

**PEMBERIAN INTERVENSI *BUERGER ALLEN EXERCISE*
TERHADAP KETIDAKEFEKTIFAN PERFUSI JARINGAN
PERIFER PADA PENDERITA DIABETES MELLITUS
*LITERATURE REVIEW***

SKRIPSI



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**PROGRAM STUDI ILMU KEPERAWATAN
FAKULTAS ILMU KESEHATAN
UNIVERSITAS dr. SOEBANDI
JEMBER
2022**

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SKRIPSI

Untuk Memenuhi Persyaratan
Memperoleh Gelar Sarjana Keperawatan (S.Kep)



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LEMBAR PERSETUJUAN

Skripsi ini telah diperiksa oleh pembimbing dan telah disetujui untuk mengikuti sidang skripsi pada Program Studi Ilmu Keperawatan Fakultas Ilmu Kesehatan Universitas dr. Soebandi

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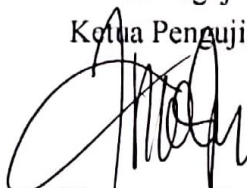
Skripsi yang berjudul *Pemberian Intervensi Buerger Allen Exercise Terhadap Ketidakefektifan Perfusi Jaringan Perifer Pada Penderita Diabetes Mellitus : Literatur Review* telah diuji dan disahkan oleh Dekan Fakultas Ilmu Kesehatan pada:

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Menyatakan dengan sesungguhnya bahwa skripsi yang saya tulis ini benar-benar merupakan hasil karya saya sendiri dan bukan merupakan pengambilan tulisan atau hasil tulisan orang lain.

Apabila di kemudian hari terbukti atau dapat dibuktikan bahwa sebagian atau keseluruhan skripsi ini adalah karya orang lain atau ditemukan adanya pelanggaran terhadap etika keilmuan dalam skripsi ini, maka saya bersedia menerima sanksi atas perbuatan tersebut. Demikian pernyataan ini saya buat dengan sebenar-benarnya.

Jember, 22 Agustus 2022

Yang menyatakan,



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TERHADAP KETIDAKEFEKTIFAN PERFUSI JARINGAN
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SKRIPSI

Oleh :

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Dosen Pembimbing Utama : Trisna Vitaliati, S.Kep., Ns., M.Kep

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HALAMAN PERSEMBAHAN

Bismillahirrohmanirrohim, Segala puji bagi Allah SWT atas limpahan rahmat serta ridho-Nya yang senantiasa selalu memberikan kemudahan dan petunjuk sehingga saya dapat menyelesaikan penyusunan skripsi ini tepat waktu.

Skripsi ini dengan sepenuh hati saya persembahkan kepada:

1. Kepada keluarga tercinta, Ayah, Ibu, dan Adik, terimakasih untuk segala dukungan baik material ataupun non material sehingga saya mampu menyelesaikan studi dengan baik.
2. Kepada Mas Willian, terimakasih banyak untuk kesediaannya membantu dan memberikan banyak solusi untuk pengerjaan skripsi ini.
3. Kepada teman dan sahabat saya, terimakasih banyak sudah mendengarkan keluh kesah saya dan tidak jarang pula untuk membantu saya serta memberikan solusi untuk pengerjaan skripsi ini.
4. Almamater Universitas dr. Soebandi.

MOTTO

“Ilmu itu lebih baik dari kekayaan, karena kekayaan itu harus kamu jaga,
sedangkan ilmu yang akan menjagamu”

(Ali bin Abi Thalib)

“Let’s walk slowly enjoying every step of the journey”

(Mark Lee NCT)

*“Nothing last forever, you only live once. So live your life, not any other lives.
Take chances and never regret. Never, never be late to do what you wanna do
right now. Because at one point someday, everything you do would be exactly
what you will be”*

(BTS)

ABSTRAK

Anggraeni, Hani Nur* Vitaliati, Trisna** Cahyono, Hendra Dwi***. 2022.
**Pemberian *Buerger Allen Exercise* Terhadap Ketidakefektifan
Perfusi Jaringan Perifer Pada Penderita Diabetes Mellitus.**
Skripsi. Program Studi Ilmu Keperawatan Universitas dr.
Soebandi.

Latar Belakang: Diabetes mellitus yang tidak segera ditangani dapat menyebabkan komplikasi salah satunya ketidakefektifan perfusi jaringan perifer. Ketidakefektifan perfusi jaringan perifer dapat berisiko terjadinya amputasi ekstremitas bawah pada penderita diabetes mellitus. Terapi non farmakologi yang dapat diberikan adalah *buerger allen exercise* yang dapat memperbaiki ketidakefektifan perfusi jaringan perifer dengan indikator peningkatan nilai *ankle brachial index* (ABI). Tujuan *literature review* ini untuk mengeksplorasi intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus.

Metode: Penelitian ini menggunakan metode *literature review* dengan 3 database yaitu *Proquest*, *Google Scholar*, dan *PubMed* dengan sejumlah 6 artikel yang ditelaah dengan kriteria PICOS framework. Kriteria artikel yang digunakan adalah yang diterbitkan tahun 2016 sampai 2021 berjumlah 2.445 artikel, kemudian dilakukan seleksi berdasarkan judul duplikat, PICOS dan *critical appraisal* menjadi 6 artikel.

Hasil: Hasil penelitian dari 6 artikel yang direview memiliki hasil yang sama yaitu pemberian intervensi *buerger allen exercise* sangat berpengaruh terhadap peningkatan nilai *ankle brachial index* (ABI) sebagai indikator dari keefektifan perfusi jaringan perifer pada penderita diabetes mellitus.

Kesimpulan: Dari 6 artikel yang direview menunjukkan hasil yang sama. *Buerger allen exercise* akan meningkatkan oksigen di pembuluh darah sehingga bisa menjadi terapi alternatif yang dapat diberikan kepada penderita diabetes mellitus untuk memperbaiki ketidakefektifan perfusi jaringan perifer.

Saran: Bagi penderita diabetes mellitus dapat melakukan *buerger allen exercise* untuk meningkatkan perfusi jaringan perifer.

Kata Kunci: *Buerger Allen Exercise*, Ketidakefektifan Perfusi Jaringan Perifer, Diabetes Mellitus

* Peneliti

**Pembimbing I

***Pembimbing II

ABSTRACT

Anggraeni, Hani Nur* Vitaliati, Trisna** Cahyono, Hendra Dwi***. 2022.
**Giving Buerger Allen Exercise on The Ineffective Peripheral
Tissue Perfusion in Patients With Diabetes Mellitus.** Thesis.
Nursing Science Study Program, University of dr. Soebandi.

Introduction: Diabetes mellitus that is not treated immediately can cause complications, one of which is ineffective peripheral tissue perfusion. Ineffective peripheral tissue perfusion can be a risk for lower extremity amputation in people with diabetes mellitus. Non-pharmacological therapy that can be given is buerger allen exercise which can improve ineffective peripheral tissue perfusion with an indicator of increasing the value of the ankle brachial index (ABI). The purpose literature review is to explore the intervention of buerger allen exercise on the ineffectiveness of peripheral tissue perfusion in patients with diabetes mellitus.

Methods: This study uses a literature review with 3 databases, namely Proquest, Google Scholar, and PubMed with a total of 6 articles reviewed with the PICOS framework criteria. The criteria for the articles used are those published from 2016 to 2021 amounting to 2.445 articles, then a selection is made based on duplicate titles, PICOS and critical appraisal to 6 articles.

Results: The results of the 6 articles reviewed have the same results, namely the provision of buerger allen exercise greatly affects the increase in the value of the ankle brachial index (ABI) as an indicator of the effectiveness of peripheral tissue perfusion in patients with diabetes mellitus.

Conclusion: Of the 6 articles reviewed showed the same results. Buerger allen exercise will increase oxygen in the blood vessels so that it can be an alternative therapy that can be given to people with diabetes mellitus to improve ineffective peripheral tissue perfusion.

Suggestion: For people with diabetes mellitus can do buerger allen exercise to increase peripheral tissue perfusion.

Keywords: Buerger Allen Exercise, Ineffective Peripheral Tissue Perfusion, Diabetes Mellitus

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KATA PENGANTAR

Alhamdulillah, segala puji dan syukur bagi Allah SWT yang telah melimpahkan rahmat serta hidayah-Nya sehingga penyusunan skripsi ini dapat terselesaikan. Skripsi ini disusun untuk memenuhi persyaratan memperoleh gelar Sarjana Keperawatan di Program Studi Ilmu Keperawatan Fakultas Ilmu Kesehatan Universitas dr. Soebandi dengan judul “Pemberian Intervensi *Buerger Allen Exercise* Terhadap Ketidakefektifan Perfusi Jaringan Perifer Pada Penderita Diabetes Mellitus *Literature Review*”.

Selama proses penyusunan penulis dibantu dan dibimbing oleh berbagai pihak, oleh karena itu penulis mengucapkan terima kasih kepada:

1. Bapak Drs. H. Said Mardijanto, S.Kep, Ns, M.M. selaku Rektor Universitas dr. Soebandi yang telah memberikan izin sehingga penulis dapat menyelesaikan tugas akhir ini.
2. Ibu Hella Meldy Tursina, S.Kep., Ns., M.Kep. selaku Dekan Fakultas Ilmu Kesehatan Universitas dr. Soebandi yang telah memberikan izin dalam penyelesaian tugas akhir ini.
3. Ibu Irwina Angelia Silvanasari, S.Kep., Ns., M.Kep. selaku Ketua Program Studi Ilmu Keperawatan Universitas dr. Soebandi serta selaku ketua penguji yang telah memberikan masukan hingga terselesainya skripsi ini.
4. Ibu Trisna Vitaliati, S.Kep., Ns., M.Kep. selaku dosen pembimbing utama yang telah meluangkan waktu serta memberikan arahan dan bimbingan kepada penulis sehingga skripsi ini dapat diselesaikan dengan baik.

5. Bapak Hendra Dwi Cahyono, S.Kep., Ns., M.Kep. selaku dosen pembimbing anggota yang telah meluangkan waktu serta memberikan bimbingan dan arahan dalam penulisan skripsi ini sehingga dapat diselesaikan dengan baik.

Penulis tentu menyadari bahwa skripsi ini masih jauh dari kata sempurna. Penulis mengharapkan kritik serta saran dari semua pihak demi kesempurnaan skripsi ini. Semoga skripsi ini dapat bermanfaat. Akhir kata penulis mengucapkan terima kasih.

Jember, 22 Agustus 2022

Penulis

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DAFTAR SINGKATAN

ABI	: <i>Ankle Brachial Index</i>
ADL	: <i>Activity of Daily Living</i>
CTA	: <i>Computed Tomography Angiography</i>
DM	: <i>Diabetes Mellitus</i>
DSA	: <i>Digital Subtraction Angiography</i>
DUS	: <i>Duplex Ultrasound</i>
HDL	: <i>High Density Lipoprotein</i>
IDDM	: <i>Insulin Dependent Diabetes Mellitus</i>
IDF	: <i>International Diabetes Federation</i>
LEAD	: <i>Lower Extremity Artery Disease</i>
MRA	: <i>Magnetic Resonance Angiography</i>
NIDDM	: <i>Non Insulin Dependent Diabetes Mellitus</i>
NPH	: <i>Neutral Protamine Hagedorn</i>
OH	: <i>Oral Hypoglycemic Agent</i>
PAD	: <i>Peripheral arterial disease</i>
WHO	: <i>World Health Organization</i>

BAB 1

PENDAHULUAN

1.1 Latar Belakang

Diabetes mellitus merupakan penyakit tidak menular yang paling umum dan penyebab utama kematian di seluruh dunia (WHO, 2021). Diabetes mellitus adalah penyakit yang ditandai dengan peningkatan kadar glukosa darah (gula darah) akibat ketidakmampuan tubuh untuk melepaskan atau menggunakan insulin secara adekuat (Suryati *et al.*, 2019). Komplikasi umum pada pasien diabetes adalah ketidakefektifan perfusi jaringan perifer (Nadrati *et al.*, 2020). Gangguan ini dapat mengakibatkan penderita diabetes mellitus mempunyai risiko amputasi ekstremitas bawah lantaran kurangnya penanganan dan perawatan diabetes sehingga berakibat terjadinya infeksi, dan muncul ulkus kaki yang tidak dapat disembuhkan (Radhika *et al.*, 2020).

Menurut *International Diabetes Federation* (IDF), diperkirakan 463 juta orang di seluruh dunia berusia 20-79 tahun hidup berdampingan bersama diabetes mellitus pada tahun 2045 dan jumlah tersebut akan meningkat menjadi 700 juta. Indonesia menempati peringkat ketujuh dengan kejadian diabetes tertinggi di dunia dengan jumlah 10,7 juta penderita setelah Cina, Amerika Serikat, Pakistan, Brasil, dan Meksiko (IDF, 2021). Menurut Riset Kesehatan Dasar (RISKESDAS) (2018), prevalensi diabetes mellitus berdasarkan diagnosis dokter pada rentang umur 55-64 tahun menempati posisi tertinggi sebesar 6,3%, dan pada umur 65-74 tahun adalah sebesar 6,0%. Prevalensi diabetes mellitus berdasarkan hasil

pengukuran kadar glukosa darah pada umur > 15 tahun adalah 10,6%. Provinsi Jawa Timur sendiri memiliki prevalensi penderita diabetes mellitus sebesar 2,6% (Kementerian Kesehatan RI, 2018). Komplikasi pada penderita diabetes mellitus salah satunya ialah neuropati perifer/ketidakefektifan perfusi jaringan perifer jumlahnya berkisar antara 10% sampai 60% (Husen & Basri, 2021). Indonesia mempunyai resiko sekitar 15% terjadinya ulkus diabetik, komplikasi amputasi sebanyak 30%, angka mortalitas 32% dan ulkus diabetik adalah perawatan rumah sakit terbanyak sebesar 80% untuk diabetes melitus (Efendi *et al.*, 2020).

Penyakit Diabetes mellitus yang tidak segera ditangani dapat menyebabkan penyakit arteri perifer, sehingga menimbulkan beberapa komplikasi serius seperti borok, gangren, gangguan perfusi jaringan perifer ekstremitas bawah, dan proses penyembuhan luka yang lambat disebabkan oleh gangguan atau penyumbatan aliran darah perifer pada ekstremitas bawah (Saputra *et al.*, 2020). Pada penderita diabetes mellitus ketidakefektifan perfusi jaringan perifer dapat terjadi, hal tersebut disebabkan oleh penurunan oksigen dalam darah sehingga membuat penyaluran nutrisi dan oksigen ke jaringan kapiler mengalami kegagalan yang diakibatkan oleh peningkatan kekentalan darah akibat gula darah yang tinggi (Nadrati *et al.*, 2020). Ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus dapat berdampak muncul ulkus kaki yang tidak dapat disembuhkan, hingga risiko amputasi ekstremitas bawah (Radhika *et al.*, 2020).

Pengobatan pasien diabetes mellitus sebagai tindakan pencegahan dengan tujuan memperlancar sirkulasi jaringan perifer pada kaki dengan ketidakefektifan perfusi jaringan perifer dapat dilakukan dengan terapi farmakologi dan non

farmakologi. Pengobatan farmakologi yang dapat diberikan ialah pemberian terapi insulin dan obat hipoglikemik oral (Nopriani & Saputri, 2021). Sedangkan pengobatan terapi non farmakologi salah satunya ialah dengan melakukan latihan fisik/senam seperti senam kaki, *acupressure*, rendam kaki air hangat, ROM (*Range Of Motion*) dan *buerger allen exercise* (Mataputun *et al.*, 2020). *Buerger allen exercise* sendiri dicetuskan oleh Leo Buerger pada tahun 1924 dan kemudian dimodifikasi oleh Arthur W. Allen pada tahun 1931 (Nadrati *et al.*, 2020). *Buerger allen exercise* merupakan bentuk latihan aktif yang dilakukan dengan menerapkan gaya gravitasi pada kaki, sehingga setiap langkah latihan perlu dilakukan secara teratur dan merupakan latihan yang dapat dilakukan secara individu, tidak harus dilakukan berkelompok, dan tidak memakan waktu yang lama (Suryati *et al.*, 2019). Pemilihan *buerger allen exercise* sebagai salah satu terapi non farmakologi yang dapat diberikan pada penderita diabetes mellitus dengan ketidakefektifan perfusi jaringan perifer ialah karena lebih simpel dan lebih efektif. Hal ini dibuktikan dengan penelitian yang dilakukan oleh Sari *et al.*, (2019) dimana peneliti membandingkan efektivitas *buerger allen exercise* dan senam kaki terhadap nilai ABI pada penderita diabetes mellitus tipe 2 dan mendapatkan hasil yaitu *buerger allen exercise* dan senam kaki sebenarnya sama-sama efektif dalam meningkatkan nilai *ankle brachial index* (ABI), namun *buerger allen exercise* lebih efektif daripada senam kaki (Sari *et al.*, 2019).

Peran perawat dalam upaya preventif dengan melakukan pengkajian kaki untuk mengetahui adanya gangguan vaskularisasi perifer di area kaki, sehingga kejadian ulkus kaki diabetik dapat dicegah yang salah satunya dengan melakukan

pengukuran ABI dan memonitor nilai ABI yang ditunjukkan dengan penurunan nilai ABI $< 0,9$ dan dikatakan ABI normal apabila nilai ABI $\geq 1,0-1,2$ (Nadrati & Supriatna, 2021). Di samping itu bila gangguan vaskularisasi perifer sudah terjadi, dapat dilakukan upaya penanganan dengan pemberian intervensi mandiri perawat yang salah satunya dalam bentuk *exercise* adalah pemberian *buerger allen exercise* untuk upaya meningkatkan vaskularisasi perifer (Nadrati & Supriatna, 2021).

Penelitian yang dilakukan oleh Nadrati *et al.*, (2020), yang menyatakan bahwa *buerger allen exercise* berdampak pada sirkulasi ekstremitas bawah di RSUD Kota Mataram yang dilakukan 2 kali sehari dalam 4 hari dengan durasi ± 15 menit. Hal ini juga sejalan dengan penelitian lain yang dilakukan oleh Suryati *et al.*, (2019) yang juga menunjukkan bahwa *buerger allen exercise* berpengaruh terhadap sensitivitas kaki, perbedaan rata-rata sebelum dan sesudah latihan *buerger allen* adalah -2,846 dengan *p value* 0,000 ($<0,05$).

Berdasarkan dari berbagai data yang telah diuraikan diatas, maka peneliti tertarik untuk melakukan *literature review* mengenai pemberian intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus.

1.2 Rumusan Masalah

Berdasarkan latar belakang diatas rumusan masalah *literature review* ini sebagai berikut : “Apakah pemberian *buerger allen exercise* dapat dijadikan intervensi terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus?”

1.3 Tujuan Penelitian

1.3.1 Tujuan Umum

Tujuan umum pada *literature review* ini adalah : mengeksplorasi intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus.

1.3.2 Tujuan Khusus

Tujuan khusus pada *literature review* ini adalah :

1. Mendeskripsikan ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus.
2. Mendeskripsikan intervensi *buerger allen exercise* pada penderita diabetes mellitus.
3. Menganalisis pengaruh intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus.

1.4 Manfaat Penelitian

1.4.1 Bagi Peneliti

Meningkatkan kemampuan dalam berpikir kritis dan ilmiah serta sebagai tambahan wawasan peneliti terkait pemberian intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus serta sebagai studi awal sebelum peneliti melakukan original riset.

1.4.2 Bagi Masyarakat

Memberikan informasi khususnya kepada keluarga dan penderita diabetes mellitus mengenai salah satu cara penanganan diabetes mellitus yaitu dengan *buerger allen exercise*.

1.4.3 Bagi Tenaga Kesehatan/Profesi Keperawatan

Literature review ini diharapkan dapat memberikan pengetahuan dan sebagai acuan untuk memberikan pelayanan kesehatan kepada masyarakat terkait pemberian intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus.

1.4.4 Bagi Institusi Pendidikan

Literature review ini diharapkan dapat memberikan tambahan referensi bagi instansi pendidikan khususnya Universitas dr. Soebandi tentang pemberian intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus.

BAB 2

TINJAUAN PUSTAKA

2.1 Konsep Diabetes Mellitus

2.1.1 Pengertian Diabetes Mellitus

Diabetes Mellitus merupakan penyakit yang terjadi akibat gangguan pada pankreas yang tidak dapat menghasilkan insulin sesuai dengan kebutuhan tubuh dan/atau ketidakmampuan dalam memecah insulin (Tholib, 2016). Diabetes mellitus (DM) adalah penyakit menahun (kronis) berupa gangguan metabolik yang ditandai dengan kadar gula darah yang melebihi batas normal (Kementerian Kesehatan RI, 2018).

Definisi diabetes mellitus secara umum merupakan suatu penyakit dengan keadaan dimana tubuh tidak dapat menghasilkan hormon insulin sesuai kebutuhan atau tubuh tidak dapat memanfaatkan secara optimal insulin yang dihasilkan, sehingga terjadi kelonggaran kadar gula dalam darah melebihi normal (Fitriana & Rachmawati, 2021). Berdasarkan penjelasan diatas, dapat disimpulkan bahwa diabetes mellitus adalah suatu penyakit dengan gangguan pada pankreas yang disertai dengan meningkatnya kadar glukosa dalam darah (gula darah) yang diakibatkan oleh gangguan dalam produksi insulin.

Pada keadaan normal, kadar gula darah pada pagi hari adalah 70-110 mg/dl (Tarwoto dkk, 2012). Kadar gula darah biasanya kurang dari 120-140 mg/dl dalam 2 jam setelah makan atau minum cairan yang mengandung gula maupun segala macamnya (Masriadi, 2016).

2.1.2 Faktor-Faktor Risiko Diabetes Mellitus

Menurut Fitriana dan Rachmawati (2021), secara umum ada beberapa faktor yang diyakini dapat menimbulkan risiko penyakit diabetes mellitus. Beberapa faktor tersebut diantaranya:

1. Faktor Keturunan (Genetik)

Pada seseorang penderita diabetes mellitus, faktor genetik atau keturunan memiliki peranan atau kontribusi yang tidak bisa dianggap remeh atau sepele. Mempunyai keturunan dengan diabetes, misalnya pada diabetes mellitus tipe 1 diturunkan sebagai sifat heterogen, mutagenik. Kembar identik mempunyai risiko 25% - 50%, sementara saudara kandung berisiko 6% dan anak berisiko 5% (Tarwoto dkk, 2012). Cara seseorang supaya terhindar dari penyakit diabetes mellitus yang disebabkan oleh faktor genetik dapat dilakukan dengan memperbaiki pola makan dan pola hidup sehat, sehingga akan terhindar dari penyakit diabetes mellitus.

2. Obesitas atau kegemukan

Obesitas atau kegemukan pada seseorang dapat menyebabkan tubuh mengalami resistensi terhadap hormon insulin karena menyebabkan terjadinya persaingan yang ketat antara sel-sel tubuh dengan jaringan lemak untuk menyerap insulin. Hal ini mengakibatkan pankreas harus bekerja dengan keras dalam memproduksi insulin sebanyak-banyaknya sehingga dapat mengakibatkan rusaknya pankreas (Fitriana & Rachmawati, 2021).

3. Usia

Menurut (Damayanti, 2015), Faktor usia yang risiko menderita diabetes mellitus tipe 2 adalah usia diatas 30 tahun, hal ini karena adanya perubahan anatomis, fisiologis dan biokimia. Perubahan dimulai dari tingkat sel, kemudian berlanjut pada tingkat jaringan dan akhirnya pada tingkat organ yang dapat mempengaruhi homeostasis. Setelah seseorang mencapai umur 30 tahun, maka kadar glukosa darah naik 1-2 mg% tiap tahun saat puasa dan akan naik 6-13% pada 2 jam setelah makan, berdasarkan hal tersebut bahwa umur merupakan faktor utama terjadinya kenaikan relevansi diabetes serta gangguan toleransi glukosa (Sudoyo,*et al.* 2009).

4. Aktivitas fisik

Aktifitas fisik yang kurang pada seseorang dapat menjadi faktor yang cukup besar untuk mengalami kegemukan sehingga melemahkan kerja organ-organ vital seperti jantung, liver, ginjal, dan juga pankreas (Fitriana & Rachmawati, 2021). Aktivitas fisik juga berdampak terhadap aksi insulin pada orang yang berisiko diabetes mellitus (Damayanti, 2015). Menurut Ketua Indonesian Diabetes Association (Persadia), Soegondo bahwa diabetes mellitus tipe 2 selain faktor genetik, juga bisa dipicu oleh lingkungan yang menyebabkan perubahan gaya hidup tidak sehat, seperti makan berlebihan (berlemak dan kurang serat), kurang aktivitas fisik, stres. Diabetes mellitus tipe 2 sebenarnya dapat dikendalikan atau dicegah

terjadinya melalui gaya hidup sehat, seperti makanan sehat dan aktivitas fisik teratur (Damayanti, 2015).

5. Mengonsumsi makanan berkolesterol tinggi

Menurut (Fitriana & Rachmawati, 2021) mengonsumsi makanan kolesterol lebih dari 300 mg/harinya diyakini dapat memberikan peranan atau kontribusi yang cukup besar bagi seseorang terserang penyakit diabetes mellitus.

6. Tekanan Darah

Seseorang yang berisiko menderita diabetes mellitus adalah yang mempunyai tekanan darah tinggi (hipertensi) yaitu tekanan darah $\geq 140/90$ mmHg. Pada umumnya pada diabetes mellitus menderita juga hipertensi. Hipertensi yang tidak dikelola dengan baik akan mempercepat kerusakan pada ginjal dan kelainan kardiovaskuler. Sebaliknya apabila tekanan darah dapat dikontrol maka akan memproteksi terhadap komplikasi mikro dan makrovaskuler yang disertai pengelolaan hiperglikemia yang terkontrol. Patogenesis hipertensi pada penderita diabetes mellitus tipe 2 sangat kompleks, banyak faktor yang berpengaruh pada peningkatan tekanan darah. Pada diabetes mellitus faktor tersebut adalah : resistensi insulin, kadar gula darah plasma, obesitas selain faktor lain pada sistem autoregulasi pengaturan tekanan darah (Sudoyo, 2006; Damayanti, 2015).

2.1.3 Tanda Dan Gejala Diabetes Mellitus

Tanda dan gejala penderita diabetes mellitus diantaranya yaitu (Tarwoto dkk, 2012):

1. Sering kencing/miksi atau meningkatnya frekuensi buang air kecil (poliuria).

Adanya hiperglikemia menyebabkan sebagian glukosa dikeluarkan oleh ginjal bersama urin karena keterbatasan kemampuan filtrasi ginjal dan kemampuan reabsorpsi pada tubulus ginjal. Untuk mempermudah pengeluaran glukosa maka diperlukan banyak air, sehingga frekuensi miksi menjadi meningkat.

2. Meningkatnya rasa haus (polidipsia).

Banyaknya miksi menyebabkan tubuh kekurangan cairan (dehidrasi), hal ini merangsang pusat haus yang mengakibatkan peningkatan rasa haus.

3. Meningkatnya rasa lapar (polipagia).

Meningkatnya katabolisme, pemecahan glikogen untuk energi menyebabkan cadangan energi berkurang, keadaan ini menstimulasi pusat lapar.

4. Penurunan berat badan.

Penurunan berat badan disebabkan karena banyaknya kehilangan cairan, glikogen dan cadangan trigliserida serta massa otot.

5. Kelainan pada mata, penglihatan kabur.

Pada kondisi kronis, keadaan hiperglikemia menyebabkan aliran darah menjadi lambat, sirkulasi ke vaskuler tidak lancar, termasuk pada mata yang dapat merusak retina serta kekeruhan pada lensa.

6. Kulit gatal, infeksi kulit, gatal-gatal disekitar penis dan vagina.

Peningkatan glukosa darah mengakibatkan penumpukan gula pada kulit sehingga menjadi gatal, jamur dan bakteri mudah menyerang kulit.

7. Ketonuria.

Ketika glukosa tidak lagi digunakan untuk energi, maka digunakan asam lemak untuk energi, asam lemak akan dipecah menjadi keton yang kemudian berada pada darah dan dikeluarkan melalui ginjal.

8. Kelemahan dan keletihan.

Kurangnya cadangan energi, adanya kelaparan sel, kehilangan potassium menjadi akibat pasien mudah lelah dan letih.

9. Terkadang tanpa gejala.

Pada keadaan tertentu, tubuh sudah dapat beradaptasi dengan peningkatan glukosa darah.

2.1.4 Patofisiologi Diabetes Mellitus

Menurut Tarwoto dkk (2012), diabetes mellitus adalah penyakit gangguan metabolisme kronik ditandai dengan peningkatan glukosa darah (hiperglikemia) yang disebabkan oleh menurunnya sekresi atau aktivitas insulin. Glukosa dibentuk didalam hati yang berasal dari makanan yang dikonsumsi dan sebagian juga digunakan untuk kebutuhan energi serta disimpan dalam bentuk glikogen di hati

dan jaringan lain dengan bantuan insulin. Insulin merupakan hormon yang dihasilkan oleh sel beta pulau langerhans di pankreas dan membantu memindahkan glukosa dari darah ke otot, hati dan sel lemak. Ketika terjadi gangguan pada pankreas, sel beta tidak dapat menghasilkan insulin sesuai dengan kebutuhan tubuh (defisiensi insulin) dan/atau ketidakmampuan dalam memecah insulin sehingga menyebabkan peningkatan kadar glukosa dalam darah (Tholib, 2016).

Adanya hiperglikemia atau kadar glukosa darah yang tinggi menyebabkan sebagian glukosa dikeluarkan oleh ginjal bersama urin (*glycosuria*) dan hal ini disertai pengeluaran cairan dan elektrolit yang berlebihan (*osmotic diuresis*) sehingga meningkatkan frekuensi buang air kecil (*poliuria*) dan meningkatnya rasa haus (*polidipsia*) akibat dari tubuh yang kekurangan cairan (*dehidrasi*) (Tarwoto dkk, 2012).

Pada diabetes mellitus tipe 2 terdapat dua masalah utama yaitu resistensi insulin dan gangguan sekresi insulin. Resistensi insulin ini menunjukkan adanya penurunan sensitivitas jaringan pada insulin, dimana insulin yang normal biasanya bekerja dengan mengikat reseptor khusus pada permukaan sel dan terjadi rangkaian reaksi meliputi metabolisme. Pada diabetes mellitus tipe 2 reaksi intraseluler berkurang, hal tersebut menyebabkan efektivitas insulin menurun dalam menstimulasi penyerapan glukosa oleh jaringan dan pada pembesaran oleh hati. Mengatur kadar glukosa darah dalam batas normal atau setidaknya sedikit lebih tinggi kadarnya dapat dilakukan untuk mengatasi resistensi insulin dan mencegah penumpukan glukosa dalam darah dengan peningkatan jumlah insulin.

Namun, ketika sel beta tidak mampu menjaga peningkatan kebutuhan insulin dapat menyebabkan kadar glukosa dalam darah meningkat sehingga diabetes mellitus tipe 2 berkembang (Tarwoto dkk, 2012).

2.1.5 Penatalaksanaan Diabetes Mellitus

Menurut (Damayanti, 2015), tujuan utama terapi diabetes mellitus adalah menormalkan aktivitas insulin dan kadar glukosa darah untuk mengurangi komplikasi yang ditimbulkan akibat diabetes mellitus seperti vaskuler serta neuropati, dengan cara yaitu menjaga kadar glukosa darah dalam batas normal serta memelihara kualitas hidup yang baik. Ada 5 komponen dalam penatalaksanaan diabetes yaitu:

1. Manajemen Diet

Kontrol nutrisi, diet dan berat badan merupakan dasar dalam penanganan pasien diabetes mellitus, serta komponen nutrisi pada diet diabetes mellitus adalah kebutuhan kalori, karbohidrat, lemak, protein dan serat (Tarwoto dkk, 2012).

2. Latihan Fisik (Olahraga)

Pengobatan terapi non farmakologi yang dapat diberikan pada pasien diabetes mellitus untuk mencegah komplikasi salah satunya dengan melakukan aktivitas fisik seperti olahraga senam kaki diabetes, *brisk walking exercise*, *buerger allen exercise*, *acupressure*, *foot massage*, dan rendam kaki air hangat (Mataputun *et al.*, 2020). Menurut (Tarwoto dkk, 2012), latihan fisik bagi penderita diabetes mellitus sangat dibutuhkan,

karena pada saat latihan fisik energi yang dipakai adalah glukosa dan asam lemak bebas. Latihan fisik bertujuan :

- (1) Menurunkan kadar gula darah dengan meningkatkan metabolisme karbohidrat
- (2) Menurunkan berat badan dan mempertahankan berat badan normal
- (3) Meningkatkan sensitivitas insulin
- (4) Meningkatkan kadar HDL (*high density lipoprotein*) dan menurunkan kadar trigliserida
- (5) Menurunkan tekanan darah

Yang perlu diperhatikan dalam latihan fisik penderita diabetes mellitus adalah frekuensi, intensitas, durasi waktu dan jenis latihan.

3. Pemantauan (*monitoring*) kadar gula darah

Pemantauan/*monitoring* kadar glukosa darah sangat penting untuk memastikan glukosa darah dalam keadaan stabil, pengukuran ini dapat dilakukan pada sewaktu-waktu atau pengukuran gula sewaktu yaitu pasien tanpa melakukan puasa, pengukuran 2 jam setelah makan dan pengukuran pada saat puasa (Tarwoto dkk, 2012).

4. Terapi Farmakologi

Penderita diabetes mellitus tipe 1 tidak mampu memproduksi insulin dalam tubuh sehingga sangat tergantung pada pemberian insulin dan diabetes mellitus tipe 2 tidak tergantung pada insulin, tetapi memerlukannya sebagai pendukung untuk menurunkan glukosa darah dalam mempertahankan kehidupan. Tujuan dari pemberian insulin adalah

untuk menjaga kadar glukosa dalam darah menjadi normal atau mendekati normal (Tarwoto dkk, 2012). Beberapa daya kerja insulin dibedakan menjadi :

- (1) Insulin dengan masa kerja pendek (2-4 jam) seperti Regular insulin, actrapid.
- (2) Insulin dengan masa kerja menengah (6-12 jam) seperti NPH (Neutral Protamine Hagedorn) insulin, Lente insulin.
- (3) Insulin dengan masa kerja panjang (18-24 jam) seperti Protamine zinc insulin dan ultralente insulin.
- (4) Insulin campuran yaitu kerja cepat dan menengah, misalnya 70% NPH, 30% regular.

Absorpsi dan durasi dari insulin bervariasi tergantung pada tempat penyuntikan, misalnya injeksi pada abdomen diabsorpsi lebih cepat sehingga durasinya lebih pendek dibandingkan pada lengan atau bokong.

Dosis insulin ditentukan berdasarkan pada :

- (1) Kebutuhan pasien. Kebutuhan insulin meningkat pada keadaan sakit yang serius/parah, infeksi, menjalani operasi dan masa pubertas.
- (2) Respon pasien terhadap injeksi insulin. Pemberian insulin biasanya dimulai antara 0.5 dan 1 unit/Kg BB/hari.

Penanganan efektif pada penderita diabetes mellitus tipe 2 dengan pemberian obat antidiabetik oral atau *Oral Hypoglycemic Agent* (OH), jika manajemen nutrisi dan latihan gagal (Tarwoto dkk, 2012). Jenis obat-obatan antidiabetik oral diantaranya :

- (1) Sulfonilurea : bekerja dengan merangsang beta sel pankreas untuk melepaskan cadangan insulinnya. Yang termasuk obat jenis ini adalah Glibenklamid, Tolbutamid, Klorpropamid.
- (2) Biguanida : bekerja dengan menghambat penyerapan glukosa di usus, misalnya metformin, glucophage.

Pemberian terapi insulin dapat menyebabkan satu atau lebih komplikasi diantaranya :

- (1) Hipoglikemia.

Terjadi apabila kadar glukosa darah di bawah 60 mg/100 ml, karena kelebihan dosis insulin atau terlambat makan sementara pasien sudah diberikan insulin, aktivitas yang berlebihan. Kelebihan pemberian dosis biasanya terjadi akibat kesalahan menggunakan alat suntik insulin dengan ukuran 40 U/ml atau 100 U/ml. Pada keadaan hipoglikemia pasien biasanya mengalami gangguan kesadaran, takikardia, keringat dingin, berkunang-kunang, lemas.

- (2) Hipertrofi atau atrofi jaringan.

Hipertrofi jaringan meliputi penebalan dari jaringan subkutan pada tempat injeksi. Jaringan atrofi terjadi dengan hilangnya lemak pada area injeksi.

- (3) Alergi insulin baik reaksi alergi setempat maupun reaksi alergi sistemik.

Reaksi alergi setempat biasanya terjadi pada tahap permulaan pemberian terapi insulin 1-2 jam setelah pemberian. Reaksi setempat

ditandai adanya kemerahan, pembengkakan, nyeri tekan pada durasi 2-4 cm di lokasi penyuntikan. Reaksi alergi sistemik jarang terjadi, merupakan reaksi anafilaktik yang merupakan keadaan emergensi.

