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SYSTEMATIC REVIEW

Effectiveness of muscle energy technique in patients with nonspecific low back pain: a systematic review with meta-analysis

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ABSTRACT

INTRODUCTION: Low back pain (LBP) is a major cause of physical disability in the world. The origin of this condition can be due to differents causes, with a specific cause or of unknown mechanical origin,being characterized as unspecific. In this case a physical therapy treatment approach with manual therapy is relevant, which includes the muscle energy technique (MET) classified as a common conservative treatment for pathologies of the spine, mainly in LBP and disability. This study assessed the effectiveness of the muscle energy technique on nonspecific low back pain.

EVIDENCE ACQUISITION: Patients with acute, subacute or chronic non-specific low back pain. The primary outcomes were pain and disability. This study was designed by a systematic review and meta-analysis, registered in PROSPERO (CRD42020219295). For the report and methodological definitions of this study, the recommendations of the PRISMA protocol and the Cochrane collaboration, were followed, respectively.

EVIDENCE SYNTHESIS: The search yielded 164 citations, which 19 were eligible randomised trials were included in the review (N.=609 patients with low back pain). The methodological quality of the studies averaged 4.2 points, with an interval of 2 to 7 points. Three RCTs showed satisfactory methodological quality (PEDro Score ≥6). For patients with chronic LBP, a significant result on pain (but with a small and clinically unimportant effect) in favor of MET *versus* other (MD=-0.51 [95% CI,-0.93 to -0.09] P=0.02, N.=376, studies=11, I2=80%). In patients with subacute LBP, MET enabled a significant and moderate effect to reduce pain intensity when compared to the control group (MD=-1.32 [95% CI,-2.57 to -0.06] P=0.04, N.=120, studies=3, I^2=88%). No significant effects were observed for the disability.

CONCLUSIONS: MET is not considered an efficient treatment to improve the incapacity of the lumbar spine, but it may be beneficial in reducing the intensity of LBP, although showing a small clinical effect in chronic LBP and a moderate effect in subacute LBP.

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KEY WORDS: Acute pain; Chronic pain; Low back pain; Manipulation, osteopathic; Muscle contraction.

Introduction

Low back pain (LBP) is a major cause of physical disability in the world. It is associated with a high rate of absence from work and high health costs related to the disorder, which in turn affect 70% to 80% of the population.[1] It occurs in a similar proportion in all cultures and races, interferes with quality of life and performance at work, and becomes the main reason for medical consultation when compared to other diseases.[2] In its chronic form, LBP affects over 20% of the population, worldwide; 24-80% of patients have a relapse of pain in the first year.[1] Although 31% of patients with LBP demonstrate an improvement within 6 months, the recurrence of moderate pain is reported in 33% of cases, and acute pain is observed in 15% of sufferers within 1-2 years.[3]

The origin of this condition can be due to differents causes, with a specific cause or of unknown mechanical origin, being characterized as unspecific[4] However, fatigue of the trunk muscles, specifically the lower back muscles, is now considered as one of the main risk factors associated with the origin of LBP and its disabilities.[5]

Recent studies indicate that people with LBP experience pain and the related disability longer than patients suffering from the pain of other diseases.[6] Nonspecific back pain increasingly affects young people, and this can be an important determinant of LBP in adulthood.[6] The necessity for systematization of therapeutic procedures results from the fact that back pain causes motor disability, thereby significantly reducing (and even temporarily disabling) motor activity leading to absence from work, particularly in countries with a highly developed market economy.[7]

The primary goals of treatment for LBP are to improve patient function and facilitate a return to the patient's desired level of daily activity. Although different treatment modalities are used, many practice guidelines recommend a biopsychosocial approach with greater focus on self-management, psychological support and physiotherapy, and less emphasis on the use of medication and surgical interventions.[8]

LBP involves musculoskeletal changes in the lumbar region generating functional disability. A physical therapy treatment approach with manual therapy is also relevant, which includes the muscle energy technique (MET) developed by Fred Mitchell[9] classified as a common conservative treatment for pathologies of the spine, mainly in LBP and disability. MET is a multifunctional method conventionally used to treat muscle tension, pain, and joint dysfunction and to develop range of motion.[9]It is considered a gentle manual therapy, for restricted spine and extremity amplitudes, and for many years, it has been advocated to treat muscle imbalances, especially in the lumbopelvic region.[10]

Since the systematic review[11] by Cochrane on the topic in 2015, many other trials have been published[4, 12-32] and an updated literature summary is required. The objective of this systematic review and meta-analysis of randomized clinical trials was to estimate the effectiveness of the muscle energy technique on nonspecific LBP.

Evidence acquisition

Identification and selection of trials

Data sources and search strategy

The search was carried out in the following databases: PubMed, CENTRAL (Cochrane Library), Scopus, ScienceDirect, PEDro, LILACS, SciELO, without the use of a filter to limit publication date or language. A search of a clinical trial registry database (clinicaltrials.gov) was performed to find unpublished studies. The last search took place on October 16, 2021.

This study was designed by a systematic review and meta-analysis,[32] registered in PROSPERO (CRD42020219295). For the report and methodological definitions of this study, the recommendations of the PRISMA[33] protocol and the Cochrane[32] collaboration, were followed, respectively.

Study selection and eligibility criteria

Two reviewers (LCO and GKS) carried out the initial search strategy in the databases, extracting the titles and abstracts. Subsequently, the selection of studies, evaluation, and data extraction, was conducted independently by two authors (GKS and CFCO), based on the reading of titles and abstracts. Potentially eligible articles were read in full. A manual search was performed in the reference lists of all eligible articles, to find new references. Disagreement between author evaluations was resolved through discussion or by consulting a third review author (LCO). The same form for data extraction was used by the authors.

The PICO[34] method was used to structure the bibliographic search and data extraction: P (population)=Adults over 18 years old; I (intervention)=Muscle energy technique; C (comparison)=other intervention techniques, simulation of the muscle energy technique (Sham) or no intervention; O (outcome)=LBP and disability.

Inclusion criteria were: randomized controlled clinical trials (RCTs), investigating the effects of MET in patients with subacute or chronic non-specific LBP (there was no restriction on ethnicity or level of physical activity); population aged over 18 years.

