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Research Papers

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A REVIEW OF LITERATURE ON THE EFFECTIVENESS OF DRY CUPPING THERAPY ON MUSCULOSKELETAL PAIN

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ABSTRACT

BACKGROUND: Musculoskeletal disorders account for 17% of all years that young adults worldwide have lived with a disability and are one of the main global causes of disability, making them the most common source of severe long-term pain and physical impairment. Even though these conditions are complex, 30–40% of musculoskeletal complaints among employed individuals have a work-related component. On the other hand, it has been found that musculoskeletal discomfort is the main cause of occupational incapacity.

OBJECTIVE: To find out the efficacy of dry CT on musculoskeletal pain.

METHOD: The articles were chosen from authentic platforms like PubMed and Google Scholar. The articles were selected from the years 2011-2023, a total number of 57 articles were identified, out of which 20 were selected for review.

RESULTS: dry cupping therapy has a significant impact on reducing musculoskeletal pain.

CONCLUSION: This study focuses on the conclusion that dry CT is often used to treat various musculoskeletal conditions. The conclusion of this investigation indicates that dry CT is efficient in reducing painwith no adverse effects. The second conclusion indicates that a minimum of five sessions are necessary to observe significant changes in dry CT intervention. The cups are typically held in place for 15 to 20 minutes, and interval periods between sessions are crucial for tissue re-establishment.

Keywords: dry cupping therapy, musculoskeletal pain, blood flow.

INTRODUCTION

Cupping is an ancient method used in treating pain and various disorders. Cupping is a basic technique that involves using quick, vigorous, and rhythmic strokes to activate muscles. It is very useful in treating aches and pains linked to a variety of illnesses. Cupping, then, has the potential to improve life quality.[1] A cupping session lasts approximately 20 minutes. During the procedure, the therapist designates particular locations or places for cupping and cleans the area. The therapist places a cup of the appropriate size in the chosen location and uses a flame, electrical suction, or manual suction to remove the air from the cup. After that, the cup is put to the skin and left there for three to five minutes.[1]

Effects of cupping therapy: There is growing evidence that cupping can promote comfort and relaxation throughout the body, which boosts the brain's natural production of opioids and enhances pain management. According to other research, cupping therapy works primarily to improve blood circulation and eliminate waste and toxins from the body[1]. Improving microcirculation, encouraging capillary endothelial cell repair, and speeding up granulation and angiogenesis in the local tissues—all of which would contribute to the patient's functional state returning to normal and progressive muscular relaxation. Additionally, cupping helps the patient by removing harmful substances from the interstitial compartment and skin microcirculation.[1]Cupping therapy increases blood supply to injured areas by rupturing capillaries in the skin surface, aiding in healing and bringing oxygenated blood and nutrients to damaged tissue, and also providing pain relief.[2]

Application of cupping: Cupping therapy involves applying small round cups made of glass, bamboo, ceramic, or plastic to the pain area, ensuring tight contact with skin and maintaining negative pressure through heat or vacuums.[3]Negative pressure holds a cupping cup onto the skin, creating suction and pulling it upwards. Therapists use lubricants for wider coverage. Application areas that are commonly used are back, abdomen, chest, buttocks[3].

Categorization of cupping intervention: A new categorization of cupping, comprising technical categories, suction power, method, materials, area treated, and other adjustments in cupping therapy, was introduced by Al-Bedah et al. in 2016.Dry cupping Dry cupping, known by other names as static or retained cupping, is a traditional CT used for a range of excruciating ailments and chronic diseases, increasing blood circulation and activating the immune system.[4]Wet cupping also referred to as full cupping, bleeding cupping, and bloodletting cupping, is a traditional medicine method used to reduce pain. However, it has been linked to increased infection risk, vasovagal attacks, and scar formation, making it less significant in medical science. Flash

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cupping, or empty cupping, is a short, moderate to low force application technique used to excite particular areas, particularly among adolescents and women, andmay made using one or four cups of moderate size.Massage cupping involves applying oil on skin surface and moving the cups using weak suction, suitable for both young and elderly individuals, using oils like olive, peppermint, and lavender.

Suction power in Cupping Therapy: Cupping is categorized according to the negative pressure level created within the cups, using light, medium, strong, or pulsatile pressure levels

Light cupping pressure: Light cupping pressure, a pressure level between 100-300 millibar, is used for children, elderly patients, and sensitive body parts. It might be combined with massage, dry, and flash techniques, leaving most patients without cupping marks.[3]

Medium cupping pressure: Medium cupping pressure, created by 3-4 manual pump suctions, is common for common cupping but can leave marks and is not recommended for sensitive body areas.[3]

Strong cupping pressure: Strong cupping pressure, generated using a hand pump suction, is not recommended for children or elderly individuals due to potential health risks including inflammation, dermatitis, skin burns, and pain.[3]

Pulsatile cupping: Pulsatile cupping uses mechanical devices to generate variable pressure pulses every 2 seconds, typically 100-200 mb, for pain alleviation in knee osteoarthritis patients

Mechanisms of action[1]:
There are three primary ideas and theory that could explain the mechanisms involved. Among these are "Reflex Zone Theory" (RZT), "Diffuse Noxious Inhibitory Controls (DNICs)," and "Pain-Gate Theory" (PGT). In the subsections that follow, each hypothesis will be briefly described

1. Pain-Gate Theory: the hypothesis presented suggests a mechanism through which pain stimulates to the brain, where it is processed and potentially alleviated. Cupping therapy, along with other reflex therapies, is posited to activate pain receptors, leading to changes in signals are processing at the brain and spinal cord levels. The Pain Gate Theory, proposed by Melzack and Wall in 1965, forms the foundation of this hypothesis, suggesting that increased activity in large fiber nerves can inhibit the transmission of pain signals.

The systematic evaluation of randomized controlled trials supports the therapeutic benefit of cupping for pain management, indicating its potential as a viable treatment option. However, the specific mechanisms through which cupping exerts its effects remain to be fully elucidated. It is hypothesized that cupping activates pain receptors, increasing impulse frequency and ultimately causing pain gates to close, thereby reducing pain perception.

2. Diffuse Noxious Inhibitory:Diffuse Noxious Inhibitory Controls (DNIC) is a concept that explains how CT may decrease pain. The idea behind this mechanism is that one pain can suppress another, known as "one pain masks another." In experimental settings, this pain-inhibitory mechanism can be easily triggered. The term "noxious inhibitory controls" or "DNIC-like" effects have been replaced with "conditioned pain modulation" (CPM). Experts recommend using "CPM" to describe the human behavioral aspect and "diffuse noxious inhibitory controls" to characterize the lower brainstem-mediated inhibitory mechanism seen in animal studies.

Study on this idea has mostly concentrated onidiopathic pain syndromes that respond well to CT, such as fibromyalgia, tension headaches, temporomandibular disorders, and irritable bowel syndrome. CT may induce localized injury to the epidermis and capillary vessels, triggering a nociceptive signal that activates DNICs. This mechanism requires a strong conditioning stimulus to attenuate pain, which may involve distraction effects. Additionally, CT has the potential to work by inducing a DNIC or by reducing oxidative stress and eliminating oxidants. The analgesic impacts of cupping technique may also be mediated through mechanically stimulated nerves, particularly $A\partial$ and C nerve fibers connected to the DNIC system. This mechanisms are related to acupuncture, as both involve the modulation of pain through the "pain inhibits pain" phenomenon.

3. Reflex Zone Theory: In European traditional medicine, cupping therapy has historically been utilized to address carpal tunnel syndrome by targeting specific zones or segments of the shoulder triangle that are segmentally connected to the median nerve. This practice has garnered support from numerous investigations. The technique involves applying suction stimulation to the affected site to simplify the migration of red blood cells from the circulatory system to the surrounding tissue areas, promoting healing without damaging capillary vessels. This process, known as dry diapedesis, allows the connective tissue to either absorb or eliminate extravasations.According to traditional medicine principles, symptoms manifesting externally to an internal disease process often appear in regions not directly adjacent to the afflicted organ. The interaction of nerve,

muscle, and chemical pathways is responsible for the idea of a connection between two body components. Reflex zone therapy (RZT) is based on the premise that alterations in nearby dermatomes may reflect indications and symptoms of disease connected to a particular dermatome.Response indicators of sickness include skin flushing due to vasodilation and pallor, coldness, and clamminess resulting from vasoconstriction. Subcutaneous tissue may become swollen, thickened, and edematous, while muscle contraction may decrease. Degenerative changes in ligaments, cartilage, and joint capsules, coupled with reduced synovial fluid, contribute to painful and restricted movement. Impaired blood and tissue fluid circulation further compromises organ function. Changes in skin tone, texture, and perspiration often manifest early on during illness.Research by Sato and colleagues (1997) suggests that stimulating somatic structures, such as skin and peripheral joints, in experimental animals can significantly influence bladder, gastrointestinal, and cardiovascular functions. These reflexes operate through spinal, supra-spinal, and cortical pathways, exerting both excitatory and inhibitory effects on visceral function.In cupping therapy, the skin may become tender, uncomfortable, and swollen when the affected organ transmits signals to the skin via autonomic nerves. Application of cups activates skin receptors, fostering neurological connections that enhance blood flow and circulation to both the skin and internal organs.

Further elucidation of reflex treatment mechanisms will enhance clinical evidence and advance our comprehension of the neurobiology of complementary medicine, including cupping therapy.

METHODOLOGY

Literature search methodology

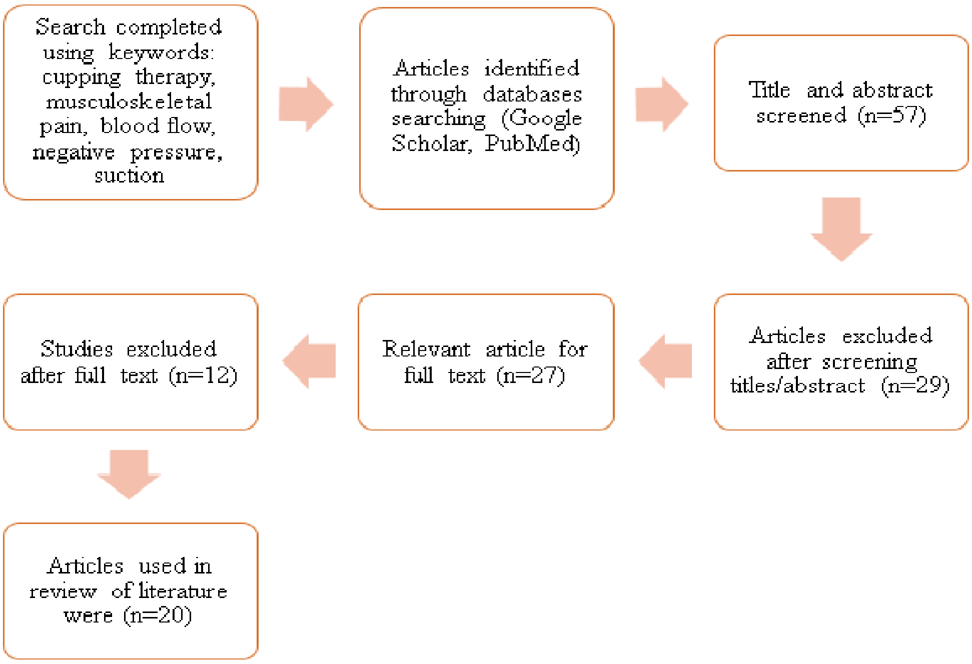
The search engines on the internet that are utilized to collect journals are Google Scholar and PubMed. The authors identified articles according to specific keywords. The articles were collected in full text. A total number of 57 articles collected and identified, out of which 20 articles were selected for review.

Study selection

Inclusion criteria:
- Articles discussing about the impactof CT were included
- The article was exclusively published in English.
- Articles with full text from 2011-2023 have been included

Exclusion criteria:
- The articles published in other languages were excluded.
- Post-2011 articles were not included.
- Articles not containing information about cupping therapy.