- (4) Resistensi insulin. Merupakan keadaan dimana pasien membutuhkan insulin lebih dari 100 unit per hari. Keadaan ini disebabkan antibodi yang menangkap molekul insulin tidak aktif.

5. Pendidikan kesehatan

Menurut Tarwoto dkk (2012), pendidikan kesehatan merupakan hal penting yang harus dilakukan pada pasien diabetes mellitus. Beberapa hal penting yang perlu disampaikan pada pasien diabetes mellitus adalah :

- (1) Penyakit diabetes mellitus yang meliputi pengertian, tanda dan gejala, penyebab, patofisiologi dan tes diagnosis.
- (2) Diet atau manajemen diet pada penderita diabetes mellitus.
- (3) Aktivitas sehari-hari termasuk latihan dan olahraga.
- (4) Pencegahan terhadap komplikasi diabetes mellitus.
- (5) Pemberian obat-obatan diabetes mellitus dan cara injeksi insulin.
- (6) Cara memonitoring dan mengukur kadar glukosa darah secara mandiri.

2.1.6 Komplikasi Diabetes Mellitus

Penderita diabetes mellitus berisiko terjadi komplikasi baik bersifat akut maupun kronis diantaranya (Tarwoto dkk, 2012) :

1. Komplikasi akut

- (1) Koma hiperglikemia disebabkan kadar gula sangat tinggi biasanya terjadi pada NIDDM (*Non Insulin Dependent Diabetes Mellitus*).
- (2) Ketoasidosis atau keracunan zat keton sebagai hasil metabolisme lemak dan protein terutama terjadi pada IDDM (*Insulin Dependent Diabetes Mellitus*).
- (3) Koma hipoglikemia akibat terapi insulin yang berlebihan atau tidak terkontrol.

2. Komplikasi kronis

- (1) *Mikroangiopati* (kerusakan pada saraf-saraf perifer) pada organ-organ yang mempunyai pembuluh darah kecil seperti pada :
 - a) *Retinopati diabetika* (kerusakan saraf retina di mata) sehingga mengakibatkan kebutaan.
 - b) *Neuropati diabetika* (kerusakan saraf-saraf perifer) mengakibatkan baal/gangguan sensoris pada organ tubuh.
 - c) *Nefropati diabetika* (kelainan/kerusakan pada ginjal) dapat mengakibatkan gagal ginjal.
- (2) *Makroangiopati*
 - a) Kelainan pada jantung dan pembuluh darah seperti *miokard infark* maupun gangguan fungsi jantung karena arteriosklerosis.

- b) Gangguan sistem pembuluh darah otak atau stroke.
- (3) Gangren diabetika karena adanya neuropati dan terjadi luka yang tidak sembuh-sembuh.
- (4) Disfungsi erektile diabetika.

2.2 Konsep *Buerger Allen Exercise*

2.2.1 Pengertian *Buerger Allen Exercise*

Buerger exercise atau *buerger allen exercise* diusulkan oleh Leo Buerger pada tahun 1924 dan kemudian dimodifikasi oleh Arthur W. Allen pada tahun 1931 (Nadrati *et al.*, 2020). *Buerger allen exercise* adalah salah satu jenis gerakan aktif pada kaki dengan menerapkan gaya gravitasi dan gerakan harus dilakukan dengan teratur agar mendapatkan manfaat yang maksimal (Zamaa *et al.*, 2021). *Buerger allen exercise* adalah latihan yang dilakukan untuk upaya mencegah ataupun rehabilitasi bagi penderita diabetes mellitus yang berisiko menderita gangguan vaskularisasi perifer pada tungkai bawah ataupun yang sudah terdiagnosis (Mataputun *et al.*, 2020).

Buerger allen exercise adalah sistem latihan yang bertujuan untuk mensuplai darah ke arteri tungkai bawah yang tidak mencukupi dengan menggunakan perubahan gravitasi dari posisi yang diterapkan dan *muscle pump* (pompa otot) yang terdiri dari dorsofleksi dan plantarfleksi melalui gerakan aktif pergelangan kaki untuk melancarkan peredaran darah (Sari *et al.*, 2019). *Muscle pump* dengan dorsofleksi dan plantarfleksi dapat merangsang endotel untuk pelepasan dan pengeluaran nitrit oksida, sehingga memberikan sinyal relaksasi untuk otot polos

pembuluh darah dan kemudian terjadi vasodilatasi dan membuat darah mengalir ke perifer kaki secara lancar (Purnawarman & Nurkhalis, 2014; Sari *et al.*, 2019). Sedangkan perubahan postur dalam *buerger allen exercise* (gravitasi pada posisi yang diterapkan) akan membantu mengosongkan dan mengisi kolom darah secara bergantian, sehingga meningkatkan transportasi darah melalui pembuluh darah (Sherwood, 2016; Sari *et al.*, 2019). *Buerger allen exercise* adalah latihan yang sangat mudah dilakukan karena hanya memiliki 3 gerakan sehingga tidak akan membuat pasien merasa lelah, tidak menggunakan perlengkapan olahraga, dapat dilakukan dimana saja (Mataputun *et al.*, 2020). Berdasarkan beberapa pengertian *buerger allen exercise* diatas, dapat disimpulkan bahwa *buerger allen exercise* itu sendiri adalah latihan kaki yang mengkombinasikan gaya gravitasi dan *muscle pump* (pompa otot) dimana terdiri dari gerakan dorsofleksi dan plantarfleksi, dengan tujuan untuk meningkatkan sirkulasi darah di kaki serta latihan ini dapat dilakukan sendiri di rumah dan tidak memakan waktu lama.

2.2.2 Manfaat Buerger Allen Exercise

Berdasarkan beberapa penelitian, manfaat *buerger allen exercise* pada penderita diabetes mellitus diantaranya ialah dapat meningkatkan sirkulasi pembuluh darah perifer dengan perubahan gravitasi (elevasi kaki, penurunan kaki, dan tidur terlentang) pada ekstremitas bawah disertai kontraksi otot melalui gerakan dorsofleksi dan plantarfleksi dari pergelangan kaki (Salam & Laili, 2020). Hal tersebut juga dapat memenuhi kebutuhan oksigen dan nutrisi yang masuk ke arteri dan vena sehingga memperkuat dan memaksimalkan kerja otot-otot kecil, serta membantu meningkatkan nilai *Ankle Brachial Index* (ABI) (Zamaa *et al.*,

2021). Selain meningkatnya kebutuhan nutrisi jaringan dan suplai darah di area telapak kaki, hal itu juga meningkatkan perfusi ekstremitas pada penderita diabetes mellitus (Romlah & Mataputun, 2021). *Buerger allen exercise* yang dilakukan dengan baik dan benar akan membuat melebarnya pembuluh darah di daerah kaki sehingga peredaran darah menjadi lancar, dan menyebabkan penggunaan glukosa meningkat selama proses metabolisme serta menyebabkan sensitivitas kaki menjadi lebih baik dan meningkat (Suryati *et al.*, 2019).

2.2.3 Tujuan *Buerger Allen Exercise*

Buerger allen exercise adalah sistem latihan yang bertujuan untuk mensuplai darah ke arteri tungkai bawah yang tidak mencukupi dengan menggunakan perubahan gravitasi dari posisi yang diterapkan dan *muscle pump* (pompa otot) yang terdiri dari dorsofleksi dan plantarfleksi melalui gerakan aktif pergelangan kaki untuk melebarkan pembuluh darah sehingga melancarkan peredaran darah (Sari *et al.*, 2019). Hal tersebut juga menyebabkan meningkatnya penggunaan glukosa dalam darah yang diakibat oleh berkontraksinya otot-otot kaki sehingga metabolisme otot meningkat (Suryati *et al.*, 2019).

2.2.4 Indikasi dan Kontraindikasi *Buerger Allen Exercise*

Menurut Vijayabarathi (2014) dan Hidayat (2014) indikasi dan kontraindikasi dari senam kaki atau *buerger allen exercise* diantaranya (Supriyadi, 2017; Syah *et al.*, 2021):

1. Indikasi
 - 1) Pasien penderita diabetes melitus tipe 1 dan tipe 2,
2. Kontraindikasi
 - 1) *Buerger allen exercise* dapat digunakan untuk diabetes mellitus namun latihan ini mungkin sulit dilakukan apabila pasien mengalami penurunan kemampuan fungsional atau ADL (*Activity of Daily Living*).

2.2.5 Hal-hal yang Harus Dikaji Sebelum Melakukan *Buerger Allen Exercise*

Menurut Salihun (2022) yang berdasarkan dari teori (Vijayabarathi & Hemavathy, 2014) menjelaskan bahwa hal yang harus dikaji sebelum melakukan *buerger allen exercise*, meliputi :

- a. Melihat keadaan umum seperti keadaan kaki pasien dan kesadaran pasien.
- b. Melakukan pemeriksaan tanda-tanda vital sebelum tindakan dimulai.
- c. Memperhatikan indikasi dan kontraindikasi tindakan yang akan dilakukan.
- d. Mengkaji suasana hati atau mood dan motivasi pasien

2.2.6 Tahapan *Buerger Allen Exercise*

Buerger allen exercise terdiri dari 3 tahap yaitu (Nadrati *et al.*, 2020) :

1. Tahap elevasi, posisi supinasi (terlentang) dengan kaki diangkat lebih tinggi dari jantung (*leg elevasi*) dengan sudut 45° - 90° ditambah dengan gerakan dorsofleksi dan plantarfleksi, fase ini selama 1-2 menit. Tahap ini bertujuan untuk melakukan perubahan gravitasi dengan memposisikan kaki elevasi sehingga menyebabkan peningkatan aliran darah ke jantung dan menyebabkan dinding ruang jantung meregang serta otot berkontraksi lebih kuat lagi, sehingga semua penambahan darah yang kembali ke jantung akan dipompa masuk lagi ke sirkulasi secara otomatis (Sari *et al.*, 2019).
2. Tahap penurunan (*sit, feet lowered*), posisi duduk dengan kaki menjuntai (menggantung di tempat tidur) dan ditambah dengan gerakan dorsofleksi dan plantarfleksi, fase ini dilakukan selama 2-5 menit. Tahap ini bertujuan untuk melakukan perubahan gravitasi dengan meningkatkan aliran darah dari jantung ke ujung-ujung kaki atau tungkai bawah, hal ini dapat membantu pendistribusian cairan dalam tubuh dengan secara bergantian untuk mengosongkan dan mengisi kolom darah, yang dapat meningkatkan transportasi darah melalui pembuluh darah (Sari *et al.*, 2019).
3. Tahap horizontal atau tahap istirahat, posisi supinasi dengan kaki horizontal untuk beristirahat dan ditambah gerakan dorsofleksi dan plantarfleksi dari pergelangan kaki, dilakukan selama kurang lebih 5

menit. Pada tahap ini tujuannya untuk dapat memperbaiki aliran darah atau reperfusi dari tungkai kaki saat efek gravitasi mulai berkurang (Chang *et al.*, 2016; Saputra *et al.*, 2020).

Waktu yang dibutuhkan untuk melakukan *buerger allen exercise* sehingga mendapatkan hasil yang optimal dapat dilakukan sebanyak 6 kali selama 6 hari dengan durasi 15 menit setiap kali pertemuan (Salam & Laili, 2020). Selain itu ada juga yang menyatakan bahwa *buerger allen exercise* diberikan setiap hari 5-6 kali/hari selama 4 hari (Radhika *et al.*, 2020).



Figure 1. (A) Step 1 of Buerger exercise. (B) Step 2 of Buerger exercise. (C) Step 3 of Buerger exercise.

Gambar 2.1 Gerakan *Buerger Allen Exercise*

(Sumber : Chang *et al.* (2016))



Gambar 2.2 Gerakan Dorsofleksi Dan Plantarfleksi

(Sumber : Muktasambhasa (2012))

2.3 Konsep Perfusi Jaringan Perifer

2.3.1 Pengertian Perfusi Jaringan Perifer

Perfusi jaringan perifer adalah suatu kondisi dimana seseorang mengalami atau kemungkinan akan mengalami penurunan sirkulasi darah ke perifer (Goesalosna *et al.*, 2019). Ketidakefektifan perfusi jaringan perifer adalah keadaan dimana seseorang mengalami penurunan sirkulasi darah ke perifer yang dapat mengganggu kesehatan atau metabolisme tubuh (NANDA, 2018).

Peripheral arterial disease (PAD) atau penyakit arteri perifer adalah suatu kondisi di mana aliran darah ke tungkai tersumbat karena penyempitan pembuluh darah yang berasal dari jantung (arteri), sehingga tungkai yang kekurangan suplai darah akan terasa sakit atau pegal, terutama saat berjalan (Willy, 2019). Penyakit arteri perifer terkadang tidak menimbulkan gejala, tetapi bila dibiarkan tanpa penanganan, penyakit arteri perifer bisa memburuk hingga menimbulkan kematian jaringan dan risiko amputasi (Willy, 2019).

Penyakit arteri perifer pada penderita diabetes mellitus mengakibatkan perfusi jaringan perifer menjadi tidak efektif sehingga menyebabkan sensasi kesemutan yang berhubungan dengan berkurangnya sirkulasi darah perifer (Permata & Musta'in, 2019). Hal tersebut disebabkan oleh penurunan oksigen dalam darah sehingga membuat penyaluran nutrisi dan oksigen ke sel dan jaringan kapiler mengalami kegagalan yang diakibatkan oleh peningkatan kekentalan darah akibat gula darah yang tinggi (Nadrati *et al.*, 2020; Permata & Musta'in, 2019).

2.3.2 Tanda-tanda Perfusi Jaringan Perifer Menurun

Ketidakefektifan perfusi jaringan perifer ini pada pasien diabetes mellitus dapat menyebabkan rasa kesemutan yang sering timbul, hal ini berkaitan sirkulasi darah perifer menurun hingga ke serabut saraf (Lestari, 2016; Permata & Musta'in, 2019). Menurut (Nadrati *et al.*, 2020) melalui survey pendahuluan yang telah dilakukan, mendapatkan data dari hasil observasi dan wawancara bahwa penderita diabetes mellitus mengeluh adanya nyeri pada kaki, baal (mati rasa), dan kulit kaki yang menghitam dimana gejala ini merupakan gejala pada gangguan vaskuler. Penelitian lain juga mengungkapkan bahwa proses melambatnya penyembuhan luka disebabkan oleh adanya gangguan maupun sumbatan aliran darah perifer di ekstremitas bawah yang berfungsi dalam pemenuhan suplai darah (Mataputun *et al.*, 2020). Selain itu, salah satu indikator yang dapat mengetahui adanya penurunan perfusi aliran darah ke tungkai atau ekstremitas bawah yaitu dengan melakukan pengukuran menggunakan *Ankle Brachial Index* (ABI) (Mataputun *et al.*, 2020). Terjadi penurunan aliran darah ke perifer jika didapatkan nilai $ABI < 0,9$ dan dikatakan Nilai ABI normal dengan nilai 0,9-1,4 (Setiati, 2014).

2.3.3 Pengukuran Jaringan Perifer

Untuk mengetahui adanya penyakit arteri perifer, diperlukan pemeriksaan sistem vaskular perifer diantaranya yaitu (Setiati, 2014) :

1. *Ankle Brachial Index* (ABI)

Ankle Brachial Index (ABI) merupakan tes non invasif yang penting pada pasien yang dicurigai mengalami penyakit arteri perifer atau pasien yang

berisiko tinggi terjadi penyakit arteri perifer. Nilai ABI normal atau pada orang sehat berkisar 0,9-1,4. Nilai ABI 0,4-0,9 menunjukkan adanya penyakit arteri perifer ringan-sedang, dan nilai ABI $< 0,4$ menunjukkan suatu penyakit arteri perifer berat.

2. Metode Ultrasound

Pemeriksaan *Duplex Ultrasound* (DUS) dapat memberikan informasi anatomi dan aliran darah (hemodinamik) pada arteri. Pemeriksaan ABI dan DUS cukup menegakkan diagnosis dan menentukan tatalaksana yang sesuai untuk pasien dengan LEAD (*Lower Extremity Artery Disease*) atau penyakit arteri ekstremitas bawah. Kelemahan dari DUS selain pemeriksaan membutuhkan pengalaman dan ketelitian pemeriksa, DUS juga tidak dapat memberikan gambaran penuh secara jelas dari arteri bila dibandingkan dengan pemeriksaan DSA (*Digital Subtraction Angiography*), CTA (*Computed Tomography Angiography*) atau MRA (*Magnetic Resonance Angiography*).

Pemeriksaan lain seperti CTA, MRA, dan DSA dapat dilakukan sebagai pemeriksaan tambahan dan pemeriksaan tersebut memiliki sensitivitas dan spesifisitas yang tinggi dan dapat menggambarkan arteri dengan jelas, namun tidak dapat memperlihatkan status hemodinamika arteri seperti DUS.

2.3.4 Interpretasi Nilai ABI (*Ankle Brachial Index*)

1. Normal

ABI dengan nilai lebih dari 0,9 dinilai sebagai nilai normal atau terbebas dari keadaan penyakit arteri perifer atau PAD (*Peripheral arterial disease*) karena darah masih bersirkulasi dengan baik tanpa adanya obstruksi yang bermakna pada pembuluh perifer, sehingga kebutuhan nutrisi dan oksigen pada ekstremitas bawah dapat terpenuhi dengan baik (Brunner & Suddarth, 2010 dalam Darwis, 2020).

2. Iskemia ringan

ABI dalam rentang 0,6 sampai 0,8 merupakan iskemia ringan/*borderline perfusion*/batasan perfusi/obstruksi ringan. Gejala primer penyakit arteri perifer atau PAD (*Peripheral arterial disease*) berupa nyeri pada pantat/betis ketika berjalan (*klaudikasio intermiten*) mulai terasa (Brunner & Suddarth, 2010 dalam Darwis, 2020). Rasa nyeri timbul karena adanya oklusi pembuluh darah yang mengakibatkan ketidakmampuan aliran darah untuk memenuhi kebutuhan nutrisi terutama pada ekstremitas bawah saat metabolisme meningkat, dan oklusi yang terjadi masih dalam rendang ringan sehingga untuk mengatasinya dapat melakukan latihan fisik/*exercise* seperti senam kaki (Bryant & Nix, 2006 dalam Darwis, 2020).

3. Iskemia Berat

Kondisi iskemia berat/obstruksi sedang dengan interpretasi ABI sebesar $\leq 0,5$ terjadi akibat buruknya perfusi perifer karena oklusi

yang mulai memanjang sehingga denyut jantung dan tekanan arteri menurun. Keadaan ini menyebabkan hipoksia jaringan sehingga mengakibatkan iskemia pada kaki dan bila terdapat luka, maka penyembuhan luka sulit kecuali dilakukan revaskularisasi (Sudoyo, 2009 dalam Darwis, 2020).

4. Iskemia Kritis

Nilai $ABI \leq 0,4$ mengartikan bahwa telah terjadi iskemia kritis/obstruksi parah pada kaki. Hal ini merupakan kondisi klimaks dari iskemia berat/obstruksi sedang yang dimanifestasikan dengan terjadinya ulkus diabetikum dan gangren (Price & Wilson, 2006 dalam Darwis, 2020).

Tabel 2.1 Interpretasi Nilai ABI (*Ankle Brachial Index*)

Nilai ABI	Interpretasi
$\leq 0.9-1.3$	Normal
$\leq 0.6-0.8$	Iskemia ringan/ <i>borderline perfusion</i> /batasan perfusi/obstruksi ringan
$\leq 0,5$	Iskemia berat/obstruksi sedang
$\leq 0,4$	Iskemia kritis/obstruksi parah

(Sumber : WOCNS (2012) dalam Darwis (2020))

2.4 Pengaruh *Buerger Allen Exercise* Terhadap Peningkatan Perfusi

Jaringan Perifer

Diabetes mellitus adalah gangguan metabolisme yang ditandai dengan peningkatan kadar gula darah yang diakibatkan oleh gangguan produksi insulin atau resistensi tubuh terhadap hormon (Saputra *et al.*, 2020). Apabila hal tersebut tidak segera diobati dapat menyebabkan penyakit arteri perifer, sehingga menimbulkan beberapa komplikasi serius salah satunya ialah ketidakefektifan perfusi jaringan perifer yang disebabkan oleh penurunan oksigen dalam darah sehingga membuat penyaluran nutrisi ke jaringan kapiler mengalami kegagalan yang disebabkan oleh peningkatan kekentalan darah (hiperglikemia) akibat gula darah yang tinggi (Nadrati *et al.*, 2020). Gangguan perfusi jaringan perifer ini dapat mengakibatkan penderita diabetes mellitus mengalami kematian jaringan dan risiko amputasi ekstremitas bawah karena kurangnya penanganan dan perawatan (Radhika *et al.*, 2020).

Penanganan yang dapat dilakukan untuk meningkatkan perfusi jaringan perifer pada penderita diabetes mellitus adalah dengan pemberian tindakan terapi non farmakologi (Mataputun *et al.*, 2020). Tindakan tersebut seperti perawatan kaki, menggunakan sepatu khusus penderita diabetes, senam kaki diabetes, latihan mobilitas dan *buerger allen exercise* (El-Fattah *et al.*, 2019). *Buerger allen exercise* ini berpengaruh terhadap peningkatan nilai *ankle brachial index* (ABI) pada penderita diabetes mellitus (Hasina *et al.*, 2021). Nilai *ankle brachial index* (ABI) sendiri ialah sebagai salah satu indikator yang dapat mengetahui adanya

penurunan ataupun peningkatan perfusi jaringan perifer pada penderita diabetes mellitus (Hasina *et al.*, 2021; Mataputun *et al.*, 2020).

Buerger allen exercise adalah latihan yang bertujuan untuk mensuplai darah ke arteri tungkai bawah yang tidak mencukupi dengan menggunakan perubahan gravitasi dari posisi yang diterapkan, dan *muscle pump* (pompa otot) yang terdiri dari dorsofleksi dan plantarfleksi melalui gerakan aktif pergelangan kaki untuk melancarkan peredaran darah (Sari *et al.*, 2019).

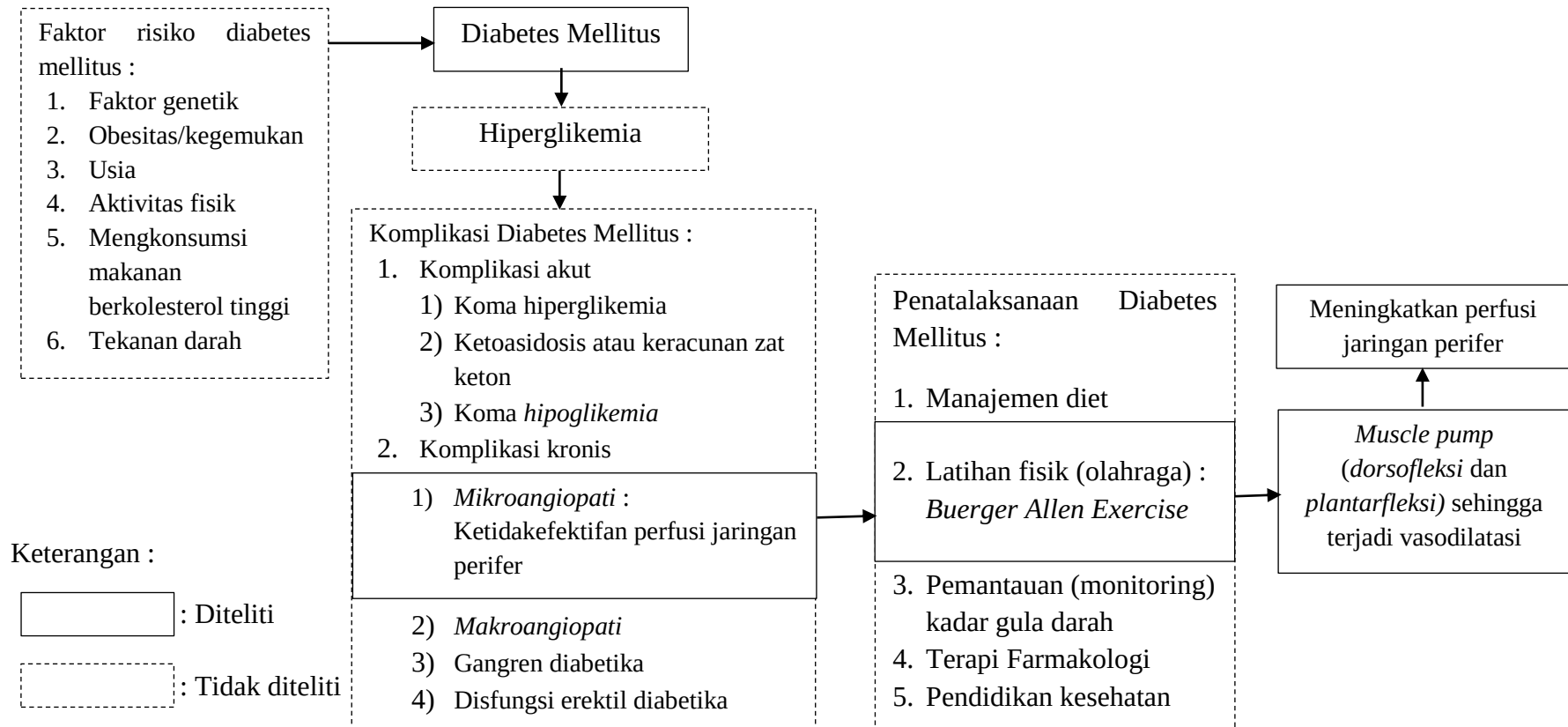
Manfaat *buerger allen exercise* untuk penderita diabetes mellitus diantaranya ialah dapat meningkatkan sirkulasi pembuluh darah perifer dengan perubahan gravitasi (elevasi kaki, penurunan kaki, dan tidur terlentang) pada ekstremitas bawah disertai kontraksi otot melalui gerakan dorsofleksi dan plantarfleksi dari pergelangan kaki (Salam & Laili, 2020). Hal tersebut juga dapat memenuhi kebutuhan oksigen dan nutrisi yang masuk ke arteri dan vena sehingga memperkuat dan memaksimalkan kerja otot-otot kecil, serta membantu meningkatkan nilai *ankle brachial index* (ABI) (Zamaa *et al.*, 2021). *Buerger allen exercise* yang dilakukan dengan baik dan benar akan membuat melebarnya pembuluh darah di daerah kaki sehingga peredaran darah menjadi lancar, dan menyebabkan penggunaan glukosa meningkat selama proses metabolisme serta menyebabkan sensitivitas kaki menjadi lebih baik dan meningkat (Suryati *et al.*, 2019).

Mekanisme *buerger allen exercise* untuk meningkatkan perfusi jaringan perifer yaitu dengan menggunakan perubahan gravitasi dan diikuti oleh *muscle pump* (pompa otot) yang terdiri dari dorsofleksi dan plantarfleksi melalui gerakan

aktif pergelangan kaki untuk melancarkan peredaran darah (Sari *et al.*, 2019). *Muscle pump* dengan dorsofleksi dan plantarfleksi dapat merangsang endotel untuk pelepasan dan pengeluaran nitrit oksida, sehingga memberikan sinyal relaksasi untuk otot polos pembuluh darah dan kemudian terjadi vasodilatasi dan membuat darah mengalir ke perifer kaki secara lancar (Purnawarman & Nurkhalis, 2014; Sari *et al.*, 2019). Sedangkan perubahan postur dalam *buerger allen exercise* (gravitasi pada posisi yang diterapkan) akan membantu mengosongkan dan mengisi kolom darah secara bergantian, sehingga meningkatkan transportasi darah melalui pembuluh darah (Sherwood, 2016; Sari *et al.*, 2019).

Menurut penelitian Salam & Laili (2020) menyatakan bahwa intervensi *buerger allen exercise* yang diberikan sebanyak 6 kali selama 6 hari dengan durasi 15 menit setiap kali pertemuan terbukti memberikan efek peningkatan nilai *ankle brachial index* (ABI) yang artinya meningkatkan perfusi jaringan perifer pada penderita diabetes mellitus. Penelitian tersebut sejalan dengan penelitian Radhika *et al.*, (2020) menyatakan bahwa *buerger allen exercise* yang dilakukan setiap hari 5-6 kali/hari selama 4 hari dapat meningkatkan kadar perfusi jaringan ekstremitas bawah pada penderita diabetes mellitus.

2.5 Kerangka Teori



Gambar 2. 3 Kerangka Teori

(Sumber : Damayanti, 2015; Fitriana & Rachmawati, 2021; Nadrati *et al.*, 2020; Salam & Laili, 2020; Sari *et al.*, 2019; Tarwoto dkk, 2012)

BAB 3

METODE PENELITIAN

3.1 Strategi Pencarian Literature

3.1.1 Protokol dan Registrasi

Rangkuman menyeluruh dalam bentuk *literature review* mengenai pemberian intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus. Setiap artikel yang ditemukan kemudian diseleksi dan disesuaikan dengan tujuan dari *literature review*.

3.1.2 Database Penelitian

Literature review yang merupakan rangkuman menyeluruh dari beberapa studi penelitian berdasarkan tema yang telah ditentukan. Tahun penerbitan yang digunakan pada pencarian *literature* adalah tahun 2016 sampai 2021. Data yang digunakan dalam penelitian ini merupakan data sekunder yaitu data yang diperoleh bukan dari pengalaman langsung, melainkan diperoleh dari hasil penelitian yang telah dilakukan oleh peneliti-peneliti terdahulu dan sumber data sekunder yang didapat berupa artikel jurnal bereputasi baik nasional maupun internasional berdasarkan tema yang telah ditentukan (Nursalam, 2020). Pencarian *literature review* ini menggunakan 3 database yaitu *ProQuest*, *Google Scholar*, dan *Pubmed*.

3.1.3 Kata Kunci

Pencarian artikel atau jurnal menggunakan kata kunci dan *Boolean Operator* (*and*, *or*, atau *and not*) yang digunakan peneliti untuk memperluas atau menspesifikkan pencarian, sehingga mempermudah dalam penemuan artikel atau jurnal yang digunakan. Kata kunci dalam *literature review* ini adalah “*buerger allen exercise*”, “latihan buerger allen”, “diabetes mellitus”, “perfusi jaringan perifer”, “*lower extremities perfusion*”, “*peripheral perfusion*”.

Tabel 3.1 Kata Kunci *Literature Review*

Intervensi		Variabel		Populasi
<i>Buerger allen exercise</i>	And	Perfusi jaringan perifer	And	Diabetes mellitus
Or		Or		
Latihan buerger allen	And	<i>Lower extremities perfusion</i>		
		Or		
		<i>Peripheral perfusion</i>		

3.2 Kriteria Inklusi dan Eksklusi

Strategi yang digunakan untuk mencari artikel menggunakan *PICOS framework*, yang terdiri dari:

1. *Population/problem* yaitu populasi atau masalah yang akan dianalisis sesuai dengan topik yang sudah ditentukan dalam *literature review*.
2. *Intervention* yaitu tindakan penatalaksanaan terhadap kasus individu atau kelompok serta penjelasan tentang penatalaksanaan studi sesuai dengan topik yang sudah ditentukan dalam *literature review*.

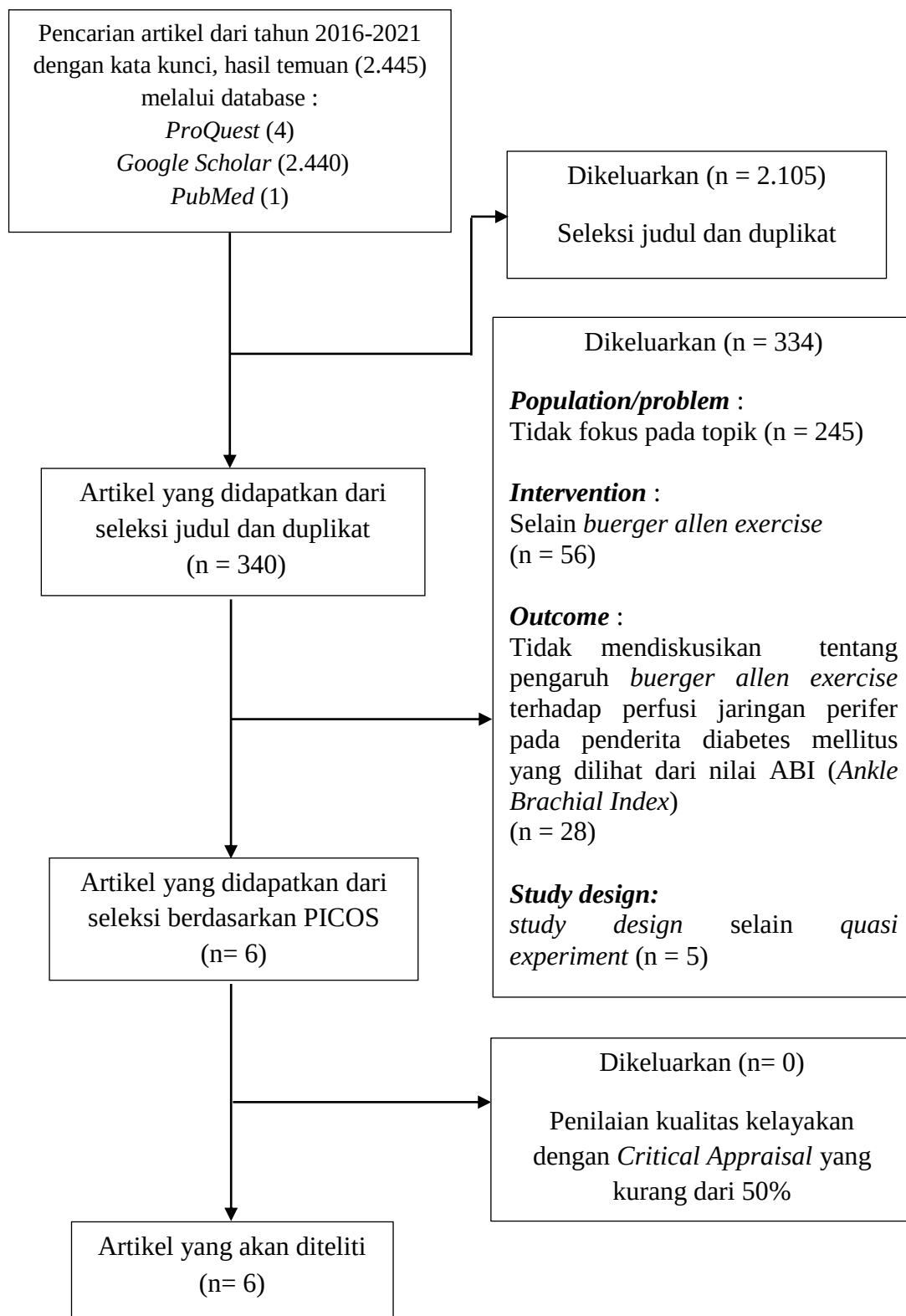
3. *Comparison* yaitu intervensi atau penatalaksanaan lain yang digunakan sebagai pembanding, jika tidak ada dapat menggunakan kelompok kontrol dalam studi terpilih.
4. *Outcome* yaitu hasil yang diperoleh pada penelitian sebelumnya yang sesuai dengan topik yang sudah ditentukan dalam *literature review*.
5. *Study design* yaitu desain penelitian yang digunakan dalam artikel yang akan di *review*.

Tabel 3.2 Kriteria Inklusi dan Eksklusi

Kriteria	Inklusi	Eksklusi
<i>Population</i>	Jurnal nasional dan internasional yang berhubungan dengan topik yang diteliti yaitu diabetes mellitus	Jurnal nasional dan internasional yang tidak berhubungan dengan topik yang diteliti
<i>Intervention</i>	Intervensi <i>buerger allen exercise</i>	Intervensi lain selain <i>buerger allen exercise</i>
<i>Comparation</i>	Ada pembandingan	
<i>Outcome</i>	Menganalisa pengaruh pemberian intervensi <i>buerger allen exercise</i> terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus dilihat dari nilai ABI (<i>Ankle Brachial Index</i>)	Tidak menganalisa tentang pengaruh pemberian intervensi <i>buerger allen exercise</i> terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus
<i>Study design</i>	<i>Quasi experiment, Pre-experimental design</i>	Kualitatif, <i>cross sectional, literatur review</i>
<i>Publication years</i>	Tahun 2016-2021	Sebelum tahun 2016

3.3 Seleksi Studi dan Penilaian Kualitas

Strategi dalam pencarian artikel yang dilakukan peneliti untuk menganalisis *literature review* ini dengan menggunakan kata kunci : “*buerger allen exercise*”, “latihan buerger allen”, “diabetes mellitus”, “perfusi jaringan perifer”, “*lower extremities perfusion*”, “*peripheral perfusion*”. Pencarian dalam 3 database dengan rentang mulai tahun 2016 hingga tahun 2021 yang dilakukan di *ProQuest*, *Google Scholar*, dan *Pubmed* mendapatkan 2.445 artikel yang sesuai dengan kata kunci. Peneliti kemudian melakukan seleksi berdasarkan judul dan duplikat sehingga ditemukan sebanyak 2.105 artikel yang sama sehingga dikeluarkan dan tersisa 340 artikel. Diseleksi kembali sesuai dengan PICOS dan mendapatkan 6 artikel, kemudian dilakukan penilaian *critical appraisal* memenuhi kriteria minimal 50% dan sesuai dengan tema *literature review* mendapatkan 6 artikel.