Exclusion criteria were: study designs other than RCTs (studies with quasi-random allocation were excluded to avoid biased estimates of treatment effects)[35, 36] studies with duplicate information in another RCT, or that presented preliminary data from a study published later; not using MET; studies whose outcomes did not involve intensity of LBP or disability; and RCTs that included participants with subacute and chronic pain and who did not present separate analyses for the two conditions.

Data extraction and analysis

Quality

Methodological quality was assessed using the PEDro scale (Physiotherapy Evidence Database)[37-41] by two independent reviewers (GKS and CFCO). This scale considers the internal validity and the sufficiency of statistical information of the studies, and presents 11 questions, with 3 items of the Jadad scale[41] and nine list items Delphi.[39] The first question is not scored (related to the external validity of the study), and the other 10 questions are scored. Each item meeting the required criteria receives a point, making it possible to classify each study according to quality: excellent (9-10), good (6-8), fair (4-5) or poor (<4). Studies with a score ≥ 6 are of high quality. Maher *et al.*[38] demonstrated good reliability between raters, with an intraclass correlation coefficient of 0.68 when using consensus ratings, generated by 2 or 3 independent raters on the PEDro scale. Whenever possible, scores were extracted from the PEDro database itself. When the articles were not found in the PEDro database, 2 trained independent reviewers (RGO and LCO) evaluated the article blindly, and disagreements were resolved by consensus.

Study characteristics

The following information was extracted from each study: 1) name of the first author, year of publication and country where the study was conducted; 2) sex and number of volunteers allocated to each group; 3) mean and standard deviation of age; 4) number of treatments and duration of treatment; 5) MET protocol; 6) activities of the comparison groups; 7) assessment instrument used to verify the intensity of pain and disability; 8) duration of LBP according to the inclusion criteria; 9) intra and intergroup results for the outcomes of interest; 10) adverse events.

The MET

The MET is a manual therapy approach[42] commonly used in treatment through osteopathy.[43] It was developed 50 years ago by Fred Mitchell Sr. and was then improved and partially modified by his son, Fred Mitchell Jr.[35] The MET uses a voluntary contraction of the patient's muscle in a controlled manner, against a force applied by the therapist.It is suggested that MET can be used to:Strengthen a weakened muscle; Stretch a shortened muscle; Reduce localized edema; Mobilize a joint with restricted mobility; and Analgesia.

Several factors are theoretically important for the successful use of MET. Among these:[9] Exact diagnosis; Precise positioning of the muscles and joints involved; Appropriate muscle contraction (25% to 75% of maximum contraction)[41] regulated by the patient against resistance by the therapist; Precise control of modification and ADM; and when necessary, repositioning the joint at a new point of movement restriction.

The classic concept of MET focuses on an osteokinemic diagnosis where the muscle is contracted in the context of joint dysfunction[9] while more recent approaches emphasize the application of MET in muscle tension, reduced muscle extensibility, and myofascial pain.[41]

Evidence synthesis

Flow of studies through the review

The RCT included in this systematic review (Supplementary Digital Material 1: Supplementary Table I)[4, 12-32] were published between 2005 and 2020, and the total number of participants was 822. The groups in each study ranged from 2,[12, 16-18, 20, 22, 23, 25-27, 29, 31] 3[13, 21, 25, 29] and 4.[19, 31] The age of the volunteers ranged between 18[17] and 55[23] years, and interventions were done between 1 week[16, 30] to 8 weeks.[19]

Characteristics of included studies

Quality

Supplementary Digital Material 2: Supplementary Table II shows the methodological quality of the studies, with an average of 4,4 points and with an interval between 2 to 8 points. Of the 22 studies included in the systematic review, only 4 RCTs[12, 14, 18, 30] showed satisfactory methodological quality (PEDro Score ≥6).

Synthesis of the results

The mean difference between the groups in the post-intervention and the respective 95% confidence intervals (95% CI) were calculated and used to quantify the effect of the

results. For meta-analysis in which the studies used the same scales (pain intensity), the results were presented as mean difference (MD) and 95% confidence intervals. Otherwise (disability), the effects were calculated using standardized mean difference (SMD) and 95% confidence intervals. The size of the effect of the interventions was defined as small (MD<10% or SMD<0.4); moderate (MD between 10% and 20% or SMD between 0.41–0.7) or big (MD>20% or SMD>0.7).[45] Thus, for the average differences, the effect was considered as clinically important when there was a difference of at least 20% in the comparison between groups.[46] It was only possible to verify the immediate post-intervention effects (short term), considering the data provided by the studies included in the meta-analysis.

The Cochrane Q test for heterogeneity was performed and considered statistically significant if P≤0.10. Heterogeneity was also quantified with the I2 statistic, where 0-40% may not be important, 30-60% can represent moderate heterogeneity, 50-90% can represent great heterogeneity and 75-100% is defined as considerable heterogeneity.[36] Fixed effects models were used when there was no statistically significant heterogeneity. Otherwise, random effects models were used. The values referring to the treatment effect were only considered as statistically significant when P<0.05. A meta-analysis was only carried out if there were at least 2 studies to be included in the analysis. To assess the risk of publication bias, funnel plot was used when there were ≥10 trials in the same meta-analysis. All analysis were performed using the Review Manager program (RevMan) [Computer program], version 5.4, Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration.

Extraction of quantitative data and comparisons made

When extracting the results (mean and standard deviation) in each study, preference was given to data with intention to treat (ITT) analysis, unless they had not been reported. When MET was compared with other interventions and there was more than one comparison group, results from the comparison groups were combined into a single group, where pertinent. Studies that associated MET with another form of intervention were only included when there was a comparison group that used the same form of intervention. In this sense, it was possible to carry out the following analyses, subdivided into patients with chronic and subacute pain:

Comparison 1 - MET *vs.* other therapies, when:

1) MET+any intervention *versus* other therapies plus this intervention (ex: muscle energy+hot pack *vs.* positional release therapy technique+hot pack);

2) MET *vs.* another intervention;

Comparison 2 - MET *vs.* control group, when:

1) MET+any intervention *versus* that same intervention alone (ex: Muscle energy+infrared radiation, ultrasonic, therapeutic exercise program *vs.* Infrared radiation, ultrasonic, therapeutic exercise program);

2) MET+any intervention versus Sham MET plus the same intervention (ex: Muscle energy+self-corrections, stretching and strengthening exercises *vs.* Sham muscle energy+self-corrections, stretching and strengthening exercises);

3) MET *vs.* Sham MET.

