Jurnal Sains Sukan dan Pendidikan Jasmani Vol 12, No 2, 2024 (68-75)
ISSN: 2232-1918 / eISSN: 2600-9323
https://ejournal.upsi.edu.my/journal/JSSPJ

EFFICACY OF ABDOMINAL HOLLOWING VERSUS ABDOMINAL BRACING ON BALANCE AND FUNCTIONAL DISABILITY AMONG NON-SPECIFIC CHRONIC LOW BACK PAIN PATIENTS: AN ARTICLE REVIEW

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Published: 26 September 2024

To cite this article (APA): Zamani, H., & Mohamad Chan, E. W. (2024). Efficacy of Abdominal Hollowing Versus Abdominal Bracing on Balance and Functional Disability among Non-Specific Chronic Low Back Pain Patients: An Article Review. *Jurnal Sains Sukan & Pendidikan Jasmani*, *13*(2), 68–75. https://doi.org/10.37134/jsspj.vol13.2.7.2024

To link to this article: https://doi.org/10.37134/jsspj.vol13.2.7.2024

Abstract

Non-specific chronic low back pain (NSCLBP), which affects 80% to 90% of adults, presents symptoms without a clearly identifiable source. This review aimed to evaluate the effects of abdominal hollowing versus abdominal bracing exercises on balance and functional disability in NSCLBP patients. A systematic search was conducted using the Google Scholar and PubMed databases, covering literature from 2006 to 2023. Out of 30 identified articles, only 4 met the inclusion criteria for this review. The results suggest that both abdominal bracing and abdominal hollowing exercises can improve balance and functional disability in NSCLBP patients. Functional disability improvements were associated with pain reduction, while dynamic balance was enhanced through core stability exercises, likely due to the preferential activation of core muscles following training adaptations, which reduces abnormal lumbar motion. However, the impact on static balance was not significant, indicating it may not be a useful outcome measure for NSCLBP in relation to these exercises.

Keywords – *abdominal hollowing, abdominal bracing, low back pain, functional disability, balance*

INTRODUCTION

Low back pain is the most prevalent musculoskeletal illness and a major health concern in Western countries which is also linked to rising medical costs and lost productivity at work (Baharuddin, 2021). 90**%** of patients with low back pain experience undiagnosed pathologic low back pain, also known as non-specific chronic low back pain (NSCLBP). It is difficult to specify a single cause for chronic low back pain, it is thought to be a complicated issue. Increasing the strength of core muscles could help stabilize the lumbar spine. Core stabilization exercises significantly reduced NSCLBP by 76.8%. Patients suffering from chronic NSCLBP exhibit core muscle weakness as well as abnormal lumbar pelvic movement patterns. Weakness in the stabilising and respiratory muscles causes spinal instability and loading, ultimately resulting in low back pain (Yalfani, 2023).

Core is a a muscular box with diaphgram as roof, abdominals at front, paraspinals and gluteals at back, pelvic floor and hip girdle as bottom. Core muscles consist of stabilisers and global muscle. Stabilisers or deep muscle layer include pelvic floor, transverse abdominis, internal obliques, multifidus, diaphgram. Function is to provide primary stabilization for the spine. Global or superficial muscles include rectus abdominis, external oblique, erector spinae, quadratus lumborum. Its function is

to provide secondary stabilization for spine and acts as prime movers (Behm et al., 2010). Abdominal muscles consist of anterolateral and posterior abdominal wall. Anterolateral abdominal wall muscles include external oblique, internal oblique, and transverse abdominis as three flat muscles with 2 vertical muscles located at midine which are rectus abdominus and pyramidalis. Posterior abdominal wall muscles include quadratus lumborum, psoas major and iliacus (Flynn, 2024).

Abdominal hollowing and abdominal bracing are common stabilizing procedures utilized in NSCLBP rehabilitation and training regimens. By engaging the deep abdominal muscles and raising intraabdominal pressure, abdominal bracing improves spine stabilization. Abdominal bracing exercises increase trunk muscular activity via co-contraction of all core muscles (Mohamad Chan, 2020). Abdominal hollowing is another strategy which increases intraabdominal pressure preventing excessive lordosis (Park, 2013). Abdominal hollowing specifically activates the transverse abdominis muscle in both symptomatic and asymptomatic low back pain patients (Madokoro, 2020b).

