as the irrelevant outcome of trials with DM signs and symptoms or its complications and other manipulations such as reflexology, acupressure, Yumeiho therapy, and chiropractic.

The key data (i.e., patients, interventions, controls, outcomes, aims, and Jadad scale) were extracted from all included RCTs (Table 1). The protocol of this systematic review was according to the PRISMA-P (Preferred Reporting Items for Systematic Review and Meta-analysis Protocols) 2015 checklist.

Results

A total of 1086 records were retrieved from the search strategy, including data from PubMed (n = 820), Google Scholar (198), and Scopus (68). Duplicate records were removed (237 titles) by Mendeley software, followed by excluding irrelevant studies (823 titles), and finally, a total of 26 articles were selected for full-text review. Eventually, the quality evaluation was conducted on 12 articles that met the inclusion criteria. Figure 1 is a flowchart of the study selection process.

Interventions and Controls

All studies included two massage and control groups and only one study had massage, relaxation, and control groups (15). Different types of massages were done in intervention groups, including tactile (superficial) massage (TM),

Table 1. Study Characteristics

Author	Aim	Massage/Control	Variables	Jadad Scale
Wändell et al[18]	Effect of TM on metabolic control (T2DM)	TM/music CD	FPG (FBS), HbA1c, insulin, CRP, TNF-alpha, Interleukin- 6, Adiponectin, Leptin, Ghrelin Catecholamine's, cortisol HOMA2, and BMI	5
Wändell et al[19]	Effect of TM on HRQoL in T2DM	TM/music CD	SF-36 questionnaire (Swedish version) and BMI	5
Sajedi et al[21]	Effect of Swedish massage on blood glucose level in T1DM children	Swedish massage/ conventional therapy	FBS and BMI	3
Wändella and Ärnlöv[17]	Effects of TM on T2DM laboratory tests	TM/music CD	BMI, WC, W, H, FPG, HbA1c, IGF, insulin, adiponectin, leptin, ghrelin, HOMA2–IR glucose / insulin, adiponectin/leptin, adiponectin/HOMA–IR, adiponectin/WC, and adiponectin/HbA1c	3
Ghazavi et al[15]	Effects of massage therapy and PMR on HbA1c level in T1DM children	Massage/PMR/conventional therapy	HbA1c	3
Castro-Sánchez et al[22]	Effects of CTM on blood circulation and intermittent claudication in T2DM	CTM and exercise (flexion, extension)/sham magnetotherapy	SAP, HR, ST, OS, SBF, and BMI	3
Mars et al[23]	Effect of CAM on diabetic foot ulcers	CAM/conventional therapy	Ulcer size, vascular status, sensory changes, and co-morbidities	3
Joseph et al[23]	Effect of CTM in diabetic foot ulcer (T2DM)	CTM/conventional therapy	PWAR BCC	3
Gok Metin et al[25]	Effect of AM on neuropathic pain severity and quality of life	Aromatherapy massage/ conventional therapy	NePIQoL, the VAS and neuropathic pain impact on quality of life questionnaire	5
Yu et al[26]	Effect of traditional massage on FBS and sugar tolerance of T2DM	Traditional massage+ Jiangtangling/Jiangtangling (herbal drug)	FBS and insulin thirsty, debilitation, obesity, lose of body mass, backache, and range of spinal	3
Ghasemipoor et al[16]	Effect of TM on FBS, HBA1C in T2DM women	TM/ conventional therapy	HbA1C and FBS	5
Boghrabadi et al[20]	Effect of SM on some physiological factors in T2DM women	Swedish massage/ conventional therapy	Glucose test, insulin resistance, HOMA-IR, Cortisol, BP, PR, Adrenaline, weight, and height	3

Note. BCC, bacterial colonization count; BF, blood flow; BP, blood pressure; BSPP, blood sugar post prandial; CAM, compressed air massage; CM, Contact (tactile) massage; CRF, cortico-releasing hormone; CTM, connective tissue manipulation; HR, heart rate; OS, oxygen saturation; PMR, progressive muscle relaxation; PWAR, PWAR is the percentage difference in wound surface area (WSA) from baseline to the end of intervention and is calculated by Baseline WSA-final WSA*100, Final WSA; SAP, segmental arterial pressure; SBF, skin blood flow; ST, skin temperature; TM, tactile massage; VAS, visual analog scale; WAR, wound area reduction; BMI, body mass index; FPG, fasting plasma glucose; FBS, fasting blood sugar; T1DM, type 1 diabetes; T2DM, type 2 diabetes; HbAlc, glycated hemoglobin A1c; HRQoL, health-related quality of life; NePIQoL, Douleur neuropathique questionnaire.