FLOW CHART:



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REVIEW OF LITERATURE:

- **Ayman A Mohamed, Xueyan Zhang, Yih-Kuen (2023)**[5] conducted a study to evaluate Evidence level of the impact of CT in musculoskeletal and sports rehabilitation. This study examines cupping therapy's evidence in musculoskeletal and sports rehabilitation, finding low to moderate evidence for pain reduction, improved blood flow, and low adverse effects. However cupping has low to moderate evidence in musculoskeletal and sports rehabilitation and might be used as a useful treatment.
- **S. Andrew Cage & Laurel Trail et al. (2023)**[6] did a research to evaluate the efficacy of CT on Muscle Tenderness in collegiate baseball players. 20 players aged from 22+- 2 years were randomly assigned in two groups. A treatment and sham treatment group. A 15-minute of CT procedure can reduce muscle tenderness in the triceps surae, according to a research that accounted for the placebo effect and bias during statistical analysis.
- **Dave Hammons & Molly McCullough (2021)**[7] Conducted a study on effects of cupping therapy on muscle stiffness, active Dorsiflexion and perceived pain of the medial gastrocnemius muscle following a cupping therapy treatment, Twenty participants were included, 10 Women 10 Men completed an exercise protocol. 5-minute dry cupping was performed on dominant leg medial gastrocnemius and Five minutes of rest for the non-dominant control leg. Muscle stiffness, active dorsiflexion and perceived pain were measured at baseline, pre-treatment, post-treatment and 5 minutes post-treatment in the medial gastrocnemius muscle. A single cupping treatment significantly improved active Dorsiflexion and decreased pain was observed in treatment group. No significant differences in Muscle stiffness was observed following the treatment.
- **Sweety Malik, Pooja Anand, PoojaBhati, M. Ejaz Hussain (2022)**[8]did a study on pain, dynamic balance and functional performance in young female with recreational runners chronic plantar fasciitis. 30 female were included from outpatient department of SGT hospital. They were assigned into 2 groups dry cupping group (Experimental group n=15) and conventional group (control group n=15). They received 4 weeks of intervention (3days/day). The study suggests that dry cupping therapy can be an additional treatment method for young female runners suffering from chronic plantar fasciitis.
- **John Smith, Amy Morrison & Myra Villarreal (2021)**[9] Conducted research to analyze the effect of CT on muscle soreness of the gastrocnemius muscle and ROM in the ankle. 36 sample were divided into 3 groups, A group (no exercise) B group (bilateral heel drops to exhaustion) C group (right unilateral heel drops to exhaustion). Dorsiflexion range of motion was assessed bilaterally for all groups. All participants receive the cupping protocol on the right gastrocnemius but C also received it on the left gastrocnemius. Dry cupping was applied for 90 seconds and soreness was measured using a 10- point VAS scale at 24 & 48 hours. The study concluded that the 90 second of dry cupping on the gastrocnemius may reduce 24 hour muscle soreness but has no effect on range of motion.
- **Marianna de MeloSalemi and Vanessa Maria da Silva Alves Gomes et al(2021)**[10]did research on Dry CT on Pain and Functional Disability from Persistent Non-Specific Low Back Pain. The participants were allocated to a cupping therapy (n=19), or sham (n=18) group, the intervention session ranges from 5 to 10 minute, twice a week for 3 week. It was discovered that dry cupping was more successful in lowering all symptoms compared to sham.
- **Sarah Wood, Gary Fryer, Liana Lei Fon Tan & Caroline Cleary (2020)**[11]conducted a systematic review and meta-analysis of 21 randomized controlled trials (RCTs) involving 1049 participants assessed the efficacy and safety of western dry cupping methods for treating musculoskeletal pain and reduced range of motion.Dry cupping significantly reduces pain in chronic neck pain, improves functional status, and significantly improves range of motion compared to no treatment.

- **Bailey David (2020)**[12]conducted a research on pre-post study design to see the effects of dry CT on planter fascia pain and function. Subjects were taken from Sacramento State University. 12 subjects were randomly assigned to the cupping therapy or the sham cupping therapy, for two sessions through the week. The study found that dry cupping therapy is effective to alleviate pain and enhance functional performance in patients suffering from plantar fasciitis.
- **Yen-Chun Chiu and IoannisManousakas et al (2020)**[13]did Experimental research that aimed to develop a quantified dry cupping on soft tissue compliance in athletes with myofascial pain syndrome. The study used a dry cupping system to treat elite baseball players with myofascial pain syndrome. Results showed that 89% of patients could not identify MTrP after 4 weeks of cupping, and soft tissue improvements were observed.
- **Nazar Alkhadhrawi & Ali Alshami (2019)**[14] Conducted a study on calf muscle myofascial trigger point on pain and function in patient. 71 patients were assigned and divided into 2 groups an Intervention group (Dry CT) & Control group(stretching exercises), both group performs stretching exercise for calf muscle & plantar fascia and ankle Dorsiflexion exercise. A pre and post measurement of Ankle dorsiflexor ROM & Ankle plantar flexor strength were taken. In Intervention group Patients with planter heel pain experienced significant improvements in pain.
- **Hugo Jário de Almeida Silva & Bruno T Saragiotto et al (2019)**[15] conducted research on individuals with non-specific chronic low back pain to examine the impact of dry CT: A protocol for a placebocontrolled, randomised, doubleblind study. 90 individuals, aged from 18-59 years will be assigned randomly into 2 group Dry cupping group and placebo dry cupping group. The intervention was given for once in a week for 8 weeks. A pre-test measurement was taken, immediately after the first treatment session, after 4 weeks of intervention, and after 8 weeks of intervention. This study evaluates dry cupping therapy's effectiveness in reducing discomfort and symptom-related to individuals.
- **Jae-Eun Kim & Ji-Eun Cho et al (2017)**[16] did research on flexibility, Pain Threshold, and Muscle Activity of the Hamstring Muscle Compared to Passive Stretching in healthy individuals to measure the effect of CT. 30 healthy individuals were assigned randomly to CT and passive stretching. 1 weeks of intervention proves that CT has as much positive impact as passive stretching.
- **S Anjum & A Anjum et al. (2016)**[17]conducted a study in relieving non-specific neck pain and its potential role in improving the health-related quality of life. 46 subjects of neck pain were recruited for the study, of which 31 subjects were diagnosed as having non-specific neck pain and were assigned in the study and from this 1 subject werelost to follow up and only 30 subjects were given 6 sessions of dry CT for 2 weeks. Dry cupping procedure is an excellent method for lowering generalized neck pain and raising overall health-related quality of life.
- **Michael Teut, & Stefan Kaiser et al (2012)**[18] Conducted research the study aims to evaluate the efficacy of cupping in reducing the symptoms of knee osteoarthritis. 40 subjects were randomized to either 8 sessions of treatment within 4 weeks or no intervention. After 4 weeks it’s noticed that Dry cupping with a pulsatile device relieves knee osteoarthritis symptoms, potentially useful in ambulatory healthcare services.
- **Romy Lauche& Holger Cramer et al. (2011)**[19]did research, a randomized controlled pilot study investigated that the impact of dry cupping treatments on pain and mechanical thresholds in chronic non-specific neck pain patients.50 patients were randomised to a treatment group or a control group. Subjects in the TG received a series of 5 CT and control group with no treatment over a period of 2 weeks. Five sessions of dry CTs provide good relieve from chronic neck pain, improving subjective measures and affecting mechanical pain sensitivity, suggesting cupping influences functional pain processing.

DISCUSSION

The objective was to evaluate the impact of CT on musculoskeletal discomfort. CT is commonly used to treat musculoskeletal discomfort, including shoulder and lower back pain, neck pain, osteoarthritis, gastrocnemius muscle soreness, plantar fasciitis, etc. The clinical evidence of CT is minimal. The study's findings indicate that CT is useful way to relieve discomfort without any adverse effects. Aboushanab et al's[20] review highlights CT as a reliable and ancient treatment for neck and back pain, reducing inflammation, enhancing blood flow, and facilitating deep-tissue massage.The mechanism of action underlying dry cupping therapy, the negative pressure to the skin surface, which promotes increased blood circulation, tissue oxygenation, and nutrient delivery to injured or affected areas. This process aids in tissue healing, reduces inflammation, and alleviates pain symptoms.Furthermore, articles delineate different types of CT including dry cupping, wet cupping, flash cupping, and massage cupping, each offering distinct therapeutic approaches tailored to specific patient populations and clinical presentations.Several studies have suggested that Wet cupping also promotes nociceptive stimulation, activating pain regulation pathways, making it beneficial for musculoskeletal disorders. However, it may lead to infection risk, scar formation, and vasovagal attacks. Dry cupping, also known as cupping massage, possesses more analgesic effect. The studies utilized variable suction strength while adhering to standardized protocols for light suction of 100-300 millibars with two pumping by hand and medium suctions of 500 millibars with 5 or more pumping or pulsatile pressures between 100 to 200 millibars every 2 seconds. A cupping session was applied for 5 sessions around 20 minutes for 3-4 days. Researchers suggest that CT intervention requires a minimum of five sessions to observe significant changes, with interval periods crucial for tissue re-establishment. Most studies show low-quality evidence and high heterogeneity, with a significant decrease in pain connected with cupping therapy. Clinical trials have investigated cupping's role in neurological and infectious diseases.

Overall, the findings of this literature review underscore the growing body of evidence supporting the impact and harmlessness of dry CT as a complementary treatment modality for MSK pain management. However, further research including larger-scale clinical trials and long-term follow-up studies is warranted to elucidate optimal treatment protocols, patient selection criteria, and potential adverse effects associated with dry cupping therapy.

CONCLUSION

With this study, we came to the first conclusion CT is often utilized to treat a range of musculoskeletal pain such as low back and shoulder pain, non-specific neck ache, osteoarthritis, gastrocnemius muscle soreness, plantar fasciitis, etc. The study's findings indicate that CT is useful method to relieve of ache without any adverse effects. Another conclusion indicates that a minimum of five sessions are necessary to observe significant changes in cupping therapy intervention, the cups are typically held in place for 15 to 20 minutes, and interval periods between sessions are crucial for tissue re-establishment.

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A LITERATURE REVIEW ON EFFECTIVENESS OF THE BLOOD FLOW RESTRICTION TECHNIQUE TO REDUCE PAIN AND INCREASE MUSCLE STRENGTH

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ABSTRACT

Background: *Blood Flow Restriction Training (BFRT) is a promising rehabilitation and exercise method that uses pressure cuffs to induce muscle fatigue and metabolic stress, potentially improving muscle strength and pain management. A systematic review found BFRT significantly reduces pain and enhances muscle strength.*

Study design: *Systematic Review.*

Objective*: The goal of this research of the literature was to find out whether the BFRT is effective in reducing pain and strengthening muscles.*

Method*: The authors conducted a PubMed, ScienceDirect, and Google Scholar search and collected the reviews consisting of total systematic analyses, RCT and experimental studies regarding the current evidence of the effect of BFRT on reduce pain and increase muscle strength.*

Results: *BFRT significantly effect on reduce pain and increase muscle strength. The articles were collected in full text. Out of the 46 articles that were discovered, 20 were selected for evaluation.*

Conclusion: *BFRT has been demonstrated in this research review to significantly reduce pain and increase muscle strength.*

Keywords*: Blood Flow Restriction Technique (BFRT), pain, muscle strength.*

INTRODUCTION

Blood flow restriction (BFR) technique, also known as Kaatsu training, was created in the 1970s and 1980s by Yoshiaki Sato of Japan.to ensure that create mechanical compression from the underlying vasculature, this training technique involves reducing blood supply to a muscle by using an external constricting device, like a blood pressure cuff or tourniquet. BFR is used with the intention of encouraging blood to collect in the leg muscles' capillary beds away through the tourniquet.[1] During exercise, BFR is achieved by totally preventing venous return flow and just partially preventing arterial input. While exercising, a blood pressure cuff or restrictive straps are placed and inflated on the limb's top part to a pressure that can prevent arterial entrance while limiting venous return.[2]

Utilising BFR for training is a recently developed method for either preventing muscle atrophy or, maybe, inducing muscular growth. An inflated cuff or tourniquet is used the proximal end of an extremity during the process, and internal pressure is gradually increased until it limits venous efflux and arterial blood flow.[3] During all stages of rehabilitation, including bedrest, there have been indications restricting blood flow can help muscles adapt. as a method to support muscle adaptations. It is crucial to regain ambulation as soon as possible since muscle weakening and disuse atrophy can happen rather fast as a reaction to immobilization. Depending on your healing stage, physical activity may be delayed or even harmful. BFR in this situation offers a potentially practical stimulus to slow down the frequency of atrophy and preserve muscle strength.[4]

The Sports Medicine Institute of America recommends resistance training between sixty and eighty percent of a 1RM for maximum strength and muscular growth improvements. However, high-intensity exercise is often not feasible due to various reasons. Using BFR for Patients can benefit from training with age, injury, or weight gain similar results while reducing joint pressure. While LL-BFR can achieve similar results to high-load training, it remains to be seen if bone improvements can be achieved at the same efficacy as high-load training.[5]

There are two primary causes of muscle hypertrophy: mechanical strain and metabolic stress. Muscle growth results from elevated anabolic hormone levels brought on by mechanical strain. Anabolism of muscle tissue includes the release of hormones, hypoxia, and cell swelling brought on by metabolic stress. Normally dormant, myogenic stem cells become active in response to increasing muscle stress or a physical injury to a muscle, and they aid in both the development of new muscle fibres and the healing of damaged ones. It has been seen that 4–6 weeks of short-term, low-intensity BFR exercise increases muscular strength by 10%–20%. These increases were similar to those obtained from vigorous exercise in the absence of BFR. BFR training attempts to imitate the effects of vigorous exercise by employing a cuff to simulate a hypoxic environment. Light workouts can be done once the cuff is positioned close to the muscle being worked. Because the cuff restricts blood flow, low-oxygen blood builds up and raises proton and lactic acid levels. Low-intensity exercise and BFR training induce the same physiological changes in the muscles as high-intensity exercise, resulting in cell edema, hypoxia, and hormone release.[6]

METHODOLOGY

Study design: It is a systematic review, which was described according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

Eligibility criteria:

Inclusion criteria:

- Included were articles addressing the results of muscle strength, discomfort, and blood flow restriction techniques.
- There were articles available exclusively in English.
- Articles with full text.
- Articles with full text from 2010-2023 have been included.