Analysis of sensitivity

We plan to verify the effects of the interventions excluding studies with low methodological quality (PEDro Score <6). However, this was not possible due to the low number of included studies that presented satisfactory methodological quality.

Qualitative synthesis of the studies

It was possible to identify 2059 potentially relevant titles and abstracts. After removing the duplicates (366), the titles and abstracts of 1.693 studies were read. At this stage, most of the excluded studies (1.529) were not RCT, or the intervention did not occur through MET. Of the 164 studies remaining to be read in full, 145 were excluded for not meeting the eligibility criteria. Therefore, the main reason for exclusion was the non-use of MET (121).

One study was excluded for associating the use of drugs in the intervention, 4 studies with potential for inclusion, where the effects of MET on LBP were compared, had the sample of patients with pathological conditions, where LBP was not due to a nonspecific cause and finally, 1 study was excluded because it did not classify LBP as acute, sub acute or chronic. A complete list of studies excluded after reading the full text is available in Supplementary Digital Material 2, Supplementary Table III. Thus, only 21 studies were included for subsequent qualitative and quantitative analysis (Figure 1).[4, 12, 13, 15, 17, 19, 23-29]

The activities that the different groups performed when associated or compared to MET were: cranial sacral therapy (CST);[15] sensory motor training (SMT);[12] high velocity and low amplitude technique (HLVA)[12]; Mulligan;[13] neural tissue mobilization (MTN);[4] Dynamic Stabilization Exercise (DSE);[14] hot pack to lower back (HP);[16, 27] McKenzie extension exercise program (MEE);[17] strain-

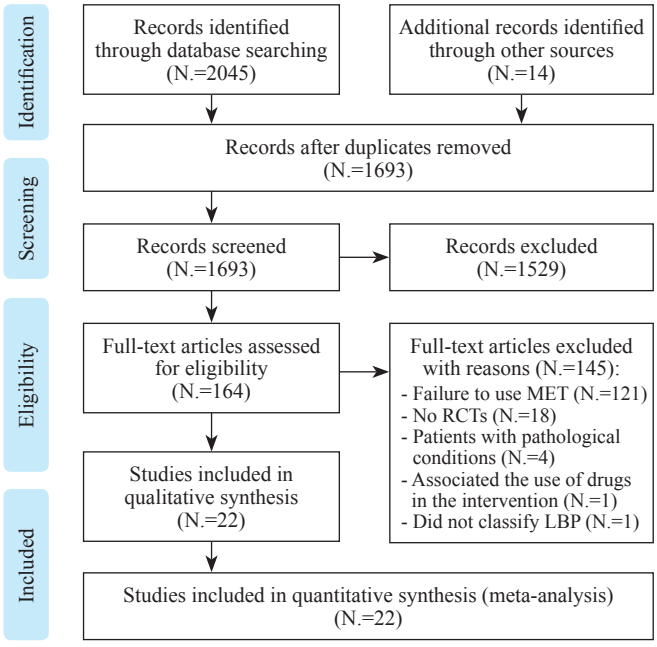

Figure 1.—PRISMA flowchart presenting the summary of searches carried out in literature.

counterstrain technique (SCS);[18, 24] core stability exercise; (SE);[19, 25] back care education and stretching exercises of lower limbs (ESS);[19] supervised exercises, hot pack and TENS (SPT);[20] proprioceptive neuromuscular facilitation (FNP);[21] static stretching in hamstring flexibility (SS);[21] therapeutic ultrasound (US);[22] monitored by the sensation felt by the patient, transcutaneous electrical stimulation (TENS)[22]; infrared radiation, ultrasonic, TENS, therapeutic exercise program (USPT);[22, 24] myofascial release (MRF);[22] moist heat, TENS, conventional exercises (CTE);[25] stretching, strengthening and ergonomic advice (CE);[26]TENS;[26] positional release therapy technique (PRT);[27] interferential therapy with quadripolar application (IFT);[28] exercises designed to gently move the sacroiliac joint (EX);[29] Maitland's concept of mobilization for the sacroiliac joint dysfunction (MM);[29] simulation of the technique (Sham MET);[30, 31] self-corrections, stretching and strengthening exercises (SSE);[31] exercises not designed to treat specific musculoskeletal disorders (NE);[31] passive movements were performed in 4 different intensities depending on the patient's evolution (MP).[32]

In seven studies, MET was compared to TENS.[20, 22-26] Three studies performed the comparison with SE.[19, 25] In two studies, treatment through MET was compared to placebo MET.[30, 31] Two studies compared with HP[16, 27] and two others compared it with USPT.[23, 24] Two different studies performed the comparative analysis with the Strain-Counterstrain technique[18, 24] and unique studies compared the MET with Mulligan,[13] MTN,[4] DSE,[14] CST,[15] SMT,[15] HLVA,[12] MEE,[17] ESS,[19] SPT,[20] PNF,[21] SS,[21] US/ME,[22] MFR,[23] CTE,[25] CE,[26] PRT,[27] IFT,[28] EX,[29] MM,[31] SSE/NE[32] e MP.[32]

The evaluation of the LBP intensity was performed through the VAS,[4, 13, 17-19, 21, 22, 25-31] of the Pain Scale (NPS),[12, 16] of the NRS-101 Scale,[32] of the McGill questionnaire (SF-MPQ),[12, 24, 25] of the Quebec Back Pain Disability Scale (QBPDS),[31] of the Interference subscale of the Multidimensional Pain Inventory (MPI),[31] Orebro Musculoskeletal Pain Questionnaire (OMPSQ)[14] and pain produced during the provocation test.[30] To measure functional disability, the Oswestry Disability Index (ODI),[4, 14, 15, 17, 18, 20, 23, 24, 26, 29, 31] the Oswestry Disability modified (MODQ)[19, 25, 27, 28] and Roland Morris Disability Questionnaire (RMDQ)[12, 18] were used.