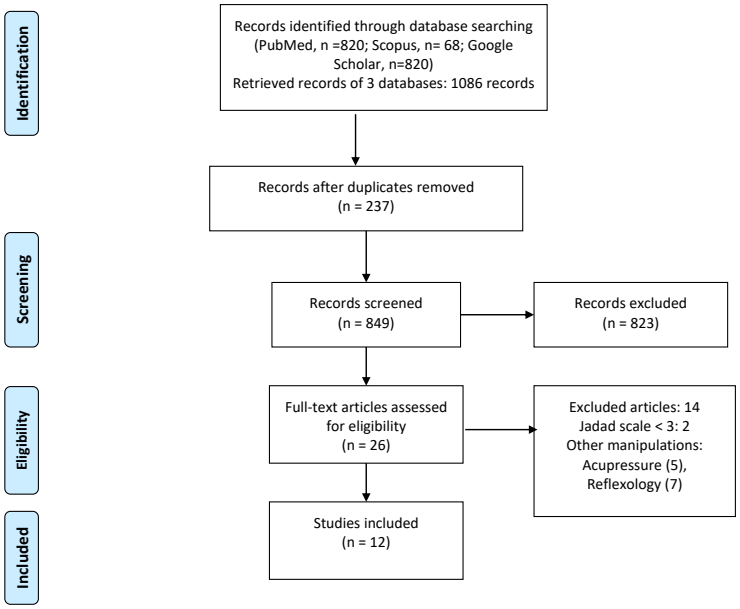

Figure 1. Study Flow Diagram.

Swedish massage (SM), connective tissue massage (CTM), compressed air massage (CAM), aromatherapy massage (AM), and Chinese (Tui-Na) massage (CM). The TM (16-19), SM (15,20,21), and CTM (22,23) were used more than the CAM (24), AM (25), and CM (26).

Comparatively, the routine conventional therapies were the most commonly used type of therapy in control groups (15,16,20,21,23-25) and the other therapies encompassed music (17-19), progressive muscle relaxation (15), traditional herbal therapy (26), and silent magneto therapy (22). No article reported the quantity pressure of massage on the surface.

All RCTs were done in adults except for 2 RCTs of T1DM children (15,21). There was no gender predominance in the RCTs except for two RCTs that were done in type 2 diabetic women (16,20).

The RCT contained 48 people in control or intervention groups (22), and there were two RCTs with low sample sizes including 10 and 12 people in each group, respectively (20,23) whereas most of the included RCTs had extremely average sample sizes (18-27 people in control or intervention groups).

The body mass index (BMI) of the patients were not specified in six articles (15,16,23-26). These studies investigated the effect of massage on uncomplicated diabetic patients (15-21,26), diabetic foot ulcer (23, 24), vascular and neurological complications (22), and neuropathic pain (25), but no massage had an effect on the other complications of the DM (e.g., cardiac, ocular, and renal complications). In addition, T2DM was evaluated in all RCTs except for two cases that completely had T1DM (15, 21).

The retrieved outcomes can be divided into 2 groups including the significantly changed variables and non-significant, each of which has three subgroups of laboratory, clinical, and quality of life (QoL) changes. Further, the findings can be assessed according to the type of massage.

The significant results presented in eight (15,16,19,21,23-26) and four RCTs (17,18,20,22) had significant and non-significant results. The significant results were fasting plasma glucose (fasting blood sugar, FBS), BS2HPP (blood sugar 2 hour post prandial), HbA1c (glycated hemoglobin A1c), insulin, adiponectin, cortisol, adrenaline, waist circumference, ankle-brachial index difference, changes in segmental arterial pressure in the limbs, changes in blood flow to the skin of the toe, as well as the reduced duration of treatment for diabetic foot ulcer wound area reduction (WAR), decreased neuropathic pain score, the decreased index of the symptoms of thirst, disability, obesity, decreased BMI, the recovery of back pain, and spinal motor range (15-26). Finally, non-significant results included HbA1c, FBS, serum insulin, insulin resistance, heart rate (HR), blood pressure (BP) and the QoL (17,18,20,22). More details are listed in Tables 1 and 2.