Exclusion criteria:

- Articles published in other languages were excluded.
- Articles published below the year 2010 were excluded.
- Articles not containing information regarding BFRT

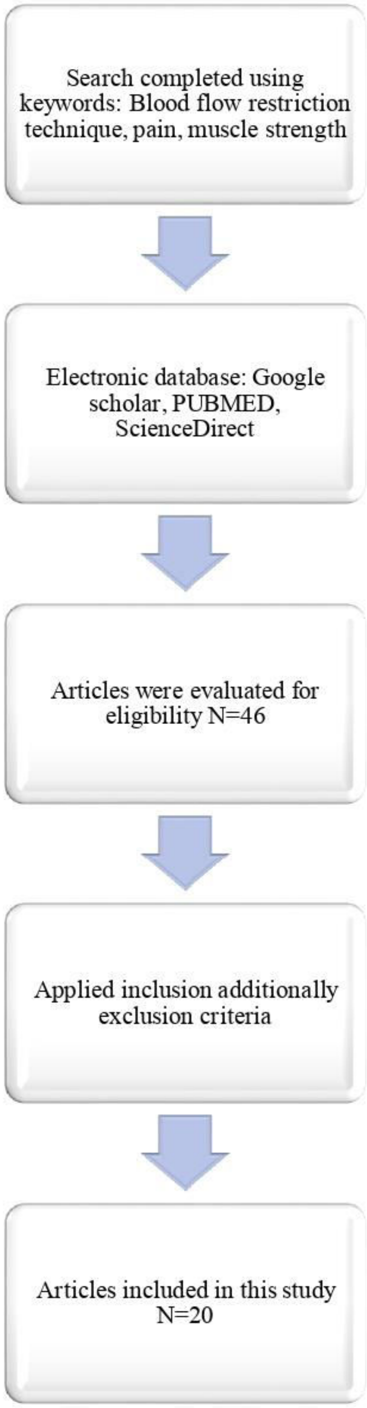
Information sources: Internet-based search engines that were used to collect journals are Google Scholar, PubMed and ScienceDirect. Journals from the year 2010 -2023 were searched.

Search strategy: Internet-based search engines that are used to collect journals are Google Scholar, PubMed and ScienceDirect.

Selection process: The authors identified articles according to the keywords. The whole text of the articles was gathered. A total of 46 articles were collected and only 20 articles were used in this study for the research. Articles were included from year 2010 to 2023. Articles include the incidence of effectiveness of blood flow restriction technique on reducing pain and increase muscle strength

Data collection process: The randomized controlled studies, systemic reviews and experimental studies that included evaluations of the information that was available on blood flow restriction technique associated with reducing pain and increase muscle strength were gathered by the authors through searches on PubMed and Google Scholar.

Study Flowchart



REVIEW OF LITERATURE:

Sr no.	Author	Title	Duration of treatment	Outcome measures	Study design	Conclusion
1.	Pehzaan Sarfabadi et al, 2023 [6]	Elevating athletic performance: Maximizing strength and power in long jumpers through combined low-intensity	6 weeks	Muscle strength	Experimental study	A study shows that combining low-intensity BFR and HI- RT enhances long jumper performance and strength, with future research focusing on individual muscle training.

		blood flow restriction and high-intensity resistance training				
2.	Sandra Rodrigues et al,2022 [7]	Effect of Blood Flow Restriction Technique on Delayed Onset Muscle Soreness: A Systematic Review	-	Muscle strength, pain, muscle girth	Systematic Review	According to the study, eccentric exercise along with high restrictive forces can cause DOMS, lengthen the recovery period, and result in strength improvements and muscle hypertrophy. Applying post conditioning with a preset restrictive pressure, with protocols varying from occlusion one to three times and three to five minutes, can help protect DOMS.
3.	Ian Burton et al, 2022 [8]	Blood Flow Restriction Training for Tendinopathy Rehabilitation: A Potential Alternative to Traditional Heavy-Load Resistance Training	9 weeks	Patellar Instability scale, VAS for pain	Randomized controlled trial	LL-BFRT has been shown to improve muscular adaptations and tendon function in healthy tendons, particularly Achilles and patellar tendons. Despite limited research on its effects on other musculoskeletal conditions, BFRT is an encouraging method for tendinopathy rehabilitation, complementing HL-RT interventions.
4.	Shuoqi Li et al, 2021 [9]	Effects of Blood Flow Restriction Training on Muscle Strength and Pain in Patients with Knee Injuries	-	Muscle strength, pain	A comprehensive analysis and meta-analysis	According to a study, L-BFR and high resistance exercise load considerably enhanced strength of muscles and lowered leg pain perception, suggesting that they could be used as a useful intervention for the recovery of knee injuries.
5.	Alexios Pitsillides et al, 2021 [10]	Blood flow restriction training in patients with knee osteoarthritis: Systematic review of randomized controlled trials	-	Muscle strength, pain	A Systematic review	study shows that BFR-TR method is ideal for managing KOA pathology, as it lessens discomfort and enhances muscular adaption. A six-week rehabilitation program with a maximum tolerable workload and rest period is recommended.
6.	Ryan J. Wortman et al, 2021 [11]	Blood Flow Restriction Training for Athletes A Systematic Review	-	Muscle strength, muscle size	A Systematic review	review suggests that Blood flow Resistance Training (BFR) can enhance strength and performance in healthy athletes, although there is variation within the extent to which BFR can increase muscle size.
7.	Cristina	Comparison of Blood	-	Muscle	Systemi	According to the reviewed

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	Bobes Álvarez et al,2020 [2]	Flow Restriction Training versus Non-Occlusive Training in Patients with Anterior Cruciate Ligament Reconstruction or Knee Osteoarthritis: A Systematic Review		strength, CSA, Pain, Functionality and/or Life Quality	c review	research, BFR exercise may have benefits for CSA and muscular strength comparable to high-intensity training. It could also yield outcomes comparable to low-intensity training in terms of life quality and degree of knee pain during exercise.
8.	Birk Mygind Grønfeldt et al, 2020 [12]	Effect of blood-flow restricted vs heavy-load strength training on muscle strength: Systematic review and meta-analysis	-	strength of muscle	A comprehensive analysis and meta-analysis	The meta-analysis suggests that LL-BFR training and high-load strength training are equally effective in enhancing maximal muscle strength in healthy adults, making it a viable alternative or supplement to conventional heavy-load resistance exercise.
9.	Simon Gavanda et al,2020 [13]	Low-intensity blood flow restriction calf muscle training leads to similar functional and structural adaptations than conventional lowload strength training: A randomized controlled trial	6 weeks	Pain, muscle strength, muscle mass.	A randomized controlled trial	The conclusion of the study showed that while LS and CV did not change, BFR calf training enhanced 1-RM and MT in guys trained in RT. Both groups pain VAS scores were comparable. Because BFR calf training takes less time to complete a session until concentric muscle failure, it is therefore preferable to No BFRT.
10.	Breanne S. Baker PhD et al, 2020 [14]	Does Blood Flow Restriction Therapy in Patients Older Than Age 50 Result in Muscle Hypertrophy, Increased Strength, or Greater Physical Function? A Systematic Review		Muscle strength, muscle hypertrophy	A Systematic Review and Meta-Analyses	The evidence suggests that BFR can stimulate muscle hypertrophy, thereby enhancing strength of muscles and athletic abilities in the elderly.
11.	Luke Hughes et al, 2019 [15]	Comparing the Effectiveness of Blood Flow Restriction and Traditional Heavy Load Resistance Training in the Post-Surgery Rehabilitation of Anterior Cruciate Ligament Reconstruction Patients: A UK National Health Service Randomised Controlled Trial	8 weeks	Muscle strength, pain, ROM,	A randomized control trial	As stated by the BFR-RT can lessen knee joint discomfort, increase skeletal muscle growth and strength, and effusion, and enhance overall physical function, making it more suitable for progressive limb loading in NHS ACLR patient populations.

12.	Ashley B. Anderson, MD et al, 2019 [16]	Blood Flow Restriction Therapy: From Development to Applications	6 weeks	Muscle strength	Review of literature	BFR training, supplemented with routine resistance, may enhance strength and muscle hypertrophy in military servicemen. It's suitable for patients' post-surgery or those unable to perform higher exertion levels, offering a potential rehabilitation augmentation method.
13.	Sue Barber-Westin, et al, 2019 [17]	Blood Flow–Restricted Training for Lower Extremity Muscle Weakness due to Knee Pathology: A Systematic Review	-	Muscle strength	Systematic Review	This thorough investigation showed that BFRT may improve quadriceps strength in knee-related weakness and atrophy patients. Short-duration vascular occlusion and low-load resistance exercises are safe after surgery or arthritic knees.
14.	Rubens Vinícius Letieri et al,2018 [18]	Effect of 16 weeks of resistance exercise and detraining comparing two methods of blood flow restriction in muscle strength of healthy older women: A randomized controlled trial	6 weeks	Muscle strength	A study that is controlled and randomized	BFR and resistance exercise in elderly women increase muscle strength levels, similar to high-intensity interval training (HI) without occlusion. Muscle strength gains are well preserved after six weeks of detraining, possibly due to neural adaptations. BFR methods are effective elder females, individuals with long-term disabilities, and post-surgical rehabilitation, the way they are low-cost and well-tolerated alternatives to traditional exercise.
15.	Rodrigo Branco Ferraz et al, 2018 [19]	Benefits of Resistance Training with Blood Flow Restriction in Knee Osteoarthritis	12 weeks	Muscle strength, muscle mass, pain	A randomized control trial	The study found that BFRT and HI-RT improved muscle strength, quadriceps muscle mass, and functionality in older female knee OA patients, while also improving pain and reducing joint stress, making BFRT a viable therapeutic adjuvant.
16.	Luke Hughes et al, 2017 [20]	Blood flow restriction training in clinical musculoskeletal rehabilitation: a systematic review and meta-analysis	-	Muscle strength, size, and mass	A comprehensive evaluation and meta-analysis	This review showed the significance of strength training in MSK rehabilitation, demonstrating that LL-BFR training offers a more effective and tolerable approach to low-load and heavy-load rehabilitation, with individualized prescriptions potentially reducing pain.

17.	Joshua Slysz Jack Stultz Jamie F. Burr et al, 2015 [1]	The efficacy of blood flow restricted exercise: A systematic review and meta-analysis	-	Muscle strength, muscle size	comprehensive evaluation and meta-analysis	This study demonstrated that exercise, when paired with BFR, increases muscle growth and strength. more than just low-load exercise. This suggests that BFR significantly contributes to adaptive processes, offering potential benefits to various practitioners, including individuals healing from orthopedic conditions and athletes. It also helps in progressing strength while lowering the weights on associated tissues.
18.	Christopher A. Fahs et al,2015 [21]	Muscular adaptations to fatiguing exercise with and without blood flow restriction	6 weeks	Muscular strength, muscular power, muscle endurance	Experimental study	The study suggests low-load resistance training, BFR or not, can increase muscular mass and endurance in middle-aged individuals. It suggests that total exercise volume is crucial for muscle adaptation, and low-muscular strength individuals may see the greatest strength adaptation.
19.	Stephen D. Patterson et al, 2011 [22]	Enhancing Strength and Post occlusive Calf Blood Flow in Older People With Training with Blood-Flow Restriction	4 weeks	Muscle strength	Experimental study	Research shows that a 4-week training intervention combining BFR and LLRT can dramatically boost power and blood-flow parameters in older adults.
20.	Stephen D. Patterson et al, 2010 [23]	Increase in calf post-occlusive blood flow and strength following short-term resistance exercise training with blood flow restriction in young women	4 weeks	Muscle strength	Experimental study	The study found that resistance exercise utilizing BFR increased peak post-occlusive blood pressure and power parameters, including maximal dynamic strength, maximal voluntary contraction, and isokinetic strength, compared to training without limitation of blood flow.This suggests that Blood flow limitation in LLRT is more effective.

DISCUSSION

This research attempted to evaluate BFRT's impact. to reduce pain and increase muscle strength. BFR training significantly improves strength of muscle over weeks, particularly in long jumpers. Combining low-intensity BFR with high-intensity resistance training enhances isometric, dynamic, and isokinetic strength, promoting muscle mass and strength. According to some research, eccentric exercise coupled with high restrictive forces can cause DOMS, lengthen the healing period, and encourage muscle mass and growth. Applying BFR after exercise could prevent DOMS more effectively. BFR's effects on DOMS, however, is still debatable; some research indicates pro-inflammatory effects, while others show anti-inflammatory benefits. some article suggests that, Patellar instability is a complex condition affecting the lower extremity, affecting quadriceps and hip strength. This trial aims to evaluate if combining standard physical therapy with BFRT significantly improves patient outcomes, function, and joint health over the initial two years of recovery. According to certain articles, BFR training helps patients with knee problems feel less discomfort and build more muscle. A meta-analysis showed that both L-BFR and H-RT improved patients' strength of muscles after knee injuries. However, L-BFR training had a lower pain score and more muscle strength. BFR training is linked to decrease blood flow, venous blood aggregation, and increased expression of insulin-like growth factor-1, leading to muscle growth and strength. L-BFR training is a desirable rehabilitation technique for the restoration of muscular strength as it is more successful in raising pain scores and lowering pain sensitivity. According to certain research, BFR training is just as effective as high intensity training (HI-TR) I helping people with knee osteoarthritis (KOA) increase their muscle strength. However, the results conflicted on the effect of BFR-TR compared to other intensities. BFR technique is popular for its potential to achieve strength and performance gains with lower resistance levels. It can be included into high-level athletes' training regimens or utilised in patients' rehabilitation after surgery who can't bear weight or engage in much activity. Larger muscles, sports performance metrics, as well as muscular strength can all be significantly increased with BFR training. But there is variability in frequency, durations, and protocols, making it challenging to determine which sports and athletes can benefit most from BFR training. some study showed that Occlusive training significantly increase strength of muscles and pain intensity in people who have ACL reconstruction or knee OA, according a systematic evaluation of ten RCTs. The study also revealed that quadriceps weakness persists post-surgery, emphasizing the need for rehabilitation. Despite differences in training regimens, the BFR group outperformed the high-load group of control in terms of performance**.** Some study explores the consequences of BFR pressures on strength in the muscles in older women, finding that resistance training that combines BFR and LI exercise increases strength, maintains it, and prevents decline to baseline values.