Gambar 3.1 Diagram Hasil Pencarian dan Seleksi Studi

BAB 4

HASIL DAN ANALISA

4.1 Hasil

4.1.1 Karakteristik Studi

Berdasarkan hasil pencarian artikel pada penelitian yang berjudul “Pemberian Intervensi *Buerger Allen Exercise* Terhadap Ketidakefektifan Perfusi Jaringan Perifer Pada Penderita Diabetes Mellitus *Literature Review*” didapatkan 6 artikel penelitian. Berdasarkan analisis yang dilakukan pada 6 artikel didapatkan 5 artikel menggunakan *Quasi experimental design* dan 1 artikel menggunakan *Pre-experimental design* dengan *pre-post test without control group*, analisa data sebagian besar menggunakan *Wilcoxon test* dan *paired t-test*, dan 6 artikel yang dianalisis menyebutkan bahwa ada peningkatan secara signifikan pada nilai *ankle brachial index* (ABI) setelah pemberian intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus. Berikut ini hasil analisis artikel yang ditampilkan dalam bentuk tabel sebagai berikut :

Tabel 4.1 Karakteristik Studi

Penulis dan Tahun Terbit	Judul	Metode (Desain, Sampel, Variabel, Instrument, Analisis)	Hasil
Walaah El-khanany Zahran, Amira Ahmed Hassanen, Madiha Hassan Nabih, Fady Azmy Kyrillos (2018)	<i>Effect Of Buerger Allen Exercise On Lower Limb Perfusion Among Patients With Type 2 Diabetes Mellitus</i>	D : Quasi experimental research design S : 48 responden V : Buerger allen exercise, lower limb perfusion I : skala Ankle Brachial Index (ABI) menggunakan standard manual sphygmomanometer dan standard hand Doppler A : Uji ANOVA (analysis of variance)	Hasil penelitian menyatakan terdapat perbedaan yang signifikan pada rata-rata ankle brachial index (ABI) antara kedua kelompok setelah melakukan buerger allen exercise (tp = <0,001).
Hanan Saber A. El-Fattah, Amal F. Garas, Nawal E. Hanna, Naglaa M. Elsayed (2019)	<i>Effect of buerger exercises on improving peripheral circulation of the lower extremities among patients with type 2 diabetes mellitus at selected university hospital-egypt</i>	D : Quasi experimental design S : 60 responden V : Buerger exercises, peripheral circulation I : Skala Ankle Brachial Index (ABI) A : Wilcoxon test	Hasil penelitian menyatakan bahwa setelah intervensi buerger allen exercise diberikan nilai rata-rata skor ankle brachial index (ABI) dari kedua tungkai menunjukkan nilai signifikansi yang lebih tinggi dibandingkan dengan skor sebelum intervensi (p = 0.001)
Siti Nur Hasina, Ima Nadatien, Iis Noventi, Tata Mahyuvi (2021)	<i>Buerger Allen Exercise Berpengaruh Terhadap Ketidakefektifan</i>	D : Quasy Experimental dengan rancangan Pre test and post test with control group S : 54 responden V : buerger allen exercise,	Hasil penelitian menyatakan bahwa di dapat nilai p value < 0.05 yang artinya terdapat perbedaan

	Perfusi Perifer Penderita Mellitus	Jaringan Pada Diabetes	ketidakefektifan perfusi jaringan perifer I : nilai ABI (<i>Ankle Brachial Index</i>) dengan peralatan <i>simple hand held vascular Doppler ultrasound probe</i> dan <i>Spignomanometer Digital</i> A : uji <i>t independent</i> dan uji <i>t paired</i>	signifikan nilai ABI sebelum dan sesudah diberikan intervensi buerger allen exercise pada kelompok intervensi dan kelompok kontrol.
Muh. Anwar Hafid, Ilhamsyah, La Ode Agustino Saputra, Mutmainnah Sari (2021)	<i>The effect of buerger allen exercise on the lower extremity peripheral circulation in type 2 diabetic patients</i>		D : <i>Pre-experimental design</i> dengan <i>pre-post test without control group</i> S : 5 responden V : <i>buerger allen exercise, lower limb peripheral circulation</i> I : ABI (<i>Ankle-Brachial Index</i>) dengan menggunakan <i>aneroid Sphignomanometer</i> dan <i>Vascular Dopler Ultrasound probe</i> A : <i>Wilcoxon Signed Rank Test</i> dan <i>Paired T-Test</i>	Hasil penelitian menyatakan bahwa terdapat pengaruh <i>buerger allen exercise</i> terhadap sirkulasi perifer ekstremitas bawah pada penderita diabetes melitus tipe 2 menggunakan <i>Wilcoxon Signed Rank Test</i> dan <i>Paired T-Test</i> dimana diperoleh nilai <i>p value</i> 0,05 yang artinya ada pengaruh yang signifikan.
Inshrah Roshdy Mohammad, Eman Mawed Fahim, Eman Hessien Heggy (2021)	<i>Impact of Buerger-Allen Exercises on Foot Perfusion and Pain Level for Diabetic Patients Risk with Peripheral Arterial Disease</i>		D : <i>Quasi experimental research design</i> S : 100 responden V : <i>buerger allen exercises, foot perfusion</i> I : <i>Ankle Brachial Index (ABI)</i> menggunakan <i>Sphygmomanometer manual standar</i> dan <i>Handheld</i>	Hasil penelitian menyatakan bahwa terdapat perbedaan yang sangat signifikan secara statistik antara kelompok belajar dan kelompok kontrol dalam hal pengukuran nilai <i>ankle brachial</i>

			<i>Doppler standar dengan probe vaskular 8.0MHZ</i>	<i>Index (ABI) hanya setelah penerapan buerger allen exercise selama enam minggu (p ≤ 0,004)</i>
			<i>A : Pearson correlation test.</i>	
Reham Adel	<i>Effect of buerger-</i>	D : Quasi-experimental design	Hasil penelitian	
Ebada El Sayed,	<i>allen exercise on</i>	S : 70 responden	menyatakan bahwa	
Shimaa Nabil	<i>lower extremities</i>	V : buerger- allen exercise,	ada hubungan yang	
Abd Elsalam,	<i>perfusion among</i>	<i>lower extremities perfusion</i>	sangat signifikan	
Rasha Mohamed	<i>patients with type 2</i>	I : skala Ankle Brachial Index	secara statistik antara	
Elmetwaly (2021)	<i>diabetes mellitus</i>	(ABI) menggunakan <i>sphygmomanometer manual standar</i>	pre and post 2 pada kedua kaki p < 0,001 dan signifikansi statistik dianggap pada nilai <i>p value</i> ≤ 0,05, dan p < 0,001 dianggap sangat signifikan	
		A : chi-square test		

4.2 Karakteristik Responden Studi

Dalam *literature review* ini, peneliti menganalisis beberapa karakteristik dari enam artikel antara lain sebagai berikut :

4.2.1 Karakteristik Responden Berdasarkan Usia

Dalam *literature review* ini, peneliti menganalisis sebanyak enam artikel yang berhubungan dengan “Pemberian Intervensi *Buerger Allen Exercise* Terhadap Ketidakefektifan Perfusi Jaringan Perifer Pada Penderita Diabetes Mellitus”. Artikel pertama dengan judul “*Effect Of Buerger Allen Exercise On Lower Limb Perfusion Among Patients With Type 2 Diabetes Mellitus*” menjelaskan bahwa berdasarkan karakteristik usia, dari 48 responden yang diteliti mayoritas berusia antara 40-60 tahun. 25 responden berusia 50-60 tahun, 10 responden pada kelompok belajar dan 15 responden pada kelompok kontrol. 21 responden berusia 40-50 tahun, 12 responden pada kelompok belajar dan 9 responden pada kelompok kontrol. Artikel kedua dengan judul “*Effect of buerger exercises on improving peripheral circulation of the lower extremities among patients with type 2 diabetes mellitus at selected university hospital–egypt*” menjelaskan bahwa sebagian besar responden berusia 50 tahun ke atas (51.7%) sebanyak 31 responden dengan rata-rata usia 51,98 tahun. Artikel ketiga yang berjudul “*Buerger Allen Exercise Berpengaruh Terhadap Ketidakefektifan Perfusi Jaringan Perifer Pada Penderita Diabetes Mellitus*” menjelaskan bahwa berdasarkan karakteristik usia menunjukkan sebagian besar responden pada kelompok intervensi berada pada usia 46-55 tahun (51.9%) yaitu sebanyak 14

responden, sedangkan pada kelompok kontrol sebagian besar berada pada usia 46-55 tahun (55.6%) sebanyak 15 responden.

Artikel keempat yang berjudul “*The effect of buerger allen exercise on the lower extremity peripheral circulation in type 2 diabetic patients*” menjelaskan bahwa berdasarkan karakteristik usia dari 5 responden yang diteliti sebagian berusia 41-50 tahun (40%) sebanyak 2 responden, 51-60 tahun (40%) sebanyak 2 responden, dan yang berusia lebih dari 60 tahun (20.0%) 1 responden. Artikel kelima dengan judul “*Impact of Buerger-Allen Exercises on Foot Perfusion and Pain Level for Diabetic Patients Risk with Peripheral Arterial Disease*” menjelaskan bahwa berdasarkan karakteristik usia dari 100 responden yang diteliti mayoritas rata-rata usia di antara kedua kelompok adalah sekitar 50 sampai < 60 tahun sebanyak 35 responden, 20 responden pada kelompok belajar dan 15 responden pada kelompok kontrol. Artikel keenam dengan judul “*Effect of buerger- allen exercise on lower extremities perfusion among patients with type 2 diabetes mellitus*” menjelaskan bahwa karakteristik berdasarkan usia mayoritas berusia 41 sampai < 51 tahun (34.3%) sebanyak 24 responden dengan rata-rata usia mereka 54,72 tahun.

Dari hasil analisis keenam artikel terkait karakteristik berdasarkan usia dapat disimpulkan bahwa dari enam artikel mayoritas berusia sekitar 40 sampai 50 tahun ke atas.

4.2.2 Karakteristik Responden Berdasarkan Jenis Kelamin

Tabel 4.2 Karakteristik Responden Berdasarkan Jenis Kelamin

Penulis dan Tahun Terbit	Hasil Temuan		
	Jenis Kelamin	N	%
Walaa El-khanany Zahran, Amira Ahmed Hassanen, Madiha Hassan Nabih, Fady Azmy Kyrillos (2018)	Laki-laki	3	12.5
		2	8.3
	Perempuan	21	87.5
		22	91.7
Hanan Saber A. El-Fattah, Amal F. Garas, Nawal E. Hanna, Naglaa M. Elsayed (2019)	Laki-laki	23	38.3
	Perempuan	37	61.7
Siti Nur Hasina, Ima Nadatien, Iis Noventi, Tata Mahyuvi (2021)	Laki-laki	9	33.3
		12	44.4
	Perempuan	18	66.7
		15	55.6
Muh. Anwar Hafid, Ilhamsyah Ilhamsyah, La Ode Agustino Saputra, Mutmainnah Sari (2021)	Laki-laki	1	20.0
	Perempuan	4	80.0
Inshrah Roshdy Mohammad, Eman Mawed Fahim, Eman Hessien Heggy (2021)	Laki-laki	20	40
		21	42
	Perempuan	30	60
		29	58
Reham Adel Ebada El Sayed, Shimaa Nabil Abd Elsalam, Rasha Mohamed Elmetwaly (2021)	Laki-laki	32	45.7
	Perempuan	38	54.3

Berdasarkan tabel 4.2 diatas, karakteristik responden menurut jenis kelamin dari keenam artikel yang telah direview menunjukkan sebagian besar responden berjenis kelamin perempuan. Berjenis kelamin perempuan sebanyak 214 responden dan laki-laki sebanyak 123 responden. Keseluruhan jumlah responden baik laki-laki dan perempuan dari keenam artikel tersebut sebanyak 337 responden.

4.2.3 Karakteristik Responden Berdasarkan Lama Menderita Diabetes

Mellitus

Tabel 4.3 Karakteristik Responden Berdasarkan Lama Menderita Diabetes Mellitus

Penulis dan Tahun Terbit	Hasil Temuan		
	Lama Menderita	N	%
Walaa El-khanany Zahran, Amira Ahmed Hassanen, Madiha Hassan Nabih, Fady Azmy Kyrillos (2018)	-	-	-
Hanan Saber A. El-Fattah, Amal F.	1 sampai > 5 tahun	21	35
Garas, Nawal E. Hanna, Naglaa M. Elsayed (2019)	5 sampai > 10 tahun	20	33.3
	Lebih dari 10 tahun	19	31.7
Siti Nur Hasina, Ima Nadatien, Iis Noventi, Tata Mahyuvi (2021)	≤ 10 tahun	12	44.4
		10	37
	≥ 10 tahun	15	55.6
		17	63

Muh. Anwar Hafid, Ilhamsyah	1-5 tahun	4	80.0
Ilhamsyah, La Ode Agustino Saputra,	> 5 tahun	1	20.0
Mutmainnah Sari (2021)			
Inshrah Roshdy Mohammad, Eman	5-10 tahun	33	66.0
Mawed Fahim, Eman Hessien Heggy		32	64.0
(2021)	> 10 tahun	16	32.0
		17	34.0
	Tidak tahu	1	2.0
		1	2.0
Reham Adel Ebada El Sayed, Shimaa	Kurang dari 5 tahun	28	40.0
Nabil Abd Elsalam, Rasha Mohamed	5-10 tahun	25	35.7
Elmetwaly (2021)	Lebih dari 10 tahun	17	24.3

Karakteristik responden berdasarkan lama menderita diabetes mellitus berdasarkan tabel 4.3 diatas, hasil analisis dari keenam artikel menunjukan sebagian besar responden lama menderita diabetes mellitus 5 tahun sampai 10 tahun. Sedangkan satu artikel tidak menyebutkan terkait karakteristik responden berdasarkan lama menderita diabetes mellitus.

4.3 Analisa

4.3.1 Ketidakefektifan Perfusi Jaringan Perifer Pada Penderita Diabetes

Mellitus

Tabel 4.4 Ketidakefektifan Perfusi Jaringan Perifer Pada Penderita Diabetes

Mellitus

Penulis dan Tahun Terbit	Hasil Nilai ABI <i>Pre Test</i>	Hasil Nilai ABI <i>Post Test</i>
Wala El-khanany, Zahran, Amira, Ahmed Hassanen, Madiha Hassan Nabih, Fady Azmy, Kyrillos (2018)	1. Kelompok belajar : Normal (0%), Ringan (66.7%), Sedang (33.3%) 2. Kelompok kontrol : Normal (0%), Ringan (70.8%), Sedang (29.2%)	1. Kelompok belajar : Normal (41.7%), Ringan (54.2%), Sedang (4.2%) 2. Kelompok kontrol : Normal (0%), Ringan (54.2%), Sedang (45.8%)
Hanan Saber A. El-Fattah, Amal F. Garas, Nawal E. Hanna, Naglaa M. Elsayed (2019)	1. Kaki kanan : Normal (11.70%), Batas normal (33.30%), Ringan (55.00%) 2. Kaki kiri : Normal (20.00%), Batas normal (50.00%), Ringan (30.00%)	1. Kaki kanan : Normal (70.00%), Batas normal (20.00%), Ringan (10.00%) 2. Kaki kiri : Normal (75.00%), Batas normal (16.70%), Ringan (8.30%)
Siti Nur Hasina, Ima Nadatien, Iis Noventi, Tata Mahyuvi (2021)	1. Kelompok Intervensi 0.78 (obstruksi ringan) 2. Kelompok kontrol 0.75 (obstruksi ringan)	1. Kelompok Intervensi 0.99 (normal) 2. Kelompok kontrol 0.70 (obstruksi ringan)
Muh. Anwar Hafid, Ilhamsyah, Ilhamsyah, La Ode Agustino Saputra, Mutmainnah Sari (2021)	1. Ekstremitas kanan : AHM (0.857), S (0.833), H (1.181), MJ (0.909), ASR (0.866) 2. Ekstremitas kiri : AHM (1.071), S (0.846), H (1.1), MJ (0.9), ASR (0.467)	1. Ekstremitas kanan : AHM (1.153), S (1.454), H (1.363), MJ (1.333), ASR (1.230) 2. Ekstremitas kiri : AHM (1.115), S (1.272), H (1.363), MJ (1.333), ASR (1.153)
Inshrah Roshdy, Mohammad, Eman	1. Kelompok belajar : Obstruksi ringan (46,0%), Obstruksi	1. Kelompok belajar : Normal (20.0%), Obstruksi ringan

Mawed Eman Heggy (2021)	Fahim, Hessien	sedang (54.0%)	2. Kelompok kontrol : Obstruksi ringan (60.0%), Obstruksi sedang (40.0%)	(50.0%), Obstruksi (30.0%)	2. Kelompok kontrol : Obstruksi ringan (64.0%), Obstruksi sedang (36.0%)
Reham Adel Ebada El Sayed, Shimaa Nabil Abd Elsalam, Rasha Mohamed Elmetwaly (2021)		1. Perfusi ekstremitas bawah kanan : Normal (5.7%), Ringan (35.7%), Sedang (51.4%), Berat (7.1 %)	2. Perfusi ekstremitas bawah kiri : Normal (11.4%), Ringan (55.7%), Sedang (22.9%), Berat (10.0%)	1. Perfusi ekstremitas bawah kanan : Normal (70.0%), Ringan (20.0%), Sedang (10.0%), Berat (0.0%)	2. Perfusi ekstremitas bawah kiri : Normal (75.7%), Ringan (15.7%), Sedang (8.6%), Berat (0.0%)

Berdasarkan tabel 4.4 hasil analisa dari keenam artikel didapatkan bahwa ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus *pre test*/sebelum intervensi sebagian besar memiliki kategori nilai ABI ringan dan sedang. Sedangkan pada *post test* sebagian besar memiliki kategori nilai ABI normal dan ringan.

4.3.2 *Buerger Allen Exercise* Pada Penderita Diabetes Mellitus

Tabel 4.5 *Buerger Allen Exercise* Pada Penderita Diabetes Mellitus

Penulis dan Tahun Terbit	Lama Pemberian <i>Buerger Allen Exercise</i>	Tahapan <i>Buerger Allen Exercise</i>
Walaah El-khanany Zahran, Amira Ahmed Hassanen, Madiha Hassan Nabih, Fady Azmy Kyrillos	<i>Buerger allen exercise</i> dilakukan selama 2 minggu sebanyak 2 sesi per hari.	Terdiri dari 3 fase : 1. Fase pertama, berbaring dan kaki diangkat dengan sudut 45-90° dan dilakukan sekitar 2 menit; 2. Fase kedua, pasien duduk dengan posisi kaki menggantung ditepi tempat tidur ditambah gerakan plantarfleksi,

(2018)		dorsofleksi, rotasi internal dan eksternal, dilakukan sekitar 5 menit;
		3. Fase ketiga, pasien berbaring ditempat tidur sekitar 5 menit dengan kaki tertutup selimut.
Hanan Saber A.	<i>Buerger allen exercise</i>	Terdiri dari 3 tahapan :
El-Fattah, Amal	diberikan 2-3 kali/hari	1. Pasien berbaring dengan posisi kaki diangkat hingga sudut 45-90°.
F. Garas, Nawal	selama 15 hari dengan sekitar	2. Posisi pasien duduk dan kaki menggantung ditepi tempat tidur dan ditambah gerakan fleksi, ekstensi, dan sirkumduksi pergelangan kaki.
E. Hanna, Naglaa	12 – 15 menit.	3. Pasien posisi berbaring di tempat tidur (horizontal).
M. Elsayed		
(2019)		
Siti Nur Hasina,	<i>Buerger allen exercise</i>	Terdiri dari 3 tahapan :
Ima Nadatien, Iis	dilakukan selama 6 hari	1. Tahap elevasi, posisi supinasi dengan <i>leg elevasi</i> 45-90° ditambah gerakan dorsofleksi dan plantarfleksi, dilakukan selama 1-2 menit
Noventi, Tata	sebanyak 6 sesi/hari dengan	2. Tahap penurunan (<i>sit, feet lowered</i>), posisi duduk dengan kaki yang menjuntai (menggantung ditepi tempat tidur) ditambah gerakan dorsofleksi dan plantarfleksi, dilakukan selama 2-5 menit;
Mahyuvi	durasi 15 menit persesinya.	3. Tahap horizontal atau tahap istirahat, posisi supinasi dengan kaki horizontal ditambah gerakan dorsofleksi dan plantarfleksi dari pegelangan kaki, dilakukan selama 5 menit.
(2021)		
Muh. Anwar	<i>Buerger allen exercise</i>	Tidak menjelaskan tahapan <i>buerger allen exercise</i> .
Hafid, Ilhamsyah	diberikan sebanyak 6 kali	
Ilhamsyah, La	kepada responden.	
Ode Agustino		

Saputra, Mutmainnah Sari (2021)					
Inshrah Mohammad, Eman Fahim, Hessien (2021)	Roshdy Mawed Eman Heggy	<i>Buerger allen exercise</i> dilakukan selama 6 minggu dengan frekuensi sebanyak 2 kali per hari selama 8-13 menit.			Terdiri dari 3 langkah : 1. Langkah 1 elevasi, kaki diangkat dengan sudut 45-90° dan dilakukan selama 2-3 menit. 2. Langkah 2 ketergantungan, posisi pasien duduk dengan kaki menjutai ditepi tempat tidur selama 3-5 menit; 3. Langkah 3 horizontal, posisi pasien terlentang diatas tempat tidur selama 3-5 menit.
Reham Ebada El Shimaa Abd Rasha Elmetwaly (2021)	Adel Sayed, Nabil Elsalam, Mohamed	<i>Buerger allen exercise</i> dilakukan selama 15 hari dengan frekuensi 5-6 kali/hari selama 12-15 menit.			Terdiri dari 3 langkah : 1. Langkah 1 ketinggian, kaki diangkat dengan sudut 45° dan dilakukan 3-5 menit. 2. Langkah 2 ketergantungan, kaki diturunkan/menjuntai ditepi tempat tidur dengan posisi pasien duduk dan dilakukan 3-5 menit. 3. Langkah 3 horizontal, posisikan pasien berbaring di tempat tidur selama 5 menit dengan melakukan gerakan dorsifleksi, plantarfleksi, dan rotasi.

Berdasarkan tabel 4.5 hasil analisa dari keenam artikel didapatkan bahwa, lima artikel mengatakan *buerger allen exercise* pada penderita diabetes mellitus memiliki 3 tahapan, dan satu artikel tidak menjelaskan berapa banyak tahapan yang diberikan dalam melakukan *buerger allen exercise*.

4.3.3 Analisa Pengaruh Intervensi *Buerger Allen Exercises* Terhadap Ketidakefektifan Perfusi Jaringan Perifer Pada Penderita Diabetes Mellitus

Tabel 4.6 Analisa Pengaruh Intervensi *Buerger Allen Exercises* Terhadap Ketidakefektifan Perfusi Jaringan Perifer Pada Penderita Diabetes Mellitus

Penulis dan Tahun Terbit	Hasil		
	Pre	Post	P value
Wala El-khanany Zahran, Amira Ahmed Hassanen, Madiha Hassan Nabih, Fady Azmy Kyrillos (2018)	Kelompok belajar = 0,74	Kelompok belajar = 0,85, dan fase <i>follow up</i> = 0,91	P < 0.001(<i>pre</i> dan <i>post</i>) P = 0.010 (<i>post</i> dan <i>follow up</i>)
	kelompok kontrol = 0,73	kelompok kontrol = 0,71, dan fase <i>follow up</i> = 0,76	P = 0.129 (<i>pre</i> dan <i>post</i>) P = 0,001 (<i>post</i> dan <i>follow up</i>)
Hanan Saber A. El-Fattah, Amal F. Garas, Nawal E. Hanna, Naglaa M. Elsayed (2019)	Tungkai kanan = 0,885	Tungkai kanan = 1,097	0.0001
	Tungkai kiri = 0,937	Tungkai kiri = 1,086	0.0001
Siti Nur Hasina, Ima Nadatien, Iis Noventi, Tata Mahyuvi (2021)	Kelompok intervensi 0.78	Kelompok intervensi 0.99	0.002
	Kelompok kontrol 0.75	Kelompok kontrol 0.70	0,011
Muh. Anwar Hafid, Ilhamsyah Ilhamsyah, La Ode Agustino Saputra, Mutmainnah Sari (2021)	Ekstremitas kanan 0.9296	Ekstremitas kanan 1,3072	0,043
	Ekstremitas kiri 0.8768	Ekstremitas kiri 1,2478	0,025
Inshrah Mohammad, Roshdy Eman	kelompok belajar (46,0% obstruksi	kelompok belajar (20.0% normal, 50.0%	$P \leq 0.004$

Mawed Fahim, Eman Hessien Heggy (2021)	ringan, obstruksi sedang)	54.0%	obstruksi ringan, 30.0% obstruksi sedang)
	kelompok kontrol	kelompok kontrol	
	(60.0% ringan, obstruksi sedang)	(64.0% obstruksi ringan, 40.0% obstruksi sedang)	36.0% obstruksi sedang)
Reham Adel Ebada El Sayed, Shimaa Nabil	Perfusi ekstremitas bawah kanan 9.00	Perfusi ekstremitas bawah kanan 4.70	< 0.001
Abd Elsalam, Rasha Mohamed Elmetwaly (2021)	Perfusi ekstremitas bawah kiri 9.17	Perfusi ekstremitas bawah kiri 5.00	< 0.001

Berdasarkan tabel 4.6 hasil analisa dari keenam artikel yang telah diperoleh, menyatakan bahwa terdapat peningkatan yang signifikan pada nilai *ankle brachial index* (ABI) dilihat dari *pre* dan *post* intervensi *buerger allen exercise* disetiap artikel yang berbeda-beda dengan nilai *p value* < 0,05. Sehingga dengan ini dapat disimpulkan bahwa ada pengaruh dari pemberian intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus.

BAB 5

PEMBAHASAN

5.1 Deskripsi Ketidakefektifan Perfusi Jaringan Pertifer Pada Penderita Diabetes Mellitus

Berdasarkan hasil *review* dari keenam artikel menunjukkan bahwa ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus sebelum pemberian *buerger allen exercise* memiliki nilai *ankle brachial index* (ABI) mulai dari normal, ringan, sedang dan parah, namun dari keenam artikel mayoritas menderita obstruksi ringan dan sedang. Dan pada *post test* sebagian besar memiliki kategori nilai ABI normal dan ringan. Penelitian yang dilakukan oleh Mohammad *et al.*, (2021), menyatakan bahwa nilai rata-rata *ankle brachial index* (ABI) pada *pre test* mayoritas menderita obstruksi ringan dan obstruksi sedang, pada kelompok belajar 23 responden (46.0%) obstruksi ringan, 27 responden (54.0%) obstruksi sedang, dan kelompok kontrol 30 responden (60.0%) obstruksi ringan, dan 20 responden (40.0%) obstruksi sedang. Sedangkan pada *post test* menunjukkan penurunan jumlah penderita ABI sedang, pada kelompok belajar 10 responden (20.0%) ABI normal, 25 responden (50.0%) obstruksi ringan, 15 responden (30.0%) obstruksi sedang, pada kelompok kontrol 32 responden (64.0%) obstruksi ringan, dan 18 responden (36.0%) obstruksi sedang. Hasil penelitian tersebut sejalan dengan El Sayed *et al.*, (2021) bahwa nilai *ankle brachial index* (ABI) pada *pre test* adalah pada perfusi ekstremitas kanan menderita obstruksi normal 4 responden (5.7%) obstruksi ringan 25 responden (35.7%), obstruksi sedang 36 responden (51.4%) dan obstruksi parah 5 responden

(7.1%), pada perfusi ekstremitas kiri normal 8 responden (11.4%) obstruksi ringan 39 responden (55.7%), obstruksi sedang 16 responden (22.9%) dan obstruksi parah 7 responden (10.0%). Sedangkan pada *post test* menunjukkan peningkatan jumlah responden yang memiliki ABI normal dan untuk ABI obstruksi parah sudah tidak ada, perfusi ekstremitas kanan obstruksi normal 49 responden (70.0%) obstruksi ringan 14 responden (20.0%), obstruksi sedang 7 responden (10.0%), pada perfusi ekstremitas kiri normal 53 responden (75.7%) obstruksi ringan 11 responden (15.7%), obstruksi sedang 6 responden (8.6%).

Penderita diabetes mellitus dikatakan memiliki ABI (*Ankle Brachial Index*) dalam kategori normal jika nilai $ABI \geq 0,9$ yang artinya terbebas dari gangguan perfusi jaringan perifer karena darah masih bersirkulasi dengan baik tanpa adanya obstruksi pada pembuluh darah perifer sehingga kebutuhan nutrisi dan oksigen pada ekstremitas bawah dapat terpenuhi dengan baik (Brunner & Suddarth, 2010 dalam Darwis, 2020). Dikatakan kategori ABI ringan/iskemia ringan/*borderline perfusion*/batasan perfusi jika nilai $ABI \leq 0,6 - 0,8$. Gejala yang terjadi berupa nyeri pada pantat/betis ketika berjalan (*klaudikasio intermiten*) mulai terasa (Brunner & Suddarth, 2010 dalam Darwis, 2020). Rasa nyeri timbul karena adanya oklusi pembuluh darah/sumbatan pembuluh darah yang mengakibatkan ketidakmampuan aliran darah untuk memenuhi kebutuhan nutrisi terutama pada ekstremitas bawah saat metabolisme meningkat, dan oklusi yang terjadi masih dalam rendang ringan sehingga untuk mengatasinya dapat melakukan latihan fisik/*exercise* seperti senam kaki (Bryant & Nix, 2006 dalam Darwis, 2020). Interpretasi ABI pada kategori obstruksi sedang/iskemia berat yaitu $\leq 0,5$, hal ini

terjadi akibat buruknya perfusi perifer karena oklusi yang mulai memanjang sehingga denyut jantung dan tekanan arteri menurun. Keadaan ini menyebabkan hipoksia jaringan sehingga mengakibatkan iskemia pada kaki dan bila terdapat luka, maka penyembuhan luka sulit kecuali dilakukan revaskularisa (Sudoyo, 2009 dalam Darwis, 2020). Kategori ABI obstruksi parah/iskemia kritis diinterpretasikan dengan nilai $ABI \leq 0,4$. Hal ini merupakan kondisi klimaks dari iskemia berat/obstruksi sedang yang dimanifestasikan dengan terjadinya ulkus diabetikum dan gangren (Price & Wilson, 2006 dalam Darwis, 2020).

Pengobatan terapi non farmakologi yang dapat diberikan pada pasien diabetes mellitus untuk mencegah obstruksi menjadi lebih parah satunya dengan melakukan aktivitas fisik/*exercise* (Mataputun *et al.*, 2020). Latihan fisik/*exercise* bagi penderita diabetes mellitus sangat dibutuhkan, karena pada saat latihan fisik energi yang dipakai adalah glukosa dan asam lemak bebas, dan yang perlu diperhatikan dalam latihan fisik penderita diabetes mellitus adalah frekuensi, intensitas, durasi waktu dan jenis latihan (Tarwoto dkk, 2012).

Menurut peneliti, ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus memiliki nilai ABI berada di kategori obstruksi ringan dan sedang terjadi akibat kurangnya latihan fisik/*exercise*. Agar hal tersebut tidak menunjukkan kategori yang semakin parah, dapat ditanganain dengan latihan fisik/*exercise* yang dilakukan secara teratur dan juga konsisten. Sehingga gangguan perfusi jaringan perifer yang awalnya berada di kategori ABI ringan dan sedang dapat meningkat/menunjukkan nilai ABI normal.

5.2 Deskripsi Intervensi *Buerger Allen Exercise* Pada Penderita Diabetes Mellitus

Berdasarkan keenam artikel yang telah direview didapatkan bahwa tahapan dalam pemberian intervensi *buerger allen exercises* pada penderita diabetes mellitus pada setiap artikel sama yaitu terdiri dari 3 tahapan. Penelitian yang dilakukan oleh Zahran *et al.*, (2018) menjelaskan bahwa *buerger allen exercise* memiliki 3 fase diantaranya: fase pertama, berbaring dan kaki diangkat dengan sudut 45-90° dan dilakukan sekitar 2 menit; fase kedua, pasien duduk dengan posisi kaki menggantung ditepi tempat tidur ditambah gerakan plantarfleksi, dorsofleksi, rotasi internal dan eksternal, dilakukan sekitar 5 menit; fase ketiga, pasien berbaring ditempat tidur sekitar 5 menit dengan kaki tertutup selimut. Hasil penelitian tersebut sejalan dengan penelitian El-Fattah *et al.*, (2019), bahwa *buerger allen exercise* memiliki 3 tahap diantaranya yaitu: pertama, pasien berbaring dengan posisi kaki diangkat hingga sudut 45-90°; kedua, letakkan kaki menggantung ditepi tempat tidur ditambah gerakan fleksi, ekstensi, dan sirkumduksi pergelangan kaki; ketiga fase terakhir, posisi berbaring selama beberapa menit dan diberikan 2-3 kali/hari selama 15 hari dengan sekitar 12–15 menit. Penelitian yang dilakukan oleh Hasina *et al.*, (2021) juga memperkuat hal tersebut, bahwa *buerger allen exercise* terdiri dari 3 tahapan diantaranya; tahap elevasi, posisi supinasi dengan *leg elevasi* 45-90° ditambah gerakan dorsofleksi dan plantarfleksi, dilakukan selama 1-2 menit; tahap penurunan (*sit, feet lowered*), posisi duduk dengan kaki yang menjuntai (menggantung ditepi tempat tidur) ditambah gerakan dorsofleksi dan plantarfleksi, dilakukan selama 2-5 menit; tahap

horizontal/istirahat, posisi supinasi dengan kaki horizontal ditambah gerakan dorsofleksi dan plantarfleksi, dilakukan selama 5 menit, dalam penelitian ini intervensi dilakukan selama 6 hari sebanyak 6 sesi/hari dengan durasi 15 menit/sesi.

Setiap artikel melakukan 3 tahapan *buerger allen exercise*, namun disetiap tahapannya ada perbedaan. Pada artikel pertama, kedua, kelima, dan keenam pada tahap 1 elevasi, hanya memposisikan pasien berbaring kemudian mengangkat kaki (*leg elevasi*) dengan sudut 45-90° tanpa melakukan gerakan tambahan apapun. Sedangkan pada artikel ketiga tahap 1 elevasi, selain memposisikan pasien berbaring dan mengangkat kaki (*leg elevasi*) dengan sudut 45-90° juga melakukan gerakan tambahan yaitu gerakan dorsofleksi dan plantarfleksi. Tahap 2, artikel pertama pada tahap 2 menjelaskan bahwa selain memposisikan pasien duduk dengan kaki menggantung ditepi tempat tidur, juga melakukan gerakan tambahan yaitu gerakan dorsofleksi, plantarfleksi, rotasi internal dan eksternal. Artikel kedua menjelaskan bahwa memposisikan pasien duduk dengan kaki menggantung ditepi tempat tidur ditambah dengan gerakan fleksi, ekstensi, dan sirkumduksi pergerlangan kaki. Artikel ketiga menjelaskan pada tahap 2 yaitu tahap penurunan, dengan memposisikan pasien duduk ditepi tempat tidur dengan kaki yang menjuntai (menggantung) dan ditambah gerakan dorsifleksi dan plantarfleksi. Sedangkan pada artikel kelima dan keenam tahap 2 tahap ketergantungan yaitu hanya menjelaskan dengan cukup memposisikan pasien duduk ditepi tempat tidur kemudian menggantungkan kaki tanpa ada tambahan gerakan apapun.

Untuk tahap 3 yaitu tahap terakhir, pada artikel pertama selain memposisikan pasien berbaring, kaki pasien juga ditutupi dengan selimut tanpa menambah gerakan apapun. Artikel kedua dan kelima menjelaskan bahwa hanya memposisikan pasien berbaring diatas tempat tidur (horizontal) tanpa ada tambahan gerakan apapun. Artikel ketiga menjelaskan bahwa pada tahap 3 yaitu tahap horizontal/istirahat, selain memposisikan pasien berbaring juga melakukan gerakan tambahan yaitu gerakan dorsofleksi dan plantarfleksi. Artikel keenam juga menjelaskan selain memposisikan pasien berbaring, ditambah gerakan dorsofleksi, plantarfleksi dan rotasi untuk melatih sendi dan pergelangan kaki. Sedangkan untuk artikel keempat, didalam artikel tidak dijelaskan berapa banyak tahapan yang diberikan kepada responden dalam melakukan *buerger allen exercise*.