Presentation of the Outcomes According to Laboratory, Clinical, and the Quality of Life Changes

1. Laboratory Changes

There was a significant decrease ($P < 0.05$, $P < 0.05$, and $P < 0.001$) in the FBS after SM, CM, and TM (16, 21, 26) while unchanged FBS was reported after the SM (20).

There was a significant decrease in serum insulin ($P < 0.01$), and BS2HPP ($P < 0.05$) after CM (26), whereas after SM serum insulin was not changed (20).

According to Ghasemipoor et al study (16), a significant decrease was also observed in the HbA1c ($P < 0.05$) after the SM and TM ($P < 0.001$) but HbA1c revealed no

Table 2. Comparison of Findings of Included RCTs

Type of Massage	Numbers of RCTs	Sample Size: Massage/Control	Type of DM	Significant Findings	Non- significant Finding	Reference
TM	4	23/24	T2DM	↓HbA1C, ↓FBS	-	(16)
		21/25	T2DM	↓ Waist circumference	HbA1C, adiponectin/ leptin	(17)
		22/23	T2DM	↑Quality of life: Scale of role functioning, physical	-	(19)
		26/27	T2DM	↓ Waist circumference, ↑Adiponectin	HbA1C	(18)
SM	3	12/12	T2DM	↓Cortisol, ↓PR, ↓Adrenaline	BP, FBS, insulin	(20)
		25/25/25	T1DM	↓HbA1C	-	(15)
		18/18	T1DM	↓FBS	-	(21)
CTM	2	10/10	T2DM	↓WAR, ↓BCC, MCT↓	-	(23)
		48/46	T2DM	SAP, ↑SBF +	HR	(22)
CM	1	19/19*	T2DM	Insulin↓, FBS ↓, BS2HPP↓, Symptoms index↓	-	(26)
AM	1	21/25	T2DM	↓Neuropathic pain, quality of life ↑	-	(25)
CAM	1	28/29	(T1DM, T2DM)	↓Treatment duration (foot ulcer)	-	(24)

Note. TM, Tactile Massage; SM, Swedish massage; CTM, Connective tissue massage; CM, Chinese massage; AM, Aromatherapy massage; CAm, Compressed air massage; RCT, randomized controlled trial; DM, diabetes mellitus; HbAlc, glycated hemoglobin A1c; FBS, fasting blood sugar; T1DM, Type 1 diabetes; T2DM, Type 2 diabetes; WAR, wound area reduction; BCC: bacterial colonization count; MCT: medium chain triglyceride; PR: pulse rate; SAP, segmental arterial pressure; SBF, skin blood flow; BP, blood pressure; HR, heart rate; BS2HPP, Blood sugar 2 hour post prandial.

change after the TM in two studies.

Based on the results of other studies (17,18), increased adiponectin ($P < 0.01$) and non-significant increasing of adiponectin/leptin ratio after the TM compared to the control group. There was a significant decrease in cortisol and adrenaline ($P < 0.05$) after SM as well (20).

2. Clinical Changes

Similarly, there were decreased symptom index (i.e., thirsty, debilitation, obesity or losing of body mass, backache, and the range of spinal motion) after the CM ($P < 0.01$), decreased treatment duration of foot ulcers ($P = 0.001$) after CAM, and a reduction in neuropathic pain ($P < 0.001$) after AM (24-26).

In another studies, significant changes were detected in differential segmental arterial pressure ($P < 0.05$) and skin blood flow ($P < 0.05$) (22) and a significant decrease was observed in the WAR, bacterial colonization count (BCC), and medium chain triglyceride (MCT, $P < 0.05$) after CTM (23). On the other hand, CTM and SM failed to change HR (22), and BP (20), respectively.