CONCLUSION:

However, after conducting this study BFR technique (BFRT) was found effective in reducing pain and improve muscle strength in various conditions like Long Jumpers, DOMS, Knee Injury, OA Knee, Patellar Instability, Athletes, ACL Reconstructions, Older Women, Muscle weakness. These results highlight BFRT's adaptability and potential use as a performance-enhancing and rehabilitative technique across a range of demographics and situations. The extensive applicability of BFRT in enhancing musculoskeletal health and function across many populations and clinical circumstances is supported by the study's substantial amount of data.

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A LITERATURE REVIEW ON WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG PROLONGED STANDING OCCUPATIONS

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ABSTRACT

Background: *Prolonged standing at work raises the risk of developing work-related musculoskeletal diseases (WRMSDs) in workers. According to studies, extended standing causes pain, discomfort, tiredness, and a variety of other musculoskeletal disorders. The goal of this literature review is to guide future research and interventions to promote musculoskeletal health in the workplace, and to further our understanding of WRMSDs among individuals in standing employment by synthesizing the available information.*

Study design: *Systematic Review.*

Objective*: This overview of the literature was conducted to identify the occurrences of musculoskeletal problems linked to long-term standing occupations.*

Method*: The randomized controlled studies, systemic reviews and experimental studies that included evaluations of the information that was available on musculoskeletal disorders associated with prolonged standing at work in long-standing occupations were gathered by the authors through searches on PubMed and Google Scholar. The entire texts of the articles were gathered. 20 out of a total of 53 recognized articles were selected for review.*

Results: *All of this research points to the adverse effects that long-standing at work has on musculoskeletal health. Long-standing relates to pain, exhaustion, and a various kind of musculoskeletal disorder in settings ranging from industrial enterprises to schools.*

Conclusion: *In conclusion, this review confirms that prolonged standing at work significantly increases the risk of musculoskeletal disorders, causing pain, discomfort, and fatigue among workers in various occupations. Comprehending these hazards is essential for implementing efficient interventions and ergonomic fixes to enhance employees' well-being.*

Keywords: *Work-related musculoskeletal disorder, pain, discomfort, standing occupations.*

INTRODUCTION

A wide spectrum of inflammatory and degenerative conditions that cause discomfort and functional impairment affecting the neck, shoulders, elbows, wrists, hands, lower back and legs are collectively referred to as work-related musculoskeletal disorders. Musculoskeletal disorders associated with work are regarded as a serious occupational health issue that lowers productivity and working capacity in the working population. According to the Oxford Dictionary, "standing" refers to being straight and supported by one's feet, and "prolonged" refers to maintaining the same position for a longer period than usual. "Prolonged standing" is defined as a work environment in which employees must maintain a standing posture for the majority of their shift and spend more than half of their working hours in this posture. When there is no movement, prolonged standing can be very detrimental; nevertheless, even little motions within a one-meter radius can improve worker health. Over four hours day of standing and more than an hour without getting away from one's desk is referred to as extended standing by the Dutch Health Council.[2]

Musculoskeletal disorders associated with work are regarded as a serious occupational health issue that lowers productivity and working capacity in the working population. Risks associated with repeated motions, bad posture, pushing and transporting heavy weights, carrying large objects, and bending are experienced by workers in a variety of industries and occupations. The risk of musculoskeletal injuries rises with exposure to certain risk factors. The degree and length of exposure, in addition to the work environment, all influence the likelihood of health hazards.[9]

WRMSDs are excruciating conditions affecting the ligaments, tendons, and muscles. The main causes are uncomfortable working postures and repeated tasks. Muscles, tendons, and nerves are the soft tissue types that are typically damaged. When a muscle contracts, lactic acid from the blood is produced, building up within the muscle and causing irritation and discomfort. A robust, fibrous collagen structure called a tendon connects muscle to bone. It is neither elastic nor flexible. It falls into two categories: sheathed tendons, which are found in the hands and wrist, and unsheathed tendons, which are located in the shoulder, elbow, and forearm. Cells within the sheaths generate a fluid. This liquid lubricates the joint between the muscle and the tendon. The tendon becomes inflamed and swollen between the tendon and sheath when it moves too much or repetitively, which inhibits lubrication and may not generate enough fluid for it. Owing to the thickening of the tendon sheath caused by fibrous tissue growth, recurrent inflammation inhibits tendon mobility.[9]

Workers are prone to weariness and injuries due to the fact that their occupations necessitate them to use the same muscles and tendons repeatedly throughout the day. Repetitive motions can be dangerous when the same joints and muscle groups are used repeatedly, rapidly, and for extended periods. Performing repetitive tasks in an uncomfortable posture is the primary cause of musculoskeletal disorders .[9]

When joints are repeatedly functioned outside of the neutral position for prolonged periods of time without adequate rest, the likelihood of developing a musculoskeletal condition rises. The physical strain brought on by maintaining the same position or posture for an extended amount of time is known as static posture. Fatigue is a result of the increased load or stresses that these kinds of exertions place on the muscles and tendons. Long-term static postures cause workers' muscles to stiffen up while they are working without a chance to relax. Injuries might result from repeatedly adopting this stationary position.[9]

Muscle cramps, varicose veins and foot and ankle issues are the results of prolong standing. When standing for an extended amount of time, muscles must maintain the posture of the body. This causes the muscles blood vessels to constrict, lowering the amount of blood flowing through them. Inadequate blood flow causes muscles to become more easily fatigued and more vulnerable to damage.[2]

Blood pooling was the most often mentioned mechanism for lower extremities discomfort after extended standing. Extended standing times have been linked to higher amounts of blood flow, skin temperature, and leg volume, perhaps exacerbating the beginning of musculoskeletal complaints.[10]

Long periods of standing can also cause static spasms in the legs and back, which can exacerbate lower back discomfort by transferring the weight of the upper body to the lower extremities.[14]

METHODOLOGY

Study design: It is a systematic review, which was described according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

Eligibility criteria:

Inclusion criteria:

- Articles were included from year 2010 to 2023.
- Articles include the incidence of workplace musculoskeletal disorder due to long periods of standing in different occupations.

Exclusion criteria:

- Articles before the year 2010 not be included.
- No pathological disorders, fractures, or neurological conditions were included which caused work-related musculoskeletal disorders.

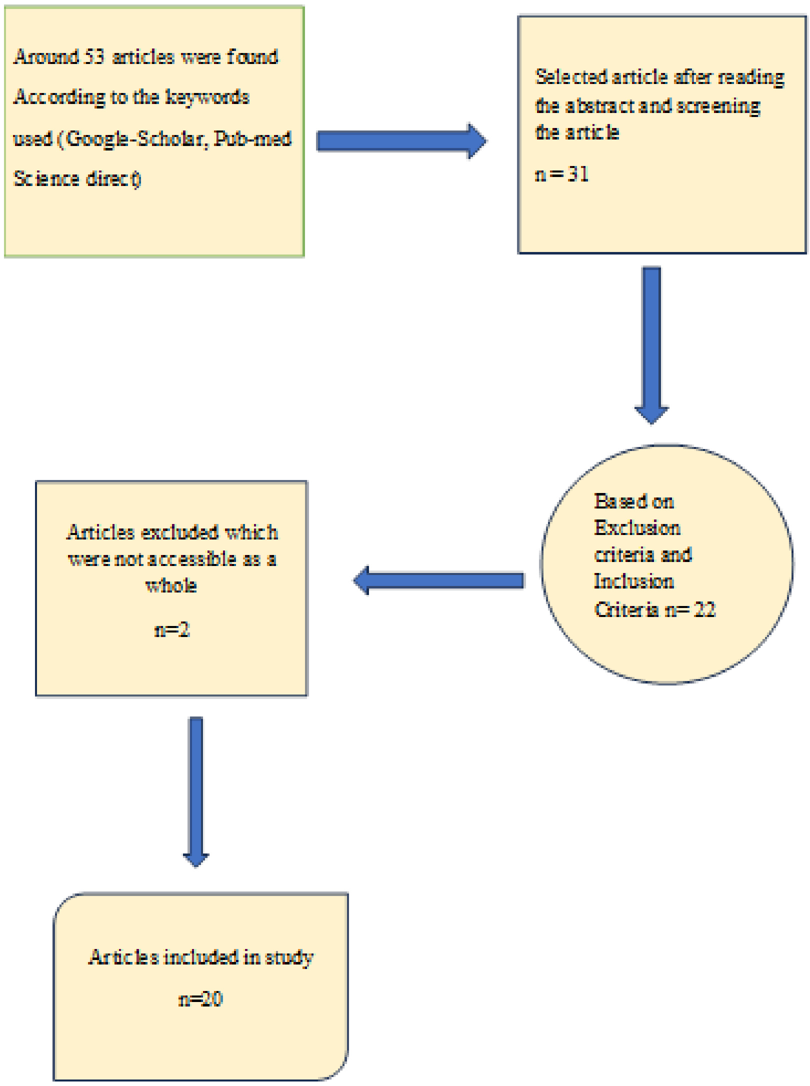
Information sources: Internet-based search engines that were used to collect journals are Google Scholar, PubMed and ScienceDirect. Journals from the year 2023 -2010 were searched

Search strategy: Internet-based search engines that are used to collect journals are Google Scholar, PubMed and ScienceDirect.

Selection process: The authors identified articles according to the keywords. The whole text of the articles was gathered. A total of 53 articles were collected and only 20 articles were used in this study for the research. Articles were included from year 2010 to 2023. Articles include the incidence of workplace musculoskeletal disorder due to long periods of standing in different occupations.

Data collection process: The randomized controlled studies, systemic reviews and experimental studies that included evaluations of the information that was available on musculoskeletal disorders associated with prolonged standing at work in long-standing occupations were gathered by the authors through searches on PubMed and Google Scholar.

Study Flowchart



REVIEW OF LITERATURE:

- **Hoon Jo, One-bin Lim et al 2021**; conducted a study on the Negative Impacts of Prolonged Standing at Work on Musculoskeletal Symptoms and Physical Fatigue. This study sought to ascertain the consequences of varying durations of standing work on the potential for low back discomfort, lower extremity muscle soreness, and general body exhaustion, taking into account exposure to risk variables and rest periods. Their findings demonstrated that, even after adjusting for a number of factors, the incidence of lower extremity muscular discomfort rose significantly with the length of time spent standing.[1]

- **Nicolien de Langen et al 2020,** investigated the hazards and health effects of extended standing at work. Frequently standing for extended periods can cause weariness and discomfort in the feet, lower back, and lower limbs. It is linked to low blood pressure, leg pain, premature birth, musculoskeletal pain, chronic venous insufficiency, and spontaneous abortions. The worst cases of prolonged standing occur when there is little to no movement; even modest motions within a one-meter radius can improve worker health.[2]

- **Ayuni Nabilah Alias et al 2020**, conducted a study on Does Prolonged Standing at Work Among Teachers Associated With Musculoskeletal Disorders (MSDs).This study reviews the MSDs that result from standing for extended periods and disseminates information about current ergonomic and non-ergonomic strategies to reduce standing for pain that lasts for a long time. Teachers frequently stand for prolonged lengths of time, which can cause soreness, weariness in the muscles, and even musculoskeletal illnesses (MSDs). It is recommended to maintain the same posture for over half of the working hours which is known as prolonged standing. This could result in muscle discomfort and exhaustion by the end of the workday., which may eventually compromise posture.[3]

- **Fatima Bashir et al 2020,** conducted a study on Frequency of Work-Related Musculoskeletal Disorders of Lower Extremity Among Construction Workers. Lower extremity pain from musculoskeletal (MSK) disorders is a significant occupational danger for construction workers. Because labourers must perform heavy lifting, constant bending, twisting, prolonged standing, and uncomfortable sitting. 20 people (13.2%) reported having hip discomfort, 25 had knee pain (16.6%), and 29 reported ankle/foot pain (19.9%). Age and the kind of work has a strong correlation with lower extremity discomfort. Due to the nature of their work, construction workers frequently have lower extremity musculoskeletal pain.[4]

- **Olanrewaju O Okunribido. David Lewis et al 2020,** examined lower limb musculoskeletal disorders at work and their impact on quality of life. Their findings emphasized the prevalence of lower limb disorders in various workplace settings and highlighted the economic and social impacts of these injuries, stressing the importance of preventive measures to reduce lost productivity.[5]

- **Zutiqa Aqmar Yazuli1 et al 2019** conducted a study on Discomfort, fatigue and work-related musculoskeletal disorders associated with prolonged standing among Malaysian manufacturing workers: A mini - review. Extended periods of standing, particularly in the absence of sufficient rest, may lead to weariness, musculoskeletal disorders (WMSDs), and soreness in the muscles. Pain can arise from awkward standing positions, and extended standing can cause muscle exhaustion as early as ninety minutes. Additionally, research shows that muscular soreness gets greater with time, especially during the first 30 and 90 minutes of standing. The body sections commonly afflicted include the foot, ankle, upper back, lower leg, hips, and lower back.[6]

- **Amara Afzal, Qaseem Idrees et al 2018**, conducted study on Prevalence Musculoskeletal Disorder of Lower Quadrant among teachers**.** The aim of this article is to determine how common lower quadrant musculoskeletal disorders are among educators. A questionnaire was utilized in this cross-sectional research to collect data from 184 school teachers, and the NPRS was accustomed to gauge each teacher's level of discomfort. Findings: Of the 184 participants, 60 reported low back discomfort, 15 pelvic pain, 26 knee pain, and 22 ankle/foot pain. In conclusion, the job routines of teachers lead to the development of musculoskeletal disorders. Musculoskeletal disorders are caused by prolonged work hours and uncomfortable standing positions.[7]