Of the 22 RCT included in this systematic review, two studies[15, 29] observed improvement in pain and disability outcomes in both analyses (intra and inter-groups); six studies[18, 19, 23, 24, 27, 31] observed improvement in pain and disability only in the intra-group analysis (pre *vs.* post-intervention; two studies[13, 16, 21] observed improvement (inter and intra-groups) only for the pain outcome. Two other studies[14, 25] observed improvement in pain and disability in intra-group analysis and only improvement in pain between groups in favor of MET. Unique studies observed a reduction in pain and disability from intra-group analysis;[12] improvement of pain and intergroup disability;[4] improvement only of inter and intra-group disability;[20] improvement only of intra and inter-group pain;[30] improvement of pain and intra-group disability and only improvement of inter-group disability;[28] improvement of intra-group pain and disability and only improvement of pain between groups.[17] In two studies,[26, 32] no results were found.

Quantitative synthesis of the studies (meta-analysis)

MET versus *other therapies for pain intensity and disability*

For patients with chronic low back pain, a significant difference was observed in favor of MET compared to other therapies for pain intensity (MD=-0.67 [95% CI, -1.16 to -0.17] P=0.008, N.=416, studies=13, I^2=87%; Figure 2A), while no effect was observed for the disability outcome (SMD=-0.16 [95% CI, -0.53 to 0.20] P=0.38, N.=366, studies=11, I^2=65%; Figure 2B). Funnel charts involving these analyses showed no evidence of publication bias (Figure 3).

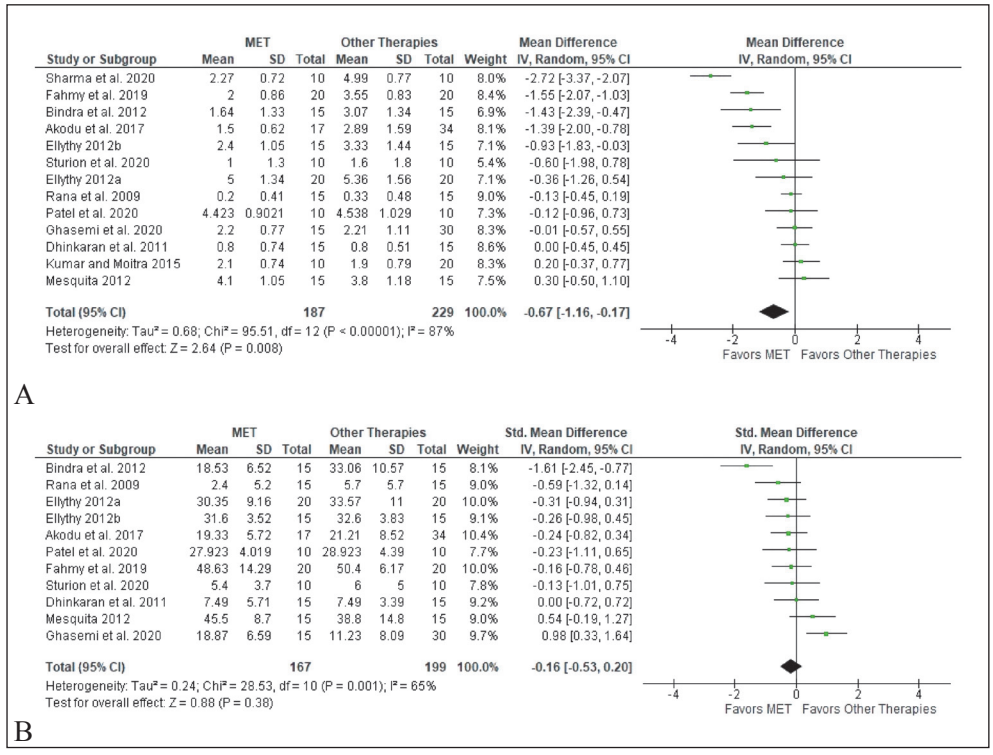

Figure 2.—Meta-analysis of the comparison between MET versus other therapies in patients with chronic low back pain: A) pain intensity (0-10 points); B) disability.[4, 12, 13, 15, 17, 19, 23-29]

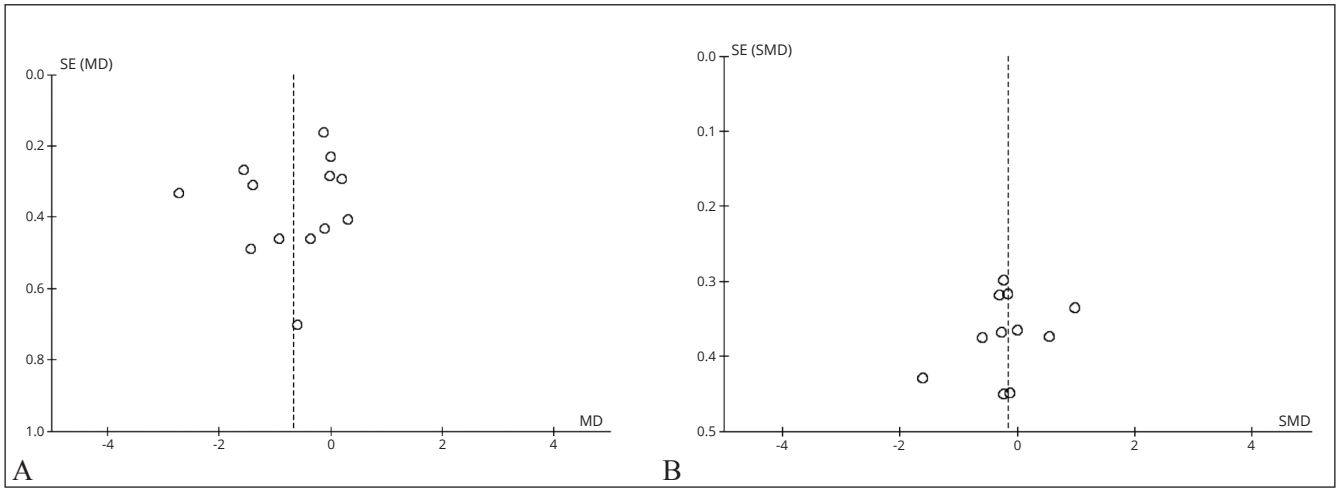

Figure 3.—Funnel charts of the comparison between MET *versus* other therapies in patients with chronic low back pain: A) pain intensity (0-10 points); B) disability.