Menurut peneliti, hasil dari *review* keenam artikel didapatkan bahwa setiap artikel memiliki 3 tahapan terdiri dari tahap elevasi, tahap penurunan, dan tahap horizontal/istirahat, namun dengan tambahan gerakan yang berdeda-beda di setiap tahapannya. Hal ini menunjukkan bahwa setiap gerakan yang ditambahkan pada setiap tahapannya itu memiliki efek yang juga mampu meningkatkan keefektifitasan perfusi jaringan perifer pada penderita diabetes mellitus ditunjukan dengan nilai *post test* pada setiap artikel yang menunjukkan peningkatan jumlah responden yang memiliki ABI normal.

5.3 Pengaruh Intervensi *Buerger Allen Exercise* Terhadap Ketidakefektifan Perfusi Jaringan Perifer Pada Penderita Diabetes Mellitus

Terdapat enam artikel yang dilakukan *review* untuk mengetahui pengaruh intervensi *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus. Keenam artikel tersebut menyatakan bahwa *buerger allen exercise* efektif dalam meningkatkan nilai *ankle brakhial index* (ABI) sebagai indikator keefektifan perfusi jaringan perifer. Penelitian yang dilakukan oleh El-Fattah *et al.*, (2019) menyatakan bahwa *buerger allen exercise* efektif dalam meningkatkan sirkulasi ekstremitas bawah pada pasien dengan diabetes mellitus tipe 2, hal ini ditunjukkan dengan setelah intervensi diberikan nilai rata-rata *ankle brakhial index* (ABI) dari kedua tungkai (tungkai kanan = 1,097, tungkai kiri = 1,086) yang menunjukkan nilai signifikansi yang lebih tinggi dibandingkan dengan nilai rata-rata sebelum intervensi (tungkai kanan = 0,885, tungkai kiri = 0,937) dengan *p value* 0.0001. Hasil penelitian tersebut sejalan dengan penelitian Hasina *et al.*, (2021), bahwa *buerger allen exercise* efektif dalam meningkatkan vaskularisasi pembuluh darah perifer dengan ditunjukkan nilai rata-rata *ankle brakhial index* (ABI) kelompok intervensi kanan (*pre test* = 0.78, *post test* = 0,99) dan kelompok kontrol kanan (*pre test* = 0.75, *post test* = 0,70) dengan *p value* = 0.002, *p value* = 0.011 pada masing-masing kelompok intervensi dan kontrol. Penelitian yang dilakukan oleh Hafid *et al.*, (2021), juga memperkuat hal tersebut bahwa *buerger allen exercise* terbukti secara signifikan meningkatkan sirkulasi perifer ekstremitas bawah pada penderita diabetes mellitus

tipe 2 dengan peningkatan nilai *ankle brachial index* (ABI) dan diperoleh nilai *p value* < 0,05.

Buerger allen exercise dapat meningkatkan nilai ABI yang juga menjadi indikator dari meningkatnya perfusi jaringan perifer. Hal tersebut disebabkan oleh perubahan gravitasi (*leg elevasi*, penurunan kaki, dan tidur terlentang) pada ekstremitas bawah disertai kontraksi otot melalui gerakan dorsofleksi dan plantarfleksi dari pergelangan kaki (Salam & Laili, 2020). Selain itu juga dapat melebarkan pembuluh darah di daerah kaki sehingga peredaran darah menjadi lancar (Suryati *et al.*, 2019; Zamaa *et al.*, 2021). Hal ini sejalan dengan penelitian yang dilakukan oleh Hafid *et al.*, (2021), yang mengungkapkan bahwa *buerger allen exercise* merangsang peningkatan sirkulasi perifer melalui gerakan kaki *dorsofleksi* dan *plantarfleksi* yang dilakukan secara teratur dan terus menerus.

Tahapan pertama *buerger allen exercise* yaitu perubahan gravitasi dengan *leg elevasi* sudut 45°-90° menyebabkan peningkatan aliran darah ke jantung yang diakibatkan oleh pengosongan vena dan meningkatnya aliran atrium kanan (Chang *et al.*, 2016; Sari *et al.*, 2019). Tahap kedua yaitu penurunan (*sit, feet lowered*) dengan posisi kaki menggantung ditepi tempat tidur, gravitasi di tahap ini berperan dalam meningkatkan aliran darah dari jantung ke ujung-ujung kaki (Sari *et al.*, 2019). Tahap ketiga yaitu horizontal/istirahat yaitu berbaring di tempat tidur, hal ini dapat memperbaiki aliran darah atau reperfusi dari tungkai kaki saat efek gravitasi mulai berkurang (Chang *et al.*, 2016; Saputra *et al.*, 2020). Kontraksi otot yang disebabkan oleh gerakan dorsofleksi dan plantarfleksi dari pergelangan kaki juga dapat membantu untuk melatih tendon dan kekuatan sendi

agar terhindar dari kontraktur juga deformitas tungkai (Chang *et al.*, 2016; Hafid *et al.*, 2021).

Menurut peneliti, *buerger allen exercise* dalam pengobatan non farmakologi merupakan intervensi yang lebih simple dan cukup signifikan dalam meningkatkan perfusi jaringan perifer pada penderita diabetes mellitus dengan nilai $p\text{ value} < 0,05$. Hal ini terbukti sebelum pemberian *buerger allen exercise*, mayoritas memiliki kategori *Ankle Brachial Index* (ABI) obstruksi ringan dan sedang. Didalam beberapa artikel ada pula yang memiliki nilai ABI obstruksi berat dan untuk normal sangat sedikit. Namun setelah pemberian *buerger allen exercise*, *Ankle Brachial Index* (ABI) obstruksi berat tidak ada dan *Ankle Brachial Index* (ABI) normal meningkat. Penerapan gaya gravitasi dan kontraksi otot pada kaki dalam *buerger allen exercise* dapat meningkatkan perfusi jaringan perifer, membuat melebarnya pembuluh darah di kaki sehingga melancarkan peredaran darah, serta dapat melatih kekuatan sendi kaki dan pergelangan kaki.

Sehingga peneliti merekomendasikan intervensi *buerger allen exercise* pada penderita diabetes mellitus yang mengalami gangguan perfusi jaringan perifer dapat diberikan 2-3 kali/hari selama 15 hari dengan durasi 12-15 menit, dengan $p\text{ value} 0.0001$ yang menunjukkan bahwa $p\text{ value}$ tersebut lebih kecil dibandingkan dengan penelitian yang lain yaitu salah satunya $p\text{ value} = 0.002$ dan $p\text{ value} = 0.011$ pada masing-masing kelompok intervensi dan kelompok kontrol yang diberikan selama 6 hari sebanyak 6 sesi/hari dengan durasi 15 menit. Hal ini menunjukkan bahwa meningkatkan durasi dan lama pemberian intervensi serta kepatuhan/konsisten dan setiap tahapan dilakukan secara teratur dalam melakukan

buerger allen exercise dapat membantu meningkatkan perfusi jaringan perifer pada penderita diabetes mellitus yang ditunjukan dengan meningkatnya nilai *ankle brachial index* (ABI) yang menjadi indikator dari keefektifan perfusi jaringan perifer.

BAB 6

KESIMPULAN DAN SARAN

6.1 KESIMPULAN

Berdasarkan hasil analisis dari beberapa artikel dapat ditarik kesimpulan bahwa :

1. Terdapat enam artikel yang menunjukkan bahwa ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus pada *pre test* mayoritas memiliki nilai ABI pada kategori obstruksi ringan dan obstruksi sedang.
2. Terdapat enam artikel yang menunjukkan bahwa pemberian intervensi *buerger allen exercise* pada penderita diabetes mellitus memiliki 3 tahapan diantaranya ialah tahap elevasi, tahap penurunan, dan tahap horizontal/istirahat serta dengan durasi pemberian intervensi dapat diberikan 2-3 kali/hari selama 15 hari dengan durasi 12-15 menit.
3. Terdapat enam artikel yang menunjukkan bahwa pemberian intervensi *buerger allen exercise* sangat berpengaruh terhadap peningkatan nilai *ankle brachial index* (ABI) sebagai indikator dari keefektifan perfusi jaringan perifer pada penderita diabetes mellitus.

6.2 SARAN

Berdasarkan hasil penelitian diatas maka peneliti menyarankan beberapa hal sebagai berikut:

1. Bagi Peneliti

Dari hasil *literature review* ini penulis memperoleh pengetahuan tentang salah satu cara penanganan untuk penderita diabetes mellitus yang mengalami masalah ketidakefektifan perfusi jaringan perifer dengan memberikan intervensi *buerger allen exercise*. Serta bagi peneliti selanjutnya diharapkan melakukan penelitian langsung (*original riset*) untuk mengetahui secara langsung pengaruh dari *buerger allen exercise* dengan pemberian intervensi dapat diberikan 2-3 kali/hari selama 15 hari dengan durasi 12-15 menit.

2. Bagi Masyarakat

Dari hasil *literature review* ini dapat memperoleh pengetahuan tentang salah satu penanganan untuk penderita diabetes mellitus yaitu dengan pemberian *buerger alen exercise* serta segera melakukan pemeriksaan ABI (*ankle brachial index*) jika mulai mengeluhkan adanya nyeri pada kaki, baal/mati rasa dan kulit kaki menghitam karena ini merupakan gejala gangguan perfusi jaringan perifer.

3. Bagi Tenaga Kesehatan/Profesi Keperawatan

Bagi tenaga kesehatan/profesi keperawatan diharapkan dapat menjadi acuan atau sumber informasi dalam memberikan pelayanan kepada masyarakat tentang pemberian intervensi *buerger allen exercise* pada

penderita diabetes mellitus, melakukan pendidikan kesehatan terkait tanda-tanda perfusi jaringan menurun, pentingnya pemeriksaan ABI pada penderita diabetes mellitus.

4. Bagi Instansi Pendidikan

Dari hasil *literature review* diharapkan dapat membantu dalam proses pembelajaran serta menambah wawasan baru khususnya untuk mahasiswa Universitas dr. Soebandi Jember.

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LAMPIRAN

Lampiran 1.1 Artikel 1

Mansoura Nursing Journal (MNJ)

vol.5 No.1 ISSN:18235-2018

EFFECT OF BUERGER ALLEN EXERCISE ON LOWER LIMB PERFUSION AMONG PATIENTS WITH TYPE 2 DIABETES MELLITUS

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Abstract:

Diabetes related lower extremity complication increase the risk for amputation which include peripheral neuropathy, peripheral vascular disease, and infection. Peripheral arterial disease is estimated to be 2 to 4 times more common in persons with diabetes than in others. Buerger Allen exercise intended to improve feet, legs circulation and relieve the symptoms in patients with lower limbs arterial insufficiency. Therefore, *the aim of the study*, evaluate the effect of Burger Allen exercise on lower limb perfusion in patients with type 2 diabetes mellitus. *Method and sample*, Quasi-experimental research design was conducted in the diabetic and endocrine ward and diabetic foot clinic in Specialized-Medical Hospital, at Mansoura University. The sample of this study composed of 48 adult patients with type 2 Diabetes who attend the diabetic ward and diabetic foot clinic in Specialized-Medical Hospital throughout six months. Patients randomly assigned into two matched groups; study group (group A) and control group (group B). *Results*, indicates significant improvement into patients lower extremity perfusion by using Ankle Brachial Index (ABI) scale after performance of Buerger Allen exercise and at the same time it helped to improve the vascularity and thus promotes the wound healing process. *Conclusion*, positive effect of Buerger Allen exercise on diabetic patients lower extremity perfusion.

Key words: Buerger Allen Exercise, Lower Limb perfusion, Type 2 Diabetes Mellitus

Introduction:

Diabetes is one of the major global health emergencies of the 21st century. The prevalence of diabetes mellitus is increasing rapidly because of population ageing, urbanization and lifestyle changes^(1,2). According to WHO This number of people with diabetes has risen to 422 million in 2014, and expected to rise to 552 million (or 1 in 10 adults) by 2030, which equal to 3 new cases per second^(3, 4). The number of diabetic patients in the Middle East and North Africa (MENA) Region is more than 35.4 million and expected to rise by 2040 to 72.1 million. In Egypt, there are more than 7.8 million cases of diabetes⁽²⁾. Feet

problems considered among the most serious complications of diabetes mellitus⁽⁵⁾. Diabetes associated lower extremity complications like peripheral arterial disease (PAD), peripheral neuropathy, foot ulceration or lower extremity amputations (LEA), are emerging as a public health concern which likely to occur twice in diabetics than non-diabetics⁽⁶⁾. Peripheral arterial disease (PAD) is a chronic atherosclerotic process that causes narrowing of the peripheral blood vessels, predominantly of the lower limbs. Patients with diabetes have 4 fold increased risk of developing PAD⁽⁷⁾. Buerger Allen exercise is a system of exercises for

arterial insufficiency of lower limbs to improve circulation to the feet and legs. This exercise produce gravitational changes in positions which aid in increasing blood flow rate, removal of stagnant blood and create collateral circulation to the ischemic area ^(8,9). Buerger exercise is an ideal and noninvasive physical therapy for patients with diabetes combined with PAD as it is an easy to learn, low cost, and low risk physical activity ⁽¹⁰⁾.

1. **The study aim:** The aim of the study was to evaluate the effect of Burger Allen exercise on lower limb perfusion of patients with type 2 diabetes mellitus.

2. **Research hypothesis:**

H1: There will be significant association between Buerger Allen exercise and lower limb perfusion of patients with type 2 diabetes mellitus.

3. **Subjects & method :**

3.1 - **Research Design:** Quasi – experimental research design was utilized in this study.

3.2 - **Setting:** This Study was conducted at diabetic and endocrine ward and diabetic foot clinic in Specialized-Medical Hospital, at Mansoura University.

3.3 **Participants:** Purposive sample of 48 adult patients with type 2 Diabetes who attend the diabetic and endocrine ward and diabetic foot clinic in Specialized-Medical Hospital, at Mansoura University throughout six months. Patients randomly assigned into two matched groups; study group (group A) and control group (group B). The study group involved patients who performed Burger Allen exercise in addition to routine care while the control group involved patients receiving only routine care. Study included adult patients of both sexes with type 2 Diabetes and ankle

Brachial Index (ABI) : ranged from 0.4 – 0.9 and excluded patients with ABI : less than 0.4, Wagner grade (3,4,5) classification of diabetic foot, deep vein thrombosis, unstable coronary heart diseases, acutely ill patient, chronic renal failure, chronic liver disease and patients with no palpable extremity pulse.

4.4 **Tools:** Two tools had used in this study as the following :

4.4.1- **Tool I:** Patient's Health Relevant Information Sheet. This tool was developed by the researcher based on literature review to collect the required base line data and consists of two parts: Part 1: socio-demographic data sheet: This part was used to collect personal data of patients as : age, gender, marital status, educational level ,occupation and type of job.

Part 2: Patient's Health status :This part was used to assess patient current diagnosis, length of time since diagnosis, presence of diabetic foot ulcer, other health problems, past history, family history, dietary pattern etc.

4.4.2- **Tool II:** Tissue perfusion assessment: Ankle Brachial Index (ABI). The ABI is used to assess tissues perfusion of lower limbs and calculated by dividing the systolic blood pressure at the ankle (Posterior tibial or Dorsalis Pedis) by the systolic blood pressures in the arm (Brachial) by using sphygmomanometer ^(11,12).

$$ABI = \frac{\text{Highest ankle systolic pressure}}{\text{Highest brachial arm pressure}}$$

Scoring system:

Above 0.9	Normal
0.71 – 0.90	Mild Obstruction
0.41 – 0.70	Moderate Obstruction
0.0 – 0.40	Severe Obstruction

4.5- Methods:

- The researcher obtained the required permissions from the Research Ethics Committee of Nursing faculty, Mansoura University.
- A verbal consent was obtained from patients who participated in the study after clear explanation of the aim and the nature of the study.
- Tools tested for content validity by seven experts from both field of medicine and nursing. Faculty of nursing –Mansoura university (5 members), and medical specialist (2members) in the Specialized-Medical Hospital, at Mansoura University. The required modifications were done.
- A pilot study was carried out on 10 patients, before data collection to test the clarity, feasibility, applicability, reliability. The tools was modified according to results of pilot study. These ten patients were excluded from the study.
- Data collection extended over a periods of six months
- **Filed work:** The field of working included the following phases:

A. Assessment phase: Every patient was interviewed individually to collect the necessary data after giving him a brief idea about the aim of the study using tool I, part(1).The researcher started by assessing patients on day (1) before intervention , assessment was done using tool I, part (2) and tool II (ABI) scale .ABI was done by using standard manual sphygmomanometer and standard hand Doppler.

Ankle brachial pressure index measured by blood pressure cuff tied on upper arm, palpate the brachial pulse then applying gel, place the Doppler and inflate the cuff about 20 -30 mmHg after pulse is not audible and then deflate slowly and mark the first heard pulse as the systolic blood pressure and repeat for the other arm and the highest was used . Blood pressure cuff tied on 2.5 cm above the malleolus , measurement was made for both the dorsalis pedis(DP) and posterior tibial(PT)and the highest value was used. Then divided the higher systolic pressures

of DP or PT pulse for each ankle by the higher of the two upper extremity brachial systolic pressures to obtain the ABI for each of the lower limbs⁽¹³⁾.

B. Implementation phase:

The researcher instructed to the patients the importance of Buerger Allen exercise in improving perfusion of lower limbs and preventing further complication related to circulation ,then taught Buerger Allen exercises to the patient using colored booklet after assessment followed by return demonstration from the patient and patients were instructed to perform it at least two sessions per day.

- Buerger Allen exercise consisted of two to three sessions a day according to patient tolerance ,every session consisted of 3 phases. In first phase the patient Lie flat with legs elevated above the level of the heart to a 45 to 90 degree angle until blanching occurred (about 2 minutes).
- Then sit on edge of bed and lower the legs with no pressure against the back of the knees to fill the vessels and exercise feet by plantarflexion, dorsiflexion ,internal and external rotation until the legs are pink (about 5 minutes)⁽¹⁰⁾.
- Finally, the third phase in which patient lie flat for about 5 minutes with feet covered with a warm blanket before repeating the exercises .

C. Evaluation phase: After two weeks of performing Buerger Allen exercises for doing immediate post-test by using Tool II(ABI) scale and assessing wound healing through using Wagner Meggitt's classification of diabetic foot .

D. Follow up phase: After 4 weeks from intervention.

5. Results: The data collected were analyzed statistically and the results are categorized as following parts:

The demographic characteristics of the patients was shown in Table (5.1) at baseline; there were no statistically significant differences observed among study and control groups.

- Females were more prevalent in the sample than males. They constituted (87.5% and 91.7%) for the study and

control groups respectively. In relation to age, the majority of diabetic patients were between 40 to 60 years old. As regards marital status the majority of diabetic patients in both groups were married.

Regarding the educational level, the highest percentage of the studied diabetic patients were able to read and write. Concerning patient's occupation, it was observed that about three quarter of the

studied diabetic patients were housewives. Regarding activity level, the results revealed that the highest percentage of the studied diabetic patients had both sedentary & standing activity level, the reported percentage were 54.2% and 70.8% of the study and control groups respectively. It was found that the majority of diabetic patients in both groups reported family history of DM from first degree relativity.

Table (5.1): Distribution of studied groups according to their demographic characteristics.

	Study (n = 24)		Control (n = 24)		□ □	p
	No	%	No.	%		
Gender						
Male	3	12.5	2	8.3		FE p=1.000
Female	21	87.5	22	91.7	□ □ □	
Age						
20 – < 30	0	0.0	0	0.0		3.038 MC p=0.215
30 – < 40	2	8.3	0	0.0		
40 – < 50	12	50.0	9	37.5		
50 – 60	10	41.7	15	62.5		
Mean ± SD.	47.83 ± 5.91		50.38 ± 5.19		t=1.583	
Marital status						
Married	20	83.3	18	75.0		2.110 MC p=0.644
Single	0	0.0	1	4.2		
Widow	2	8.3	4	16.7		
Divorced	2	8.3	1	4.2		
Level of education						
Illiterate	5	20.8	6	25.0		4.075 MC p=0.209
Read and write	16	66.7	10	41.7		
Secondary education	3	12.5	6	25.0		
University education	0	0.0	2	8.3		
Occupation						
Manual work	2	8.3	1	4.2		3.353 MC p=0.422
Employee	2	8.3	6	25.0		
House wife	19	79.2	17	70.8		
Retired	1	4.2	0	0.0		
Activity level						
Sedentary	9	37.5	2	8.3		6.126* MC p=0.047*
Standing	2	8.3	5	20.8		
Both sedentary & standing	13	54.2	17	70.8		
Family history of diabetes mellitus						
Yes	21	87.5	24	100.0		3.200 FE p=0.234
No	3	12.5	0	0.0		
Degree of relativity	(n = 21)		(n = 24)			
First degree relative	13	61.9	18	75.0		0.896 0.344
Second degree relative	8	38.1	6	25.0		
Third degree relative	0	0.0	0	0.0		

χ^2 , p: χ^2 and p values for **Chi square test** for comparing between the two groups

*: Statistically significant at $p \leq 0.05$

MC p: p value for **Monte Carlo** for Chi square test for comparing between the two groups

FE p: p value for **Fisher Exact** for Chi square test for comparing between the two groups

Figure (5.1): Represent difference between studied groups through the study period as regard grades of diabetic foot ulcer. It can be observed from the figure that there is no statistically significant difference was observed between both groups before intervention ($MCp=0.831$). In relation to study group, a statistical difference between pre, post and follow up grades of foot ulcer improvement, as grade 2 changed from (20.8%) to reach (12.5% and then 4.2%) in pre, post and follow up phases respectively and grade 1 from (8.3% to 16.7% and changed to 12.5%) as this difference become related to grade zero. After four weeks grade 0 changed from 70.8% in pre-test to reach 83.3% with healing ratio of 12.5%. Compared with no changes in pre and immediate post-test of control group.

Figure (5.1): Difference between studied groups through the study period as regard grades of diabetic foot ulcer.

Table (5.2) : Comparison between studied groups according to ulcer surface area through the study period.

Ulcer surface area	Pre-test		p_1	immediate post-test		P_2	follow up test		p_3
	Study (n = 7)	Control (n = 9)		Study (n = 7)	Control (n = 9)		Study (n = 7)	Control (n = 9)	
Mean $\pm$ SD.	4.30 $\pm$ 3.94	5.96 $\pm$ 5.32	0.502	2.48 $\pm$ 2.15	4.88 $\pm$ 5.99	0.333	0.54 $\pm$ 0.71	4.76 $\pm$ 5.12	0.039*

p_1 : p value for Student t-test for comparing between study and control group in before intervention

p_2 : p value for Student t-test for comparing between study and control group in after 2nd week

p_3 : p value for Student t-test for comparing between study and control group in after 4th week

*: Statistically significant at $p \leq 0.05$

Table (5.3) and Table (5.4) : show comparison between studied groups according to ABI through the study period, there was significant difference in mean ankle brachial index after performance of Buerger Allen exercise for the study group as it elevated from (0.74 ± 0.11) to (0.85 ± 0.08) in immediate post-test ($p < 0.001$) and changed to (0.91 ± 0.11) into follow up phase ($p < 0.001$) and between immediate post-test and follow up test ($p =$

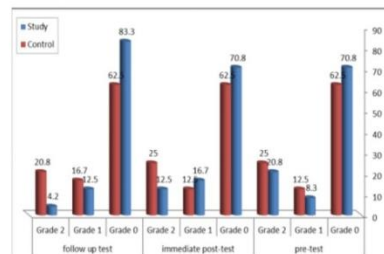


Table (5.2) : shows Comparison between the studied groups according to ulcer surface area through the study period, there was significant statistical difference from the beginning ($P = 0.502$) to the end ($P = 0.039$) of the study between two groups after performance of Buerger Allen exercise as mean ulcer surface area decrease constantly for study group ($p = 0.038$). For the control group, there is no significant difference between mean ulcer surface area through the study period.

0.010) . Compared to (0.73 ± 0.10) for control group changed into (0.71 ± 0.09 and 0.76 ± 0.08) into post and follow up phases respectively. There was no significant difference between two studied groups at the beginning of the study ($tp = 0.682$) on the other side mean difference between them into immediate post-test and follow up test was high significant ($tp < 0.001$).

Table (5.3) : Differences between studied groups according ABI through the study period.

Ankle Brachial pressure Index (ABPI) (mmHg)	Mean $\pm$ SD.			p ₁	p ₂	p ₃
	Pre-test	immediate post-test	follow up test			
Study (n = 24)	0.74 $\pm$ 0.11	0.85 $\pm$ 0.08	0.91 $\pm$ 0.11	<0.001*	<0.001*	0.010*
Control (n = 24)	0.73 $\pm$ 0.10	0.71 $\pm$ 0.09	0.76 $\pm$ 0.08	0.129	0.041*	0.001*

p: p value for F test (ANOVA) with repeated measures

*: Statistically

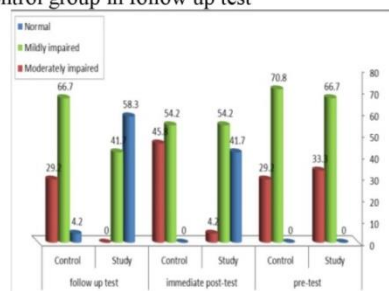
significant at $p \leq 0.05$ p₁: p value for comparing between Pre-test and immediate post-test with in same groupp₂: p value for comparing between Pre-test and follow up test with in same groupp₃: p value for comparing between immediate post-test and follow up test with in same group**Table (5.4): Comparison between studied groups according ABI through the study period.**

Ankle Brachial pressure Index (ABPI) (mmHg)	pre-test		P1	immediate post-test		P2	follow up test		p3
	Study (n=24)	Control (n=24)		Study (=24)	Control (n=24)		Study (n=24)	Control (n=24)	
Mean $\pm$ SD	0.74 $\pm$ 0.11	0.73 $\pm$ 0.10	p=0.682	0.85 $\pm$ 0.08	0.71 $\pm$ 0.09	tp=<0.001*	0.91 $\pm$ 0.11	0.76 $\pm$ 0.08	tp=<0.001*

t, p: t and p values for Student t-test

*: Statistically significant at $p \leq 0.05$ p₁: p value for comparing between study and control group in before interventionp₂: p value for comparing between study and control group in immediate post-testp₃: p value for comparing between study and control group in follow up test

Figure (5. 2): illustrate lower extremity perfusion improvement among studied groups through the study period. There was no significant difference between two studied groups at the beginning of the study. But there was significant difference between them after performance of Buerger Allen exercise. In relation to study group , a statistical difference between pre, post and follow up where level of impairment improved to reach 41.7% normal lower extremity perfusion in immediate post-test and 58.3 % in follow up test. Compared with no noticeable change in control group.

**Figure (5. 2):** Lower extremity perfusion improvement among studied groups through the study period.

Normal lower extremity perfusion (ABI): Above 0.9	Mild Obstruction(ABI):0.71 – 0.90	Moderate obstruction (ABI):0.41 – 0.70
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Table (5.5) and Figure (5.3 ,5.4 and 5.5): Demonstrate the correlation between patient's ABI with Ulcer surface area through the study period for study group. As observed, there was a significant negative correlation between patient's ABI and ulcer surface area before and after performing Buerger Allen exercises where p values were found to be ($p=0.027$) in Pre-test and ($p=0.035$) in immediate post-test. But, this correlation was not significant in follow up where ($p=0.144$).

Table (5.5): Correlation between patient's ABI with Ulcer surface area through the study period for study group.

Ulcer surface area	ABI	
	r	P
Pre-test	-0.809*	0.027*
Immediate post-test	-0.789*	0.035*
Follow up test	-0.612	0.144

r: Pearson coefficient

*: Statistically significant at $p \leq 0.05$
ABI : Ankle Brachial Index

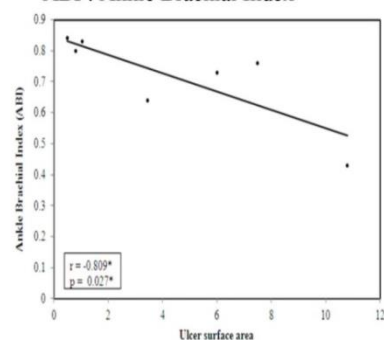


Figure (5.3):Correlation between ABI and Ulcer surface area in pre-test

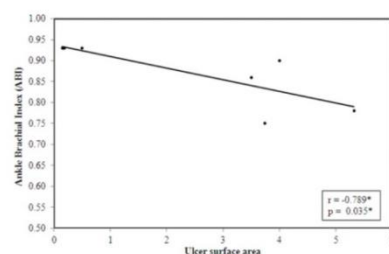


Figure (5.4):Correlation between ABI and Ulcer surface area in immediate post-test.

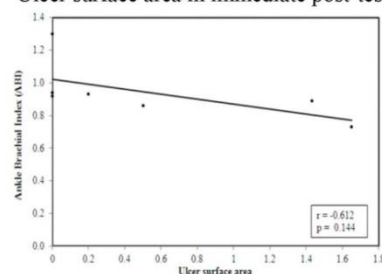


Figure (5.5):Correlation between ABI and Ulcer surface area in follow up test6-

Discussion

Foot problems in diabetic patients remain a major public health problem and are the most common reason for hospitalization of patients with diabetes with prevalence as high as 25%. This high prevalence lead to significant clinical and economic impact ⁽¹⁴⁾. Peripheral arterial disease is estimated to be 2 to 4 times more common in persons with diabetes than in others which increase the risk for amputation ⁽¹⁵⁾. Increasing foot peripheral circulation in patients with diabetes is important not only in relieving symptom, but also in prevention of ulcer and amputation. Buerger Allen exercise intended to improve feet and legs circulation, relieve the symptoms in patients with lower limbs arterial insufficiency, It drained engorged vessels by using postural changes and applying

muscle contractions to stimulate peripheral circulation⁽¹⁰⁾.

The results of the present study revealed that, females were more prevalent in the sample than males, the same results reported by **Fouad, 2009; Tavintharan et al, 2009**^(16,17). As regard to age the majority of studied groups were between forty and sixty years old, this in the same line with **Hassan & Mehani, 2012**⁽¹⁸⁾, this finding may be due to that PAD is chronic complications of D.M that require years to occur, so it appear in older adult who have diabetes since several years.

It was observed that the highest percentage of the studied diabetic patients had both sedentary & standing activity level, this result in the same line with **John & Rathiga, 2015**⁽¹⁹⁾. In relation to length of time since diagnosis, it is noticed that, the largest proportion of the studied groups had diabetes mellitus for more than 10 years, this finding in agreement with **Coce, Metelko, Jaksic, Car, & Pavkovic, 2008**⁽²⁰⁾ and this finding may be due to chronicity of the disease.

Regarding hypertension it was observed that the majority the studied groups were hypertensive, this finding in agreement with **C. Chang, Chang, Hwang, & Chen, 2015**⁽²¹⁾; this finding may be due to the fact that hypertension and DM are interrelated.

When assessing wound size and grades among the study group, our study revealed that continuous improvement along the study period from pre-test to immediate post-test and then in follow up in which there is a percentage of study group achieve wound healing and shown no break in the skin test. In comparison of control group, there was slow healing process as wound size and depth show no significant difference from pre-test to immediate post-test and follow up test, these results is in accordance with **Vijayabarathi, 2016; Vijayabarathi &**

Hemavathy, 2014^(22,23) who stated that grade and size of wound highly decrease in study group from pre -test to post-test and patients had been showed better wound healing compared to control group and this finding is due to that Buerger Allen exercise which help to improve the vascularization of lower limbs and consequently it will help to improve the wound healing process.

Concerning lower extremity perfusion, it was noted that the study group show significant improvement along the study period as level of lower limb impairment improved to reach nearly half of patients with normal lower extremity perfusion in immediate post-test and more than half normal perfusion in follow up test. Compared with control group there was not significant change in level of lower extremity perfusion impairment from beginning to the end of the study. This result in the same line with **Mellisha, 2016**⁽²⁴⁾. This finding is due to doing Buerger Allen exercise which use gravity to empty and fill blood vessels alternately to drain congested vessels, which finally improves blood transportation, stimulate and promote collateral circulation.

The same finding show positive relation between body mass index(BMI) and patients' ABI. Which were more worse in patients who have higher BMI these results come in line with **Subramaniam et al., 2011**⁽²⁵⁾. This finding may be due to that obesity is a major risk factor for PAD. As regard correlation between patient's ABI and Ulcer surface area, the present study showed significant negative correlation between patient's ABI and ulcer surface area before and after performing Buerger Allen exercises. The same results reported by **Vijayabarathi, 2016; Vijayabarathi & Hemavathy, 2014**^(22, 23). This is may be due Burger Allen exercises which improve vascularity to lower limbs and consequently it will help

to improve perfusion and wound healing process simultaneously.

7- Conclusion: The results of the current study proved that Buerger Allen exercise was found to be effective on improving the lower extremity perfusion among patients with type 2 diabetes mellitus. On the other hand, diabetic foot ulcer patients can adopt Buerger Allen exercise to promote faster wound healing.

8-Recommendations: In the light of the results of the present study, the following recommendations are suggested:

For patients:

- Organizing patient's centered workshops to teach about diabetes mellitus disease, its harmful complications especially on lower limb and to how to perform Burger Allen exercise to avoid or decrease these complication.

For health care providers:

- An educational program should be applied about Burger Allen exercise for all nurses working in medical unit (inpatient & outpatient) to provide them with the necessary and required knowledge and skills.

9-Acknowledgments: Thanks to Specialized-Medical Hospital and all the individuals who accepted and participated in this study

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Lampiran 1.2 Artikel 2



Effect of Buerger Exercises on Improving Peripheral Circulation of the Lower Extremities among Patients with Type 2 Diabetes Mellitus at Selected University Hospital–Egypt

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ABSTRACT

Diabetes Mellitus (DM) is a metabolic disorder characterized by increased glucose level in the blood, resulting from defect in the insulin secretion, insulin action, or both. In advanced stage of disease; peripheral circulation of lower extremities is impaired which increases the risk for developing peripheral arterial diseases (PAD). Buerger Exercises is a simple intervention for improving the peripheral circulation of patients with diabetes mellitus. The aim of the current study was to assess the effect of Buerger Exercises on improving the peripheral circulation among patients with type 2 DM as assessed by Ankle Brachial Index (ABI) scale. Quasi experimental design was used. A non-probability purposive sample consists of sixty male and female adult patients with type 2 DM were selected. The study findings revealed that the post intervention mean ABI scores of both legs (Rt leg =1.097, Lt leg =1.086) were significantly higher than pre-intervention scores (Rt leg =.885, Lt leg =.937) ($p=0.001$). The use of Buerger Exercises is effective in improving the perfusion of lower extremities. Therefore, it is recommended that Buerger Exercises can be used to improve the peripheral circulation of lower extremities among patients with type 2 diabetes mellitus.

Keywords: Peripheral circulation, Buerger exercises, type 2 Diabetes mellitus

Introduction

Diabetes Mellitus (DM) is becoming one of the increasing health problems' concern worldwide. Half of patients with DM were undiagnosed and about 4 out of 5 patients live in low and middle income countries. According to the World Health Organization (WHO)¹; Diabetes is a pandemic disease affecting more than 415 million adults worldwide. This number is expected to surge to 642 million by 2040, diabetes will become the seventh leading cause of death worldwide with diabetes deaths expected to rise by 50% during the next 10 years².

According to the International Diabetes Federation (IDF), Egypt is one of the top 10 countries in the number

of people with diabetes between 20 and 79 years of age, with 8.5 million of and around 4.5 million undiagnosed. Consequences of the compromised vascular system in DM are among the most devastating complications. Both macro and micro-vascular diseases are believed to contribute to the consequences of peripheral vascular disease (PVD)³.

The risk of PVD is increased in patients with DM, it occurs earlier and is often more severe and diffuse, leading to ischemic ulcers, gangrene and possible amputation, it is also a marker for generalized atherosclerosis and impaired peripheral circulation of lower extremities⁴. The use of ankle-brachial index (ABI) provides a measure of blood flow to lower extremities. This could help in early detection, initiate early therapy and reduce the risk of limb ischemia and amputation. It is recommended that patients with DM should be screened annually for impaired peripheral circulation⁵.

There are many modalities to improve the lower extremities' perfusion such, Buerger exercises which

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considered one of the low cost and simple physical interventions to stimulate the development of collateral circulation in lower extremities⁵. The exercises were proposed in 1924 by Leo Buerger⁶ and modified by Arthur Allen in 1931.

The mechanism of Buerger exercises depend on the use of gravitational changes in positions that are applied to the smooth musculature of vessels and to the vascular bed of lower extremities. Gravity helps alternately to empty and fill the blood vessels, which can eventually increase transportation of blood through it. Buerger exercises drained engorged vessels by using postural changes. However in spite of its simplicity, the application of these exercises to patients with diabetes is very rare, and the clinical significance of peripheral circulation improvement is still limited due to the lack of measuring tools⁷.