- **Jae-Gwang Lee, Guang Hwi Kim et al 2018,**investigated the association between long working hours and work-related musculoskeletal symptoms of Korean wage workers using data from the Fourth Korean Working Conditions Survey (KWCS). Furthermore, in the previous year, 26.4% of male participants and 33.0% of female participants experienced upper limb pain due to their jobs, whereas 16.4% of male participants and 23.4% of female participants reported lower limb pain. The study demonstrated the link between extended work hours and musculoskeletal symptoms linked with the workplace by showing that the frequency of upper and lower extremities pain rose in both genders as weekly working hours increased.[8]

- **Leela Paudel et al 2018**, examined musculoskeletal complaints among traffic police officers that were related to their jobs. Considering that they have to stand for extended periods of time while on duty, traffic cops frequently run health hazards. Workers who adopt static postures, where they stay remaining stationary for protracted lengths of time, put more strain on their muscles and tendons, increasing the risk of tiredness and injury. Varicose veins, foot issues, and leg tiredness can all result from prolonged standing. Moreover, it lessens the blood flow to the muscles, hastening their tiredness and making them more susceptible to harm.[9]

- **Coenen, P. and Parry, S. et al 2017,** A systematic evaluation of laboratory studies on the health effects of extended standing was carried out in 2017 by Coenen, Parry, and associates. Long hour of standing has been associated to negative health effects, such as venous problems of the lower extremities, issues during pregnancy, and musculoskeletal complaints like pain and stiffness. In particular, there was a negative correlation found between extended standing and low back pain, however there was conflicting data for lower extremities pain.[10]

- **Shaikh Abdus Samad et al 2016,** reviewed the issue of workers in manufacturing businesses who must stand for extended hours of time in 2016. Such professions require a lot of standing, which can cause a several health problems, such as stiff neck and shoulders, low back discomfort, muscular exhaustion, varicose veins, aching feet, and leg swelling. Industrial workers frequently experience pain, which lowers their productivity. Prolonged standing can cause work-related musculoskeletal diseases (WMSD), which can affect muscles, tendons, nerves, and supporting structures. These disorders can cause pain, discomfort, swelling, numbness, and other symptoms.[11]

- **Edda Maria Capodaglio 2016,** assessed the postural risks associated with prolonged standing among garment sales associates. Their study identified potential interventions to prevent lower limb fatigue, such as postural adjustments and ergonomic workstation design. They emphasized the real risk of discomfort and musculoskeletal disorders in occupations requiring prolonged standing, underscoring the need for ergonomic interventions to protect worker health.[12]

- **Thomas R. Waters, Ph.D. and Robert B. Dick, Ph.D. et al 2015 ,** A review of the health hazards and interventions associated with standing for long periods of time at work was carried out in 2015 by Thomas R. Waters and Robert B. Dick. According to the research, even brief static standing sessions as little as thirty minutes can cause pain, discomfort, and physical exhaustion. Furthermore, age affects how people react to standing for extended periods. In conclusion, a wealth of research points to a negative correlation between extended standing at work and health outcomes.[13]

- **Ahmad Alghadir, PT, et al 2015.** Investigated musculoskeletal disorders associated with dentistry professionals' jobs. Their objectives were to ascertain the frequency of these illnesses, their contributing variables, and their effects, and suggested preventive actions. The study brought to light the high frequency of musculoskeletal problems related to the workplace among dental professionals, which can have an impact on their day-to-day activities and occasionally require adjustments to their work environments.[14]

- **Isa Halim et al 2012** created the Prolonged Standing Strain Index (PSSI) in 2012 to evaluate the risk levels related to standing work. Standing for long periods can lead to pain and weariness in the muscles, particularly in the legs and back. The PSSI takes into account several risk variables associated with standing occupations, including whole-body vibration, working posture, muscular activity, length of standing, holding time, and indoor air quality. The PSSI measures the degree of risk by multiplying these parameters by the multipliers that are assigned to them. Based on the PSSI, the study suggests precautions to reduce these risks, but it also points out that more investigation is required to confirm these measures' efficacy.[15]

- **Isa HALIM, Abdul Rahman et al 2012 ,** studied the effects of prolonged standing on production workers' psychological and physical exhaustion in 2012. In order to assess psychological exhaustion, they employed questionnaire surveys and surface electromyography (sEMG) measurements to examine lower extremity muscle activation, namely in the erector spinae, tibialis anterior, and gastrocnemius. The results showed that extended standing caused psychological weariness in all of the male manufacturing workers, while sEMG readings also confirmed physical fatigue. As a result, the study found that these workers' prolonged standing caused both psychological and physical exhaustion**.**[16]

- **Isa Halim & Abdul Rahman Omar et al 2011,** reviewed the health impacts, evaluation techniques, and preventative actions associated with extended standing in industrial settings in 2011. If a worker spends more than 50% of their working hours standing, they are said to be exposed to prolonged standing. This prolonged standing can cause discomfort by wearing down your muscles, particularly in your legs and back. The analysis comes to the conclusion that extended standing is linked to a number of health issues, including musculoskeletal diseases related to the job**.** [17]

- **Christopher R. Reidet et al 2010,** conducted a review on occupational postural activity and lower extremity discomfort. The study examines the main extrinsic factors associated with profession that produce discomfort on the job. These factors include individual joint position, whole or partial body posture, and occupational activity. The review's findings show that the three joints or segments most impacted by work postures are the knee, lower leg, and foot. The hip, lower leg, ankle, and foot appear to be commonly impacted by work-related activities. Study reviews indicate that stooping positions have the greatest impact on LE.[18]

- **Robert A. Werner et al 2010,** determine risk factors for foot and ankle problems linked to extended standing and walking. Werner studied assembly line workers in 2010. The study discovered a correlation between a higher risk of foot and ankle diseases and variables such as greater metatarsal pressure while walking and increased walking time**.**[19]

- **Anil Sobti, MB, Cyrus Cooper et al 2010,** studied the relationship between physical activity at work and musculoskeletal discomfort in 2010. They polled 5,042 retired post office workers in their 70s and 75s. Over a month, 20–50% of individuals in the study reported having pain or stiffness in various musculoskeletal regions, including the knee, hip, shoulder, hand, or lower back. Women experienced these sensations more frequently, and they frequently happened in groups at various locations. [20]

DISCUSSION

The findings presented in the study possess important ramifications for policy, practice, and research. First of all, they highlight how vital it is to take preventative action to mitigate the negative consequences of extended standing on the health and well-being of workers. To reduce the incidence of musculoskeletal problems, this involves implementing ergonomic solutions including sit-stand desks and frequent rests. Furthermore, the results highlight the need to educate employers and workers about the risks associated with extended standing and the necessity of implementing preventative measures.

The 2021 study by Hoon Jo et al. revealed that long periods of standing at occupation led to increased risks of low back discomfort, lower extremity muscle ache, and whole-body fatigue. Workers in the manufacturing sector reported higher rates of plantar fasciitis and lower limbs muscle tightness due to long period of standing. Checkout counter workers, who often stand for extended periods, experienced elevated rates of lower limb and ankle/foot discomfort. Additionally, the study highlighted that awkward or unsafe standing postures contributed to work-related musculoskeletal pain.

In 2020, Nicolien de Langen and colleagues investigated the risks and consequences on health linked with prolonged standing work. They investigated that working for over 8 hours regularly while standing was linked to many health issues, such as persistent venous insufficiency, musculoskeletal pain, preterm birth, low blood pressure, and upper and lower leg pain. The study emphasized the importance of incorporating movement within a restricted radius to mitigate the adverse effects of prolonged standing.

A 2020 study by Fatima Bashir et al. explored the frequency of musculoskeletal problems linked with construction workers who faced demands such as heavy lifting, repetitive bending, twisting extended standing and uncomfortable seating. The research revealed an increased frequency of musculoskeletal discomfort in the lower limbs among construction workers, highlighting the significant impact of their occupational demands on their health. The 2020 study by Ayuni Nabilah Alias et al. focused on the discomfort, muscle fatigue, and musculoskeletal disorders (MSDs) resulting from prolonged standing in classrooms, particularly among school teachers. The research found that teachers, due to their prolonged standing during school hours, often experienced body pain and discomfort, which could lead to MSDs.

In 2019, Zutiqa Aqmar Yazuli et al. assessed discomfort, fatigue and musculoskeletal problems associated with the workplace among Malaysian manufacturing workers. Prolonged standing was identified as a leading contributor to muscle discomfort and fatigue, especially in the back and lower extremities.

A 2018 study by Amara Afzal and Qaseem Idrees examined the incidence of musculoskeletal conditions in the lower quadrant among teachers. The research found that long job durations and prolonged periods of standing in uncomfortable positions were contributing factors to musculoskeletal disorders among teachers. In2018, Jae-Gwang Lee and Guang Hwi Kim carried out research on the relationship between Korean wage earners' lengthy work hours and musculoskeletal ailments related to their jobs. The study emphasised the negative effects of extended workdays on employees discomfort in their legs and upper extremities'. In 2018, Leela Paudel and colleagues conducted a study to examine musculoskeletal complaints associated with job among traffic police officers, who frequently stand for extended periods of time. The study found that discomfort and weariness were common among traffic cops, highlighting the significance of extended standing, still positions, and repeated motions as risk factors.

In 2017, Coenen, P. and Parry, S. et al. conducted a systematic review on the associations of prolonged standing with musculoskeletal symptoms. The review underscored the adverse impacts on health associated with prolonged standing, including lower extremity venous disorders, perinatal health complications, and musculoskeletal symptoms.

Thomas R. Waters, Ph.D., and Robert B. Dick, Ph.D., presented a report in 2015 that demonstrated the health hazards and efficacy of interventions related to long hour of standing at work. The study covered consequences of extended standing on cardiovascular issues, weariness, discomfort, lumbar and lower extremity pain, and pregnancy-related health consequences. In order to lessen the risks associated with extended standing, it also suggested interventions such as floor carpets, sit-stand workstations, shoes, shoe inserts, and hosiery or stockings. Additionally, a study conducted in 2015 by Ahmad Alghadir, PT, et al. looked at musculoskeletal diseases associated with the dental profession in Saudi Arabia. The study found that long periods of standing and other work-related variables commonly caused dental practitioners to feel pain in different parts of their bodies.

Isa Halim created the Prolonged Standing Strain Index (PSSI) in 2012 to measure the dangers connected to standing occupations and to suggest ways to reduce them. The study emphasized how crucial it is to Frequently take breaks from extended standing and wear appropriate footwear to avoid weariness and pain.

Isa Halim and Abdul Rahman Omar's 2011 research shed light on the negative health impacts of standing for extended periods at industrial jobs. The study made clear that extended standing may cause pain and exhaustion in the muscles, particularly in the back and legs, even though it facilitated mobility and efficient functioning. Extended standing has been connected to work-related musculoskeletal diseases (WMSD), which are brought on by severe strain at work on the body and mind and develop over time.

An analysis of lower extremity discomfort and occupational postural activity was carried out in 2010 by Christopher R. Reid and colleagues. Their analysis revealed that distinct lower extremity regions were impacted by diverse work-related postures and activities, with the foot, lower leg, and knee being the most frequently afflicted.

Finally, in order to investigate the connection between musculoskeletal pain syndromes and occupational physical activity, Anil Sobti and Cyrus Cooper surveyed post-office pensioners in 2010. According to the survey, a sizable fraction of retirees had musculoskeletal complaints, which included pain or stiffness in the knee, hip, shoulder, hand, and lower back, among other body parts. By highlighting links between particular occupational activities and regional pain syndromes, the study emphasized the necessity of workplace preventive measures to lower the frequency of musculoskeletal illnesses.

LIMITATIONS AND PROSPECTS FOR UPCOMING STUDIES

It is crucial to recognise the inherent constraints of the studies presented in the table. Small sample sizes, the application of self-reported data, and possible confounding variables are a few examples of these. Future studies should use bigger sample sizes, longitudinal study designs, and objective measures of musculoskeletal health in an effort to overcome these limitations. More studies that concentrate on certain occupational groups and examine the efficacy of various interventions in the therapy and avoidance of musculoskeletal disorders connected to the place of employment are also required.

CONCLUSION

In conclusion, all of this research points to the negative consequences of extended standing at work on musculoskeletal health. Long hours of standing have been connected to weariness, discomfort, and various muscular-skeletal disorders in settings ranging from manufacturing enterprises to schools. Comprehending these hazards is essential for implementing efficient interventions and ergonomic fixes to enhance employees' well-being.