In patients with subacute LBP, no significant effect was observed when comparing MET *versus* other therapies for pain intensity (MD=-1.73 [IC 95%, -5.53 to 2.07] P=0.37, N.=120, studies=2, I^2=99%; Figure 4A)[29, 33] and disability (SMD=-0.07 [IC 95%, -0.42 to 0,29] P=0.72, N.=120, studies=2, I^2=0%; Figure 4B).[29, 33]

MET versus *control group for pain intensity and disability*

A significant difference was observed when comparing MET versus control group for pain intensity in favor of MET (MD=-1.88 [95% CI, -3.23 to 0.54] P=0.006, N.=237, studies=5, I^2=97%; Figure 5A)[13, 14, 19, 31, 44] and

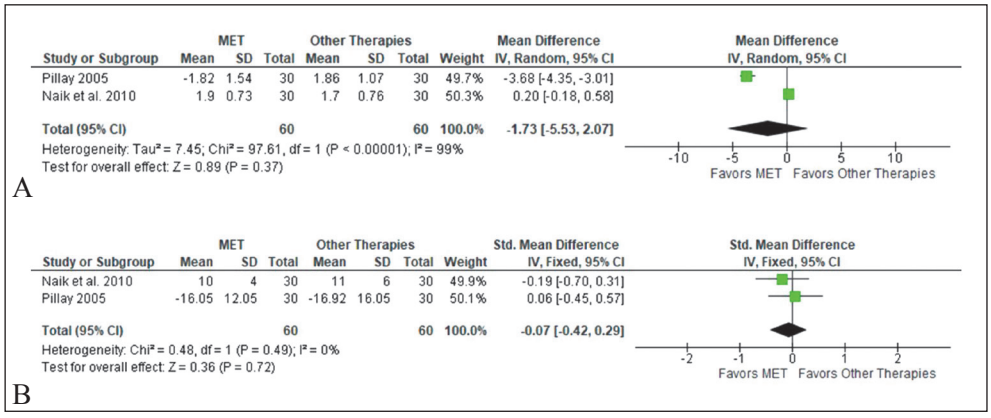

Figure 4.—Meta-analysis of the comparison between MET versus other therapies in patients with subacute low back pain: A) pain intensity (0-10 points); B) disability.[29, 33]

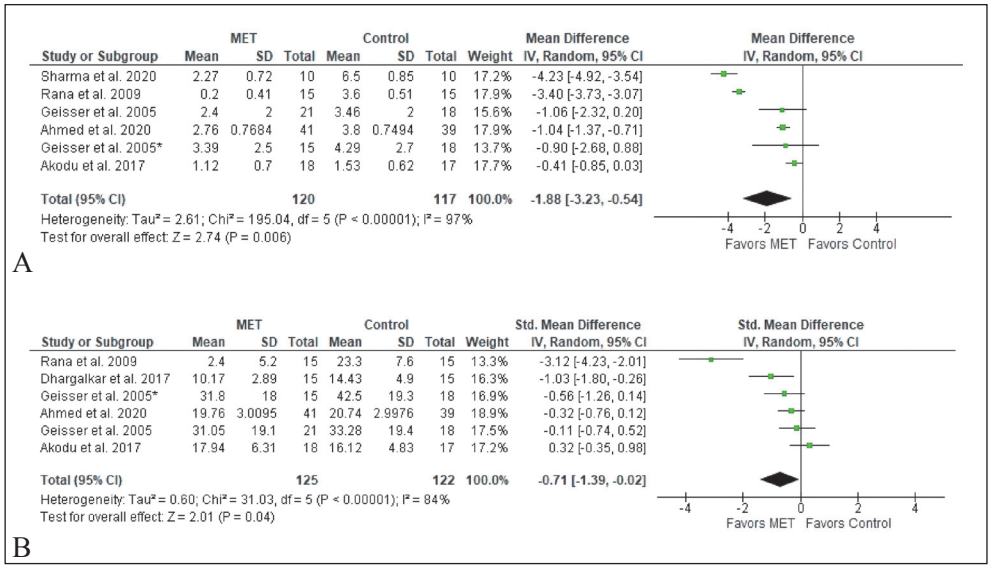

Figure 5.—Meta-analysis of the comparison between MET *versus* control group in patients with chronic low back pain: A) pain intensity (0-10 points); B) disability. * This reference represents a separate comparison in the study by Geisser *et al.* 2005.[13, 14, 19, 31, 44]

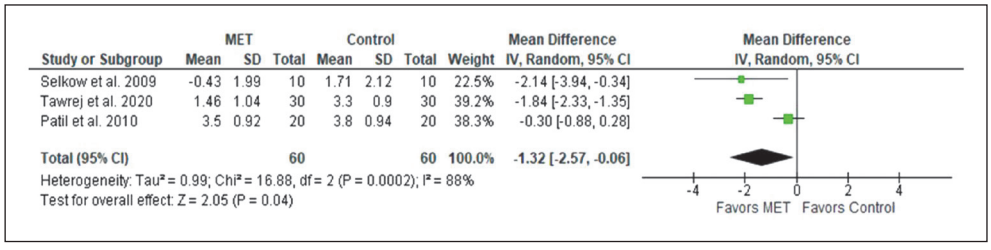

Figure 6.—Meta-analysis of the comparison between MET versus control group in patients with subacute low back pain for pain intensity (0-10 points).[16, 30, 32]

no significant effect was observed when comparing MET versus control for desability (SMD=-0.71 [95% CI, -1.39 to 0.02] P=0.04, N.=247, studies=5, I^2=84%; Figure 5B)[13, 14, 19, 31, 44] in patients with chronic LBP.

In patients with subacute LBP, MET enabled a significant moderate effect to reduce pain intensity when compared to the control group (MD=-1.32 [IC 95%, -2.57 to -0.06] P=0,04, N.=120, studies=3, I^2=88%; Figure 6).[16, 30, 32] In this case, for disability, there were not enough studies for analysis.

Adverse events

Only one study[16] reported that two volunteers were excluded due to the lack of effects associated with the disease. Seven

studies[12, 20-22, 24, 27, 29] reported that no adverse events were observed, while the other eleven studies[4, 13-17, 23, 25, 26, 29] did not report any information about adverse events.