METHODOLOGY

Search Strategy:
The database used to search related articles was Google Scholar database and Pub Med. Keywords: abdominal hollowing, abdominal bracing, non-specific chronic low back pain, functional disability and balance.

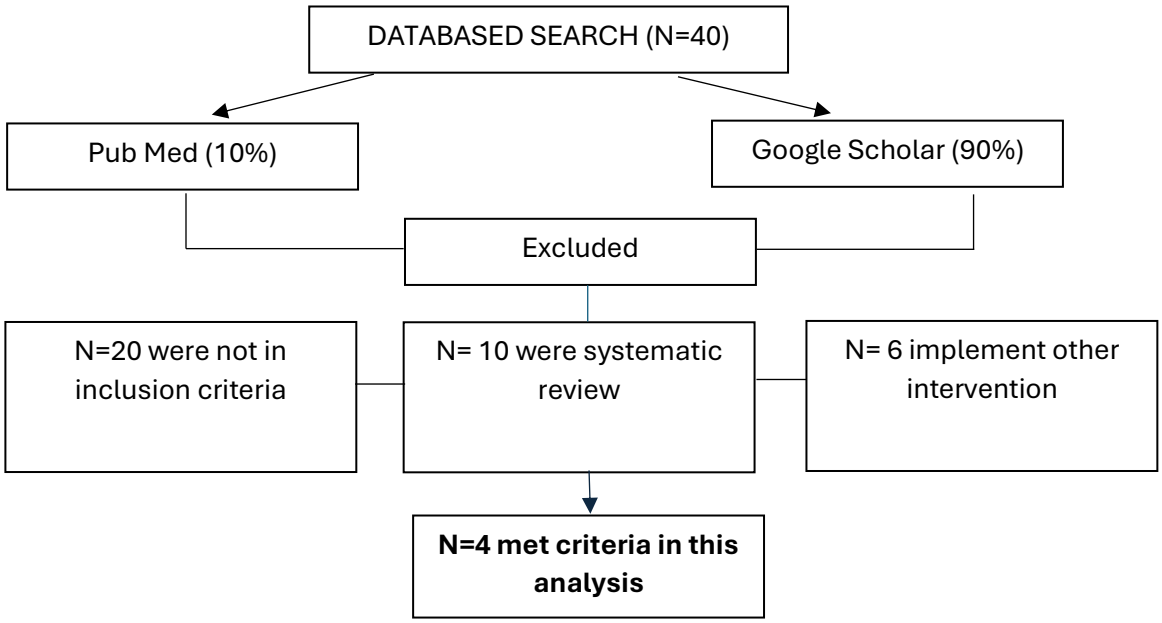
Inclusion Criteria:
A study will be included if:

1. Articles with any type of abdominal hollowing or Abdominal bracing as intervention or treatment
2. Articles published in English
3. The target population was people with non-specific chronic low back pain (NSCLBP).
4. Include functional disability or balance as outcomes.
5. Date of publication starts from 2006 until 2024.

Exclusion Criteria
A study will be excluded if:

1. The article or study was a systematic review.
2. Low back pain with specific causes.
3. Acute and subacute low back pain.

Figure 1: Data Collection Process



RESULTS

In the papers identified, however only 4 can be used as it fulfills all the inclusion and exclusion criteria according to this review. All the articles were taken from 2 databases which are Google Scholar (n = 2) and PubMed (n = 2). Most of the studies frequently use functional disability and balance. 4 studies involving the effects of abdominal hollowing exercises versus abdominal bracing on balance and functional disability among non-specific chronic low back pain patients were identified.