3. Quality of Life Changes

The QoL was evaluated in two RCTs (19, 25), which improved significantly after TM ($P = 0.02$) and AM ($P < 0.04$). These improved scales included the emotional and physical scale of the QoL. The other RCTs failed to evaluate the QoL.

Presentation of the Outcomes According to the Type of Massages

TM: It was used in 4 RCTs for T2DM. One study indicated a decrease in FBS and HbA1C (16) and 2 studies demonstrated non-significant changes in HbA1C (17, 18). Moreover, TM caused decreased waist circumference, improved adiponectin and adiponectin/leptin ratio (17, 18), and QoL improvement (19).

SM: It caused reduced FBS (21) and decreased HbA1C (15) in 2 RCTs of T1DM. Additionally, it caused reduced cortisol, pulse rate, and adrenaline in one RCT of T2DM that had non-significant changes on BP, FBS, and the serum level of insulin (20).

CTM: It was used in 2 RCTs of T2DM for DM complications (i.e., claudication and diabetic ulcer), leading to caused significant changes in differential segmental arterial pressure and improvement of skin blood flow (22) while a significant decrease in WAR, BCC, and MCT (23). However, HR represented no change (22).

CM, AM, and CAM: Each of these massages had an study. These studies indicated a significant improvement in FBS, insulin, BS2HP, symptoms index (26), as well as decreased neuropathic pain, QoL improvement (25), and decreased treatment duration (24).

Discussion

Only one systematic review has previously evaluated the effect of massage on diabetes in the two latest decades (14). In their systematic review including 6 studies, Ezzo et al (14) found that injected insulin absorption increased after the massage, but they failed to clarify the effect of massage on blood glucose and symptoms of diabetic neuropathy.

Similarly, Ng and Cohen in evidenced-based research categorized the effect of massage on diseases from A to E groups. In this category, diabetes was in "E group" and had insufficient or no evidence (13) while new findings of studies in the two latest decades help the presentation of further documentation.

In this systematic review, 12 RCTs were studied

to evaluate the effect of massage on diabetes and its complications. Although there was a plethora of significant results, few unchanged variables or non-significant results were reported in TM and SM. One RCT of TM decreased HbA1C and FBS (16) while it failed to change HbA1c in 2 other RCTs (17,18). Likewise, 1 RCT of SM in T2DM failed to change FBS and insulin (20) while FBS (21), and HbA1c (15) in 2 other RCTs in T1DM demonstrated a decrease. These discrepancies may arise from the different factors such as the type of massages, the quality and quantity of pressure in massages, the involved tissues in addition to the duration and frequency of the massage session and lubricant.

Superficial massage or TM is a light and gentle massage through which only the skin is touched with low pressure (27) whereas in SM muscles and connective tissues in addition to skin are manipulated by five stages including effleurage, petrissage, friction, tapotement, and vibration (28).

The quantity and quality of pressure affect the results of a massage. Significant differences and occasionally opposite results are observed regarding moderate and light massage in recent studies (29-32). The moderate and light pressures of massage can reduce anxiety and moderate massage can increase the delta wave in electroencephalogram and parasympathetic activity whereas light massage can reduce the delta wave and heighten the sympathetic activity (29,30,33,34).

There are different types of Dalk (massage) in traditional Persian medicine such as layen (flexible), solb (rigid), amlas (soft), khashen (rough), and motadel (temperate) which are used according to the temperament and physical conditions of the patients (7,35-37). These types of Dalk arise by combining three quality variables including pressure, duration, and velocity as lightly, moderately, or highly (3 qualities) in different forms (7,35). The Dalk is a subgroup of movement and exercise that helps prevent diseases and treat patients. In addition, it animates instinctive heat which helps the reperfusion and the elimination of waste materials. According to Avicenna's view, it is possible to achieve the opposite results of obesity or slimming, as well as the stiffness or softness of the organs by different types of Dalk. In other words, different types of massage have different or opposite results (7).

The mechanoreceptors of the skin can be stimulated by the light pressure of every strike in the TM. This stimulation is transferred to different parts of cortex, hypothalamus, and medulla by afferent sensory nerves and C-fibers that can lead to hedonic feeling, autonomic nervous system modulation, and some hormonal changes such as adrenaline, noradrenaline, and cortisol (27,30,33, 38,39). These changes depend on the quality and quantity of stimulations that arise the skin touch.