Nurses should focus on the prevention of impaired peripheral circulation among patients with DM by early recognition and detection of those at risk. An awareness of diagnostic and treatment strategies will enable nurses to educate patients. This will help to improve both concordance with treatment and disease outcome⁸. Therefore, the aim of the current study was to evaluate the effect of Buerger exercises on improving the peripheral circulation of the lower extremities among patients with type 2 DM.

Hypotheses:

H1: There is a statistical significant difference between the pre and post interventional mean scores of ankle brachial index (ABI) of the study participants after five days.

H2: There is a statistical significant difference between the pre and post interventional mean scores of ankle brachial index (ABI) of the study participants after fifteen days.

Method

Selection and Description of Participants: A non-probability purposive sample consists of sixty male and female adult patients who met the inclusion and exclusion criteria were selected for the study from the medical departments of a selected university hospital in Cairo, Egypt.

Inclusion and Exclusion Criteria: Patients diagnosed with type 2 DM according to WHO criteria¹, with regular treatment, had ABI score of 0.7 up to .99 were eligible to be included in the study. Patients who had; previous re-vascularization, hyperglycemia above 300 mg/dl, uncontrolled hypertension (BP $\geq$ 160/100 mmHg, Extreme obesity (BMI $\geq$ 37.5 kg/m², and sever edema according to level (sever edema (4): up to the groin) and severity (+4), active foot ulcer, gangrene and history of amputation, were excluded.

Data Collection Tools:

Peripheral Circulation Assessment Tool (PCAT): Tool was developed by the researcher guided by extensive literature review. It consists of three parts:

Part 1: Demographic Data: age, gender, education.

Part 2: Medical History and General Health Status: duration of diabetes, blood sugar, blood pressure, weight, height & body mass index (BMI).

Part 3: Assessment of ABI Value: The ankle-brachial index (ABI) is the ratio of the blood pressure at the ankle to the blood pressure in the upper arm (brachium).

Ankle Brachial Index = Highest ankle pressure/
Highest brachial arm pressure

Interpretations of ABI:

- Normal ABI ranges from 1.0 — 1.4
- Values above 1.4 suggest a non-compressible calcified vessel.
- Value below 0.9 is considered diagnostic of peripheral arterial disease (PAD) and less than 0.5 suggests severe PAD, according to the American Heart Association (AHA) guidelines⁹.

Tool Validity and Reliability: Tool validity was assured and was also tested for internal consistency by test-retest reliability. Cronbach's alpha was 0.99.

Procedure: Patients who met the inclusion criteria for the study were approached by the researcher; individualized interview session was conducted to collect data related to the demographic and medical data. Ankle Brachial Index (ABI) of the lower extremities of the study participants were assessed and recorded. Buerger exercises as a study intervention (independent variable) was administered on the same day and continued 2-3

times for 15 days for each patient. Post assessment of ABI was done on the fifth and 15th day using the same scale. Buerger Exercises were performed and taught for each participant in the following position sequence:

- Elevation of lower extremities to a 45 to 90 degree and keep in position until the skin blanches (appears dead white);
- Put lower extremities below the level of the rest of the body until redness appear; Flexion, extension, and circumduction of the ankles are done during this phase of dependency.
- Finally, the lower extremities are placed flat on the bed (horizontal) for a few minutes.

The length of time for each position varies with the patient's tolerance and the speed within which color change occurs. Usually the exercises were prescribed for about 12 -15 minutes. The final overall effect was determined by comparing ABI pre and post-test scores of the participants.

Statistical Analysis: Data were coded and analyzed using SPSS, version 20. Shapiro-wilk Normality test was done. Descriptive statistics including frequency distribution, mean, and standard deviations, as well as inferential statistics such as Wilcoxon test were used to examine the relationships between variables. A p-value less than 0.05 were considered statistically significant.

Results

Table 1: Frequency and Percentage Distribution of Demographic Characteristics of the Study Participants (n = 60)

Demographic Characteristics	Frequency & Percentage	
	No.	%
Age (in years):		
30 to > 40	7	11.6
40 to > 50	22	36.7
50 and more	31	51.7
Mean ± SD	51.98 ± 10.43	
Sex:		
Male	23	38.3
Female	37	61.7
Education:		
Illiterate	24	40
Can read and write	13	21.6

Contd...

Primary & Preparatory	10	16.7
Secondary	10	16.7
University	3	5

Table (1) shows that majority of participants were females, and aged 50 years old and above, with a mean of (51.98 $\pm$ 10.43). Near half of participants were illiterate.

Table 2: Frequency and Percentage Distribution of the Medical History and General Health Status of the Study Participants (n = 60).

Medical History & General Health Status	Frequency & Percentage	
	No.	%
Blood Pressure (mmHg):		
Systolic		
100 to less than 120	16	26.7
120 to 140	44	73.3
Mean ± SD	123.8 ± 13.4	
Diastolic		
60 to less than 75	34	56.7
75 to 90	26	43.3
Mean ± SD	73.3 ± 8.2	
Random Blood Sugar (mg/dl)	Min. (102)	Max. (250)
Mean ± SD	168.5 ± 35.9	
Duration of illness:		
1 to> 5 years	21	35
5 to > 10 years	20	33.3
More than 10 years	19	31.7
Mean ± SD	8.13 ± 5.20	
Body Mass Index (BMI):		
Normal (less than 23 kg/m²)	6	10
Over weight (23 – 27.4 kg/m²)	39	65
Obesity (27.5 – 37.4 kg/m²)	15	25
Mean ± SD	27.1 ± 3.4	

Table (2) illustrates that about three quarters of participants had a systolic blood pressure ranged from 120 to 140 mmHg, while more than half had a diastolic blood pressure ranged from 60 to > 75 mmHg. Participants' random blood sugar ranged from 102 – 250 mg/dl. About one third of participants were diabetics since one to > five years, and one third were from five to > 10 years. More than half of participants were overweight.

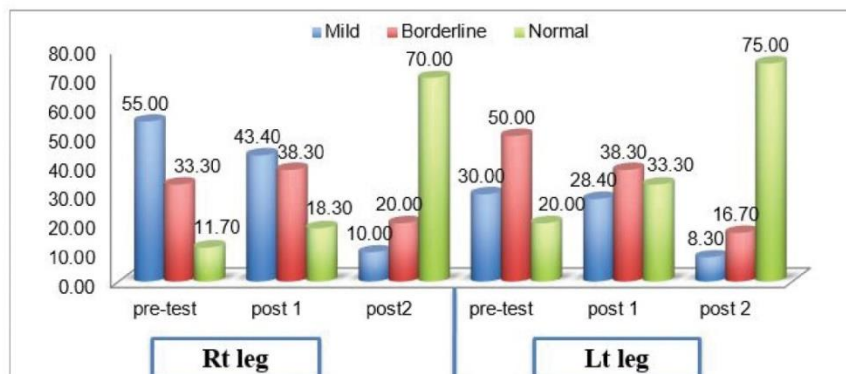


Figure 1: Percentage distribution of ankle brachial index (ABI) scores of the Rt & Lt legs among participants in the pre intervention, 1st & 2nd post-intervention (n = 60)

The Figure depicts the changes which happened between the ABI categories for both Rt and Lt legs. Before intervention; more than half of the participants had mild ABI value in the Rt leg and borderline in Lt leg while the minority had normal ABI, whereas after performing Buerger exercises for five days (post 1); Percentage of mild category decreased while the borderline and normal ones increased. In 2nd post intervention after 15 days; the majority of participants moved to the normal category for both legs. The shift of the participants from each category to another revealed the improvement of the lower extremities' peripheral circulation after performing Buerger exercises.

Table 3: Means, Standard Deviations and Wilcoxon test of Ankle Brachial Index (ABI) scores pre intervention and 1st post-intervention and 2nd post-intervention (n = 60)

	Pre intervention Mean ± SD	1 st post-intervention Mean ± SD	W(p) Pre Vs. 1 st Post	2 nd post-intervention Mean ± SD	W(p) Pre Vs. 2 nd post	W(p) 1 st post Vs. 2 nd post
Rt leg	.885 ± .144	.928 ± .168	-1.866 (.062)	1.097 ± .180	-6.086 (.0001*)	-5.033 (.0001*)
Lt leg	.937 ± .143	.968 ± .184	-1.239 (.215)	1.086 ± .166	-5.057 (.0001*)	-3.704 (.0001*)

* significant > 0.05

There was a gradual increase of the ABI mean scores in terms of improvement of the peripheral circulation after exercises. There was no statistical difference found between the ABI mean scores of pre intervention and 1st post intervention. On the other hand, there was a high statistical difference found between the ABI mean scores of pre intervention and 2nd post intervention and also between 1st and 2nd post interventions.

Discussion

The present study results revealed that ABI mean scores before performing Buerger exercises in the right and left legs were .885 and .937 respectively, while the

mean scores after were 1.097 and 1.086, in the right and left legs respectively.

According to WHO index for blood pressure; the study findings regarding blood pressure showed that participants were in the pre-hypertension category which means that they are at increased risk for developing hypertension and subsequently impaired peripheral circulation especially that they are diabetics. This is congruent with Makin¹⁰ and Priya¹¹, who reported that the diabetic patients, with elevated blood pressure, long disease duration and obesity; are at a greater risk to develop impaired circulation of lower extremities.

Ankle brachial (ABI) mean scores after performing Buerger exercises for five days didn't show any significant difference between pre intervention mean scores so the 1st hypothesis was not supported. It might be due to the short period to produce effect from performing the exercises. Also as any exercise program; increasing the duration and compliance might help in producing the desired results. The current study results were concurrent with some studies^{12,13}, While it weren't matched with other studies^{8,11} as there was a significant difference after five days.

Regarding the results related to the 2nd post intervention which was assessed after 15 days, a significant difference and acceptable level of improvement of ABI mean scores was presented as there was an observable shift from each category to another. In a simple way, the participants improved from mild-moderate ABI to borderline and from borderline to normal as shown in fig (1). This mean that performing Buerger exercises for 15 days is more effective in improving peripheral circulation. So the 2nd hypothesis was supported and verified. These results were supported and concurrent with Sathya, Vijayabarathi & Mehani¹²⁻¹⁴ who reported a significant difference after using exercises for 15 days as recommended.

The resulted change might be due to the sufficient period that help in establishing new collaterals of the lower extremities and improve the peripheral circulation, and perfusion, which was presented as acceptable ABI values. These findings were supported by the AHA⁹ and ADF³ guidelines which emphasized the importance of performing exercises regularly than other invasive procedures to maintain lower extremities' perfusion.

Conclusion and Implications

The current study concluded that Buerger exercises are effective noninvasive intervention that helps in improving the peripheral circulation of lower extremities among patients with type 2 diabetes mellitus.

The study recommended the following:

- Replication of the study by using a large sample from different geographical areas, and different settings, and for long duration.
- A comparative study is recommended to evaluate the effectiveness of Buerger exercise with other

non-pharmacological measures for improving the level of lower extremity perfusion.

- Evidence based nursing practice should be encouraged for applying Buerger exercises to prevent PAD among diabetic patients.
- There is a need for further investigation of standardized procedures of Buerger exercises.
- More studies are needed on the prevention of diabetic foot using Buerger exercises.

Conflict of Interest: No conflict of interest among authors.

Source of Funding: It is a self-funding.

Ethical Consideration: A written initial approval was obtained from the ethics and research committee of the Faculty of Nursing - Cairo University. Written informed consent was obtained from each patient after explaining the nature & purpose of the study. Patients were informed that participation in the study was entirely voluntary and anonymity and confidentiality of the data were assured.

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Lampiran 1.3 Artikel 3

**Jurnal Keperawatan**

Volume 13 Nomor 3, September 2021

e-ISSN 2549-8118; p-ISSN 2085-1049

<http://journal.stikeskendal.ac.id/index.php/Keperawatan>

**BUERGER ALLEN EXERCISE BERPENGARUH TERHADAP
KETIDAKEFEKTIFAN PERFUSI JARINGAN PERIFER PADA PENDERITA
DIABETES MELLITUS**

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ABSTRAK

Ketidakefektifan perfusi jaringan perifer merupakan komplikasi dan diagnosa keperawatan yang sering terjadi pada pasien Diabetes Mellitus. Perawatan pasien dengan ketidakefektifan perfusi perifer pada kaki berdampak pada fisik, kualitas hidup, biaya untuk perawatan, dan menjadi beban bagi pembiayaan sosial negara. Latihan *Buerger allen exercise* mempunyai indikator berupa perbaikan dan peningkatan pada nilai ABI (*Ankle Brachial Index*) yang mencakup dalam perbaikan ketidakefektifan perfusi jaringan perifer. Penelitian ini bertujuan untuk menganalisis pengaruh *buerger allen exercise* terhadap ketidakefektifan perfusi jaringan perifer pada pasien diabetes mellitus. Desain penelitian ini menggunakan Quasy Experimental dengan rancangan *Pre test and post test with control group*. Populasi pada penelitian ini adalah semua penderita DM. pengambilan sampel menggunakan cara *purposive sampling*. Jumlah responden pada penelitian ini sebesar 54 dengan pembagian 27 kelompok intervensi dan 27 kelompok kontrol. Intervensi *Buerger Allen Exercise* dilakukan selama 6 hari sebanyak 6 sesi perhari dengan durasi 15 menit persesinya. Analisa data pada penelitian menggunakan uji t paired dan uji t independent. Hasil penelitian ini didapatkan nilai rata-rata ABI sebelum diberikan intervensi didapatkan rata-rata nilai ABI pada kelompok intervensi 0.78 (obstruksi ringan) dan pada kelompok kontrol 0.75 (obstruksi ringan) dengan p value = 0,693 berarti tidak terdapat perbedaan rata-rata nilai ABI pada kelompok intervensi dan kelompok kontrol. Dan sesudah diberikan intervensi didapatkan nilai rata-rata didapatkan rata-rata nilai ABI pada kelompok intervensi 0.99 (normal) dan pada kelompok kontrol 0.70 (obstruksi ringan) dengan p value < 0.05 yang artinya terdapat perbedaan signifikan nilai ABI sebelum dan sesudah diberikan intervensi buerger allen exercise pada kelompok intervensi dan kelompok kontrol. Sehingga Buerger Allen Exercise berpengaruh baik terhadap nilai ABI sebagai indikator keefektifan perfusi jaringan perifer pada penderita Diabetes Mellitus.

Kata kunci: ankle brachial index; buerger allen exercise; diabetes mellitus; ketidakefektifan perfusi jaringan perifer

**BUERGER ALLEN EXERCISE INFLUENCES ON THE INEFFECTIVE
PERIPHERAL TISSUE PERFUSION IN DIABETES MELLITUS PATIENTS**

ABSTRACT

Ineffective peripheral tissue perfusion is a complication and nursing diagnosis that often occurs in Diabetes Mellitus patients. Treatment of patients with ineffective peripheral perfusion on the feet has an impact on physical quality, quality of life, costs for care, and becomes a burden on the country's social costs. Buerger Allen exercise has an indicator in the form of improvement and increase in the ABI (Ankle Brachial Index) value which includes improving the ineffective perfusion of peripheral tissues. This study aims to analyze the effect of buerger allen exercise on the ineffective peripheral tissue perfusion in diabetes mellitus patients. This research design using Quasy Experimental with pre test and post test design with control group. The population in this study were all DM patients. sampling using purposive sampling. The number of respondents in this study was 54 divided into 27 intervention groups and 27 control groups. The Buerger Allen Exercise intervention was carried out for 6 days with 6 sessions per day with a duration of 15 minutes per session. Data analysis in this study used paired t test and independent t test. The results of this study showed that the average ABI value before being

given intervention showed an average ABI value in the intervention group was 0.78 (mild obstruction) and in the control group was 0.75 (mild obstruction) with p value = 0.693 meaning there was no difference in the mean ABI value in the control group, the intervention group and the control group. And after being given the intervention, the average value of ABI was obtained in the intervention group 0.99 (normal) and in the control group 0.70 (mild obstruction) with a p value <0.05 , which means that there is a significant difference in ABI values before and after being given Buerger Allen intervention, exercise in the intervention group and the control group. So that the Buerger Allen Exercise has a good effect on the ABI value as an indicator of the effectiveness of peripheral tissue perfusion in people with Diabetes Mellitus.

Keywords: ankle brachial index; buerger allen exercise; diabetes mellitus; ineffective peripheral tissue perfusion

PENDAHULUAN

Diabetes Mellitus dengan komplikasinya merupakan penyakit tidak menular yang menjadi salah satu penyebab kematian terbesar di Indonesia. Ancaman serius bagi penderita diabetes mellitus adalah resiko disfungsi aliran balik vena pada kaki, ulkus diabetikum, neuropati, gangrene dan amputasi kaki (Salam & Laili, 2020). Komplikasi kaki diabetik merupakan penyebab utama disabilitas, terjadi penurunan kualitas hidup bagi penderita, kerugian finansial, amputasi tungkai bawah dan tingkat kematian (Boulton et al, 2005; Chang et al, 2015). Selain itu pembiayaan penyakit diabetes mellitus sangat besar dengan dibuktikan klaim di badan penyelenggara jaminan sosial (BPJS) dari tahun ketahun (Salam & Laili, 2020).

Komplikasi yang paling sering dialami pada penderita diabetes mellitus adalah adalah ketidakefektifan perfusi jaringan perifer. Gangguan ini menyebabkan penderita diabetes mellitus memiliki resiko amputasi pada ekstremitas bawah karena kurangnya penanganan dan perawatan diabetes sehingga terjadinya infeksi, timbul ulkus kaki yang tidak bisa disembuhkan (Radhika et al, 2020). Hampir 90% amputasi tungkai bawah pada penderita diabetes mellitus diawali dengan terjadinya ulkus pada kaki (Alvarson et al, 2012). Ketidakefektifan perawatan konvensional seperti operasi dan pengendalian infeksi seringkali terjadi dalam menyembuhkan ulkus kaki diabetik (Lavery, 2012).

Prevalensi kejadian diabetes mellitus di dunia pada orang dewasa diperkirakan 8,3 pada tahun 2011 dan akan meningkat menjadi 9,9% pada tahun 2030 (IDF, 2013). Menurut data riskesdas (2018) prevalensi diabetes mellitus berdasarkan diagnosis dokter menurut provinsi, mencapai 1.017.290 kasus di 34 provinsi dan diabetes mellitus merupakan penyakit tidak menular yang menyebabkan kematian nomor empat di Indonesia (Kemenkes RI, 2018).

Gangguan metabolisme pada penderita diabetes mellitus berupa peningkatan glukosa darah memiliki angka kejadian yang terus meningkat. Ketidakefektifan perfusi jaringan perifer pada penderita diabetes mellitus merupakan komplikasi yang sering terjadi dan merupakan masalah keperawatan yang harus diatasi dengan cepat agar tidak terjadi komplikasi yang lebih berat. Pemeriksaan perfusi perifer biasanya diukur dengan indikator nilai *ankle brachial index* atau ABI. Pada penderita diabetes sebagian besar memiliki nilai ABI, konsentrasi hemoglobin pada sirkulasi perifer ekstremitas bawah, dan capillary refill time (CRT) yang menurun (Vipin, 2018; Aruna & Thenmozi, 2015). Ketidakefektifan perfusi jaringan perifer terjadi karena penurunan oksigen dalam darah sehingga terjadi kegagalan pengantar nutrisi ke jaringan kapiler, proses ini terjadi karena peningkatan viskositas darah akibat hiperglikemi yang terjadi pada penderita diabetes mellitus (Wilkinson et al, 2011; Nadrati, 2016).

Diabetes mellitus tidak bisa disembuhkan tetapi mampu menunjukkan prognosis yang baik dengan manajemen diri berupa perubahan gaya hidup dengan melakukan aktivitas secara teratur, berhenti merokok, berhenti konsumsi alkohol, makan yang sehat, berat badan dijaga (Radhika et al, 2020). Sedangkan tindakan dalam mengefektifkan perfusi jaringan perifer

adalah dengan perawatan kaki, penggunaan sepatu khusus penderita diabetes, senam kaki diabetes, latihan mobilitas dan Buerger Allen Exercise (BAE) (El-Fattah et al, 2019).

Buerger Allen Exercise (BAE) dicetuskan oleh Leo Buerger dan Arthur Allen (Buerger, 1926; Allen, 1930). Buerger Allen Exercise (BAE) suatu terapi modalitas yang dilakukan dengan berbagai variasi gerakan postural aktif di area plantar. Melalui BAE dengan menstimulus kontraksi otot, perubahan posisi, latihan postural, maka dapat berperan dalam peningkatan sirkulasi dan oksigen dalam pembuluh darah vena serta sirkulasi ekstremitas bawah (Chang et al, 2016). Mekanisme BAE yaitu dengan perubahan gravitasi ada posisi yang diterapkan dan muscle pump melalui gerakan aktif dari pergelangan kaki untuk kelancaran otot pembuluh darah. Gravitasi membantu secara bergantian untuk mengosongkan dan mengisi kolom darah, sehingga dapat meningkatkan transportasi darah melalui pembuluh darah, dapat mencegah penyakit vascular perifer (Freire & Karina, 2015; Lapanantasin, 2016; Jemcy & Rathiga, 2015). *Muscle pump* memiliki mekanisme yaitu dengan pergerakan otot kaki yang memanfaatkan gaya gravitasi kaki (Pebrianti, 2018).

Buerger Allen Exercise (BAE) sangat efektif sekali dalam melancarkan sirkulasi perifer ekstremitas bawah, mudah, ekonomis dan tidak memiliki efek samping. Hal ini didukung oleh penelitian Chang et al (2016) bahwa latihan BAE *Buerger allen exercise* secara signifikan meningkatkan level tekanan perfusi perifer lebih dari 10 mmHg (= 46, 58.3 vs 70.0 mm Hg, $P < 0.001$). Secara mayoritas, luka kaki diabetik sembuh secara baik setelah pemberian intervensi ini (9/34=27%) dan masih dalam proses penyembuhan (9/34=27%). Selain itu menurut El-Fattah et al (2019) bahwa intervensi BAE menunjukkan nilai mean dari skor ABI dari kedua tungkai adalah (tungkai kanan = 1,097, tungkai kiri: 1,086) yang menunjukkan nilai signifikansi yang lebih tinggi dibandingkan dengan skor sebelum intervensi (tungkai kanan = 0,885, tungkai kiri = 0,937) (Pebrianti, 2018). Dari paparan latar belakang diatas didapatkan tujuan peneliti ini adalah menganalisis pengaruh buerger allen exercise terhadap ketidakefektifan perfusi jaringan perifer pada pasien diabetes mellitus. Jenis penelitian yang digunakan adalah kuantitatif berupa memberi perlakuan buerger allen exercise pada pasien diabetes mellitus.

METODE

Desain penelitian ini menggunakan Quasy Experimental dengan rancangan *Pre test and post test with control group*. Populasi pada penelitian ini adalah semua penderita DM yang berada di RW. 03 Manukan Kulon Surabaya. Pengambilan sampel dilakukan dengan cara *purposive sampling* dengan kriteria inklusi: Penderita diabetes mellitus dengan pengobatan, skor nilai ABI obstruksi ringan sampai nilai ABI abnormal, berusia 35-60 tahun, bersedia mengikuti seluruh program latihan sampai selesai dan kriteria eksklusi: penderita berusia >60 tahun, mengalami sesak nafas, mengalami fraktur pada kaki. Total responden pada penelitian ini sebesar 54 dengan pembagian 27 kelompok intervensi dan 27 kelompok kontrol. Pengumpulan data pada penelitian ini berbentuk kuesioner dan lembar observasi, kuesioner berisi data demografi (Usia, Jenis kelamin, Durasi menderita DM, dan riwayat merokok). Lembar observasi berisikan nilai ABI sebelum dan sesudah perlakuan, lembar observasi pelaksanaan Buerger Allen Exercise. Nilai ABI didapatkan dengan membagi tekanan darah sistolik kaki (dorsalis pedis) dan tekanan darah sistolis lengan (brachial). Adapun alat yang digunakan untuk mengukur ABI adalah peralatan simple hand held vascular Doppler ultrasound probe dan Spignomanometer Digital. Interpretasi nilai ABI normal (0,9-1,3), obstruksi ringan (0,70-0,89), obstruksi sedang (0,41-0,69) dan obstruksi berat (kurang dari 0,4), ABI abnormal (>1,3), karena adanya klasifikasi pada dinding pembuluh darah pada pasien dengan diabetes (Salam et al, 2020). Analisa bivariate dalam penelitian ini unu

menganalisis pengaruh buerger allen exercise terhadap ketidakefektifan perfusi jaringan perifer dengan menggunakan uji *t independent* dan uji *t paired* dengan tingkat kemaknaan $<0,05$.

Penelitian ini dilaksanakan pada Maret-April 2022. Intervensi Buerger Allen Exercise diberikan selama 6 hari sebanyak 6 sesi perhari dengan durasi 15 menit persesinya. Prosedur penelitian ini pertama melakukan perizinan dan melakukan studi pendahuluan kemudian mengajukan proposal, setelah proposal diterima untuk didanai maka akan mengurus surat izin laik etik. Kedua adalah mempersiapkan instrument yang digunakan untuk pengumpulan data berupa modul *Buerger Allen Exercise* yang didalam modul terdapat prosedur pelaksanaan *Buerger Allen Exercise*, SOP Pengukuran ABI, Lembar Observasi nilai ABI pre dan Post latihan pada kelompok intervensi maupun kelompok kontrol. Ketiga adalah peneliti meminta persetujuan dengan menggunakan informed consent kemudian peneliti dan anggota peneliti mengajarkan cara *Buerger Allen Exercise* pada penderita dan keluarga sebagai asisten peneliti. Keempat adalah: peneliti mengunjungi responden selama 6 hari berturut-turut dengan pertemuan pertama terdapat pengukuran ABI pada kelompok intervensi maupun kelompok kontrol kemudian memberikan intervensi *Buerger Allen Exercise* pada kelompok intervensi. Pada hari ke 7 responden baik kelompok intervensi maupun kelompok kontrol akan dievaluasi dengan menilai ABI. Penelitian ini laik etik dengan NO. 018/08/III/EC/KEPK/Lemb.Candle/2021.

HASIL

Tabel 1.
Karakteristik Responden (n=54)

Karakteristik responden	Kelompok			
	Kelompok Intervensi (n=27)		Kelompok Kontrol (n=27)	
	f	%	f	%
Usia				
35-45 Tahun	4	14.9	3	11.1
46-55 tahun	14	51.9	15	55.6
56-60 Tahun	7	25.8	5	18.5
> 60Tahun	2	7.4	4	14.8
Jenis kelamin				
Laki-laki	9	33.3	12	44.4
Perempuan	18	66.7	15	55.6
Pekerjaan				
Bekerja	11	40.7	13	48.1
Tidak Bekerja	16	59.3	14	51.9
Lama Menderita DM				
≤ 10 Tahun	12	44.4	10	37
≥ 10 Tahun	15	55.6	17	63

Tabel 1 menunjukkan bahwa distribusi frekuensi menurut usia diperoleh hasil bahwa sebagian besar (51.9%) responden pada kelompok intervensi berada pada usia 46-55 tahun, sedangkan untuk responden kelompok kontrol sebagian besar (55.6%) berada pada usia 46-55 tahun. Distribusi frekuensi menurut jenis kelamin diperoleh hasil bahwa sebagian besar (66.7%) responden pada kelompok intervensi berjenis kelamin perempuan, sedangkan pada kelompok kontrol sebagian besar (55.6%) berjenis kelamin perempuan. Distribusi responden menurut pekerjaan sebagian besar (59.3%) tidak bekerja pada kelompok intervensi dan pada

kelompok kontrol sebagian besar (51.9%) tidak bekerja. Lama menderita penyakit diabetes mellitus pada kelompok intervensi sebagian besar (55.6%) menderita diabetes mellitus sudah lebih dari 10 tahun dan pada kelompok kontrol sebagian besar (63%) menderita diabetes lebih dari 10 tahun.

Tabel 2.

Uji normalitas nilai ABI pada kelompok intervensi dan kelompok kontrol sebelum dan sesudah diberikan intervensi (n=27; n=27)

Kelompok	Kadar asam urat dan Kualitas Hidup	<i>p</i> *
Intervensi	ABI pre-test	0,093
	ABI post-test	0,200
Kontrol	ABI pre-test	0,200
	ABI post-test	0,173

* $p > 0,05$ Based on shapiro wilk test

Tabel 2 menunjukkan bahwa hasil uji normalitas variabel nilai ABI (Ankle Brachial Index) pre test dan post test pada kelompok intervensi dan kelompok kontrol dengan uji *Shapiro wilk test* didapatkan nilai $p > 0,05$ yang berarti sebaran data normal sehingga analisa data dapat dilanjutkan dengan menggunakan uji statistik *paired t test* dan *independent t test*.

Tabel 3.

Nilai ABI pada kelompok intervensi dan kelompok kontrol sebelum diberikan intervensi (n=27; n=27)

Kelompok	Mean	SD	Min	Max	SE	t	<i>P</i> value
Intervensi	0.78	0.248	0.4	1.4	0.04	0.397	0.693
Kontrol	0.75	0.245	0.4	1.56	0.04		

Tabel 3 didapatkan rata-rata nilai ABI pada kelompok intervensi 0.78 (obstruksi ringan) dan pada kelompok kontrol 0.75 (obstruksi ringan) dengan p value = 0,693 berarti tidak terdapat perbedaan rata-rata nilai ABI pada kelompok intervensi dan kelompok kontrol sebelum diberikan intervensi buerger allen exercise.

Tabel 4.

Nilai ABI pada kelompok intervensi dan kelompok kontrol sesudah diberikan intervensi (n=27; n=27)

Kelompok	Mean	SD	Min	Max	SE	t	<i>P</i> value
Intervensi	0.99	0.159	0.6	1.3	0.03	4.741	0.000
Kontrol	0.70	0.277	0.3	1.56	0.053		

Tabel 4 didapatkan rata-rata nilai ABI pada kelompok intervensi 0.99 (normal) dan pada kelompok kontrol 0.70 (obstruksi ringan) dengan p value = 0,00 berarti terdapat perbedaan rata-rata nilai ABI pada kelompok intervensi dan kelompok kontrol sesudah diberikan intervensi buerger allen exercise.

Tabel 5.
Distribusi nilai variabel Nilai ABI (*pre* dan *post test*) pada kelompok intervensi dan kelompok kontrol (n=27; n=27)

Kelompok		Mean	St. dev	Statistik hitung	Signifikan
Intervensi	<i>Pre</i>	0.78	0.24	-3.41	0,002
	<i>Post</i>	0.99	0.15		
Kontrol	<i>Pre</i>	0.75	0.24	2.75	0,011
	<i>Post</i>	0.70	0.27		

Tabel 5 bahwa hasil uji statistik *Paired T-Test* didapatkan nilai $p=0,002$ pada kelompok intervensi dan didapatkan nilai $p=0,011$ pada kelompok kontrol, Nilai $p<0,05$ dapat disimpulkan bahwa terdapat perubahan secara signifikan nilai ABI sebelum dan sesudah diberikan intervensi buerger allen exercise pada kelompok intervensi dan kelompok kontrol.

PEMBAHASAN

Ketidakefektifan perfusi jaringan perifer kaki berdampak negative pada individu dan menjadi beban bagi pembiayaan jaminan kesehatan maupun sosial negara serta beban mental bagi penderita maupun keluarga. pada penelitian ini didapatkan responden sebagian besar berusia 45-55 tahun baik kelompok intervensi maupun kelompok kontrol. Hasil penelitian ini sejalan dengan penelitian Salam dan Laili (2020) bahwa penderita DM rentang usia 41-50 tahun dan sebagian besar berjenis kelamin perempuan. Menurut penelitian Utami (2018) bahwa pasien DM sebagian besar (77.8%) berjenis kelamin perempuan. lama menderita DM sebagian besar ≥ 10 Tahun. Lama menderita penyakit diabetes mellitus menggambarkan patofisiologi yang jelas dan semakin lama seseorang menderita diabetes mellitus maka akan semakin mudah terjadi komplikasi (Qurratueni, 2009).

Diabetes mellitus merupakan kelainan metabolisme yang ditandai dengan peningkatan kadar glukosa dalam darah yang diakibatkan terjadigangguan pada organ penghasil insulin. Seiring dengan meningkatnya kadar glukosa darah dalam jangka waktu yang lama menyebabkan komplikasi mikrovasuler kronis dan neuropatik (Mellisha, 2016). Komplikasi yang sering terjadi pada penderita DM adalah komplikasi berupa gangguan perfusi jaringan perifer kaki bahkan timbulnya ulkus diabetikum selain itu timbul arterosklerosis (Salam & Laili, 2020). Selain itu jika komplikasi tidak ditangani lebih lanjut akan menyebabkan miokard infark, penyakit arti perifer dan stroke (Mellisha, 2016). Gangguan perfusi jaringan perifer jika tidak ditangani menyebabkan kematian saraf atau neuropati pada kaki mulai dari berkurang sampai hilangnya sensasi perabaan pada kaki. Aterosklerosis jika tidak diberi perawatan maupun pengobatan menyebabkan adanya obstruksi pembuluh darah arteri atau vena pada kaki sehingga timbul gangguan aliran darah atau blood flow di kaki.

Prevalensi angka kejadian diabetes mellitus terus meningkat sehingga berpengaruh terhadap peningkatan kasus gangguan sirkulasi perifer ekstremitas bawah sehingga diperlukan perawatan lebih lanjut dan perlu adanya pengolahan kaki diabetik dengan tindakan preventif dan rehabilitasi (Hasna & Sau, 2018). Buerger Allen Exercise merupakan terapi preventif yang terdiri dari 3 tahap: 1). Tahap elevasi, yaitu posisi supin dengan leg elevasi 45- 90° dan ditambah dengan dorsifleksi dan plantar fleksi dari, fase ini dilakukan selama 1-2 menit; 2). Tahap penurunan (*sit, feet lowered*), yaitu posisi duduk dengan kaki yang menjuntai (*menggantung ditepi tempat tidur*) dan ditambah dengan dorsifleksi dan plantarfleksi, fase ini dilakukan selama 2-5 menit; 3). Tahap horizontal atau tahap istirahat, yaitu posisi supinasi dengan kaki horizontal untuk beristirahat dan ditambah dengan gerakan dorsifleksi dan plantarfleksi dari pegelangan kaki, dilakukan selama 5 menit. Buerger allen exercise ini

dilakukan dengan intensitas 2-6 kali dalam sehari dengan frekuensi 1-5 siklus pada tiap latihan (Freire & Karina, 2015).

Pada penelitian ini menunjukkan bahwa Buerger Allen Exercise efektif meningkatkan vaskularisasi pembuluh darah perifer sehingga perfusi jaringan perifer baik dengan ditunjukkan nilai rata-rata ABI sebelum diberikan intervensi didapatkan rata-rata nilai ABI pada kelompok intervensi 0.78 (obstruksi ringan) dan pada kelompok kontrol 0.75 (obstruksi ringan) dengan p value = 0,693 berarti tidak terdapat perbedaan rata-rata nilai ABI pada kelompok intervensi dan kelompok kontrol. Dan sesudah diberikan intervensi didapatkan nilai rata-rata didapatkan rata-rata nilai ABI pada kelompok intervensi 0.99 (normal) dan pada kelompok kontrol 0.70 (obstruksi ringan) dengan p value < 0.05 yang artinya terdapat perbedaan signifikan nilai ABI sebelum dan sesudah diberikan intervensi buerger allen exercise pada kelompok intervensi dan kelompok kontrol. Hasil penelitian ini sejalan dengan penelitian bahwa buerger allen exercise sangat efektif dalam meningkatkan sirkulasi perifer pada pasien diabetes mellitus (Patidar, 2018; Radhika, et al, 2020).

Latihan Buerger Allen Exercise beberapa penelitian menunjukkan hasil yang baik dalam meningkatkan perfusi jaringan perifer melalui gerakan-gerakan yang memanfaatkan kontraksi otot dan gaya gravitasi (Salam & Laili, 2020). Latihan BAE yang dilakukan secara konsisten dapat memperbaiki ketidakefektifan perfusi jaringan perifer dengan cara meningkatkan zat NO (nitrit oksid) sehingga dinding pembuluh darah mengalami perbaikan dan hasil akhirnya meningkatkan pembuluh darah dalam menyesuaikan terhadap resiko aterosklerosis dan mampu memperbaiki aterosklerosis yang sudah terjadi pada pasien Diabetes mellitus (Vijayarathy & Hermavathi, 2014).

SIMPULAN

Buerger Allen Exercise yang dilakukan secara konsisten akan berdampak baik pada keefektifan perfusi jaringan perifer pada pasien diabetes mellitus dengan indikator meningkatnya nilai ABI (Ankle Brachial Index). Kegiatan latihan berupa Buerger allen exercise bisa menjadi tindakan preventif dalam pengolahan pasien diabetes mellitus dengan komplikasi kaki diabetik.