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5 Olanrewaju O, Okunribido D. 2020) examined lower limb musculoskeletal disorders at work and their impact on quality of life
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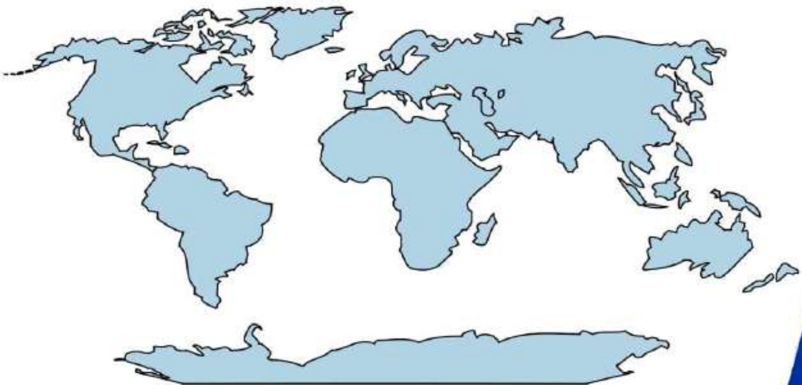

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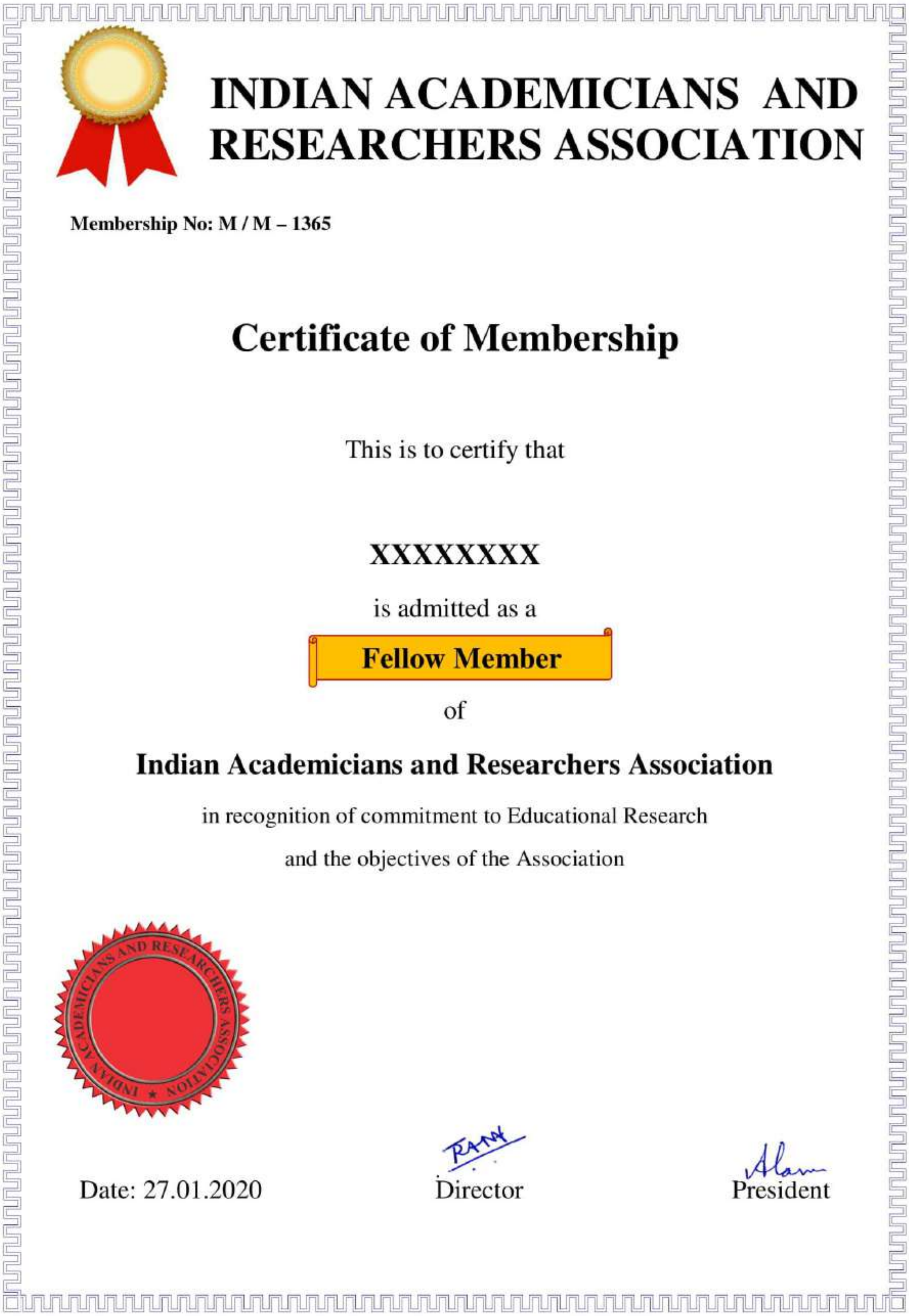

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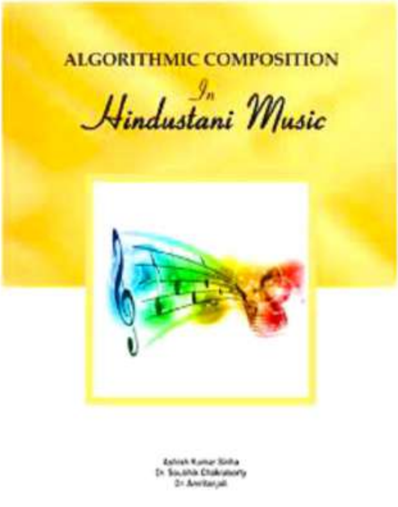

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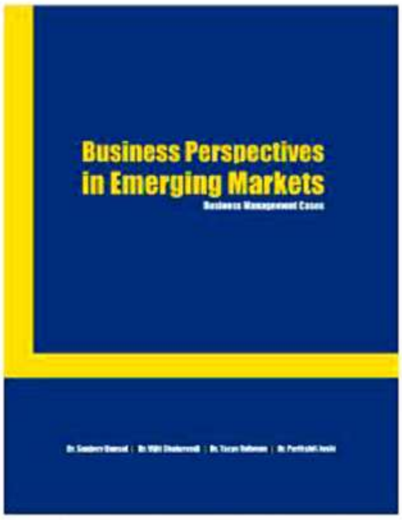

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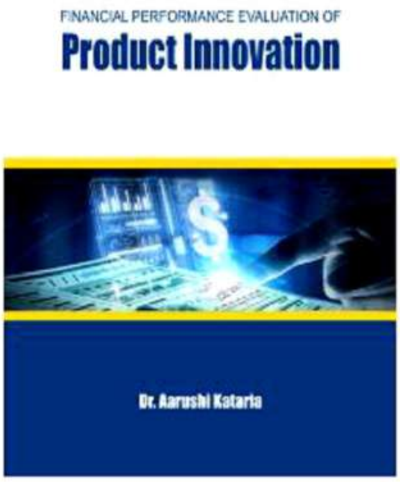

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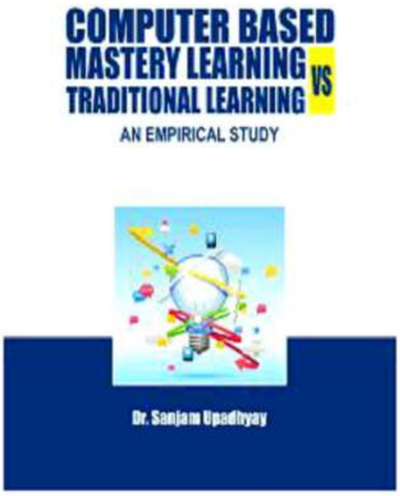

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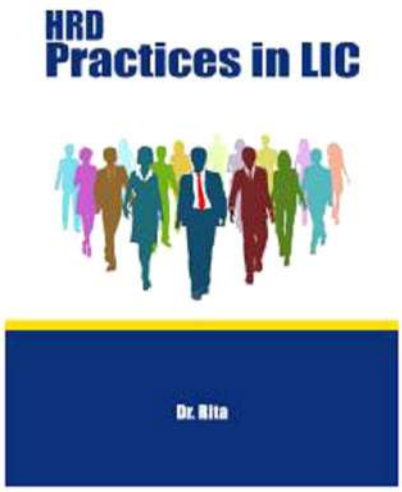

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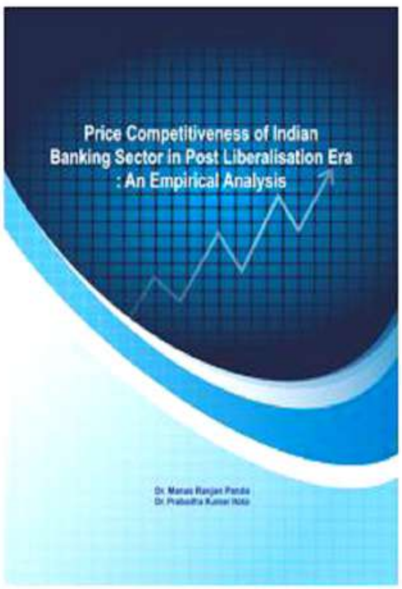

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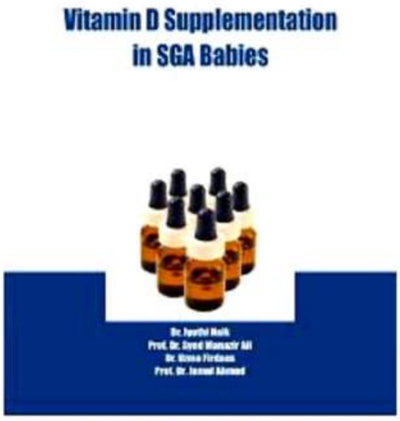

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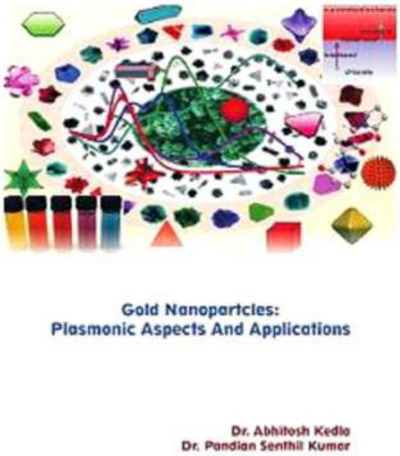

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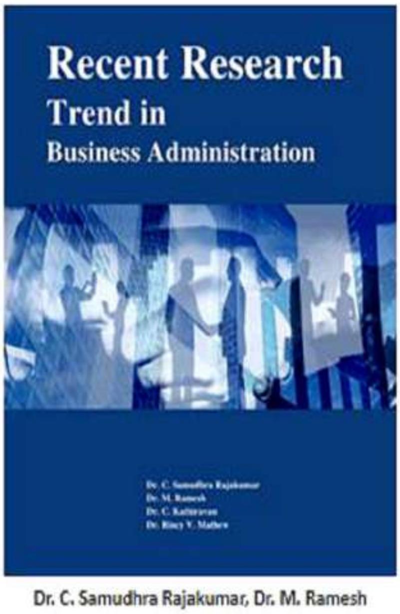

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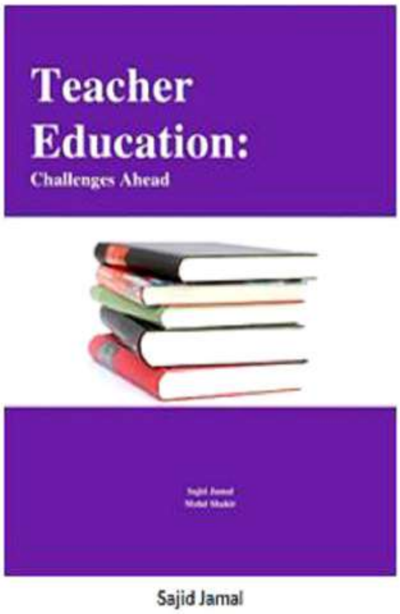

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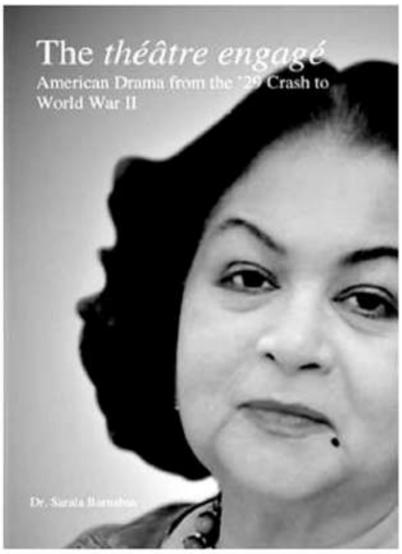

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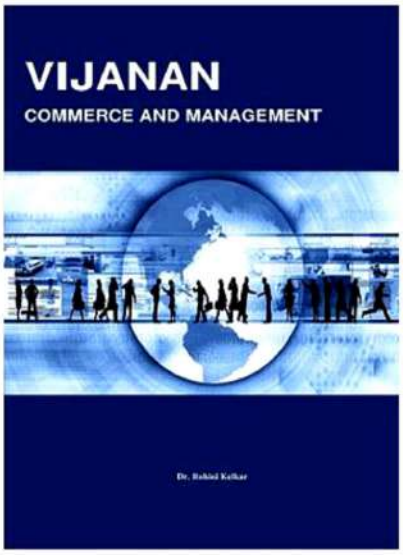

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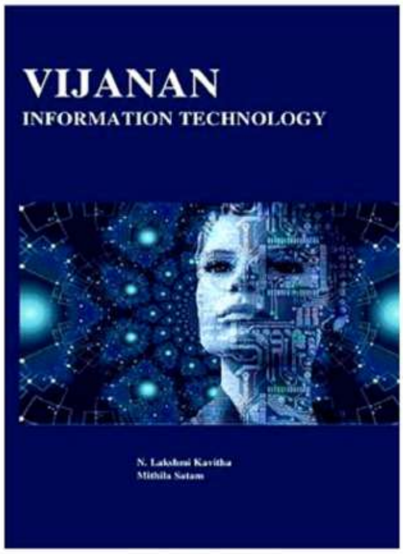

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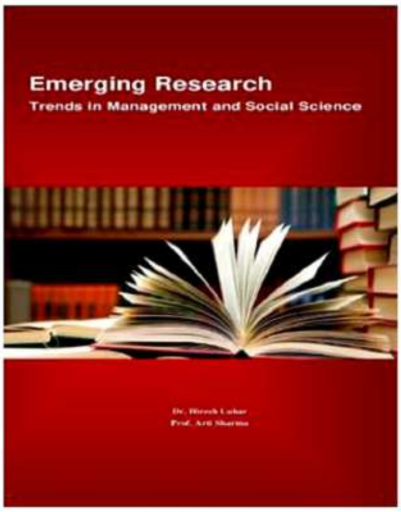