In the first article reviewed, it studied on the effects of progressive vs conventional core stability exercise in the rehabilitation of non-specific chronic low back pain among male military personnel. Although both core stability exercises, McGill Big 3 (MGB3) is considered as abdominal bracing because it uses abdominal bracing technique and has been demonstrated to increase trunk muscle activation in a setting where the spine is subjected to minimal stresses. Both McGill Big 3 (MGB3) and progressive dynamic muscular stabilization technique (DMST) improved pain severity and functional disability with p value of 0.05 lower which means it is statistically significant. In terms of body balance, both core stability exercises had improved the subjects' lumbopelvic control and body balance and these two were combined along with pain management therapy (Mohamad Chan, 2020).

In the second article review, In older adults with non-specific chronic low back pain, the therapeutic efficacy of hollowing lumbar stabilization exercise (HLSE) and bracing lumbar stabilization exercise (BLSE) was investigated. For functional disability, after 12 weeks, Korean-Roland Morris Disability Questionnaire (K-RMDQ) was significant within-group difference with (P=.001). However, Korean-Oswestry Disability Index (K-ODI) for both had significant within group difference (P=.001) with no significant difference between group (P=.202). After 12 weeks, in terms of static balance, neither helped to increase static balance since there was no significant difference between the groups in the one-leg standing test (P=.54), nor in the within-group differences for BLSE (P=.34) and HLSE (P=.33). Thus, HLSE is more effective than BLSE for functional disability while both are not effective for static balance (Kim, 2017).

Table 1: Efficacy of Hollowing and Bracing on Balance and Functional Disability

Author	Subject	Interventions/Methods	Results/ Outcomes
Chan et al., (2020)	Non-specific chronic low back pain (n = 30) Military personnel	5 weeks treatment: Intervention group Progressive dynamic muscular stabilization technique (DMST) (n = 15) Conventional McGill Big 3 (MGB3) (n = 15)	Both DMST and MGB3 improved functional disability ($p < 0.001$) and balance ($p = 0.003$) No significant differences observed between subjects ($p > 0.05$).
Kim et al., (2018)	non-specific chronic low back pain n = 38 older adult women	12 consecutive weeks, 3 times per week Intervention group: Hollowing Lumbar Stabilization Exercise (HLSE) (n = 17) Bracing Lumbar Stabilization Exercise (BLSE) (n = 21)	HLSE is more effective than BLSE for improving functional disability (P = .001), Neither exercise was effective for static balance (HLSE: P = .33; BLSE P = .34).

In this third article review, studies the efficacy of abdominal hollowing on functional disability by using musculoskeletal ultrasonography to measure the impact of a 4-week abdominal draw-in maneuver and core training on the thickness of the muscles and the disability among participants suffering from low back pain.

The findings of functional disability indicated that Oswestry Disability Index (ODI) of abdominal draw in maneuver mean was 23.55 before exercise and it has changed into 15.75. Thus, both intervention group was effective ($P<0.05$) to improve functional disability (Park, 2013).

In this fourth article review, it studies the efficacy of abdominal bracing on functional disability by examined the impact of giving individuals with non-specific chronic low back pain for 24 weeks of spine stability training and abdominal bracing. Functional disability through Oswestry disability index (ODI) mean at baseline for abdominal bracing group (ABBG) was 16.6 at baseline, 10.8 at weeks 12 and 9.1 at weeks 24 meanwhile for control group of spinal stability exercise, the mean started with the mean of 17.1 at baseline, 12.1 at week 12 and 9.1 at week 24. This indicates that both groups' pain improved over time, with ABBG's mean of functional disability improved after 24 weeks (Park, 2023).

Table 2: Efficacy of Hollowing only on Functional Disability

Author	Subject	Interventions/Methods	Results/ Outcomes
Park, S. and Yu, S (2006)	n = 20 adults • non-specific chronic low back pain	4 weeks treatment, 3 times per week Intervention group: • Abdominal draw-in maneuver (n =15) • Core Exercise (n = 15)	• Significant improvements in disability for both groups ($P < 0.05$).

continued

Park, H.S. et.al., (2023)	n = 67 adults • Abdominal bracing group (n = 33) • Spinal Stability Exercise (n = 34)	24 weeks treatment, 2 times per week Intervention group: • Abdominal Bracing Group (ABG) Control group: • Spinal stability exercise	• Pain and function improved in both groups over time, • ABBG group better results than the control group ($p < .001$).