Discussion

Summary of the main results

The objectives of the present study were to analyze the effects of MET on LBP and disability. A total of 164 articles were read in full, where only 22 of them met the inclusion criteria and were used for final analysis. The average quality score of the studies was 4.4 points, then classified as fair (4-5 points), since only studies with a score ≥6 are considered as high quality (PEdro scale). For a total of 822 individuals, it was possible to observe that MET was effective in reducing pain, having a small significant effect for chronic, moderate, and acute LBP; and no significant effects were observed for the disability outcome. The implications of these results are that MET may be used as a complementary therapy to the treatment of LBP, since some slightly beneficial results have been observed.

Compared with previous reviews, this systematic review with meta-analysis made it possible to assess the effects of MET in adults between 18 and 55 years old, of both sexes, with LBP only with non-specific character, classified as subacute and chronic. It was only possible to verify the immediate post-intervention effects (short term), considering the data made available by the studies included in the meta-analyses; meta-analysis was performed if there were at least two studies to be included in the analysis, aiming better quality of evidence. The main finding of our review compared to previous ones, is based on the fact that we can observe a significant effect, in favorof MET, in both groups of analysis. However, for the disability outcome, we did not observe significant benefical effects of MET.

When specifically observing LBP studies important significant effect was observed in favor of MET when compared to other therapies for the reduction of pain.[4, 12-15, 17, 19, 21-26, 29] In fact, all interventions that have been compared with MET are also considered to be effective in reducing pain. In subacute conditions of LBP, MET showed a moderate effect to reduce pain intensity when compared to control groups. In our analysis, no significant effect was observed for the disability outcome in patients with subacute or chronic LBP.[19, 29, 31]

Agreements and disagreements with other studies

In a study that aimed to conduct a systematic review[45] that aimed to assess the effects of manual therapy on acute LBP, including 20 RCT, two of them used MET in their therapeutic approaches, but associated with other intervention techniques. The authors were able to conclude that manual therapy was not significantly effective in participants with acute LBP, when compared to sham manual therapy or when added to another intervention. From the findings of the present study, it can be seen in the subacute LBP that MET had a moderate effect on the reduction of pain intensity when compared to control groups (sham MET), but there was also no significant difference when associated with another intervention, corroborating the study by Rubinstein *et al*.[45] However, the authors also consider that their analysis was limited by the small number of studies by comparison, result and time interval, and requires more research.

In the systematic review and meta-analysis by Licciardone *et al.*,[47] which aimed to assess the effectiveness of osteopathic manual therapy (OMT) as a complementary treatment for LBP, OMT was presented as a distinct modality that significantly reduces LBP, where the level of pain reduction was greater than expected with the effects of placebo alone, persisting for at least three months. However, the authors still suggest that additional research is needed to mechanically elucidate how OMT exerts its effects, to determine whether its benefits are lasting, and to evaluate its cost-effectiveness as a complementary treatment for LBP. However, as the objective of the Licciardone[47] review was to assess the effectiveness of OMT, the use of MET in the included studies was unclear since it is an approach that may or may not be included in the OMT protocols. However, results suggest favorable effects of manual therapy in the treatment of LBP.

In the last meta-analysis[11] carried out on the subject, which aimed to identify the effectiveness of MET in the treatment of people with nonspecific LBP compared to control interventions, with particular emphasis on the subjective results of pain and disability, the authors did not find enough evidence to safely determine whether MET was effective in clinical practice, corroborating some aspects of the present study, since the articles found still have low methodological quality in most cases. However, we can observe significant results in favor of MET in patients with subacute and chronic LBP. The studies included in, and carried out until the date of the last review[10] have provided, in large part, low quality evidence that MET would not be effective for patients with LBP, unlike our results that show a trend of improvement in LBP in favor of of MET. In the previous review,[11] non-randomized RCTs were included, as an example of the study by Salvador

et al.,[48] also differing from the present review, where this study was excluded, since the inclusion criteria was only randomized clinical trials. However, we did not consider the studies that used quasi-random allocation procedures in this review to avoid biased estimates of treatment effects in the included studies.

Although MET is routinely used by physical therapists, it is rarely administered as an isolated treatment. In clinical practice, MET is typically performed with other manual and non-manual modalities in an integrated approach.[40] This confirms that few studies in literature have examined patients with LBP using applications of this treatment modality in isolation. Several studies have examined the effect of manual therapy in the treatment of LBP, where MET was one of the integral treatment techniques. Many of these studies reported favorable results, mainly for pain in favor the TEM, but it is still not possible to clearly determine the influence of MET within the therapeutic plan, due to the lack of quality evidence.

Some systematic reviews have been carried out using these studies to determine the effect of treatment through osteopathy for LBP.[11, 47] The conclusions of these reviews differed from favorable rule results[47] to unfavorable or inconclusive results due to the lack of available high-quality studies.[11, 45] For all that, more methodologically solid and rigorous clinical trials are needed on this subject, including an appropriate control and an intervention that reflects real practice.

The lack of consensus on which is the appropriate methodology remains a substantial barrier to understanding the role of manual therapy in non-specific LBP, which is an important presentation for physical therapy clinical practice. The benefit of the consistent methodology is the ability to better compare clinical trials and, where appropriate, as in the present study, use meta-analysis to provide a statistical assessment of homogeneous clinical trials. The failure of studies to develop an effective methodological consensus may leave this question of the effectiveness of MET in non-specific LBP, unanswered.

A few methodological issues were discussed by researchers in the field these include: The problem of blinding the subject and the treatment provider for the intervention, the subject's knowledge and perceptions of the intervention, and the difficulty of control in manual therapy trials, particularly the credibility of the simulated treatment. Although the included studies were at low risk of bias according to the Cochrane Back Review Group,[46] they had methodological weakness in blinding participants and patient compliance, which appear to be common problems in trials of manual therapy interventions.[47] Licciardone and Russo, 2006 point out that the influence of a series of non-specific effects of treatment on clinical outcomes presents a major challenge to increase the evidence base of manual therapy and to build adequate clinical trials.[49, 50]

Limitations of the study

The LBP is usually categorized into 3 subtypes: acute (<6 weeks), subacute (6 to 12 weeks) and chronic (>12 weeks).[1] However, the analyses were carried out considering the classification of LBP as subacute and chronic, due to the fact that in the studies included in the present review, the acute and subacute classification was not differentiated, leaving the exact duration of pain unspecified, reporting only that the durability was less than 12 weeks, and can then be classified in two ways, thus we chose to use the subacute classification.