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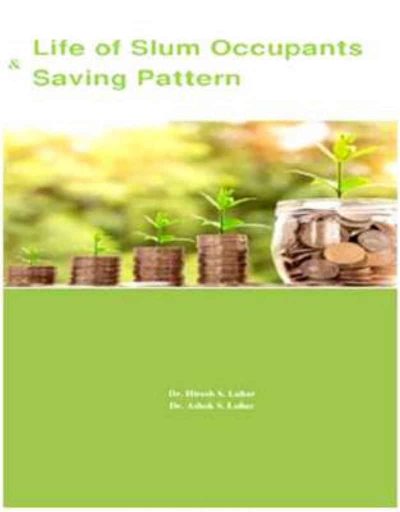

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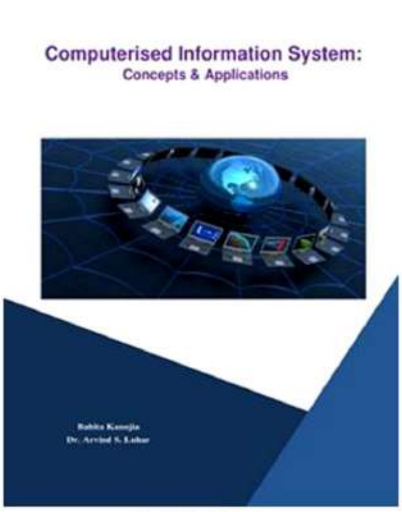

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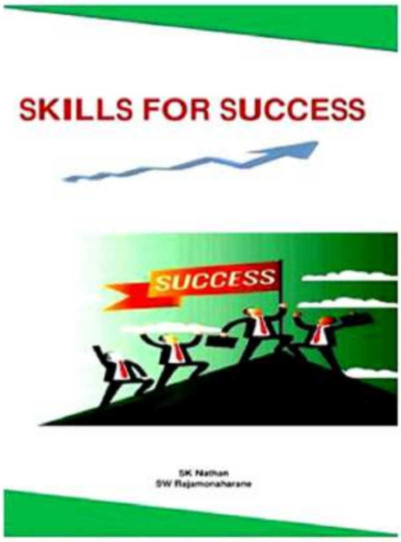

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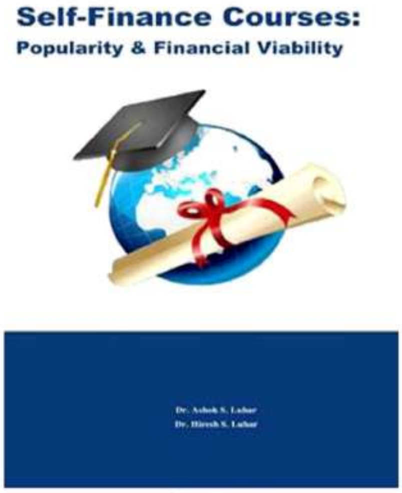

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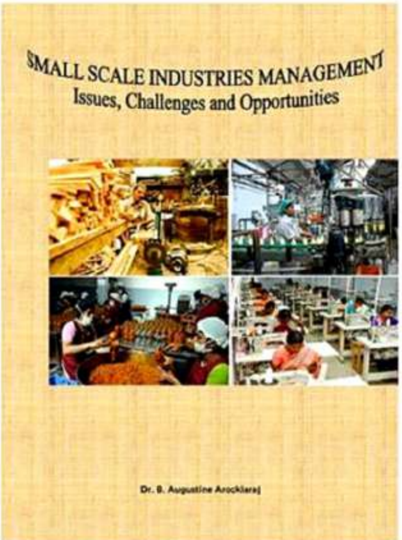

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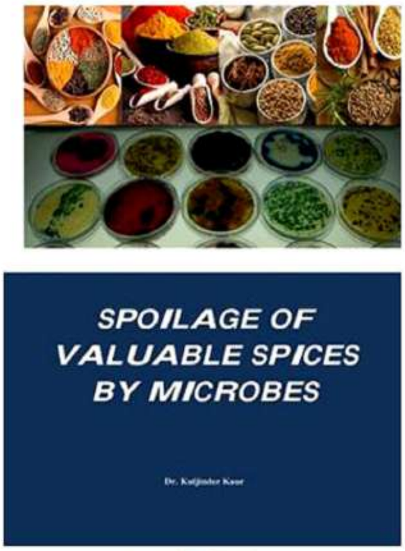

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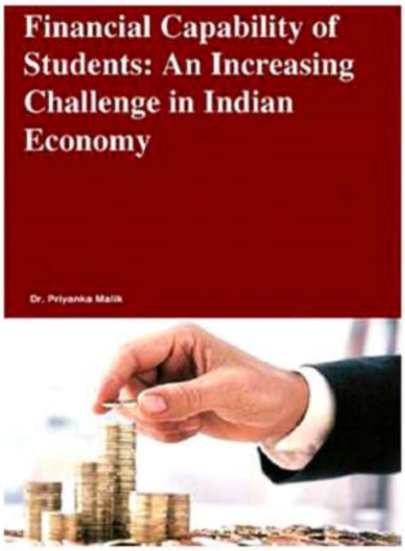

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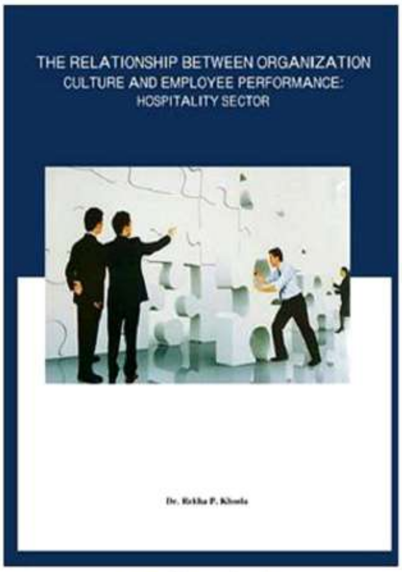

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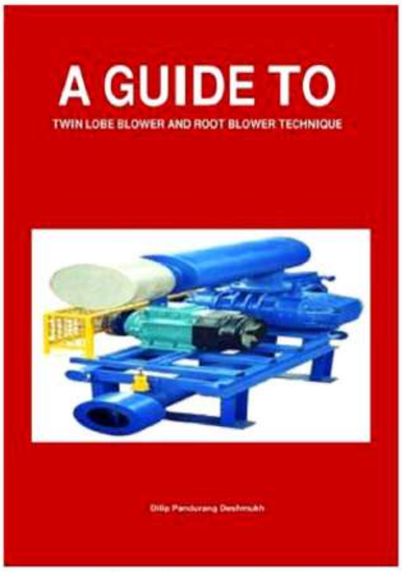

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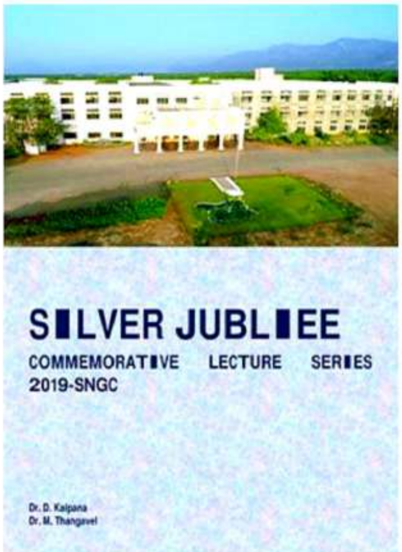

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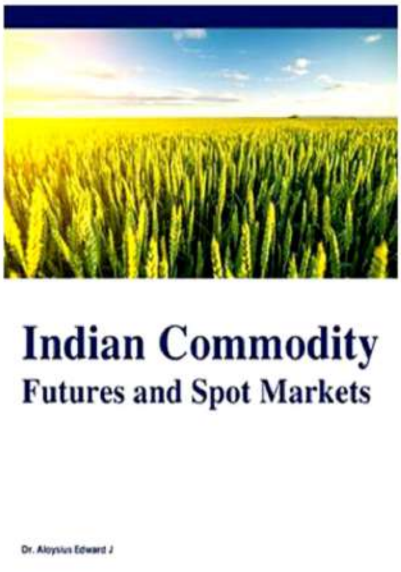

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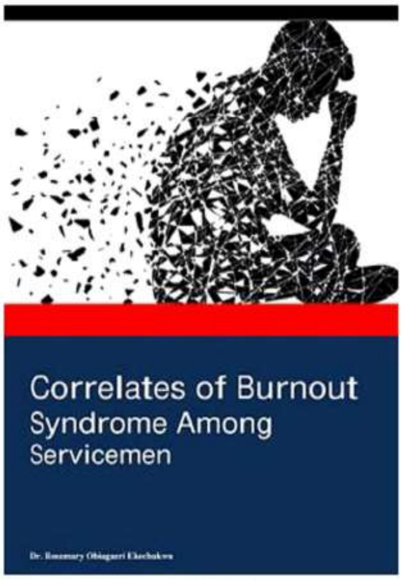

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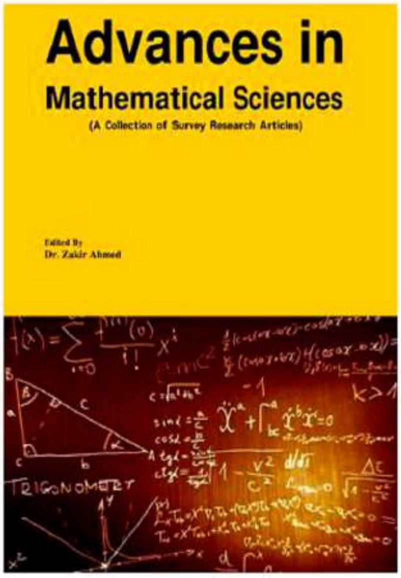

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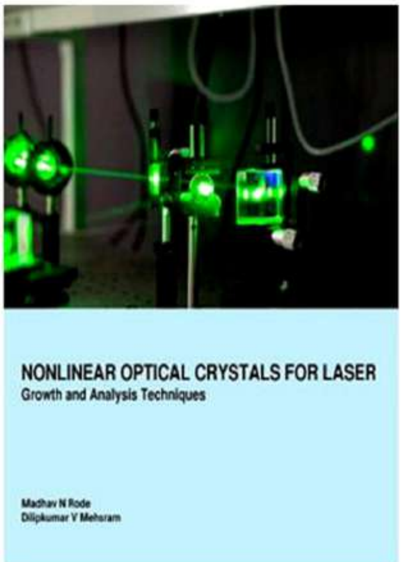

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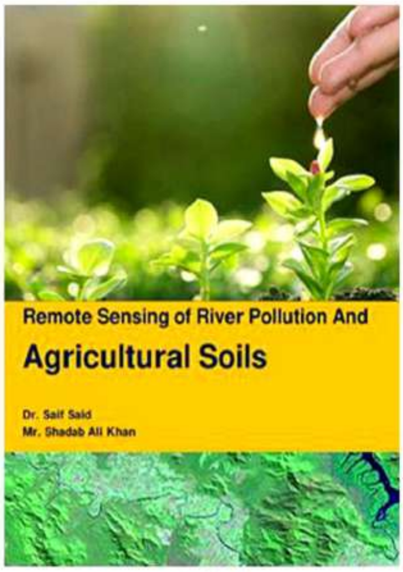

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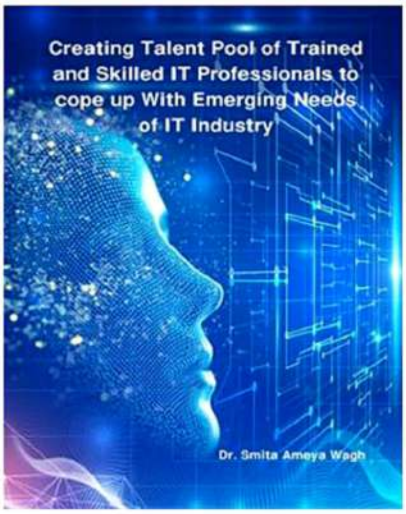

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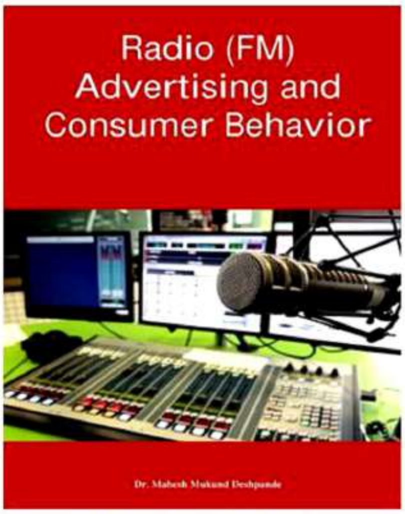

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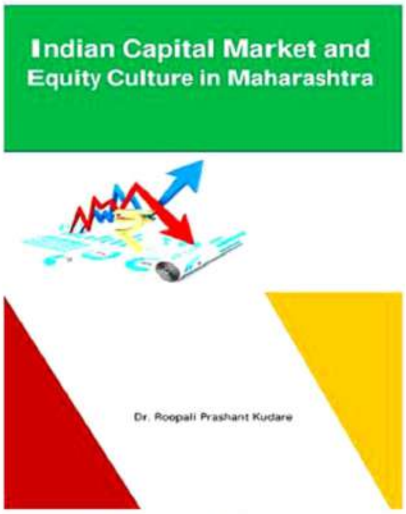