DISCUSSION

The purpose of this review is to investigate the effects of abdominal hollowing exercises versus abdominal bracing on balance and functional disability among non-specific chronic low back pain patients, 4 studies have been recognized and evaluated.

Abdominal hollowing exercises rationales

Abdominal hollowing and abdominal bracing are predicted to give the ideal neutral lumbar spine posture, whereas contraction of the abdominal muscles (transverse abdominis, internal oblique, external oblique, or rectus abdominis) contributes to spinal stabilization. (Lee, 2020). According to Lee et al. (2020), by drawing the navel toward the vertebra, the abdominal hollowing maneuver minimizes global muscle, including the rectus abdominis muscle, while specifically tightening the Transverse abdominis and internal oblique abdominis muscles. Kahlaee, A.H. et al. (2017) has proposed that abdominal hollowing is a good treatment for unstable spines with changed abdominal muscle activation patterns. Abdominal drawing-in maneuver (ADIM) which is the examples of abdominal hollowing. is essential for building deep muscle, including the internal and external obliques and transverse abdominis. By drawing the abdominal walls inward when the oblique and transverse abdominis are contracted, it might raise the pressure inside the abdomen. Increased abdominal pressure makes it possible to successfully complete lumbar trunk stability training. Additionally, it causes muscular contractions that lessen excessive lordosis and pelvic tilts, both of which are beneficial for LBP (Colby and Kissner, 2002).

Abdominal bracing exercises rationales

Abdominal hollowing and abdominal bracing are predicted to give the ideal neutral lumbar spine posture, whereas contraction of the abdominal muscles (transverse abdominis, internal oblique, external oblique, or rectus abdominis) contributes to spinal stabilization. The abdominal bracing technique uses an isometric contraction of the anterolateral abdominal muscles to realign the lumbar spine (Lee, 2020). Kahlaee, A.H. et al. (2017), has proposed that abdominal bracing may be more appropriate for usage in healthy individuals, albeit this idea requires additional exploration before being utilized therapeutically. McGill et al. (2003), believes that low levels of synchronous activation in all trunk muscles provide adequate lumbar spine stability (McGill, 2003). In addition, exercises such as McGill Big 3 (MGB3) demonstrates the recruitment of significant trunk muscular activation in a setting with minimal pressures on the spine by incorporating an abdominal bracing method (McGill & Karpowicz., 2009).

Limitations of the reviewed study

According to the first articles reviewed, there was no long term follow up after 5 weeks to supervise the effects of abdominal bracing exercises which is McGill Big 3 (MGB3) and the combination of both abdominal bracing and hollowing exercises which is dynamic muscular stabilization training (DMST) on balance and functional disability. This in turn will lead to uncertainty towards the effects of core stabilization exercises program especially with the goals to prevent injury (Mohamad Chan, 2020). In addition, a study by Park, S. and Yu, S. (2006), had conducted a four-week intervention which is considered as a short time that result in a lack of precise instruction regarding the muscular contraction technique—abdominal hollowing based on the abdominal draw-in maneuver.

The second limitation of the reviewed articles is the absence of a specific gender in sample size. Even though no sex restrictions were applied throughout the recruitment procedure, a few reviewed articles only have all male or all females as participants. A study by Kim et al. (2017) had a total of 38 older adult women with non-specific chronic low back pain in which were placed between hollowing lumbar stabilization exercises or bracing lumbar stabilization exercises while a study from Chan et al. (2020), implement progressive dynamic muscular stabilization technique (DMST) and conventional McGill Big 3 (MGB3) among non-specific chronic low back pain patients specifically male military personnel from Tuanku Mizan Military Hospital (Kim, 2017; Mohamad Chan, 2020). Thus, the effects or results only show the results of abdominal hollowing or abdominal bracing on balance and functional disability based on one gender.