Potential biases in the review process

Our review included only RCT, which reduces the risk of bias.[33, 34] However, most studies did not hide the distribution of volunteers in each group.[15-29, 31, 32] The majority of studies did not adequately deal with incomplete follow-up data[16, 20-24, 26-29, 31] and not perform ITT analysis.[15-17, 19-24, 26-31] With that, we used the results per protocol in our analyses (only from the participants who completed the intervention). Finally, the search did not extend to all existing databases. However, we conducted searches in three primary databases (PubMed, The Cochrane Library, Science Direct), three secondary databases (LILACS, PEDro e SciELO) and on a clinical trial registry basis (clinicaltrials.gov), aiming to find unpublished studies. In addition, we conducted a thorough search of all bibliographic references of the studies included in the review, to try to find other RCT.

Practical implications

Our results suggest that MET has the potential to alleviate the intensity of LBP, with the intervention effect clinically significant in patients with chronic LBP and moderate effect in patients with subacute LBP, with no effects observed in other analyses. Furthermore, no results were found for the disability outcome. The small number of studies included in the analyzes and the low methodological quality of most studies do not allow for such conclusive results at this time.

As MET aplication is considered relatively safe, does not require high motivation for its practice, and has few

adverse events, its use can be considered as an adjunctive treatment to fight the loss of LBP. However, despite our study having contributed to preliminary discussions, the factors representing an ideal intervention remain unclear; and the low methodological quality of the studies included in our analysis should be taken into account.

Implications for research

Our analysis helped to understand that MET have a beneficial influence on improving the intensity of cronic LBP, with a clinically big effect. However, the small number of RCT and the low methodological quality of most studies limited the extrapolations of our findings. For future studies, greater methodological care is suggested, especially regarding the confidentiality of allocation and blinding of the evaluators. Larger samples and longer follow-up times are also needed, which can help to clarify the long-term effects of MET on LBP.

Conclusions

Our results show that MET is not considered an efficient treatment to improve lumbar spine disability, but it is to be beneficial in reducing the intensity of LBP, showing a big clinical effect on chronic LBP and a moderate effect on subacute LBP. However, due to the low number of studies for the analysis, and to the lack of high-quality studies available, further methodologically solid, and rigorous research is needed to investigate this issue.

References

1. Balagué F, Mannion AF, Pellisé F, Cedraschi C. Non-specific low back pain. Lancet 2012;379:482–91.

2. Mangone M, Paoloni M, Procopio S, Venditto T, Zucchi B, Santilli V, *et al.* Sagittal spinal alignment in patients with ankylosing spondylitis by rasterstereographic back shape analysis: an observational retrospective study. Eur J Phys Rehabil Med 2020;56:191–6.

3. Axén I, Leboeuf-Yde C. Trajectories of low back pain. Best Pract Res Clin Rheumatol 2013;27:601–12.

4. Patel Y. Comparison of Neural Tissue Mobilization and Muscle Energy Technique on Hamstring Tightness in Chronic Low Back Pain. Med-Leg Update 2020;20:375–9.

5. Wolter T, Szabo E, Becker R, Mohadjer M, Knoeller SM. Chronic low back pain: course of disease from the patient's perspective. Int Orthop 2011;35:717–24.

6. GBD 2015 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 2016;388:1545–602.

7. Patrick N, Emanski E, Knaub MA. Acute and chronic low back pain. Med Clin North Am 2014;98:777–89, xii.

8. Foster NE, Anema JR, Cherkin D, Chou R, Cohen SP, Gross DP, *et al.*; Lancet Low Back Pain Series Working Group. Prevention and treatment of low back pain: evidence, challenges, and promising directions. Lancet 2018;391:2368–83.

9. Mitchell FL Jr, Mitchell KG. The Muscle Energy Manual. Volume Two. 2. East Lansing: MET Press; 2001.

10. Wilson E, Payton O, Donegan-Shoaf L, Dec K. Muscle energy technique in patients with acute low back pain: a pilot clinical trial. J Orthop Sports Phys Ther 2003;33:502–12.

11. Franke H, Fryer G, Ostelo RW, Kamper SJ. Muscle energy technique for non-specific low-back pain. Cochrane Database Syst Rev 2015;(2):CD009852.

12. Sturion LA, Nowotny AH, Barillec F, Barette G, Santos GK, Teixeira FA, *et al.* Comparison between low speed amplitude manipulation and muscle energy technique in pain and neuromuscular postural control of trunk in workers of the male with chronic low back pain: a randomized crossover trial. S Afr J Physiother 2020;76:9.

13. Sharma S, Akmal S, Sharma S. Comparação de duas abordagens manuais de terapia combinadas com exercício sobre dor, força e atividade muscular eletromiográfica em atletas com dor lombar mecânica subacute. Ciências do Esporte para a Saúde 2021;1–11.

14. Ahmed UA, Maharaj SS, Van Oosterwijck J. Effects of dynamic stabilization exercises and muscle energy technique on selected biopsychosocial outcomes for patients with chronic non-specific low back pain: a double-blind randomized controlled trial. Scand J Pain 2021;21:495–511.

15. Ghasemi C, Amiri A, Sarrafzadeh J, Dadgoo M, Maroufi N. Comparison of the effects of craniosacral therapy, muscle energy technique and sensorimotor training in chronic non-specific low back pain. Anaesth Pain Intensive Care 2020;24:532–43.

16. Tawrej P, Kaur R, Ghodey S. immediate effect of the muscle energy technique on the lumbar square muscle in patients with nonspecific low back pain. Indian J Physiother Occup Ther 2020;13.

17. Fahmy E, Shaker H, Ragab W, Helmy H, Gaber M. Effectiveness of the spinal extension exercise program versus muscle energy technique in the treatment of chronic mechanical low back pain. Egypt J Neurol Psychiat Neurosurg 2019;55:1–6.