Other organs such as the muscles, tendons, vessels, and nerves, along with the skin can be involved by light to moderate pressure in the SM. Therefore, the range of stimulations and their outcomes in the SM can be broader compared to the TM such as its effectiveness in circulation, removing venous return, and lymph drainage (40).

However, skin involvement in these two methods can imply some similarities in their findings and the difference in pressure and involved organs can reveal differences in their outcomes. Contrarily, this hypothesis is correctly insufficient to explain the discrepancies of findings in the same massage in different studies.

CTM is done in the presence of skin-connective tissue adhesion and limited on central areas such as the sacrum, lower back, hip, chest, and ribs. Deep pressure is recommended by detachment methods of skin and connective tissue as well (41,42).

The method, quality of pressure, involved organs, and the indication of the CTM differ from those of the SM and TM. Further, the detachment of adhesion may be painful and lead to analgesic system activation and the releasing of endorphins in the nervous system (43). Furthermore, the method of detachment, the stimulation of the autonomic nervous system, and deep organ involvements in the CTM may need moderate to high pressure. Moreover, the endorphins and histamines releasing affect circulation and immunity that accompanies therapeutic results (41,42).

According to positive findings, the CTM seems to be suitable for diabetic complications such as diabetic foot ulcer and intermittent claudication (22,23). Comparing the effect of the CTM with the other massages was impossible because infection and circulation status were evaluated in the CTM while hormones, FBS, and its relative tests were accessed in the others. There was only one RCT of Chinese massage that succeeded in lowering insulin, FBS, BS2HPP, and symptom index in T2DM. Chinese massage or Tui-Na includes shaking, twisting, grasping, rubbing, scrubbing, rotating, rolling, and vibrating which make the Qi and the blood move and remove stagnation (44). Similarly, stimulated acupoints on meridian canals during the Chinese massage may be the other cause of its positive findings that are neglected in the other types of massages. It implies the importance of the involved tissue in massage as well.

CAM was effective on diabetic complications (DM foot ulcers), implying that skin stimulation (even by air) may be an effective modality. This outcome may be insufficient because it was reported only in one RCT (24).

One RCT of aromatherapy massage had 2 prominent findings including decreased neuropathic pain and improved quality of life. In this massage, Effleurage and petrissage maneuvers were performed on hands and feet with mixture oils like coconut, rosemary, geranium, lavender, eucalyptus, and chamomile. The findings of the AM may not be comprehensive due to the same reasons that were previously mentioned for the CAM. Aromatic oils may change the findings as well. In other words, the lubricants or various oils used in massages can be absorbed and alter the results (38,39,45-48).

Compared to the systematic review of Ezzo et al, there are more articles in our study that reported decreased FBS and HbA1c with TM and SM (14). In addition, 2 other articles showed the lowering effect of FBS (21) and HbA1c (15) in T_1DM by the SM. Diabetic neuropathy and foot ulcer were improved and there was no report of massage side effect.

It should be mentioned that there were other factors which could affect the results, including the personality of the masseur and the recipients, their communication (49), the patient's temperament, as well as the season, and the time of receiving massage (5) although none of the above-mentioned parameters were evaluated in the present study. On the other hand, diabetes is caused by various pathogens (50) that may differ in response to massage. These modulators require further investigation in the future.

There were some limitations in our systematic review such as the low sample size of the RCTs, the undefined pressure and velocity of strikes, undefined lubricants, and ethnic differences. Finally, the outcome of massage therapy depends on many variables that may alter the findings. However, further study is recommended in this regard.

Conclusions

Massage has received special attention as a non-drug, safe, and feasible method of therapy from ancient times, which can be a way to health although various message methods have different effectiveness. Many modalities can influence massage efficacy. An appropriate method may have a major role in relieving the symptoms of DM if it is matched with DM pathogenesis and the patient's condition. However, more studies are required to clarify the efficacy of different types of massage on the DM.

Conflict of Interests

The authors declare that they have no conflicts of interest.

Ethical Issues

This study was a part of Dr. Bayat's thesis with the ethical code of IR.MUQ.REC.1395.147.

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