UCAPAN TERIMA KASIH

Kami mengucapkan terima kasih kepada masyarakat di Kelurahan Manukan Kulon Surabaya yang bersedia menjadi responden penelitian ini dan rekan-rekannya yang telah bekerja sama dengan peneliti selama pengumpulan data dan proses penelitian. Ucapan terima kasih diucapkan untuk Universitas Nahdlatul Ulama Surabaya dalam hal pembiayaan penelitian serta motivasi dalam meneliti.

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Lampiran 1.4 Artikel 4

STRADA Jurnal Ilmiah KesehatanDOI: [10.30994/sjik.v10i1.669](https://doi.org/10.30994/sjik.v10i1.669)

ISSN: 2252-3847 (print); 2614-350X (online)

Vol.10 No.1 May 2021 Page. 612-621

The Effect of Buerger Allen Exercise on The Lower Extremity Peripheral Circulation in Type 2 Diabetic Patients

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ABSTRACT

Prolonged elevated blood glucose levels leads to chronic microvascular complications, neuropathy complications and lower extremity peripheral circulation disorders. Actions that can be taken care in non-pharmacological that is Buerger Allen exercise.

To determine the effect of Buerger Allen Exercise in lower limb peripheral circulation in diabetes mellitus patients.

Study used a quantitative method with a pre-experimental design using a pre-post test without control group. Sampling technique is non-probability sampling with accidental sampling approach is obtained 5 respondents.

The Wilcoxon Signed Rank Test results of the ABI value in the right limb are 0.043 or $p < 0.05$ and the ABI value on the left limb are 0.025 or $p < 0.05$.

Buerger Allen Exercise is effective in improving peripheral circulation of the lower extremities and is an alternative for repairing impaired tissue perfusion in diabetic feet. Future research can examine the most appropriate frequency and duration.

Keywords: Buerger Allen Exercise, Lower Extremity Peripheral Circulation, Type 2 Diabetes Mellitus

Received February 13, 2021; Revised March 2, 2021; Accepted April 2, 2021



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BACKGROUND

Diabetes mellitus is now an increasingly hot phenomenon issue. This health problem is caused by the increasing prevalence of patients each year. Diabetes mellitus is part of the target for handling the World Leaders in 2030. The Agenda for the Political Declaration on The Prevention on Control of NDCs states that diabetes mellitus is one of the priorities for serious non-communicable diseases and must be addressed (United Nations, 2011). Global data released by the World Health Organization (WHO) shows diabetes mellitus is the seventh leading cause of death in the world in 2016 and it is predicted that around 1.6 million people will experience death from this disease before the age of 70 (WHO, 2021). In line with International Diabetes Federation (IDF) (2017) every seven seconds an individual dies in the range of 4 million people per year under the age of 60 worldwide.

Along with the increase in cases of death in the world, data released by IDF states that the prevalence of diabetes mellitus is increasing from year to year. IDF recorded that as many as 151 million people in the world or with a prevalence of 4.6% suffering from diabetes mellitus, in 2018. Patients with this disease then increased to 463 million people with a prevalence of 9.3% by 2019. IDF predicts an increase in prevalence towards 10.2% or 578 million people in the world will suffer from diabetes in 2030 (IDF, 2019). The prevalence will continue to increase by around 10.9% in 2045 with a total increase of 51% from the data released in the previous year (WHO, 2021)(IDF, 2019).

Southeast Asia has a prevalence of around 8.8% which is equivalent to 87.6 million people and 56.7% of cases were undiagnosed. This casean increase of 74% with a death rate of 1.2 million people in 2019. This figure will increase by 115 million in 2030 and will reach 153 million in 2045 (IDF, 2017). Countries in Southeast Asia that have the highest number of diabetes mellitus patients include Laos, Cambodia, Myanmar and Indonesia (Kemenkes RI, 2018b). According to the Ministry of Health of the Republic of Indonesia, which comes from the Basic Health Research (Riskesdas) in 2018, it states that diabetes mellitus is one of the non-communicable diseases (PTM), the number four cause of death in Indonesia. There is an increase in the prevalence of the population of diabetes patients in Indonesia compared to 2013 (Kemenkes RI, 2018a).

Makassar City is one of the most populous cities in Indonesia. Makassar ranks second as the area with the highest prevalence of diabetes mellitus based on symptoms. The diabetes mellitus rate based on a doctor's diagnosis in the Makassar region is 5.3%, higher among several other areas in the province of South Sulawesi. The death rate due to diabetes mellitus is 811 cases (Dinkes Sulsel, 2015). The latest data that has been reported by the Eradication of Non-Communicable Diseases from the Health Office of South Sulawesi Province which comes from surveillance results, found 27,252 new cases of diabetes mellitus. The incidence rate in 2018 was found in 46 puskesmas. This disease ranks fifth as the most common disease found in all age groups in Makassar City. The total incidence rate in 2018 was 31,284 cases with varying hospitalization rates in each hospital throughout Makassar City (Dinkes Sulsel, 2018).

Diabetes mellitus is a metabolic disorder characterized by an increase in blood glucose due to impaired insulin production or the body's resistance to this hormone. Increased blood glucose levels over a long period of time lead to chronic microvascular complications and neuropathic complications. If this disease is not treated further, it can lead to myocardial infarction, stroke, and peripheral artery disease (Mellisha, 2016). Peripheral circulation disorders can be suffered by people with diabetes mellitus with a 15% chance of experiencing the risk of ulcers throughout their life, in line with sufferers whose prevalence continues to increase every year (Lee et al., 2013). With data on the increasing prevalence

of diabetes mellitus cases and increasing cases of lower limb peripheral circulation disorders, further treatment is needed. There are several actions that can be taken in the management of diabetic feet, namely by taking preventive measures and rehabilitative measures (Hasnah & Sau, 2018).

Rehabilitative measures are usually performed on patients who have suffered diabetic foot wounds. Actions that can be done in the treatment of diabetic foot are evaluation of ulcers, metabolic control, debridement of wounds, use of appropriate antibiotics, germ culture, and surgery. Meanwhile, preventive measures that can be taken with one of the goals are to accelerate the lower extremity peripheral circulation of diabetes mellitus patients, including health education about foot care, use of diabetic foot shoes, diabetic foot exercises, foot mobility exercises, and the Buerger Allen Exercise (Hasnah & Sau, 2018).

Buerger Allen Exercise is an exercise that can be done for diabetes mellitus patients to improve peripheral circulation of the lower extremities and prevent the occurrence of diabetic foot injuries for patients who have not experienced injuries to the extremities or for patients who have poor extremity circulation levels (Hasnah & Sau, 2018). Buerger allen exercise is important to do, because it can improve circulation and blood circulation to the peripheral areas of the extremities which is very effective in preventing obstruction of blood vessels, preventing foot wounds and accelerating the healing process of diabetic foot wounds so that amputation and death rates from diabetes mellitus can decrease. In addition, the Buerger Allen training is also easy to do in a relatively short amount of time (Hasan et al., 2016).

The work area of the health center which is the location of the study shows some patient handling and diabetic foot care, which includes education on the management of diabetes mellitus management independently and administering drugs regularly. The phenomenon found by researchers at the research location is quite concerning. Based on interviews conducted by researchers with posyandu cadres and type 2 diabetes mellitus patients in the work area of the Samata Community Health Center for non-pharmacological treatment, in the form of exercises to improve peripheral circulation to reduce the risk of ulcers or other problems in the legs, none of these have been given to patients. In addition, the number of type 2 diabetes mellitus patients in this area is quite high compared to several other districts in Gowa Regency.

This phenomenon is one of the causes and the urgency of being able to do leg exercises to smooth the circulation of the extremities, namely the buerger allen exercise. It is intended that the long-term adverse effects, in the form of the possibility of limb injury, disability, amputation, and mortality, can be minimized in patients with diabetes mellitus. If preventive measures are not carried out, then the threat of diabetic foot injuries caused by lower extremity peripheral circulation disorders, even to the point of death will increase as well. In addition, the Buerger Allen Exercise is also not yet popular in the community, so it is a very strong reason for this problem, to be used as research material.

Based on the various data that have been described, related problems, and previous studies, the aim of this study was to examine the effect of the Buerger Allen Exercise on the lower extremity peripheral circulation of patients with type 2 diabetes mellitus.

Background provides the state of the art of the study and consists of an adequate background, the previous researches and significance of the study to show the scientific merit or novelties of the paper. Avoid the use of literature review or a summary of the results. Objective states the major aim of the study.

STRADA Jurnal Ilmiah KesehatanDOI: [10.30994/sjik.v10i1.669](https://doi.org/10.30994/sjik.v10i1.669)

ISSN: 2252-3847 (print); 2614-350X (online)

Vol.10 No.1 May 2021 Page. 612-621

METHODS**1. Design and samples**

The research method used is a quantitative method with a pre-experimental research design using the pretest approach without control group. This research was conducted to see the effect of the Buerger Allen Exercise on respondents who had type 2 diabetes mellitus. This research was conducted at the Samata Health Center, Romang Polong Village, Somba Opu District, Gowa Regency. This research was conducted during August 2020. The population in this study were individuals with type 2 diabetes mellitus who were recorded in the Samata Public Health Center. The sampling technique used in this study is non-probability sampling with an accidental sampling approach based on the number of patients who visited the study site at the health center. The sample in this study were 5 respondents.

a. Inclusion criteria

- 1) Patients with type 2 diabetes mellitus for 1-10 years
- 2) Have a family who can accompany you during training.
- 3) 35-69 years old
- 4) Do not have diabetic foot wounds.
- 5) Do not have dangerous complications of acute or chronic diseases.
- 6) Active in physical movement
- 7) Communicative and understand the research flow

b. Exclusion criteria

- 1) Refusing to participate is the object of research.
- 2) Experiencing a situation that interferes with the ability to carry out exercises such as diabetic foot injuries and limited movement.
- 3) Have a smoking habit.
- 4) Currently undergoing a treatment program for type 2 diabetes mellitus.
- 5) Has minor complications and major complications, such as Diabetic Kidney Disease
- 6) Are depressed, worried, or anxious.

2. Research instrument and data collection

The types of instruments used are aneroid Sphignomanometer or tension meter and the Vascular Doppler Ultrasound probe. The research data were obtained through the measurement results of the ankle brachial index before being given the Buerger Allen Exercise treatment and the measurement results of the ankle brachial index after being given the Buerger Allen Exercise treatment.

3. Data analysis

This study used the Spearman statistical test formula to determine whether there is a difference or relationship between variables with a numerical scale.

RESULTS**1. Characteristics of Respondents**

Based on table 1 on the characteristics of the respondents below, it can be seen that the respondents aged 41-50 years were 2 people (40%), respondents aged 51-60 years were 2 people (40%). Based on gender characteristics, it can be seen that the majority of respondents are female as many as 4 people (80%). Based on the characteristics of education, it can be seen that the respondents are dominated elementary school by 2 people (40%). Based on the characteristics of the job, it can be seen that the respondents are dominated by housewives as many as 3 people (60%). Finally, the characteristics of

the length of time diagnosed with DM from the most respondents who were diagnosed for 1-5 years (80%) were 4 people.

Table 1
Characteristics of Respondents, n = 5 Respondents

Variable	Frequency (n)	Percentage (n)
Age		
41-50 years	2	40.0
51-60 years	2	40.0
> 60 years	1	20.0
Gender		
Man	1	20.0
Women	4	80.0
Education		
SD	2	40.0
Junior High	1	20.0
High school	1	20.0
Diploma	1	20.0
Profession		
entrepreneur	2	40.0
Housewife	3	60.0
Long diagnosed with DM		
1-5 years	4	80.0
> 5 years	1	20.0

2. The Effect of the Buerger Allen Exercise on Peripheral Circulation

Bivariate analysis was used to determine the effect of independent variables on the dependent variable or the effect of Buerger Allen Exercise on lower limb peripheral circulation in patients with type 2 diabetes mellitus as indicated by a p value <0.05. The normality test using the Shapiro Wilk Test shows an abnormal distribution of data on the pre and post measurement results of the right limb ABI value so that the Wilcoxon Test is used and shows normal data distribution on the pre and post measurement results of the left limb ABI value, so the Paired T test is used -Test. The following shows the effect of the Buerger Allen Exercise on the peripheral circulation of the right extremities in patients with type 2 diabetes mellitus.

Based on the Wilcoxon Signed Rank Test on the ABI value of the right extremity pre and post test on 5 respondents, the p value is 0.043 <0.05. This shows a significant difference in the peripheral circulation of the right lower limb which is indicated by an increase in the ABI value in patients with type 2 diabetes mellitus before and after the intervention. Intervention on the left lower limb, which was then carried out by the T-Paired Test on the ABI value of 5 respondents, the p value was 0.025 <0.05. This shows that there is a significant difference in the peripheral circulation of the left lower limb which is indicated by an increase in the ABI value of type 2 diabetes mellitus patients before and after the intervention.

STRADA Jurnal Ilmiah Kesehatan

DOI: [10.30994/sjik.v10i1.669](https://doi.org/10.30994/sjik.v10i1.669)

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Table 2
Distribution of the Effect of Buerger Allen Exercise on Dextra (Right / Right) and Sinistra (Left / Left) Peripheral Circulation in Type 2 Diabetes Mellitus Patients in the Working Area of the Samata Health Center

ABI value	Pre Test		Post Test		Difference in Mean	P
	Mean	SD	Mean	SD		
Dextra Peripheral Circulation	0.9296	0.14362	1,3072	0.11719	-0.3776	0.043
Sinistra Peripheral Circulation	0.8768	0.25367	1,2478	0.10922	-0.371	0.025

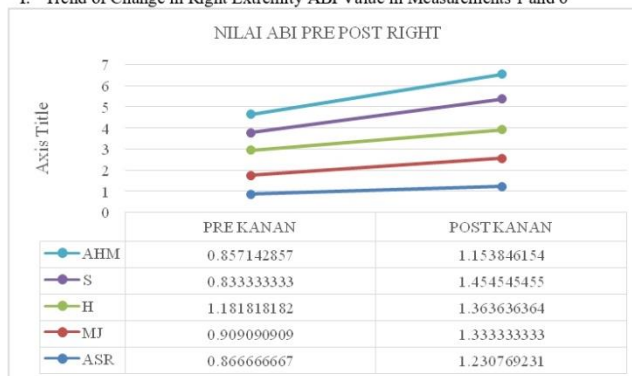
Source: Primary Data 2020

Based on the research results that have been presented in table 2 above, it can be seen that there are different results in the mean value of the pre-test and post-test results of the measurement of the peripheral circulation of the right and left limbs after giving the Buerger Allen exercise. The treatment given for 6 times to the respondent, by conducting a pre-test measuring the ABI value in the first intervention and post-test at the 6th time at the end of the intervention, the resulting mean difference in the results of both. It can be seen that the mean ABI value on the right limb pre-test is 0.9296. Whereas the average ABI value on the right limb post test was 1.3072 with an average difference of -0.3776.

Based on the results of picture 1 below, it can be seen that the trend of changes in the ABI value of the right limb in respondents is compared between the first measurement as a pre test and the last measurement as a post test. There was a significant change, in which all respondents experienced a significant change in the value or ABI score which showed an increase in the peripheral circulation of the right limb in patients with type 2 diabetes mellitus.

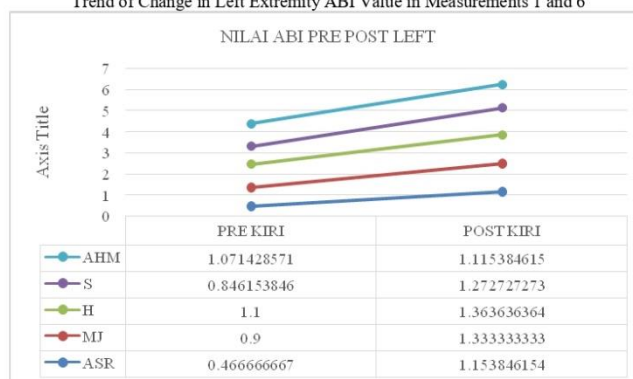
Picture 1

I. Trend of Change in Right Extremity ABI Value in Measurements 1 and 6



Based on the results of picture 2 below, it can be seen that the trend of changes in the ABI value of the left limb in respondents is compared between the first measurement as a pre test and the last measurement as a post test. There was a significant change, in which all respondents experienced a significant change in the ABI score or score which showed an increase in left limb peripheral circulation in patients with type 2 diabetes mellitus.

Picture 2
Trend of Change in Left Extremity ABI Value in Measurements 1 and 6



DISCUSSION

Based on picture 1 and picture 2 regarding the trend of changes in the ABI value of the right and left limbs in measurements 1 and 6 (pre and post test), it can be seen that there is an increasing trend in ABI values from pre test to post test. The results showed a positive value, both on the ABI value of the left limb and the ABI value of the right limb. This is also in accordance with research which has been done by Supriyadi et al., (2018) who provided BAE intervention for 15 days by pre-test by measuring before the 1st day of training and the post-test on the 15th day with the results of the study in the form of a significant increase in ABI values as a positive effect of BAE training.

The results of the analysis of several references gave birth to facts which are supported by several research results that have been investigated by researchers. Research that has been carried out by Chang et al., (2015) states that Buerger exercise can improve ABI values, improve health, and symptoms of discomfort in the lower extremities. In line with research conducted by John & Rathiga, (2015) which aims to see the level of perfusion of the lower extremities of patients with diabetes mellitus and the effect of Buerger Allen Exercise in improving the low peripheral perfusion. The results of his research showed that after the intervention was carried out, the intervention group experienced a significant change in the ABI value after leg exercises, compared to before the intervention was given.

The theory put forward by Rosales-Velderrain et al., (2013) mentioned that BAE therapy can be done to improve peripheral circulation in the vascular vessels. This is supported by research published by C. C. Chang et al., (2016) that the Buerger Allen Exercise significantly increases the level of peripheral perfusion pressure in diabetes mellitus patients who experience ischemia in the blood vessels of the extremities which causes interference with the peripheral circulation of the lower extremities, both in patients with diabetic foot injuries and those without diabetic foot injuries.

Looking at the research results obtained through the description above, the researchers saw that the Buerger Allen Exercise has been shown to significantly improve lower limb peripheral circulation with an indicator of an improved ABI value. The results obtained from the study as a whole show that BAE exercise is evidence-based practice

STRADA Jurnal Ilmiah KesehatanDOI: [10.30994/sjik.v10i1.669](https://doi.org/10.30994/sjik.v10i1.669)

ISSN: 2252-3847 (print); 2614-350X (online)

Vol.10 No.1 May 2021 Page. 612-621

proven to improve and improve lower limb peripheral circulation through good results from measurement of the ABI indicator. The Buerger Allen Exercise stimulates increased peripheral circulation through regular, continuous movements of the foot of dorsiflexion and plantarflexion. Dorsiflexion is carried out by moving the soles of the feet upward.

The increase in tissue perfusion through BAE exercises is caused by postural changes, with the modulation of the force of gravity and the application of muscle contraction can increase the perfusion of the lower extremities and help in the circulation mechanism and dilation of blood vessels, causing smooth blood circulation to the lower limb area. BAE exercises modulate muscle pump performance. Muscle pump is a pumping mechanism to the muscles, which functions to increase blood circulation through a process in the form of moving the areas and blood vessels that flow especially in the extremities to become smooth, so that blood flow to the heart and to the rest of the body also increases (Jannaim, 2018).

Furthermore, in the results of C. C. Chang et al., (2016) stated that in the first stage of BAE training, gravity causes the emptying of the veins and increases the flow of the right atrium, which in turn causes an increase in cardiac output. The second stage, gravity still plays an important role in increasing blood flow in the arterioles. Changes in leg movement also strengthen distal circulation due to increased muscle contraction. Flexion of the dorsaplanter also helps the patient to train the Achilles tendon to avoid the name contracture or joint stiffness that causes deformity of the leg. And the final stage of the exercise is lying in a supine position which can improve blood flow or reperfusion from the leg as the effects of gravity begin to wear off.

The movement of blood caused by this form of leg movement can help run the pumping mechanism of the limb muscles, increase peripheral circulation, which manifests as an increase in the ABI value measured by the Doppler device, an increase in HbO₂ and HbT concentrations through NIRS measurements and a shortening of the CRT time. In addition, this smooth pumping of blood will help in curing diabetic ulcers, reducing the degree of edema, due to the effect of smooth circulation, oxygenation and nutrition towards the periphery (increased vascularization (Jannaim, 2018).

Limitations

The limitation in this study is the lack of respondents who are involved in the study of Buerger Ellen exercise, due to the COVID-19 pandemic conditions. Researchers find it difficult to find potential respondents at the Samata Health Center. Only a small proportion of type 2 diabetes mellitus patients in the working area of the Samata Community Health Center were able to participate in the study.

CONCLUSION

The study concluded that there was an effect of Buerger Allen Exercise on the peripheral circulation of the lower extremities in patients with type 2 diabetes mellitus using the Wilcoxon Signed Rank Test and Paired T-Test where the p value was obtained, 0.05, which means that there was a significant effect. The results of this study can be used as a reference in providing intervention and nursing care for diabetes mellitus patients who have problems with lower limb peripheral circulation, namely by applying the Buerger Allen Exercise as a non-pharmacological intervention with evidence based practice.

STRADA Jurnal Ilmiah KesehatanDOI: [10.30994/sjik.v10i1.669](https://doi.org/10.30994/sjik.v10i1.669)

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Vol.10 No.1 May 2021 Page. 612-621

ACKNOWLEDGMENTS

Thanks to the Institute for Research and Community Service (LP2M), Alauddin State Islamic University of Makassar for supporting the research process to completion.

CONFLICTS OF INTEREST

There is no conflicts of interest in this study

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STRADA Jurnal Ilmiah KesehatanDOI: [10.30994/sjik.v10i1.669](https://doi.org/10.30994/sjik.v10i1.669)

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Impact of Buerger-Allen Exercises on Foot Perfusion and Pain Level for Diabetic Patients Risk with Peripheral Arterial Disease

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Abstract

The risk of peripheral arterial disease is markedly increased among individuals with diabetes. The current study aimed to evaluate diabetic patients' foot perfusion and their pain level after applying Buerger-Allen exercises. **Subjects & methods:** Quasi-experimental research design was used on a purposive sample of 100 type II diabetic patient in the General medical department and diabetic out-patient clinic, at Minia university hospital. Patients' interview questionnaire, Ankle-brachial Index test and Numerical pain rating scale were used as tools for data collection. **Results:** There were highly statistically significant differences between the study group and control group regard Ankle-brachial Index measurements only post-application of Buerger-Allen exercises for six weeks ($p \leq 0.004$). Moreover, results stated that the highest percentage (54.0%) among the study group who had moderate pain pre-application exercises but after they were performed exercises, their pain description became mild or no pain constituted (50.0% & 20.0%) respectively with highly statistical significant. **Conclusion:** Buerger-Allen exercise was efficient for improvement of lower peripheral arterial perfusion and there are highly statistically significant improvements in pain level among the study group. **Recommendations:** Diabetic patient must attend health education sessions based on evidence guidelines regard Buerger-Allen exercise which had a positive effect on the improvement of lower peripheral circulation.

Keywords: Buerger-Allen, Diabetes, Exercises, Foot Perfusion, Pain Level & Patient

Introduction

Diabetes can affect many extraordinary organ structures inside the body and, additional time can result in serious complications. Most of these complications are vascular, which may be categorized as micro-vascular or macro-vascular. Microvascular complications encompass worried device harm (neuropathy), renal system damage (nephropathy), and eye harm (retinopathy) while, macrovascular headaches encompass cardiovascular disease, stroke, and peripheral artery disorders (PAD) (American Diabetes Association, 2017). Peripheral arterial sickness or named peripheral vascular disorders (PVD), is a circumstance characterized via a gradual discount in blood flow to 1 or more limbs secondary to atherosclerosis. The danger of PAD is markedly accelerated among individuals with diabetes who had better charges than in comparable non-diabetic populations (Edwards et al., 2017). Study results conducted in 2010 by (Olin, et al., 2016) who had observed that more than 2 hundred million humans international are residing with Peripheral arterial disease, which represents a 28.7% elevated occurrence in low- and center-income countries over a ten-12 months duration. Epidemiological studies additionally have confirmed an affiliation between diabetes and an expanded

occurrence of PAD that is usually characterized by the occlusive arterial ailment of the decrease extremities. even though many patients are asymptomatic, or had peculiar exceptional symptoms, about one-0.33 experience intermittent claudications, defined as aching, cramping, or numbness inside the affected limb, taking place with exercise and relieved at relaxation (Thiruvoipati et al., 2015). Peripheral arterial disease has a terrible bodily and mental impact on those who were struggling to keep a limb from (CLI) occurrence. important limb ischemia is defined as chronic ischemia inflicting pain at relaxation, ulcers, and or gangrene, which may be attributed to lengthy-standing arterial occlusion (Curry et al., 2018).

Despite initiatives to improve on the identification and management of PAD, the number of people affected and disease morbidity continues to rise. Patients with PAD present across a spectrum of symptoms from asymptomatic to critical limb ischemia (CLI). It is estimated that up to 40% of patients with PAD report having no obvious exertional symptoms (Gulati, et al 2017). CLI is the most severe manifestation of PAD, the pain at rest which can occur is characterized as an ache or discomfort in the arch of the foot or toes, and it is

usually exacerbated with leg elevation. Patients are most uncomfortable when lying flat with their legs elevated (McDermott, 2015).

Improve the blood circulation of the lower extremity by exercise has been considered as one of the most effective non-pharmacological management among patients with type 2 diabetes mellitus. There are many techniques to improve foot perfusion such as relaxation technique, warm feet technique and treatments are available to relieve the pain and discomfort of PAD and neuropathy. (Gerhard-Herman et al., 2017). Lower extremity exercise helps to re-establish collateral blood flow to the legs and the heart. Primary care providers have an inevitable role to assess and diagnose the potential vascular complications of diabetes mellitus in the initial stage. (Dauscher & Molinaro, 2017).

Buerger-Allen exercise is one of the most common practice exercises in diabetic affected person to empty engorged vessel through the use of postural changes and inspired peripheral circulate by using modulating gravity and making use of muscle contraction for enhancing the lower extremity perfusion amongst diabetic patients which relieve the symptoms in patients with decrease limbs arterial inadequate. Therefore to sell the best of existence Buerger-Allen exercise is wanted amongst patients with type II diabetes mellitus (Patidar, 2018).

Significance of the study:

Peripheral neuropathy, peripheral vascular disorder, and infection are three major elements for diabetic foot ulcers that may result in gangrene and amputation. But, peripheral neuropathy is solely chargeable for extra than 80% of foot ulcers in diabetic patients. This no longer handiest is important for neurological exam because the first criterion for screening patients at risk for foot ulcers, however, is also in a roundabout way emphasized on nurse's position in appearing a diabetic foot examination with monofilament and collaboration with other diabetic foot team participants (Boulton, et al 2018). However, the nurse as educators can evaluate affected person necessities and layout a particular academic application for every of sufferers and their families. Nurses have a powerful function in screening high-hazard humans and they also can train patients approximately the significance of everyday visits to the health center, blood tests at exact periods, and the number one principle of diabetes care for prevention of its complication (Ammendola et al., 2017). So, this study will conducted as a penifical for improve foot perfusion and reduce pain level after applying Buerger-Allen Exercises.

Subjects and methods

Aim of The study:

The current study aimed to evaluate diabetic patients' foot perfusion and their pain level after applying Buerger-Allen Exercises.

Research hypothesis:

There is a significant improvement in diabetic' foot perfusion and their pain level after applying Buerger-Allen Exercises.

Research Design:

A quasi-experimental research design (study and control groups) was utilized in the current study.

Setting:

The study conducted at Minia university hospital in the General medical department which was included forty-two beds for patients and a diabetic outpatient clinic that workd on Saturday and Tuesday every week. Minia university hospital is located on the western bank of the Nile River and in the face of the upper bridge on the Nile south of Minia City. The area served was western of Minia city and Minia governorate. It composed of 16 outpatients' clinics and 8 inpatient departments in different medical specialties.

Sample size:

Purposive sample technique was used to select 100 from adults with type II Diabetes Mellitus who were shared in this study and those who willing were willing and meeting the study inclusion criteria, the study sample was divided equally into control and study (50 patients for each group). The total numbers of patients attending the general medical department and diabetes clinic through the year 2017-2018 were 1000 patients according to hospital statistical office record and the sample were calculated using the following equation:-

$$N = \frac{t^2 \times p(1 - p)}{m^2}$$

$$N = \frac{(1.96)^2 \times 0.07(1 - 0.04)}{0.052}$$

N = 100 patients

Description:

N = required sample size.

t = confidence level at 95 % (standard value of 1.960).

p = estimated prevalence of type 2 diabetes mellitus at Minia University Hospital 2016 (0.07).

m = margin of error at 5 % (standard value of 0.05).

Inclusion criteria:

- Patients who were medically diagnosed with Type II Diabetes Mellitus.
- Ankle Brachial Index (ABI) scored from 0.0 – 0.40 to less 0.9

Exclusion criteria:

- Patients who had severe foot ulcers or amputated.

Tools of Data Collection:

The current study data were collected by three tools and 3 tools, the first tool developed by the researcher, and the scales were adopted. The study tool was revised by five experts in the field of nursing at the faculty of nursing (medical surgical nursing department); Assiut and Minia University, to test its face content validity and feasibility, the necessary modifications if present. The current study data collection tools are

The first tool: patients' characteristics and their medical data interview questionnaire which included two parts as following:

Part 1: Demographic datasheet of the patients who had type II diabetes mellitus at outpatient clinics. It consisted of five (5) items such as age, sex, level of education.

Part 2: medical data of the patients, this part included six (6) questions about medical data as the duration of diabetes, past medical illness history, body mass index, diabetes treatment.....etc.

The second tool: Ankle-brachial index (ABI) test originally adopted by Winsor (1950), It was defined as the ratio of blood pressure (BP) at the ankle to the BP in the upper arm (brachium), this test is a simple, non-invasive tool which standard for the diagnosis and screen of lower-extremity (PAD). The ABI test was done individually for every studied subject by using standard manual Sphygmomanometer with appropriately sized cuff(s) for arm and ankle, standard Handheld Doppler device with vascular probe 8.0MHZ and the gel was used to increase conductivity during performing this test.

Calculation of Ankle-brachial Index findings scores = systolic BP at the ankle / systolic BP at the brachial in the arm.

Scores Interpretation:

Above 0.9 - Normal

0.71 – 0.90 – Mild Obstruction.

0.41 – 0.70 – Moderate Obstruction.

0.0 – 0.40 – severe obstruction.

The third tool: Numerical pain rating scale (NPRS)

This scale is a self-report and subjective measure considered the gold standard for pain measurements, usually a horizontal line with numbers from 0 to 10. The individual asked to circle the number on eleven-point numerical scale which corresponding to their pain. The scale is composed of zero (0) which mean no pain at all to ten (10) which means the worst imaginable pain. A description and scoring of this scale a simple form and usually composed of four pain intensity level such as none = zero score, mild = from one to three scores, moderate from four to six scores,

and severe from seven to ten scores (Jensen et al. 2001)

• Educational training practices for study group regarding Buerger Allen Exercises:

Buerger-Allen Exercises developed by Burger (1926) and Allen (1930), it was learned by the researcher for the study group, the researcher was given a simple definition and purpose about and its steps. Buerger-Allen exercise is Specific exercises intended to improve circulation to the feet and legs. This exercise consisted of three steps; **step 1-elevation**, the lower extremities elevated to a 45 to 90-degree angle and supported in this position for 2 to 3 minutes until the skin blanched (appears dead white). **step 2-dependency**, the feet, and legs then lowered below the level of the rest of the body for 3 to 5 minutes until redness appears (considering there was no pressure against the back of the knee); **step 3-horizontal**, the legs are placed flat on the bed for 3-5 minutes. The length of time for each position varied with the patient's tolerance. It's prescribed for 8-13 minutes for a frequency of two times per day and the researcher was informed the study group to repeat it after six weeks of practicing. . Researcher must be assured that this exercise was demonstrated by the studied group incompetent and accurately performance. Also, the researcher has given the study group a brochure in a simple method including pictures regard these exercise steps and instructions regarding duration and frequency to remember the patients or caregiver about this exercise after returning their homes.

Content validity:

The tools and faced content validity were done to identify the degree it was supposed to be measured. A developed tool, test, and scale were examined by a panel of five experts' opinions in the field of medical and surgical nursing specialty.

Tools reliability:

Internal consistency of the interview questionnaire was assessed with the Cronbach's alpha coefficient. Cronbach's alpha coefficient of 0.00 indicates no reliability and a coefficient of 1.00 indicates perfect reliability. However, a reliability coefficient of ≥ 0.70 is acceptable. Cronbach's alpha for reliability testing was performed for the first tool, ABI test, and pain scale and the results for the three were 0.897, 0.832 and 0.887 respectively.

Pilot study

To assess the clarity, reliability, and applicability of the study tools which was used in the study for data collection; a pilot study was conducted on 10% (n=10 diabetic patients) of the sample. Based on the results of the pilot study there is no modification was done. Those cases of the pilot study were included in the study sample.

Ethical consideration

Written informed permission was taken from the dean of the faculty for conducting the study. An official letter from the faculty of nursing was delivered to the director (s) of the intended study setting (director of Minia University Hospital, general medical department, and diabetic outpatient clinics). Informed verbal consent was obtained from each diabetic patient who was included in the study. The researcher was provided a full explanation about the about purpose, nature, and tools of the current study for participant patients, informed them individually their rights for privacy by coding, confidentiality, and their rights to withdraw from participation in the study at any time.

The study duration

The recent study lasted for 12 months; it was started in May 2018 and was completed by the end of April 2019.

Procedure

- All written and oral permissions were collected then the researcher has selected sample who attended the general medical department and diabetic outpatient clinic. The data collection tool and tests were gathered from the control group firstly through three days per week according to the outpatient schedule, availability of participants lasted four months. While data collection from the study group was started after finishing data collection from the control group by using the same tools.
- In the initiation, for both groups, the second tool (Ankle-brachial index test) was measured and calculated by the researcher to determine patients who have had PVD obstruction and met inclusion criteria in the current study. This test lasted for 20-30 minutes for each participant, upon completing test calculations, compare each reading with the interpretations also the researcher was informed selected both groups that this test would be measured two times pretest as baseline data and after six (6) weeks per six months.
- Ankle-brachial index test was applied by the researcher through using ankle and brachial pressure with Doppler- (BP) cuff tied on the upper arm, palpate the brachial pulse, then place the Doppler after applying gel and inflate at about 20 -30 mmHg where a pulse is not audible and then deflate and marked the first heard pulse as the systolic blood pressure and repeat for the other arm. Blood Pressure cuff tied on 2.5 cm above the malleolus, palpate the dorsalis pedis or posterior tibial pulse, then place the Doppler after applying gel and inflate at about 20 -30 mmHg where the pulse is not audible and then

deflate and mark the first heard pulse as the systolic blood pressure and repeat for the other extremity.

- The pain scale was measured two times for both groups pre-test as baseline data and after six weeks from there including in the current study (to evaluate the effectiveness of exercises on pain measurement for study group only).

Statistical Analysis

Data were summarized, tabulated, and presented using descriptive statistics in the form of frequency distribution, percentages, means, and standard deviations as a measure of dispersion. A statistical package for the social science (SPSS), version (25) was used for statistical analysis of the data, as it contains the test of significance given in standard statistical books. Numerical data were expressed as mean and SD. Qualitative data were expressed as frequency and percentage. Probability (P-value) is the degree of significance, less than 0.05 was considered significant. The smaller the P-value obtained, the more significant is the result (*), less than 0.001 was considered highly significant (**), and the correlation coefficient was done by using the Pearson correlation test.

Limitation of the study

There were some obstacles which encountered the researcher during carrying out the study:-

The difficulty of assembling a large number of diabetic patients at one time.

There is no documentation for peripheral arterial disease cases in the diabetic outpatient clinic

Results

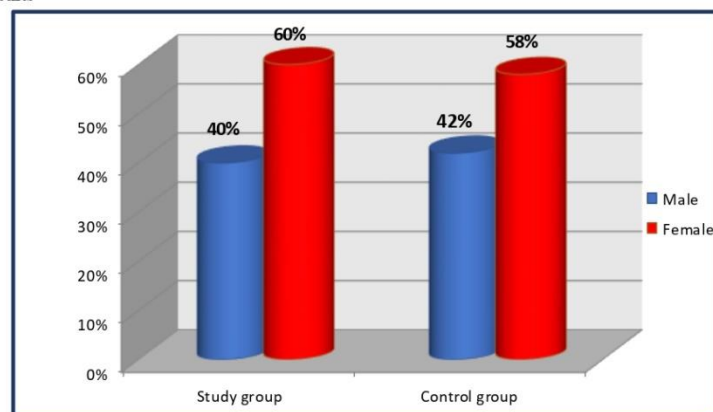


Figure (1): Distribution of the studied sample according to their sex (n= 100).