18. Patel VD, Eapen C, Ceepee Z, Kamath R. Effect of muscle energy technique with and without strain-counterstrain technique in acute low back pain - A randomized clinical trial. Hong Kong Physiother J 2018;38:41–51.

19. Akodu AK, Akinbo SR, Omootunde AS. Comparative effects of the muscle energy technique and central stability exercises in the management of patients with chronic non-specific low back pain. Medicina Sportiva. Journal of Romanian Sports Medicine Society 2017;13:2860.

20. Priyanka D. Added effect of muscle energy technique for improving Functional ability in patients with chronic nonspecific low back pain. Int J Physiother Res 2017;5:2082–7.

21. Kumar P, Moitra M. Effectiveness of the muscle energy technique and pop stretching compared to conventional physiotherapy in the hamstring flexibility program in chronic non-specific low back pain. Indian J Physiother Occup Ther Int J 2015;9:103.

22. Bindra S, Kumar M, Singh P, Singh J. A study on the e±cacy of muscle energy technique as compared to conventional therapy in chronic low back pain due to sacroiliac joint dysfunction. Indian J Physiother Occup Ther 2012;6:200–3.

23. Ellythy MA. Eficacy of muscle energy technique versus myofascial release on function outcome measures in patients with chronic low back pain. Bull Fac Phys Ther Cairo Univ 2012;17:51–7.

24. Ellythy MA. Eficacy of muscle energy technique versus strain counter strain on low back dysfunction. Bull Fac Phys Ther 2012;17:29–35.

25. Mesquita R. Comparison of the trunk stabilization exercises and the Muscular Energy Technique in recurrent low back pain. A randomized clinical trial. KLE University, Belgaum, Karnataka 2012.

26. Dhinkaran M, Sareen A, Arora T. Comparative analysis of the muscle energy technique and conventional physiotherapy in the treat-

ment of sacroiliac joint dysfunction. Indian J Physiother Occup Ther 2011;5:127–30.

27. Naik P, Heggannavar A, Khatri S. Comparison of muscle energy technique and positional release therapy in acute low back pain - RCT. Indian J Physiother Occup Ther 2010;4:32–6.

28. Patil PN, Chandu B, Metgud S, Khatri S. Effectiveness of muscle energy technique on quadratus lumborum in acute low back pain-randomized controlled trial. Indian J Physiother Occup Ther 2010;4:54–8.

29. Rana K, Bansal N. Savita. Comparative analysis of the effectiveness of the concept of mobilization technique and muscular energy of GD Maitland in the treatment of sacroiliac joint dysfunction. Indian J Physiother Occup Ther 2009;3:18–21.

30. Selkow N, Grindstaff T, Cross K, Pugh K, Hertel J, Saliba S. Short-term effect of the Muscular Energy Technique on pain in individuals with non-specific lumbopelvic pain: A pilot study. J Manual Manip Ther 2009;17:14–8.

31. Geisser ME, Wiggert EA, Haig AJ, Colwell MO. A randomized, controlled trial of manual therapy and specific adjuvant exercise for chronic low back pain. Clin J Pain 2005;21:463–70.

32. Pillay K. The relative effectiveness of the Muscular Energy Technique as opposed to specific passive mobilization in the treatment of acute and subacute mechanical low back pain. Faculty of Health at the Durban Institute of Technology, KwaZulu-Natal, South Africa; 2005.

33. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, *et al.* The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. PLoS Med 2009;6:e1000100.

34. Higgins JP, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, *et al.* Cochrane Handbook for Systematic Reviews of Interventions version 6.1. Cochrane 2020.

35. Higgins JP, Green S. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0. The Cochrane Collaboration 2011.

36. Furlan AD, Pennick V, Bombardier C, van Tulder M; Editorial Board, Cochrane Back Review Group. 2009 updated method guidelines for systematic reviews in the Cochrane Back Review Group. Spine 2009;34:1929–41.

37. Centre for Evidence-Based Medicine. Oxford (2012) [Internet]. Available from: http://www.cebm.net [cited 2022, Sep 22].

38. Maher CG, Moseley AM, Sherrington C, Elkins MR, Herbert RD. A description of the trials, reviews, and practice guidelines indexed in the PEDro database. Phys Ther 2008;88:1068–77.

39. Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. Phys Ther 2003;83:713–21.

40. The Centre of Evidence-Based Physiotherapy. Sydney (2012) [Internet]. Available from: http://www.pedro.org.au [cited 2022, Sep 22].

41. Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJ, Gavaghan DJ, *et al.* Assessing the quality of reports of randomized clinical trials: is blinding necessary? Control Clin Trials 1996;17:1–12.

42. Chaitow L. Muscle energy techniques. Third Edition. London: Elsevier; 2001.

43. Fryer G, Johnson JC, Fossum C. The use of spinal and sacroiliac joint procedures within the British osteopathic profession. Part 2: treatment. Int J Osteopath Med 2010;13:152–9.

44. Uman LS. Systematic reviews and meta-analyses. J Can Acad Child Adolesc Psychiatry 2011;20:57–9.

45. Rubinstein SM, Terwee CB, Assendelft WJ, de Boer MR, van Tulder MW. Spinal manipulative therapy for acute low back pain: an update of the cochrane review. Spine 2013;38:E158–77.

46. Ostelo RW, Deyo RA, Stratford P, Waddell G, Croft P, Von Korff M, *et al.* Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. Spine 2008;33:90–4.

47. Licciardone JC, Brimhall AK, King LN. Osteopathic manipulative treatment for low back pain: a systematic review and meta-analysis of randomized controlled trials. BMC Musculoskelet Disord 2005;6:43.

48. Salvador D, Neto PE, Ferrari FP. Aplicação de técnica de energia muscular em coletores de lixo com lombalgia mecânica aguda. Fisioter Pesqui 2005;12:20–7.

49. Mancini MC, Cardoso JR, Sampaio RF, Costa LC, Cabral CM, Costa LO. Tutorial for writing systematic reviews for the Brazilian Journal of Physical Therapy (BJPT). Braz J Phys Ther 2014;18:471–80.

50. Licciardone JC, Russo DP. Blinding protocols, treatment credibility, and expectancy: methodologic issues in clinical trials of osteopathic manipulative treatment. J Am Osteopath Assoc 2006;106:457–63.

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