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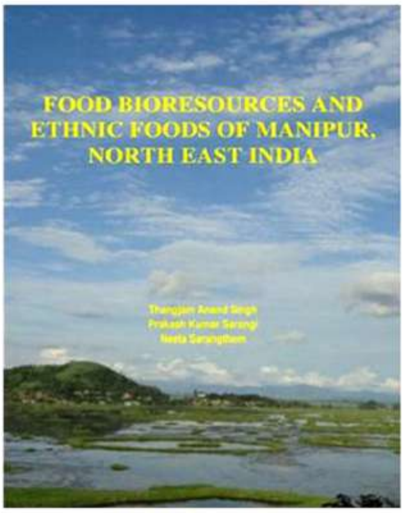

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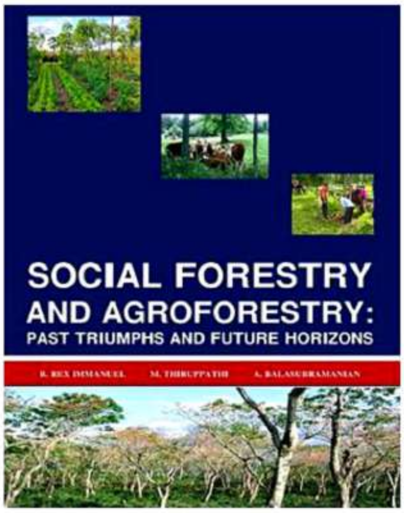

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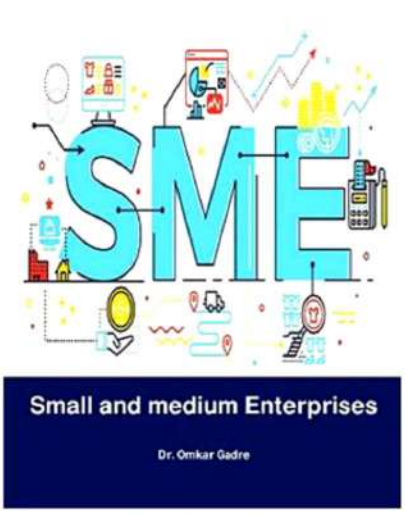

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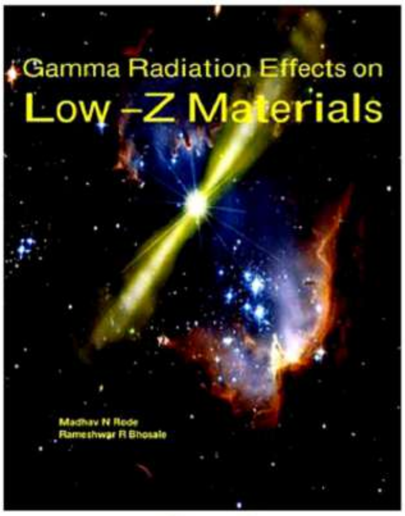

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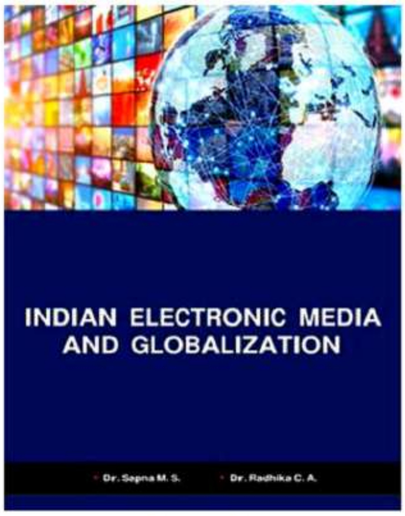

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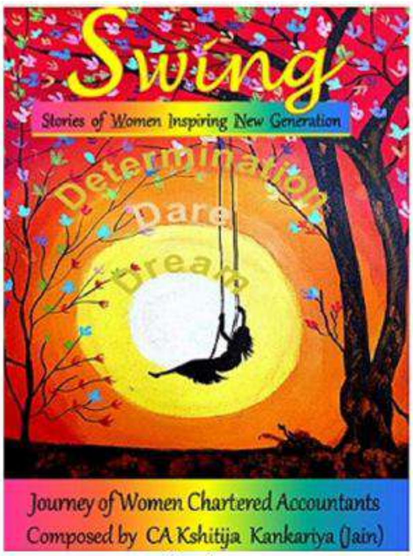

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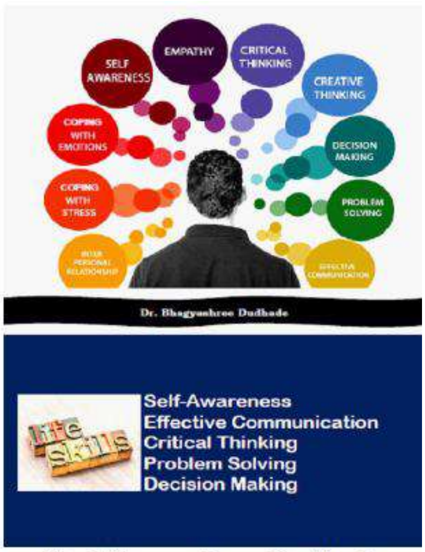

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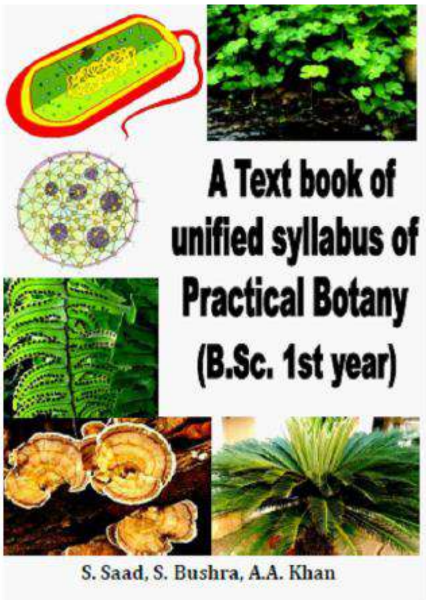

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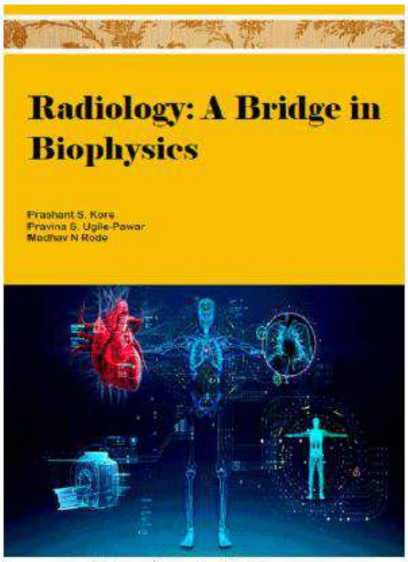

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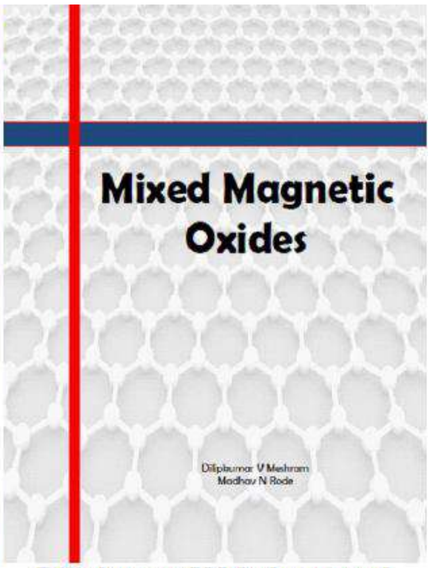

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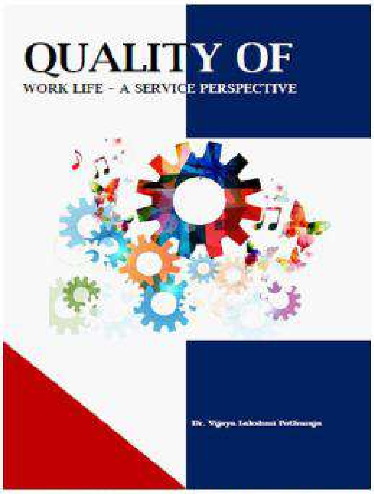

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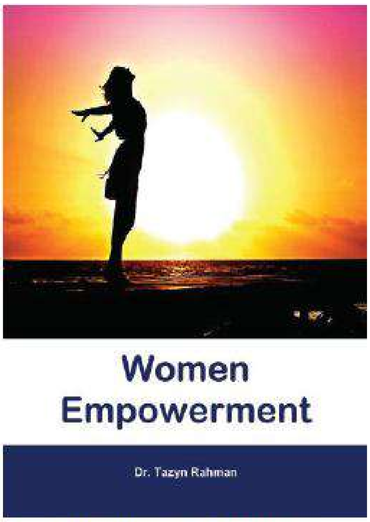

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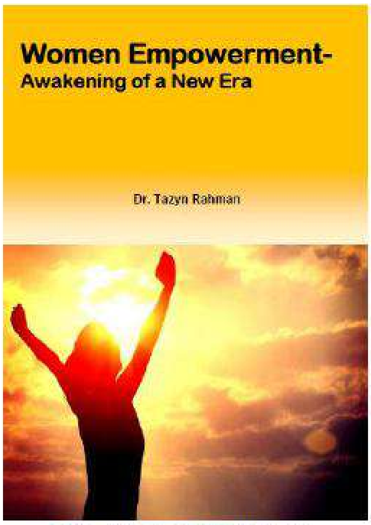

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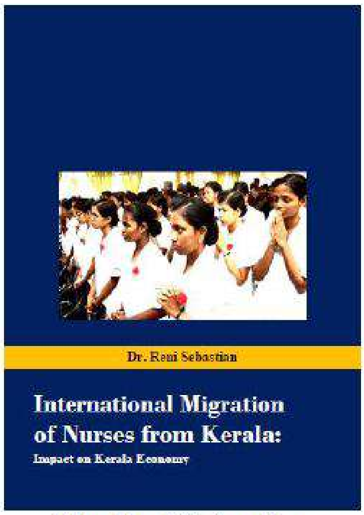

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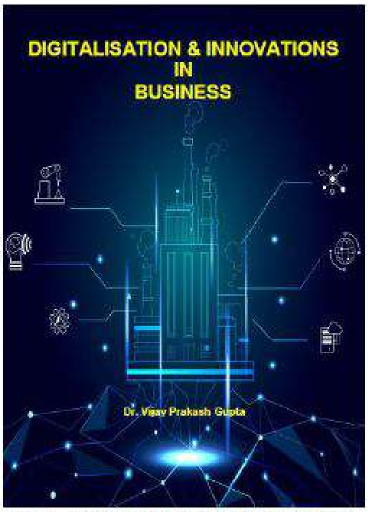

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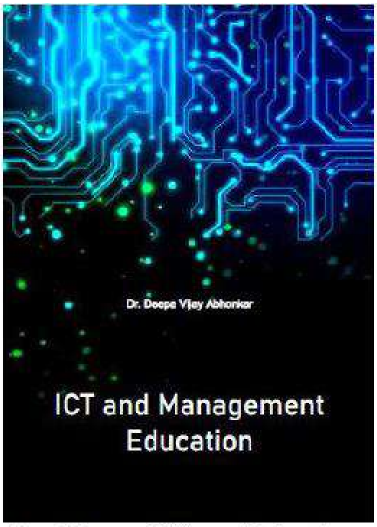

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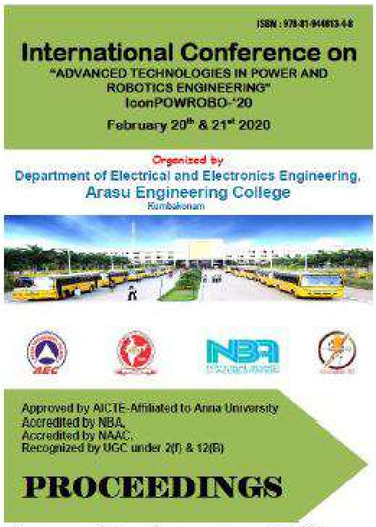

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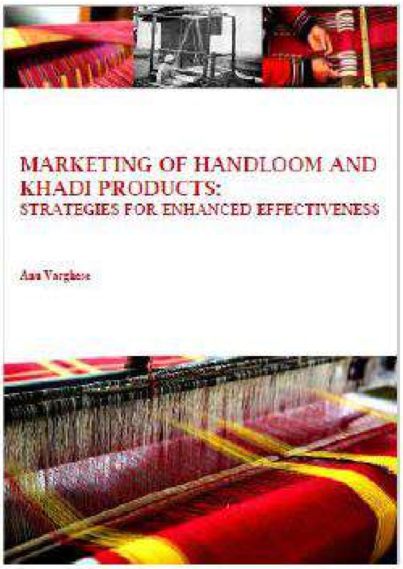

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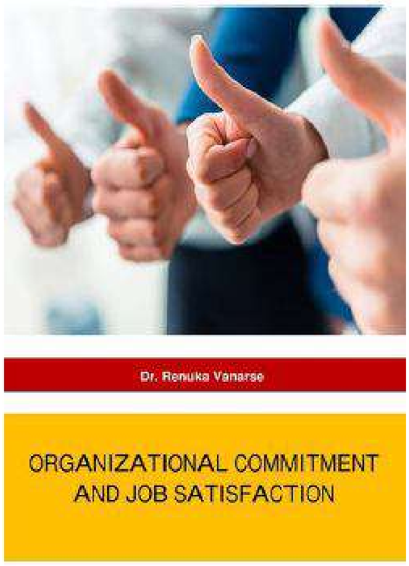

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