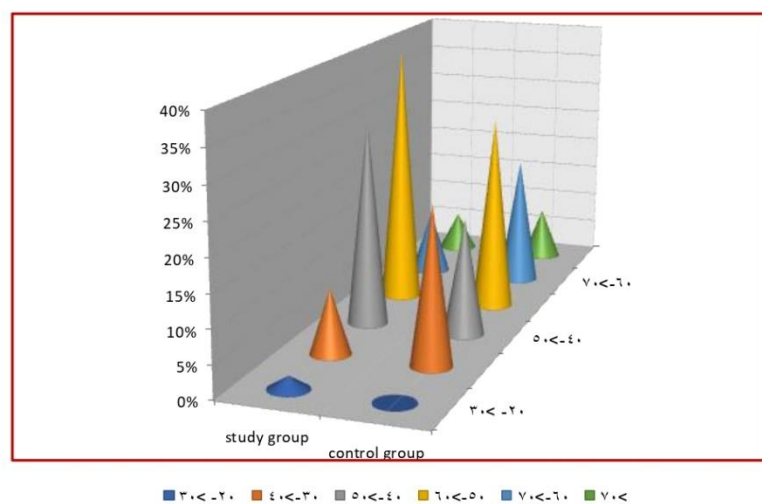


Figure (2): Distribution of the studied sample according to their age (n= 100).

Table (1): Frequency and percentage distribution of the studied sample according to their medical data (n= 100).

Medical data	Groups				χ^2 / fisher	P-value
	Study (N=50)		Control (N=50)			
	No.	%	No.	%		
Duration of type 2 diabetes						
5 – <10 years	33	66.0	32	64.0	.046	.977 NS
>10 years	16	32.0	17	34.0		
Don't know	1	2.0	1	2.0		
BMI						
Normal weight	8	16.0	14	28.0	2.125	.346 NS
Overweight	32	64.0	28	56.0		
Obese	10	20.0	8	16.0		
Past medical illness history						
Heart disease	1	2.0	3	6.0	5.191	.158 NS
Hypertension	19	38.0	18	36.0		
Heart and hypertension	4	8.0	0	.0		
Not present	26	52.0	29	58.0		
Diabetes treatment						
Oral hypoglycemic agents	33	66.0	32	64.0	1.306	.521NS
Insulin	14	28.0	17	34.0		
Insulin and oral hypoglycemic agents	3	6.0	1	2.0		
Family history of peripheral arterial disease						
Yes	14	28.0	17	34.0	.421	.517NS
No	36	72.0	33	66.0		
Receive medical treatment for PAD						
Yes	4	8.0	3	6.0	.154	.695NS
No	46	92.0	47	94.0		

NS= not significant

Table (2): Comparison between the studied patients according to their measurements Ankle-brachial index (ABI) scores pre and post six weeks of-application of exercises (n= 100).

Items	Pre-application Groups				Post application Groups			
	Study		Control		Study		Control	
	No.	%	No.	%	No.	%	No.	%
Ankle-brachial index								
Normal	0	.0	0	.0	10	20.0	0	.0
Mild obstruction	23	46.0	30	60.0	25	50.0	32	64.0
Moderate obstruction	27	54.0	20	40.0	15	30.0	18	36.0
χ^2 / fisher (P-value)	1.967 (.161) NS				11.132 (.004**)			

NS= not significant * $p \leq .05$ (statistical significance) ** $p \leq .01$ (highly statistical significance)

Table (3): Relations between frequency& duration of Buerger Allen exercise application and ABI measurement among the study group (n= 50)

And ABI measurement among the study group (n= 50)								χ^2	P-value
Items	(ABI)								
	Normal (n= 10)		Mild (n= 25)		Moderate (n= 15)				
	No.	%	No.	%	No.	%			
Frequency of application per day									
One time/ day (n= 36)	7	19.4	15	41.7	14	38.9	9.680		.002**
Twice or more time/ day (n= 14)	3	21.4	10	71.4	1	7.2			

Items	(ABI)						χ^2	P-value	
	Normal (n= 10)		Mild (n= 25)		Moderate (n= 15)				
	No.	%	No.	%	No.	%			
Duration of application									
First two weeks (n= 16)	1	6.2	8	50.0	7	43.8	7.843	.02*	
Four weeks (n= 17)	2	11.8	9	52.9	6	35.3			
Six weeks (n= 17)	7	41.2	8	47.0	2	11.8			

* $p \leq .05$ (statistical significance)** $p \leq .01$ (highly statistical significance)

Table (4): Frequency and percentage the intensity level of pain description among studied sample pre/post six weeks post application Buerger Allen exercise

Items	Pre Groups				Post Groups			
	Study		Control		Study		Control	
	No.	%	No.	%	No.	%	No.	%
Pain description								
No pain	7	14.0	6	12.0	10	20.0	0	.0
Mild pain	16	32.0	24	48.0	25	50.0	20	40.0
Moderate pain	27	54.0	20	40.0	15	30.0	30	60.0
Severe pain								
χ^2 / fisher (P – value)	1.956 (.161) NS				11.123 (.004**)			

Table (5): Correlation between exercises' frequency& duration and total scores for both ABI and pain level measurements among the study group (n= 50).

Exercises	Ankle-brachial index		Pain	
	R	P-value	R	P-value
Frequency of application per day	.214	.130	.035	.795
Duration of application	.390	.005**	.128	.373

**Correlation is significant at the 0.01

Table (6): Relation between personal data of studied sample and their peripheral artery obstruction degree post six weeks of exercise application (n= 100).

Demographic data	Ankle brachial index levels					
	Study			Control		
	Normal (n= 10) No (%)	Mild (n= 25) No (%)	Moderate (n= 15) No (%)	Normal (n= 0) No (%)	Mild (n= 32) No (%)	Moderate (n= 18) No (%)
Sex						
Male	5 (25.0)	9 (45.0)	6 (30.0)	0 (0.0)	14 (66.7)	7 (33.3)
Female	5 (16.7)	16 (53.3)	9 (30.0)	0 (0.0)	18 (62.1)	11 (37.9)
Fisher (P – value)	.583 (.157) NS			.112 (.738) NS		
Age						
20- <30	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
30- <40	2 (40.0)	2 (40.0)	1 (20.0)	0 (0.0)	11 (91.7)	1 (8.3)
40- <50	5 (31.3)	8 (50.0)	3 (18.8)	0 (0.0)	6 (66.7)	3 (33.3)
50- <60	0 (0.0)	12 (60.0)	8 (40.0)	0 (0.0)	8 (53.3)	7 (46.7)
60- <70	1 (20.0)	2 (40.0)	2 (40.0)	0 (0.0)	4 (40.0)	6 (60.0)
>70	1 (33.3)	1 (33.3)	1 (33.3)	0 (0.0)	3 (75.0)	1 (25.0)
Fisher (P – value)	35.920 (.000**)			7.465 (.113) NS		
Educational level						
Illiterate	5 (19.2)	16 (61.5)	5 (19.2)	0 (0.0)	16 (61.5)	10 (38.5)
Read and write	3 (30.0)	5 (50.0)	2 (20.0)	0 (0.0)	9 (69.2)	4 (30.8)
Secondary	2 (18.2)	4 (36.4)	5 (45.5)	0 (0.0)	7 (63.6)	4 (36.4)
University	0 (0.0)	0 (0.0)	3 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
Fisher (P – value)	22.480 (.000**)			.223 (.894) NS		

Table (7): Relation between the medical status of the studied sample and their peripheral artery obstruction degree post six weeks of exercise application (n= 100).

Medical status	Post ankle brachial index levels					
	Study			Control		
	Normal (n=10)	Mild (n=25)	Moderate (n=15)	Normal (n=0)	Mild (n=32)	Moderate (n=18)
Duration of type II diabetes mellitus						
• 5 – <10 years	7 (21.9)	15 (46.9)	10 (31.3)	0 (0.0)	25 (78.1)	7 (21.9)
• >10 yrs.	3 (17.6)	10 (58.8)	4 (23.5)	0 (0.0)	6 (35.3)	11 (64.7)
• Don't known	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	1 (100.0)	0 (0.0)
Fisher (P-value)	25.040 (.0001**)			9.414 (.009**)		
Body mass index (BMI)						
• Normal weight	3 (37.5)	3 (37.5)	2 (25)	0 (0.0)	10 (71.4)	4 (28.6)
• Overweight	6 (18.8)	17(53.1)	9 (28.1)	0 (0.0)	17 (60.7)	11 (39.3)
• Obese	1 (10.0)	5(50.0)	4 (40.0)	0 (0.0)	5 (62.5)	3 (37.5)
Fisher (P – value)	42.560 (.001**)			.474 (.789) NS		
Past medical illness history						
• Heart disease	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (100.0)
• Hypertension	2 (10.5)	8 (42.1)	2 (10.5)	0 (0.0)	10 (55.6)	8 (44.4)
• Heart and Hypertension	1 (25.0)	2 (50.0)	1 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)
• Not present	7 (26.9)	14 (53.8)	7 (26.9)	0 (0.0)	22 (75.9)	7 (24.1)
Fisher (P – value)	68.640 (.000**)			7.662 (.02*)		
Diabetes mellitus treatment						
• Oral hypoglycemic agents	8 (24.2)	18 (54.5)	7 (21.2)	0 (0.0)	18 (56.3)	14 (43.8)
• Insulin	2 (14.3)	6 (42.9)	6 (42.9)	0 (0.0)	14 (82.4)	3 (17.6)
• Insulin and oral hypoglycemic agents	0 (0.0)	1 (33.3)	2 (66.7)	0 (0.0)	0 (0.0)	1 (100.0)
Fisher (P – value)	27.640 (.000**)			5.097 (.078) NS		
Family history of peripheral arterial disease						
• Yes	1 (7.1)	7 (50.0)	6 (42.9)	0 (0.0)	8 (47.1)	9 (52.9)
• No	9 (25.0)	18 (50.0)	9 (25.0)	0 (0.0)	24 (72.7)	9 (27.3)
Fisher (P – value)	9.680 (.002**)			3.209 (.073) NS		
Receive medical treatment for peripheral arterial disease (PAD)						
• Yes	0 (0.0)	2 (50.0)	2 (50.0)	0 (0.0)	2 (66.7)	1 (33.3)
• No	10(21.7)	23 (50.0)	13(28.3)	0 (0.0)	30 (63.8)	17 (36.2)
Fisher (P – value)	35.280 (.0001**)			.010 (.921) NS		

Figure (1): Showed that (60% & 58%) of the studied sample were females among the study and control groups respectively.

Figure (2): Showed that the mean average age among both groups was around 50 years.

Table (1): Founded that more than two-thirds among both groups had diabetes less than 10 years respectively and they were overweight constituted (64% & 56%) among study and control groups respectively. The result revealed that the highest percentage (52% & 58%) among both groups were hadn't any accompanying medical illness. As regard diabetes treatment more than two-third (66% & 64 %) among both groups were taken oral hypoglycemic agents but (72% & 66%) of them hadn't a Family history of peripheral arterial disease respectively. finally, the majority (92% & 94%) among both groups

weren't received previously any medical treatment for PAD. There were no significant differences between the study and control groups regarding medical data $P > 0.005$

Table (2): Showed that there were highly statistically significant differences between the study group and control group regard ABI measurements only post-application of a Buerger - Allen Exercises for six weeks ($p \leq 0.004$).

Table (3): Presented that, 71.4% of the study group had mild obstruction when they applied the Buerger Allen exercise twice or more time per day for six weeks while (41.7) among the same group was had mild obstruction when they were performed similar exercises one time per day, also table results regard duration of Buerger Allen exercise application revealed that nearly similar percentages

(50.0&52.9&47.0) among study group were had mild obstruction when they were applied Buerger Allen exercise for only two or four or six weeks respectively. So, a statistically significant relation between frequency &duration of Buerger Allen exercise application and study group' ABI measurement ($p \leq 0.002$ & .02 respectively).

Table (4): Stated that the highest percentage (54.0%) among the study group who had moderate pain pre-application exercises but after they were performed exercises, their pain level description became mild or no pain constituted (50.0% & 20.0%) respectively. There was no statistical difference between pain intensity among the studied sample per application Buerger Allen exercise while post it is application of this exercises there was a highly statistical difference $p=(.004^{**})$.

Table (5): Showed statistically significant positive relation between an ankle-brachial index of the study group and duration of exercise application which $r=.390$ and $p\text{-value} >0.005$ but the results related to rest items, not revealed any relation between them.

Table (6): Presented that there was highly statistical significant positive relation between age and education of participated groups data of the study group and their peripheral artery obstruction degree after they applied Buerger Allen exercise for six weeks while there was no statistical significance relation between personal data of the control group and their peripheral artery obstruction degree at $p= (.004^{**})$.

Table (7): Indicated that; regarding the study group, it was found that; there were highly statistically significant relation between their peripheral artery obstruction degree and patient's duration of type II diabetes mellitus, body mass index, accompanied medical illness, family history, and received medical treatment . While within the control group; there were no significant differences detected for all items except for the duration of type II diabetes $P \leq .009$ and the accompanying medical illness $P \leq .02$.

Discussion

Diabetes mellitus is a strong risk factor for the improvement of atherosclerotic coronary and which includes ailment of the carotid, aorta, and decreases extremity arterial beds. Peripheral vascular disorder and diabetes are both progressively customary instances; influencing a predicted (two -hundred) and (3-hundred and sixty) million people everywhere in the globe, correspondingly (Berger, & Ladapo, 2017).

This chapter represents the interpretation and the discussion of the results obtained from the current study. The present study revealed that the mean average age was calculated as 50.9 ± 10.5 years and 51.5 ± 12.53 years for the study and control group

respectively, this related to increasing the risk of peripheral arterial disease among type II diabetes mellitus with the aging process, results were in agreement with John & Rathiga, (2015) In their study in India found that more than half of both groups between age 51 to 60 years were having lower extremity perfusion with Type II Diabetic. While the results were contradicted with the results of Shilshi, et al., (2017) in their study in Chennai whose found that less than half of diabetic type II patients were between the ages of forty-six to fifty years.

The control group respectively, this can be discussed as decay level of estrogen at menopause cause expanded hazard for diabetes mellitus since estrogen produces several anti-aging impacts counting hostile to oxidative properties as the oxidative stretch is considered the most imperative cause in microvascular diseases. Study results agreed with (Kumar, 2019) who reported that half of the diabetic patients in the experimental group were females. In contrary to the current study findings (Abishal, 2016) in their study in Kanyakumari mentioned that more than half were males.

Results were noted that more than half of the studied sample were females for the study and the study findings indicated that more than half of the studied samples were illiterate, it may be rationalized as in the past there was no interest in education so, and illiteracy was common among diabetic patients that lead to some lack of health awareness about complications of diabetes and its follow up. As well this finding is supported by Bhuvaneshwari, & Tamilselvi, (2018) in their study in Chennai showed that more than one-third of patients with type II diabetes mellitus were illiterate. Considering the findings of the current study were in contrast with Geethu, (2015) who mentioned that in their study approximately two-thirds of the diabetic patients had school-level education.

Outcomes of the current study showed that more than two-thirds of both groups were having diabetes mellitus from five years to less than 10 years. This can be discussed as the longer the duration of diabetes, the more susceptible to PAD, these results were in agreement with (Patidar, 2018) study found that less than two-thirds of type II diabetic patients were having a duration of diabetes from five to ten years. This finding is in contradiction with (Kumar, et al, 2018) who studied patients with diabetes mellitus in Haryana and mentioned that more than half of the diabetic patients studied samples were having a duration of diabetes mellitus for less than five years.

It was noted that more than two-thirds of the studied samples were overweight/obese, due to lack of compliance with a healthy diet for diabetic patients

and exercise. In contrast to the current study results from (Kumari, 2019) in their study in Maharashtra and reported that nearly half of the diabetic type II were in the normal range of body mass index. Regarding the family history of peripheral arterial disease more than two-thirds of the study and the control group were with no history. These findings may be due to that diabetes mellitus was caused either by getting old, obese, not exercising regularly, and not eating healthy food. Results were further supported by (Hemalatha, 2018) in their study at Kanniy Akumari district and found that the majority of both groups with type II diabetes mellitus weren't had a family history of peripheral artery disease.

The current study revealed that none of the study of group hadn't have normal brachial index pre-application of exercise while nearly one third among them became normal post its application and more than half were had a moderate level of obstruction pre-application while half of them became mild obstruction in ABI after application of Buerger Allen exercise, it may be attributed to that these postural exercises with alternating emptying and filling of the blood vessels increase circulatory efficiency and local collateral circulation through stimulation of peripheral vascular system.

In the same line the study was consistent with (Shihhi, et al., 2017) illustrated that more than half in the experimental group had moderate PAD whereas later the administration of Buerger Allen training on the level of lower extremity perfusion the majority of the same group had mild PAD among type II diabetes mellitus patients. Also, this finding is congruent with a study done by (Kumar, 2018) who found that more than two-thirds of clients with type II diabetes mellitus had a moderate reduction in peripheral vascular tissue perfusion pre-application of Buerger Allen exercise while more than half among them became mild occlusion of blood vessels after practicing the same exercise.

It was noticed from the current study that there were greatly statistically significant differences among the studied sample regarding peripheral artery obstructions degrees after they were applied Buerger Allen exercise for six weeks and there was no significant difference regarding pre-ankle-brachial index. From the researcher's point of view, it is due to applying Buerger Allen exercise that improves feet and legs circulation. Also other interpretation, it may be because of fear of complications from diabetes and its effect on the foot made patients interested in doing exercise.

This finding was compatible with (Saber, et al. 2019) they reported that the post-intervention mean ABI scores of both legs were significantly higher than the pre-intervention score among patients with

type II diabetes mellitus after they demonstrated Buerger exercises. This finding also is in agreement with (Jacob, (2013) who reported that after the application of Buerger Allen exercise in the experimental group, the posttest mean scores of lower extremity perfusion among Type II DM were highest which was improved than compared to the control group.

Outcomes of the present study indicated that a highly statistically significant improvement in pain level among the study group, from the researcher's point of view, Buerger Allen exercise intended to improve feet and legs circulation that will increase blood flow so that the feeling of pain will decrease. These results are congruent with (Selmar, 2016) in Chennai, which demonstrated that there was a statistically significant difference in the experimental group through diabetes with type II after practicing Buerger Allen exercise regarding their pain. In the same line (Baby, 2015) mentioned that the diabetic patient was decreased pain level after demonstrated Buerger Allen exercise, and t-value was statistically significant.

It is commendable of note that there was a highly statistically significant alteration among the study group concerning the duration of application Buerger Allen exercise; this may be rationalized as the effect of continuity of applying the previously mentioned exercise till six weeks. This result is congruent with (Vijayarathi, (2014) in their study that there was no significant difference in the wound healing process among both groups among the diabetic patients. Regarding the study group, it was found that; there was a highly statistically significant relation between peripheral artery obstructions degrees concerning their age after they applied the Buerger Allen exercise for six weeks. From the researcher's point of view, patients of middle age will be more careful to avoid the occurrence of diabetic foot early and they were have increased in the awareness of the performing and the importance of exercises. This finding is compatible with (Edward, et al., 2011) who said that there was a significant association regarding their age with the ABI results among diabetic and non-diabetic patients. In contrast to the current study results (Kumari, et al., 2019) reported that there wasn't a significant relationship concerning age and ABI between type II diabetes mellitus clients.

Concerning the medical status of the studied sample and their peripheral artery obstructions degrees after they applied Buerger Allen exercise for six weeks, the present study indicated that there were greatly statistically significant differences regarding the duration of type 2 diabetes among both the study and control group. The researcher suggests that may be related to most of the study group had diabetes from

five years to less than ten years, so when practicing Buerger Allen exercises, it helped them to improve. The results of the current study contradicted with the study of **Bhuvaneshwari, & Tamilselvi, (2018)** who pointed out that, there was a significant difference between the duration of DM and lower extremity perfusion among patients with type 2 DM regarding the study group after they applied Buerger Allen exercise.

Regarding the study group, it was found that; there was a highly statistically significant relation between peripheral artery obstructions degrees and the family history of peripheral arterial disease after they applied the Buerger Allen exercise for six weeks. This may be rationalized as the genetic factor increases the likelihood of the disease occurring and in the absence of it, the risk of peripheral arterial disease was less. These results in agreement with **(Hemalatha, 2018)** who conducted that there was a significant association between the posttest levels of lower extremity perfusion and selected clinical variables such as the family history of PAD among patients with type II diabetes mellitus after they demonstrated Buerger Allen exercise.

Conclusion

The study findings were concluded that Buerger Allen exercise was highly significantly efficient for improvement of lower peripheral arterial perfusion in pain intensity level among them. Also, it was found that; there were highly statistical significance relations between study group age and their education and medical history with peripheral artery obstruction degree after application of exercises.

Recommendations

Based on the findings of the present study, the following recommendations can be deduced:

1. Diabetic patients must attend health education sessions based on evidence guidelines regard Buerger Allen's exercise which had a positive effect on the improvement of lower peripheral circulation.
2. Share the diabetic patients, Family members, and significant other in planning the care for diabetic patients and encourage them to manage and reduce the complication of diabetes.
3. Encourage the diabetic patients to follow up their ankle-brachial index at least every year to avoid peripheral arterial disease.
4. Organize in-service education programs for staff nurses and students regarding Buerger- Allen exercise and technique for measuring ankle-brachial index to monitor PAD occurrence.
5. Conduct the present study on a different probability sample, that are larger and with

different socio-demographic features to attain generalization of research results.

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Lampiran 1.6 Artikel 6

Original Article

Egyptian Journal of Health Care, 2021 EJHC Vol.12 No.2

Effect of Buerger- Allen Exercise on Lower Extremities Perfusion among Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Background: Diabetes mellitus has increased the risk of more complications. One complication that often occurs is peripheral vascular diseases and decreased foot perfusion of patients by causing endothelial and smooth muscle cell dysfunction in peripheral arteries. Buerger's exercise is a simple intervention for improving the peripheral circulation of patients with Diabetes mellitus. Therefore, **Aim of the study** was to evaluate the effect of Buerger-Allen Exercise on improving lower extremities perfusion among patients with type 2 Diabetes Mellitus. **Study design:** A quasi-experimental design was utilized to achieve the aim. **Setting:** This study was conducted at medical words affiliated to Ain Shams University Hospital; Egypt. **Sample:** A Purposive sample of 70 patients. **Procedure:** data were collected using three tools as follow:1-Structured Interview Questionnaire, 2- patient's medical history and clinical variables tool and 3- Peripheral Circulation Assessment Tools. **Results:** there was no statistically significant difference between pre intervention and post 1 mean score in right leg ($t= 1.088$, $p= 0.278$), while the score of the left leg showed a statistically significant difference ($t= 3.699$, $p= 0.002$). Also, there were a statistically significant differences between post 1 and post 2 after Buerger- Allen exercise implementation mean scores in both legs ($t= 2.756$, $p= 0.007$ & $t= 3.699$, $p= 0.002$), respectively. This shows that Buerger Allen Exercise was effective in improving lower extremities perfusion. **The Conclusion:** Buerger Allen Exercise implementation is effective method for decreasing capillary refill time, increasing ankle brachial index (ABI) score and improving peripheral pulses, temperature, skin color and sensation post Buerger-Allen exercise implementation, which improving the lower extremities perfusion among patients with type 2 Diabetes Mellitus, which supported our research hypothesis. **Recommendation:** Encourage health care providers especially nurses to integrate Buerger Allen exercise in the care protocols of patients with DM in different health care settings.

Key words: Buerger Allen Exercise, lower extremities perfusion, type 2 Diabetes Mellitus.

Introduction

Diabetes mellitus (DM) is a disease that occurs when the pancreas does not produce enough insulin, or when the body cannot effectively use the insulin it produces. Type 2 diabetes is mostly a broadminded disorder defined by insufficiencies in insulin excretion and activity that leads to nonstandard glucose metabolism and interrelated metabolic imbalances. uncontrolled diabetes can cause serious complications include those that are macro vascular – for example, cardiovascular disease – and those that are micro vascular – including nephropathy, retinopathy, neuropathy and erectile dysfunction (Milne & Di Rosa, 2019 & Mukhtar, et al 2020).

Diabetes increases the risk of lower extremity amputations because of deficit in diabetic management and care that result in infected, non-healing foot ulcers. Among all other complications, peripheral neuropathy is a well-known micro vascular complications causing chronic hyperglycemia which results in sensory loss and damage causing lower extremity amputations (Radhika, et al 2020).

Peripheral arterial disease is a condition characterized by atherosclerotic occlusive disease of the lower extremities and gradual decrease in blood flow to one or more limbs secondary to atherosclerosis. The risk of Peripheral Vascular Disease (PVD) is increased in patients who are complains of diabetes mellitus, occurs earlier and is often more

severe and diffuse (Lazzarini, et al 2018). PVD most commonly affects the legs, but other arteries may also, included leg pain when walking which resolves with rest, known as intermittent claudicating is considered the classic symptom. The other symptoms including cold skin, skin ulcers, bluish skin, or poor nail and hair growth in the affected leg. Complications also, include an infection or tissue death which may require amputation. While peripheral arterial disease is a major risk factor for lower-extremity amputation, it is also, accompanied by a high risk for symptomatic cardiovascular and cerebrovascular disease (Kumari, et al 2019&Kim, et al 2021).

Perfusion is the passageway of fluid over the circulatory system or lymphatic system to an organ or tissue; it also, denotes to the transport of blood to capillaries in tissue. Heart tissue is considered over perfusion because they normally are receiving more blood than rest of tissue in organism; they need this blood because they are constantly working (Suza, et al, 2020). Diabetes causes serous and extensive changes in the vascular system, increasing the risk of developing atherosclerosis (large and medium-sized arteries) and causing a specific lesion in microcirculation (small vessels). Hyperglycemia causing excess production of reactive oxygen species that destroy and interfere with the normal endothelial functions. (Bhuvaneshwari & Tamilselvi, 2018)

Buerger-Allen Exercise (BAE) is an active postural exercise in which gravity alternatively fills and empties the blood vessels for preventing Peripheral vascular diseases and promoting collateral circulation in lower extremities and it is one of the interventions to stimulate the development of collateral circulation in the legs. Also, is one of the most common practice used for patient with diabetes to drain engorged vessel. It is performed to promote Lower Extremity Perfusion (LEP) by using postural changes and stimulated peripheral circulation by modulating gravity and applying muscle contraction for improving the lower extremity perfusion. Additionally, encouraging the wound healing process and decrease Peripheral Neuropathy Symptoms (PNS) among patients with Diabetes Mellitus (DM) (Hassan, et. al 2020).

Nurses do very crucial role in improving lower limb perfusion among patients with type 2 Diabetes mellitus. Buerger Allen exercise is simple to implement without any danger and costs, the evident proof that Buerger Allen exercise advances the lower extremity perfusion (Nair, 2019). So, the nurse should focus on prevention of complications by screening high-risk people, early recognition and prevention of PAD to those at increased risk. An awareness of diagnostic and treatment strategies will enable the nurse to educate patients and providing health care. This will benefit to develop both compatible with treatment and disease outcome (Tawabini, 2020).

Significance of the study:

Diabetes is the commonest metabolic disorder that affects populations in the entire world. The incidence of diabetes is affected by genetic, ethnic and socioeconomic factors. In 2019, an appraised 1.5 million deaths were straight produced by diabetes. About 422 million adults are living with diabetes mellitus, people worldwide have diabetes, the majority living in low-and middle-income countries, and 1.6 million deaths are directly attributed to diabetes each year. Both the number of cases and the prevalence of diabetes have been steadily increasing over the past few decades (WHO, 2020). By 2045, forecasts display this number increasing to some 700 million diabetics globally (John Elfelin, 2021). Type 2 diabetes affected about 85-90% of all cases. In Egypt, diabetes mellitus is rapidly growing public health problem with a significant effect on morbidity, mortality, and health care resources. Currently, the prevalence of type II diabetes (T2D) is around 15.6% of diabetic Egyptian adults aged twenty (20) to seventy-nine (79) years of age (Khan & Hamdy, 2017 & Hassan, et al 2020).

Individuals with diabetes mellitus have a two to fourfold increase in the risk of developing peripheral arterial disease. Diabetes mellitus increases the risk of lower extremities circulation impairment this leads to sever complications like foot ulcer and gangrene in the lower limbs because of neuropathy, vascular insufficiency, and impaired wound healing leading to lower limb amputation.

Diabetic foot is a major cause of disability, reduced quality of life, prolonged hospitalization, financial loss, lower limb amputation, and increase mortality rate. Several researches support the positive effect of Buerger- Allen exercise in patients with type 2 Diabetes. So, our study aimed to evaluate the effect of Buerger- Allen exercise on lower extremities perfusion among patients with type 2 Diabetes Mellitus.

Aim of the Study:

The aim of the current study was to evaluate the effect of Buerger-Allen Exercise implementation on lower extremities perfusion among patients with type 2 Diabetes Mellitus.

Research Hypotheses

- H 1. Patients who performed Buerger-Allen exercise will have decreasing in capillary refill time post Buerger-Allen exercise implementation.
- H 2. Patients who performed Buerger-Allen exercise will have increasing in ankle brachial index (ABI) score post Buerger-Allen exercise implementation.
- H 3. Patients who performed Buerger-Allen exercise will have improvement in peripheral pulses, Temperature, skin color and sensation in lower extremities post Buerger-Allen exercise implementation.

Subjects and Methods

A- Research design:

One group quasi experimental interrupted time series design was used in this study. This design is one of the experimental designs in which data are collected from research subjects both before and after introducing the experimental intervention and it is also called an interrupted time series design. In addition to the pre-test and immediate post-test, a delayed posttest or posttests are often included to examine the effects of the treatment over the longer term (Rogers & Révész, 2020).

B- Setting:

The study was conducted at medical departments affiliated to Ain Shams University Hospital; Egypt. Each department is divided

into four rooms (male & female), every room has 20 beds for patients with different medical diagnosis.

C- Subject:

A Purposive non probability/non randomized sample of adult patients with type 2 DM for a period of six months from the beginning of May 2020 to the end of November 2020, who fulfill the inclusion criteria.

Inclusion criteria:

1. Adult both gender male/female.
2. Willing to participate in study.
3. Never received the same intervention from other researchers and health professionals.

Exclusion criteria:

1. Diagnosed with foot ulcer or foot gangrene.
2. Critically ill.
3. Suffering from any vascular diseases.

D-Tools of data collection

1. Structured Interview Patient Questionnaire: to collect patient characteristics as: age, gender, education, dietary pattern, type of activities, BMI and habits.
2. Patient's medical history and clinical variables tool: This tool was written in English language after reviewing the recent and relevant literature (Hassan, et al 2020 & Radhika, et al 2020) to collect health related variables as: duration of diabetes mellitus, associated illness, diabetes treatment, History of leg cramps, received medical treatment for peripheral arterial diseases (PAD), nail condition, family's history with DM, Family history of PAD and eight questions related to sensation, asked about symptoms related to Diabetic Peripheral Neuropathy (DPN); as feeling of numbness, tingling, burning, crawling of insects, sensitive to touch, hot/cold water, open sore or hurt during walking; the answer were either yes or No, the presence of feeling for each question was (1) and not present of feeling was (0).

3. Peripheral Circulation Assessment Tools:

Part I: It was concerned with assessment of patients' grades of Lower extremities perfusion contains six parameters as peripheral pulses, Capillary refill Time, edema, Temperature, pain and skin color; with four responses ranged from normal (0), mild (1), moderate (2), sever (3), adopted from **Priya, (2016)** to assess peripheral pulses (posterior tibial & dorsalis pedis), Capillary refill Time (1-2 sec., 3 sec., 4 sec. & >4 sec.), presence of edema (No edema, (+1) < 2 mm pitting that disappeared rapidly, (+2) 2 to < 4 mm pitting that disappeared in 10-15 sec. & (+3) 4 to < 6 mm pitting that disappeared in 10-15 sec.), Temperature (Warm, Mild, Moderate & Cold), pain (No pain, Mild, Moderate & Sever) and skin color (pink, Pale, Cyanosis /Black & Reddish). The total Scoring was as following:

Grades	Score	Interpretation
1	0-4	Adequate perfusion (good blood circulation)
2	5-9	slightly inadequate perfusion (slightly poor blood circulation)
3	10-14	Inadequate perfusion (poor blood circulation)
4	15-18	Severely inadequate perfusion (very poor blood circulation)

Part II: Ankle Brachial Index (ABI) scale adopted from **Zahran, et al. (2018)** to calculate the perfusion of lower limbs right and left. The manual Ankle-Brachial Index (ABI) was performed by a researcher using standard manual sphygmomanometer for the measurement of lower extremity pressure (LEP). For calculating the ABI, each ankle systolic pressure was distributed by the brachial systolic pressure and the greater of the two systolic pressures for each leg was distributed by the greater of the two arm pressures to acquire the right and left ABI based on the following equation:

$$\text{Ankle-Brachial Index} = \frac{\text{Highest ankle pressure}}{\text{Highest brachial arm pressure}}$$

The score was inferred as

Score	Interpretation
above 0.9	Normal perfusion
0.71–0.90	Mildly diminished perfusion
0.41–0.70	Moderately diminished perfusion
0–0.40	Severely diminished perfusion

Educational guidelines booklet

Developed by the researchers written in Arabic language guided by images, based on the results obtained from assessment of the patients, as well as reviewing the recent and relevant literature (**Kumari et al., 2019 & Walking, et al., 2021**). The booklet was handed out for every patient; composed of 4 parts as follow: **Part (1):** Introduction about diabetes mellitus, causes, complication & treatment. **Part (2):** foot problems of patients with DM & its management. **Part (3):** Allen burger exercises definition, technique and benefits. **& Part (4):** General exercises for foot care of patients with DM.

The educational guidelines were revised by five experts 4 professors of Medical Surgical Nursing as well as 1 professor of internal medicine, at Ain Shams University for content validity. Based on the opinion of a panel of expertise some modifications were done, and then the final form was developed.

Tools validity and reliability

Validity: assessing face and content validity of the suggested tools through a jury of five experts 4 professors of Medical Surgical Nursing as well as 1 professor of internal medicine, who reviewed the instrument, for clarity, relevance, comprehensiveness, understanding, and easiness for administration, no modifications were required.

Reliability: Alpha Cronbach test was used to measure the internal consistency of the study tools. In which Peripheral Circulation Assessment Tool part 1; assessment of patients' grades of Lower extremities perfusion test was reliable at (0.897) and part 2; Ankle Brachial Index (ABI) scale test was reliable at (0.87).

Preparatory phase:

Administrative design: The necessary official approvals were obtained from the administrators of the Ain Shams University Hospital. Letters of request were issued to them from the Faculty of Nursing at Ain Shams University explaining aim of the study and its expected outcomes.

Tools validity and reliability

Validity: assessing face and content validity of the suggested tools through a jury of five experts 4 professors of Medical Surgical Nursing as well as 1 professor of internal medicine, who reviewed the instrument, for clarity, relevance, comprehensiveness, understanding, and easiness for administration, no modifications were required.

Reliability: Alpha Cronbach test was used to measure the internal consistency of the study tools. In which Peripheral Circulation Assessment Tool part 1; assessment of patients' grades of Lower extremities perfusion test was reliable at (0.897) and part 2; Ankle Brachial Index (ABI) scale test was reliable at (0.87).

Preparatory phase:

Administrative design: The necessary official approvals were obtained from the administrators of the Ain Shams University Hospital. Literatures of demand were give out to them from the Faculty of Nursing at Ain Shams University clarifying aim of the study and its expected effects.

Ethical considerations: In order to protect patients' rights in scope of the study, before the initial interview, a verbal consent was secured from each patient after being informed about the nature, purpose and benefits of the study. Patients were also, informed that participation is entirely voluntary and could withdraw at any time without giving reasons. Confidentiality and anonymity of the data was assured by stating that the personal information will be saved private after being united with the researchers and comforted patients that the data would be recycled only for the research objective. Moreover, the intervention used in the current study is safe and not causing any harm to participants.

Pilot Study:

Once permission was granted to proceed with the proposed study, a pilot study was carried out before starting data collection on 7 of targeted patients from the previously mentioned setting according to the inclusion criteria and excluded from the main sample to

evaluate feasibility, the clarity, applicability of the tools, and calculate the time needed to collect data to detect any potential hindrances that might meet the researchers and restrict with data collection.

The study analysis of feasibility revealed that the patient's level of lower extremities perfusion was different before and after Buerger- Allen Exercise. A pilot study also revealed that 15minutes repeated for 5-6 timesof Buerger- Allen Exercise were convenient for improving sensation in lower extremities as verbalized by patients.

I- Implementation phase

Field work: The study was carried out from the beginning of May 2020 to November 2020, including development of the tools. It was based on reviewing recent and relevant literature regarding Buerger- Allen exercise, lower extremities perfusion, and type 2 Diabetes Mellitus. The researchers were visiting the medical departments in the morning and afternoon shifts for 7-days/week. Aim of the study was purely clarified to patients who approved to participate in the study prior to data collection. Data collection was done by the researchers using the same tools for the same patient who fulfilled inclusion criteria; before and after the intervention (performing Buerger- Allen exercise).

The baseline assessment: The first time; individualized interview session was conducted to each participant by the researchers to collect demographic data, medical history & clinical variables and peripheral circulation assessment of both lower extremities. The researcher also clarified to the participants that the peripheral circulation assessment would be assessed at three times. The first time for measurement their perfusion level without any intervention (1st measurement).

The researchers demonstrated Buerger-Allen exercise for every patient individually with relative on the same day; 5-6 times/ day for 12-15 minutes' duration continued for 15 days, using supported educational booklet and videotape beside hospital routine care.

The researchers demonstrated the Buerger-Allen exercise as an intervention to improve

circulation to the feet and legs, encourage participants to re-demonstrate the following three steps and informed them that Buerger-Allen exercise must be performed 5-6 times per day.

Step 1- Elevation

The lower extremities are raised to 45-degree angle and maintained in this position till the skin blanches (3-5 minutes).

Step 2- Dependency

The feet and legs are then dropped below the level of the rest of the body till redness seems (3-5 minutes).

Step 3- Horizontal

The legs are located flat on the bed for 5 minutes with exercising the feet and ankle joint by demonstration of dorsi flexion, planter flexion and rotation. The length of time for each position varied with the patient's tolerance and color change occurs. Usually the exercise is prescribed for about 12-15 minutes repeated for 5-6 times/day/15 days under supervision of the researchers and relatives (Latha, et. al 2019; Hassan, et. al 2020 & Suza, 2020).

Evaluation phase:

This phase started immediately after the proposed intervention was implemented for each patient, the researchers assessed effect of Buerger-Allen exercise on patients peripheral circulation level of the lower extremities by

comparing the results pre, post1 and post 2, the 2nd measurement (post1) on the fifth day of administering Buerger-Allen exercise by using Peripheral Circulation Assessment Tool, after the first intervention then the 3rd measurement (post 2) after 15 days from baseline reading, in case of patient discharged in short time length of stay in the hospital before finishing the scheduled times of intervention and evaluation, the researchers done evaluation in his first follow up visit after discharged and contact patients by their telephone numbers to determine the other appointments in order to complete data collection process.

Statistical Design:

The data was coded and entered using a personal computer. Statistical Package for Social Science (SPSS) version 20 was utilized. Data were obtainable using descriptive statistics in the form of frequencies and percentages. T-test was utilized as an inferential statistic was used to investigate the effect of Buerger-Allen exercise on the changes in level of lower extremities perfusion at three times: pre intervention, post (1), and post (2) intervention scores. The chi-square test was used to identify the relationship between qualitative variables and Mean±SD also was used. Statistical significance was considered at $p\text{-value} \leq 0.05$, and < 0.001 was considered highly significant.

Results**Table (1):** Number and percentage distribution of the studied subjects' characteristics (N=70)

Patients Characteristics	Number & percentage	
	N	%
Age		
30 < 41	7	10
41 < 51	24	34.3
51- 60	16	22.9
above 60	23	32.8
<u>Mean±SD</u>	54.72±6.48	
Gender		
Male	32	45.7
Female	38	54.3
Education Level		
can't read or write	14	20.0
primary education	18	25.7
Secondary education	0	0.0
High education	38	54.3
Dietary pattern		
Vegetarian	16	22.9
not vegetarian	54	77.1
BMI		
normal (18.5-24.9kg/m2)	18	25.7
over weight (25-29.9 kg/m2)	37	52.9
class I obesity (30-34.9 kg/m2)	10	14.3
class II obesity (35-39.9 kg/m2)	5	7.1
<u>Mean±SD</u>	28.6±5.12	
Type of activities		
Sedentary work	37	52.8
Moderate work	23	32.9
Heavy work	10	14.3
Habits		
Smoking	14	20.0
Alcohol	5	7.1
None	51	72.9

Table 1 showed that, 34.3% of the studied subjects were aged between 41 < 51 years, the mean age of them 54.72 (*SD* 6.48) years. As regard to gender and education level 54.3% of the studied patients were female and high educated. Also, 77.1% of them not vegetarian. Moreover, 52.9% of the studied patients were overweight, the mean weight of them 28.6 (*SD* 5.12) kg/m2 and do sedentary work. In relation to special habits of patients under study, it was found that 72.9% of them do not smoke or drink alcohol.

Table (2): Number and percentage distribution of the studied subjects' medical history and clinical variables (N=70)

Medical History and Clinical Variables	Number & percentage	
	N	%
Duration of Diabetes mellitus		
Less than 5 years	28	40.0
5 – 10 years	25	35.7
More than 10 years	17	24.3
Associated illness		
Hypertension		
Yes	39	55.7
No	31	44.3
Cardiac problems		
Yes	21	30.0
No	49	70.0
Renal problems		
Yes	15	21.4
No	55	78.6
Diabetes treatment		
Oral hypoglycemic agents	42	60.0
Insulin	20	28.6
Insulin and oral hypoglycemic agents	8	11.4
History of leg cramps:		
Yes	59	84.3
No	11	15.7
Receive medical treatment for PAD		
Yes	7	10.0
No	63	90.0
Nail condition		
Normal	36	51.4
unkempt and ragged	13	18.6
Thickened	21	30.0
Family history of peripheral artery disease		
Yes	20	28.6
No	50	71.4
Family's history with DM		
Yes	45	64.3
No	25	35.7

Table 2 showed that 40% of the studied subjects diagnosed with diabetes mellitus from less than 5 years and 55.7% of them having hypertension. As regard to type of diabetes treatment and receive medical treatment for peripheral artery disease, 60% and 90% of the studied patients were receiving oral hypoglycemic agents and do not receive medical treatment for PAD, respectively. Also, 84.3% of them reported history of leg cramps. According to nail condition 51.4% had normal nails. Moreover, 28.6% and 64.3% of the studied patients had Family history of PAD and diabetes mellitus, respectively.

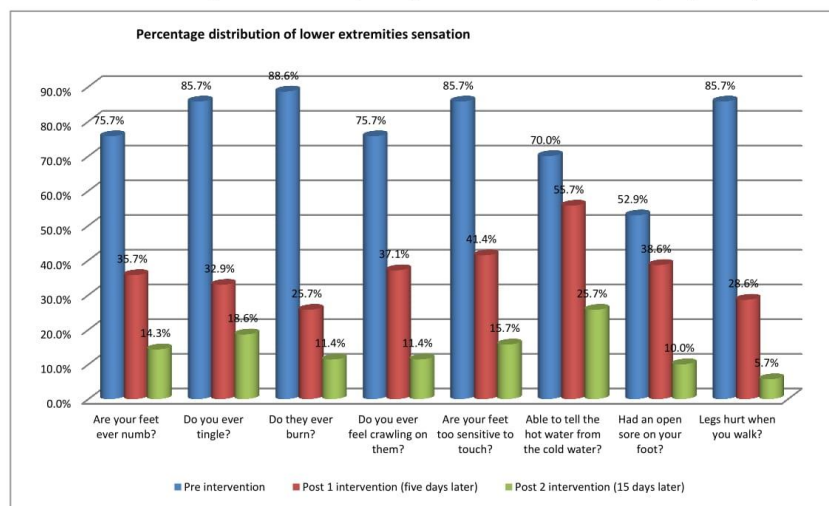


Figure (1): Percentage distribution of lower extremities sensation among the studied subjects (N=70)

Figure 1 illustrates the percentage distribution of lower extremities sensation during the three measurements. It was noted that patients had history of diabetic neuropathy/sensation in lower extremities related to feeling of numbness, tingling, burning, crawling, sensitivity to touch, sensitivity to water, open sore and hurting during walking 75.7%, 85.7%, 88.6%, 75.7%, 85.7%, 70.0%, 52.9% & 85.7%, respectively. The feeling of lower extremities improved after 1st intervention as 35.7%, 32.9%, 25.7%, 37.1%, 41.4%, 55.7%, 38.6% & 28.6%, respectively, of patients display feeling in lower extremities that decreased to 14.3%, 18.6%, 11.4%, 11.4%, 15.7%, 25.7%, 10.0% & 5.7%, respectively, after 2nd intervention.

Table (3): Number and percentage distribution of pre and post intervention scores among studied subjects of lower extremities perfusion in Right leg (N=70)

Perfusion of Right leg	Pre intervention		Post 1 intervention (five days later)		Post 2 intervention (15 days later)		Pre & post1 χ^2	Pre & post2 χ^2	post1 & post2 χ^2
	N	%	N	%	N	%			
Adequate perfusion	11	15.7	20	28.6	24	34.3	9.808 [0.020*]	31.533 [<0.001*]	10.624 [0.005*]
slightly inadequate perfusion	26	37.2	32	45.7	42	60.0			
Inadequate perfusion	29	41.4	18	25.7	4	5.7			
Severely inadequate perfusion	4	5.7	0	0.0	0	0.0			

*Significant at $p < 0.05$

Table 3 shown that there was statistically significant relation regarding total Level of perfusion at Right leg pre, post 1; pre, post 2 and post 1, post 2 of the Burger- Allen Exercise implantation at p-value <0.05.

Table (4): Number and percentage distribution of pre and post intervention scores among studied subjects of lower extremities perfusion in left leg (N=70)

Perfusion of left leg	Pre intervention		Post 1 intervention (five days later)		Post 2 intervention (15 days later)		Pre & post1 χ^2	Pre & post2 χ^2	post1 & post2 χ^2
	N	%	N	%	N	%	[p-value]	[p-value]	[p-value]
Adequate perfusion	13	18.6	23	32.8	25	35.7			
slightly inadequate perfusion	22	31.4	30	42.9	43	61.4	12.604 [0.006*]	40.074 [<0.001*]	14.241 [<0.001*]
Inadequate perfusion	30	42.9	17	24.3	2	2.9			
Severely inadequate perfusion	5	7.1	0	0	0	0.0			

*Significant at $p < 0.05$

*Highly Significant at $P < 0.001$

Table 4 indicated that there was statistically significant relation regarding perfusion at left leg between pre and post 1 of Buerger- Allen Exercise implementation at p-value <0.05. Also, there were highly statistically significant relation between pre, post2 and post 1, post 2 after Buerger-Allen Exercise implementation at p-value <0.001.

Table (5): Comparison between pre and post intervention of lower extremities perfusion score in Right and left legs among studied subjects (N=70)

Perfusion of lower extremities	Pre intervention		Post 1 intervention (five days later)		Post 2 intervention (15 days later)		Pre & post 1 t	Pre & post 2 t	post1 & post 2 t
	Mean	SD	Mean	SD	Mean	SD	[p-value]	[p-value]	[p-value]
Right	9.00	4.49	7.79	8.15	4.70	3.32	1.088 [0.278]	6.441 [<0.001*]	2.938 [0.004*]
Left	9.17	4.50	6.56	3.82	5.00	2.80	3.699 [0.002*]	6.582 [<0.001*]	2.756 [0.007*]

*Significant at $p < 0.05$

*Highly Significant at $p < 0.001$

Table 5 illustrated that there was no statistically significant relation between pre and post 1 mean score in right leg ($t = 1.088$, $p = 0.278$), while the score left leg showed a statistically significant relation ($t = 3.699$, $p = 0.002$), while there was a highly statistically significant relation between pre and post 2 in both legs at $p < 0.001$. Also, there were statistically significant relation between post 1 and post 2 after Buerger- Allen exercise implementation means scores in both legs ($t = 2.756$, $p = 0.007$ & $t = 3.699$, $p = 0.002$), respectively. This shows that Buerger Allen Exercise implementation is effective in improving lower extremities perfusion.

Table (6): Comparison between the patients' peripheral pulses, Capillary Refill and ABI pre, post1 and post 2 of Buerger- Allen exercise implementation in Right and left legs among studied subjects (N=70)

		subjects (N = 70)									
Level of perfusion		Pre		Post1		Post2		Pre & post1		Pre & post 2	post1 & post 2
		N	%	N	%	N	%	χ^2 [p-value]	χ^2 [p-value]	χ^2 [p-value]	
Rt Leg	Post. Tibial										
	Normal	23	32.9	28	40.0	51	72.9	0.771	22.473	15.368	
	Impaired	47	67.1	42	60.0	19	27.1	[0.380]	[<0.001*]	[<0.001*]	
	Dors. Pedis										
	Normal	20	28.6	25	35.7	50	71.4	0.819	25.714	17.949	
	Impaired	50	71.4	45	64.3	20	28.6	[0.366]	[<0.001*]	[<0.001*]	
	Capillary Refill										
	Normal	11	15.7	34	48.6	57	81.4	17.342	60.507	16.609	
	Impaired	59	84.3	36	51.4	13	18.6	[<0.001*]	[<0.001*]	[<0.001*]	
	Ankle Brachial Index (ABI)										
	Normal	4	5.7	14	20.0	49	70.0				
	Impaired	25	35.7	28	40.0	14	20.0	8.236	65.868	37.434	
Moderate	36	51.4	24	34.3	7	10.0	(0.041*)	[<0.001*]	[<0.001*]		
Sever	5	7.1	4	5.7	0	0.0					
Lt Leg	Post. Tibial										
	Normal	18	25.7	24	34.3	54	77.1	1.224	37.059	26.055	
	Impaired	52	74.3	46	65.7	16	22.9	[0.268]	[<0.001*]	[<0.001*]	
	Dors. Pedis										
	Normal	15	21.4	18	25.7	49	70.0	0.357	33.273	27.508	
	Impaired	55	78.6	52	74.3	21	30.0	[0.550]	[<0.001*]	[<0.001*]	
	Capillary Refill										
	Normal	7	10.0	36	51.4	62	88.6	28.228	86.446	22.993	
	Impaired	63	90.0	34	48.6	8	11.4	[<0.001*]	[<0.001*]	[<0.001*]	
	Ankle Brachial Index (ABI)										
	Normal	8	11.4	18	25.7	53	75.7				
	Impaired	39	55.7	27	38.6	11	15.7	6.806	60.422	36.529	
Moderate	16	22.9	20	28.6	6	8.6	[0.078]	[<0.001*]	[<0.001*]		
Sever	7	10.0	5	7.1	0	0.0					

*Highly Significant at $P < 0.001$

Table 6 showed that, regarding posterior tibial and dorsalis pedis pulses there were no statistically significant relation between pre and post 1 in both legs ($p = 0.380, 0.366, 0.268$ & 0.550) respectively, while there was highly statistically significant relation between pre, post 2 and post1, post 2 in both legs at $p < 0.001$. As regard capillary refill, there were highly statistically significant relation between pre, post 1; pre, post 2 and post 1, post 2 in both legs at $p < 0.001$. The same was applied to ABI there was statistically significant relation between pre and post 1 in right leg ($p = 0.041$), while there was no statistically significant relation in left leg ($p = 0.078$). There was highly statistically significant relation between pre, post 2 and post 1, post 2 in both legs at $p < 0.001$ after Buerger- Allen exercise implementation.

Table (7): Relation Between post test scores of total lower extremities perfusion and Selected studied subjects' characteristics among study sample (N=70)

Post 1 intervention (five days later)	perfusion of lower extremities			Chi-square	
	Adequate perfusion	slightly inadequate perfusion	Inadequate perfusion	X ²	P-value
Age	N	N	N		
30 < 41	1	4	2	8.871	0.181
41 < 51	7	5	12		
51 - 60	5	3	8		
above 60	3	12	8		
Gender					
Male	7	11	14	0.036	0.982
Female	9	13	16		
BMI					
normal (18.5-24.9kg/m2)	11	5	2	22.083	<0.001*
over weight (25-29.9 kg/m2)	4	14	19		
class I obesity (30-34.9 kg/m2)	1	3	6		
class II obesity (35-39.9 kg/m2)	0	2	3		
Duration of Diabetes mellitus					
Less than 5 years	9	17	2	25.471	<0.001*
5 – 10 years	4	5	16		
More than 10 years	3	2	12		
Diabetes treatment					
Oral hypoglycemic agents	11	15	16	6.802	0.147
Insulin	2	9	9		
Insulin and oral hypoglycemic agents	3	0	5		
Family history of peripheral artery disease					
Yes	7	7	6	2.890	0.236
No	9	17	24		
Receive medical treatment for PAD					
Yes	4	0	3	6.667	0.036*
No	12	24	27		

*Highly Significant at $p < 0.001$

Table 7 revealed that there was a highly statistically significant relation between BMI, Duration of Diabetes mellitus and total lower extremities perfusion ($p < 0.001$). Also, there was a statistically significant relation with Receive medical treatment for PAD ($p = 0.036$).

Table (8): Relation Between post test scores of lower extremities perfusion and sensation among studied subjects (N=70)

lower extremities sensation	Perfusion of lower extremities			Chi-square	
	Adequate N	slightly N	Inadequate N	X ²	P-value
Are your feet ever numb?					
Yes	4	3	18	14.140	<0.001*
No	12	21	12		
Do you ever tingle?					
Yes	5	2	16	12.263	0.002*
No	11	22	14		
Do they ever burn?					
Yes	1	3	14	12.262	0.002*
No	15	21	16		
Do you ever feel crawling on them?					
Yes	2	5	19	15.710	<0.001*
No	14	19	11		
Are your feet too sensitive to touch?					
Yes	5	6	18	7.617	0.022*
No	11	18	12		
Able to tell the hot water from the cold water?					
Yes	12	7	20	10.726	0.005*
No	4	17	10		
Had an open sore on your foot?					
Yes	3	13	27	23.170	<0.001*
No	13	11	3		
Legs hurt when you walk?					
Yes	2	3	15	11.813	0.003*
No	14	21	15		

*Significant at $p < 0.05$

Table 8 showed that there was a statistically significant relation between post test scores of lower extremities perfusion and feeling/sensation of diabetic neuropathy ($p < 0.05$). this table shows that Buerger Allen Exercise implementation is effective in improving lower extremities sensation related diabetic neuropathy.

Discussion

Peripheral vascular disease and diabetes are both increasingly prevalent conditions, affecting an estimated 200 and 360 million people worldwide, respectively (**Berger & Ladapo, 2017**). The risk of Peripheral Vascular Disease (PVD) is increased in patients who are suffering from diabetes mellitus, occurs earlier and is often more severe and diffuse which leads to grave complications like gangrene in the lower limbs. Buerger Allen Exercise is one of the interventions which stimulate the development of collateral circulation in the legs. The mechanism of Buerger's exercise use gravitational alterations in points that are applied to the soft musculature of vessels and

the vascular. Gravity helps alternately to empty and to fill the blood columns, which can eventually increase transportation of blood through them (**Kumari, et al 2019**).

The present study revealed that mean average age among the studied subjects was (54.72 ± 6.48) years, this is related to increase the risk of peripheral arterial disease among type II diabetes mellitus with aging process, also more than half of them were females, with high education and were doing sedentary work and more than three quarters were have mixed dietary pattern (non-vegetarian), and nearly three quarters were nonsmokers & nonalcoholic.

The previously mentioned results were in agreement with **Sasi, et al (2020)** who revealed that, the average age of experimental group in their study of lower extremities perfusion with Type 2 Diabetes Mellitus was 55.30 ± 4.58 . This result was also in contradicted with **Bhuvaneshwari & Tamilselvi (2018)** who revealed that more than one third of the patients with diabetes age group were above 60 years old.

The result of this present study illustrated that more than half of the studied subjects were females, this can be discussed as decline level of estrogen at menopause cause increased risk for diabetes mellitus because estrogen produce several anti-aging effects including anti oxidative properties as oxidative stress is considered the most important cause in micro vascular diseases. This result agreed with **Suza, (2020)** who illustrated that more than half of the patients were females. In contrary to the current study findings **Hemalatha (2018)** who study effectiveness of buerger Allen exercise on lower extremities perfusion among patients with diabetes mellitus and mentioned that most of the sample were males.

The present study shows that more than half of the studied subjects are overweight whereas that less than one third have normal BMI this result is consistent with **El-Fattah, et al (2019)**, who inferred that nearly two thirds of the patients with diabetes mellitus had B.M.I. of 23-27.4 (65%). In contrast to the current study results **Tawabini (2020)**, who reported that, nearly half of the subjects were in the normal range of body mass index. This is due to that Increased BMI was associated with increased prevalence of diabetes mellitus. An increase in body fat is commonly related with increased risk of metabolic illnesses such as type II diabetes mellitus.

The current study showed that two-fifths of the studied subjects' duration of diabetes less than five years. This can be discussed as the duration of diabetes has no relation with susceptibility to peripheral arterial disease. This finding is in the same line with **Latha, et. al (2019)** who mentioned that, more than half of the studied sample was having duration of diabetes mellitus between zero to five years. Also, this result in disagreement with **Patidar**

(2018) who stated that less than two thirds of the study sample were having duration of diabetes from five years to ten years.

Regarding other associated illness, the current study revealed that more than half of the studied subjects were hypertensive while about three quarters were have no cardiac or renal illness this results is agreed with **Kumari, et al (2019)** who showed that (50%) patients were suffering from comorbid illness in which 56.6% were suffering from hypertension, (26.6%) were suffering from Chronic Kidney Disease, (3.33%) was suffering from CVA(13.3%) were suffering from CAD, and (50%) of patients were not suffering from any comorbid illness.

The present study revealed also that more than three quarters of the studied subjects were hasn't family history of peripheral arterial disease. Because the diabetes mellitus will be caused either by getting old, obese, not exercising regularly and not eating healthy food. This result was further supported by **Hemalatha (2018)** who found that the majority of studied patients weren't have family history of peripheral atrial disease.

Regarding the lower extremities, the current study revealed improvement in the feeling & sensation of the lower extremities after first and second Buerger Allen exercise implementation. This is relevant to the research of **Awaluddin, et al (2019)**, who was stating that foot exercise affects the treatment of peripheral neuropathy as evidenced by a decrease in the average score of neuropathy among people with diabetes. The similar result also proved by research of **Zahran, et al (2018)**, who mentioned that there is a significant effect of foot exercise on peripheral neuropathy. But on the other hand, based on a research conducted by **Matos, et al (2018)** who stated that performing physical activities such as foot exercises will emit stimulants that will help restore motor nerve function. However, it should in long period, at least 13 weeks due to nerve damage.

The current study illustrated that more than three quarters of the studied subjects have normal pulses, capillary refill, & Ankle-Brachial index (ABI) post intervention in both legs, also there were a statistically significant

relation in the lower extremities' perfusion between pre and post 1 & post 2 for both legs. This result is consistent with **Hidayati, et al (2021)** they conducted a significant improvement in the lower extremities perfusion after the Buerger Allen exercise in their study. This finding is congruent with **Thakur& Sharma (2019)** who shows that Buerger Allen Exercise is effective in improving lower extremities perfusion among patients. Also (**Radhika, et al 2020**) revealed that there is a significant improvement in (ABI) score in improving the level of lower extremities perfusion among people with DM after receiving Allen Buerger exercise at the level of $P < 0.05$.

Also in a study of **Hafid, et al (2020)** which revealed that there is a significant improvement in Ankle-Brachial Index Score in preventing peripheral blood vessel illness among people with diabetes mellitus in experimental cluster once receiving Allen Buerger exercise at the level of $P < 0.05$ and there is a significant relation between the extent duration of diabetes and the pretest score of ABI. Studied subjects got benefited by Allen Buerger exercise in preventing PAD.

Results of this study showed a highly statistically significant improvement in perfusion grad among the studied subjects. The researcher's purpose of read that, Buerger Allen exercise meant to enhance feet and legs circulation this may increase blood flow, in order that the sensation of pain will decrease. These results are congruent with **Digal, (2019)** who study impact of Buerger Allen exercise on lower extremities perfusion among patients with type 2 diabetes mellitus and demonstrated that comparison of pre and posttest findings showed that within the experimental group, the mean lower extremities perfusion was 0.84 which was over the mean in control group 0.67 with $p = 0.000$.

Results of this study showed statistical significance relations among the studied subjects and their post assessment of the selected studied subjects' characteristics of peripheral vascular disease PVD relating to body mass index (BMI) once applied Buerger Allen exercise. As a result of the exercise steps were straightforward and the participants did

not need to make a great effort to do it, therefore those who have overweight were easy to exercise.

This result had been agreed with study by **Hemalatha (2018)** who showed that, the relation between post test scores based on checklist for selected clinical features of PVD was significant difference in body mass index (BMI). In contrast with the current study finding the study done by **Hassan, et. al (2020)** who revealed that the effectiveness of Buerger Allen Exercise on lower extremity perfusion and showed that, there was no association between post-test peripheral perfusion with selected variables such as patients with normal BMI.

The result of the current study revealed there were statistical significance relations among the studied subjects and their post assessment regarding lower extremities sensation post Buerger Allen exercise implementation. As well this finding also is in agreement with **Seferovic, et. al (2018)** who reported that sensation related questions provide additional prognostic information about the cardiovascular outcome in individuals with type 2 diabetes. This finding supported the research hypothesis that Patients who performed Buerger-Allen exercise had decreased in capillary refill time, increased in ankle brachial index (ABI) score and improved in peripheral pulses, temperature, skin color and sensation post Buerger-Allen exercise implementation, which improved lower extremities perfusion among patients with type 2 diabetes mellitus.

Conclusion

This study indicated that Buerger Allen Exercise implementation is effective technique for decreasing capillary refill time, increasing ankle brachial index (ABI) score and improving peripheral pulses, temperature, skin coloring and sensation post Buerger-Allen exercise implementation, that improving the lower extremities perfusion among patients with type 2 Diabetes Mellitus

Recommendations

Based on the finding of the present study, the researchers recommended the following.

- Encourage health care providers especially nurses to integrate Buerger Allen exercise in the care protocols of patients with DM in different health care settings.
- A comparative study should be conducted to evaluate the effectiveness of Buerger Allen Exercise with other non-pharmacological measures for improving the level of lower extremity perfusion.
- The study can be replicated by using a large sample there by findings can be generalized.

Nursing implication of the study

It had been found that Buerger Allen Exercise was valuable, easily to instruct patients with DM and improves their lower Extremities perfusion beside the medical treatment.

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Thakur, P., & Sharma, K. (2019). A Study to Assess the Effectiveness of Buerger Allen Exercise in Improving the Peripheral Circulation among Patients with Diabetes Mellitus Admitted in Sharda Hospital, Greater Noida. *Amarjeet Kaur Sandhu*, 11(2), 27.

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Lampiran 2.1 Lembar Konsultasi

**UNIVERSITAS dr. SOEBANDI**

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**LEMBAR KONSULTASI PEMBIMBINGAN PROPOSAL SKRIPSI/TUGAS AKHIR
PROGRAM STUDI SI ILMU KEPERAWATAN
UNIVERSITAS dr. SOEBANDI**

Nama Mahasiswa : Hani Nur Anggraeni

NIM : 18010166

Judul : *Pemberian Intervensi Buenger Allen Exercise Terhadap Ketidakefektifan perfusi jaringan perifer pada penderita Diabetes Mellitus*
Literature Review.

No	Tanggal	Materi yang Dikonsulkan dan Masukan Pembimbing	TTD Pembimbing Utama	No	Tanggal	Materi yang Dikonsulkan dan Masukan Pembimbing	TTD Pembimbing Anggota
1	25/11/2021	Tema penelitian		1	23/NOV 2021	Justifikasi Tema penelitian - pemb → Tema → Intervensi	
2.	26/11/2021	BAB I - rumus LB - rumus		2.	29/NOV 2021	Bab I - justifikasi masalah - penambahan rumus	



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3	6/1/2022	BAB - 2 - rumus kerangka teori Lengkap BAB 3		3.	07/Des 2021.	→ melampirkan BAE → perpusi ger... → Bab II	
4	13/1/2022	- Revisi BAB 3 - Skopkon 4/ Sempuro		4.	20/Des 2021	← Perangin BAE → perpusi ← Lengkapi Bab III	
5	21/1/2022	- Revisi BAB 3 (dalam studi)		5.	13/01/2022	Revisi kerangka Teori, Revisi Bab 3 Acc Sempuro	
6	2/2/2022	Acc Sempuro		6	21/01/2022	Revisi Bab III Acc Sempuro sebelum revisi	
7	21/7/2022	Revisi Hasil Sempuro		7.	20/04 ²⁰	Acc Sempuro.	



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8	22/2	Revisi		8	20/07	Revisi proposal Acc lanjutan akhir jurnal	
9	1/8	BAB IV - Revisi Haru.		9	02/08	Revisi Bab IV.	
10	5/8	lapor penerbit		10	03/08	Re Acc Bab IV	
11	10/8	Revisi surat Akr Revisi.		11	08/08	Revisi Bab V	
12	12/8	Revisi penerbitan		12	11/08	Bab V.	
13	14/8	Surat Revisi		13	14/08	Bab VI	



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14.	18/8 2022	Art Saubert	D/K	14.	15/08 2022	ACC Seminar Hasni	

Lampiran 2.2 Bukti Pencarian Artikel

The screenshot shows a Google Scholar search results page. The search query is "buerger allen exercise and peripheral perfusion and diabetes mellitus". The results are sorted by relevance. The first result is titled "Effectiveness of buerger-allen exercise on lower extremity perfusion and peripheral neuropathy symptoms among patients with diabetes mellitus" by J Radhika, G Poomalai, SJ Nalini, et al., published in the Iranian Journal of Nursing and Midwifery Research in 2020. The second result is titled "A Study to Assess the Effectiveness of Buerger Allen Exercise on Lower Extremity Perfusion among Patients with Type 2 Diabetes Mellitus in selected hospitals at ..." by H Latha, VM Gifty, published in the Asian Journal of Nursing Education in 2019. The third result is titled "... the effectiveness of Buerger Allen exercise on lower extremity perfusion among patients with type 2 diabetes mellitus in Saveetha Medical College and Hospital in ..." by S Bhuvaneshwari, S Tamilselvi, published in the International Journal for Advance in 2018. The search results are displayed in a list format with links to the full text and abstracts.

The screenshot shows a ProQuest search results page. The search query is "buerger allen exercise and peripheral perfusion and diabetes mellitus". The results are sorted by relevance. The first result is titled "Effectiveness of buerger-allen exercise on lower extremity perfusion and peripheral neuropathy symptoms among patients with diabetes mellitus" by Jinna Radhika, Poomalai, Geetha, Sirala Jagadeesh Nalini, Ramanathan Revathi, published in the Iranian Journal of Nursing and Midwifery Research in 2020. The second result is titled "Growth Hormone (GH) and Cardiovascular System" by Caicedo, Diego; Díaz, Oscar; Devesa, Pablo; Devesa, Jesús, published in the International Journal of Molecular Sciences in 2018. The search results are displayed in a list format with links to the full text and abstracts.

browser tabs: buerger allen exercise or periph... | Hasil Pencarian - ProQuest | Effectiveness of Buerger-Allen E...
address bar: pubmed.ncbi.nlm.nih.gov/33014740/
top bar: COVID-19 Information | Public health information (CDC) | Research information (NIH) | SARS-CoV-2 data (NCBI) | Prevention and treatment information (HHS) | Español

NIH National Library of Medicine
National Center for Biotechnology Information

PubMed.gov

Search: buerger allen exercise and peripheral perfusion and diabetes mellitus

Advanced Create alert Create RSS User Guide

Found 1 result for buerger allen exercise and peripheral perfusion and diabetes mell... Save Email Send to Display options

Filters applied: From 2016 to 2021. Clear all

> Iran J Nurs Midwifery Res. 2020 Jun 17;25(4):291-295. doi: 10.4103/ijnmr.IJNMR_63_19.
eCollection Jul-Aug 2020.

Effectiveness of Buerger-Allen Exercise on Lower Extremity Perfusion and Peripheral Neuropathy Symptoms among Patients with Diabetes Mellitus

FULL TEXT LINKS
PMC FREE Full text

ACTIONS
Cite

Windows taskbar: Ketik di sini untuk mencari | 28°C Hujan ringan | 22.06 23/01/2022

Lampiran 2.3 JBI Critical Appraisal Checklist



JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	☐	☐	☐	☐
2. Were the participants included in any comparisons similar?	☐	☐	☐	☐
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	☐	☐	☐	☐
4. Was there a control group?	☐	☐	☐	☐
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	☐	☐	☐	☐
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☐	☐	☐	☐
7. Were the outcomes of participants included in any comparisons measured in the same way?	☐	☐	☐	☐
8. Were outcomes measured in a reliable way?	☐	☐	☐	☐
9. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Lampiran 2.4 Hasil *Critical Appraisal*

JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

Reviewer: Hani Nur Anggraeni Date: 10 Januari 2022
Author: Walaa El-Khanany Zahran Year: 2018 Record Number: ISSN 18235-2018

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	☒	☐	☐	☐
2. Were the participants included in any comparisons similar?	☒	☐	☐	☐
3. Were the participants included in any comparisons receiving similar treatment (i.e. other than the exposure or intervention of interest)?	☐	☒	☐	☐
4. Was there a control group?	☒	☐	☐	☐
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	☒	☐	☐	☐
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☒	☐	☐	☐
7. Were the outcomes of participants included in any comparisons measured in the same way?	☒	☐	☐	☐
8. Were outcomes measured in a reliable way?	☒	☐	☐	☐
9. Was appropriate statistical analysis used?	☒	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

$$\begin{aligned}
\text{Nilai JBI} &= \frac{\text{Jumlah benar}}{\text{Total}} \times 100\% = \frac{8}{9} \times 100\% \\
&= 88,8\%
\end{aligned}$$

JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

Reviewer Hani Nur Anggraeni Date 10 Januari 2022

Author Hanan Saber A. EL-Fattah Year 2019 Record Number ISSN 0976-6245

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	☒	☐	☐	☐
2. Were the participants included in any comparisons similar?	☐	☒	☐	☐
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	☒	☐	☐	☐
4. Was there a control group?	☐	☒	☐	☐
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	☒	☐	☐	☐
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☐	☐	☒	☐
7. Were the outcomes of participants included in any comparisons measured in the same way?	☒	☐	☐	☐
8. Were outcomes measured in a reliable way?	☒	☐	☐	☐
9. Was appropriate statistical analysis used?	☒	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Nilai JBI = $\frac{6}{9} \times 100\% = 66,6\%$



JBI Critical Appraisal Checklist for Quasi-Experimental Studies

Reviewer Hani Nur Anggraeni Date 10 Januari 2022

Author Sitti Nur Hasina Ima Nadatien Year 2021 Record Number e-ISSN 2549-8118
p-ISSN 2805-1049

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	☒	☐	☐	☐
2. Were the participants included in any comparisons similar?	☒	☐	☐	☐
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	☐	☒	☐	☐
4. Was there a control group?	☒	☐	☐	☐
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	☒	☐	☐	☐
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☐	☐	☒	☐
7. Were the outcomes of participants included in any comparisons measured in the same way?	☒	☐	☐	☐
8. Were outcomes measured in a reliable way?	☒	☐	☐	☐
9. Was appropriate statistical analysis used?	☒	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Nilai JBI = $\frac{7}{9} \times 100\% = 77,7\%$



Journal of Nursing and Health Sciences

JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

Reviewer Hani Nur Anggraeni Date 10 Juli 2022
 Author Muh. Anwar Hapid Year 2021 Record Number ISSN 2252-3847

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	☒	☐	☐	☐
2. Were the participants included in any comparisons similar?	☐	☒	☐	☐
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	☒	☐	☐	☐
4. Was there a control group?	☐	☒	☐	☐
5. Were there at least two measurements of the outcomes before and post the intervention/exposure?	☒	☐	☐	☐
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?	☐	☐	☒	☐
7. Were the outcomes of participants included in any comparisons measured in the same way?	☒	☐	☐	☐
8. Were outcomes measured in a reliable way?	☒	☐	☐	☐
9. Was appropriate statistical analysis used?	☒	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (including reason for exclusion)

Nilai JBI = $\frac{6}{9} \times 100\% = 66,62$

JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

Reviewer Hani Nur Anggraeni Date 10 Juli 2022
 Author Inshrah Roshdy Mohamad Year 2021 Record Number http://asnj-journals.ekb.eg.

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	☒	☐	☐	☐
2. Were the participants included in any comparisons similar?	☒	☐	☐	☐
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	☐	☐	☒	☐
4. Was there a control group?	☒	☐	☐	☐
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	☒	☐	☐	☐
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☐	☐	☒	☐
7. Were the outcomes of participants included in any comparisons measured in the same way?	☒	☐	☐	☐
8. Were outcomes measured in a reliable way?	☒	☐	☐	☐
9. Was appropriate statistical analysis used?	☒	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Include reasons for exclusion)

$$\text{Nilai JBI} = \frac{7}{9} \times 100\% = 77,7\%$$



JBIC Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

Reviewer: Hani Nur Anggraeni Date: 10 Juli 2022

Author: Rahem Adel Ebada El Sayed Year: 2021 Record Number: EJHC Vol.12 No.2

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	☒	☐	☐	☐
2. Were the participants included in any comparisons similar?	☐	☒	☐	☐
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	☒	☐	☐	☐
4. Was there a control group?	☐	☒	☐	☐
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	☒	☐	☐	☐
6. Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analyzed?	☒	☐	☐	☐
7. Were the outcomes of participants included in any comparisons measured in the same way?	☒	☐	☐	☐
8. Were outcomes measured in a reliable way?	☒	☐	☐	☐
9. Was appropriate statistical analysis used?	☒	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Nilai JBI = $\frac{7}{9} \times 100\% = 77.7\%$