Third limitation of the articles reviewed are unreliable morphological alterations in the abdominal muscles brought about by the intervention, such as assessment of muscle thickness, were not carried out. In several studies, individuals with non-specific chronic low back pain had their transverse abdominis, internal oblique, and external oblique muscles assessed through ultrasound modalities including abdominal bracing and abdominal hollowing. This was done in a trustworthy evaluation manner. For example, a study by Park et al. (2023) had verified muscle strength, but was unable to verify morphological alterations, including muscle thickness, in the abdominal muscles (Park, 2023).

The last limitation for the articles reviewed are that most of the studies only include intervention group and no control group. For instance, a study by Chan et al. (2020), implemented core stability program with 2 intervention group consists of dynamic muscularlity stabilization technique (DMST) which consists of 4-stages core stability training and conventional McGill Big 3 exercises consists of modified curl up, kneeling side bridge and bird-dog for non-specific chronic low back pain (NSCLBP). Besides, a study by Kim et al. (2018) also only included two intervention group which are hollowing lumbar stabilization exercise (HLSE) and bracing lumbar stabilization exercise (BLSE) along with the absence of control group. Next, a study by Park et al. (2006), only consists abdominal draw-in maneuver (ADIM) and core exercises.

Implications of results for practice, policy and future

For future use or practice, it is proven that incorporation of abdominal bracing through McGill Big 3 exercises and incorporation both abdominal bracing and abdominal hollowing through dynamic muscular stabilization technique (DMST) of 4 staged progressive core stabilization program for 5 weeks are significant in decreasing functional disability and improve overall body balance among non-specific chronic low back pain (NSCLBP) military personnel (Park, 2023). However, future research should involve long-term follow-up to investigate the effects of abdominal bracing and hollowing bracing exercises on balance and functional disability.

In addition, intervention of hollowing lumbar stabilization exercise (HLSE) and bracing lumbar stabilization exercise (BLSE) for 12 weeks among older adult women with non-specific chronic low back pain (NSCLBP). However, there are contrasting results for functional disability between these two where hollowing lumbar stabilization exercises (HLSE) may be more effective in improving functional disability than bracing lumbar stabilization exercises (BLSE). From a clinical perspective, nevertheless, both can be utilized to lessen functional disability in older adult women with non-specific chronic low back pain while in terms of static balance, both appear to be not enough in improving static balance (Kim, 2017). Healthcare workers can educate patients on the importance of practicing abdominal hollowing or abdominal bracing whether it be nurses or doctors so that it will help patients to manage and prevent non-specific chronic low back pain.

Besides, for future research, they can explore any technology such an application that can help patients with non-specific chronic low back pain (NSCLBP) by reminding patients to do abdominal bracing or abdominal hollowing in terms of its frequency, times and the date to implement the exercises. Through the use of wearable devices in the future, it can be designed to monitor patients' abdominal bracing or abdominal hollowing posture and provide feedback.

Among policy that can be implement in the future are by including or incorporating abdominal bracing or abdominal hollowing exercises in clinical guidelines for treating non-specific chronic low back pain (NSCLBP) as this can ensure that patients receive standard treatment thus improve outcome measure consist of balance and functional disability. The second policy is supporting researchers on

studies of abdominal hollowing and abdominal bracing through fund allocation and resources for long term exercise program as treatment. This can help healthcare practices by providing strong evidence and recommendations that will be found.

CONCLUSION

This review evaluated the efficacy of abdominal hollowing versus abdominal bracing exercises in improving balance and functional disability among patients with non-specific chronic low back pain (NSCLBP). The findings indicate that both abdominal hollowing and abdominal bracing can enhance functional disability and dynamic balance, likely due to the activation of core muscles and improved lumbar stability. Abdominal bracing showed superior results compared to abdominal hollowing for functional disability, while neither method significantly impacted static balance. The review highlights the need for further research, particularly long-term studies and trials involving diverse populations, to better understand the benefits and limitations of these exercises. Incorporating these interventions into clinical practice could potentially improve patient outcomes for NSCLBP. Future research should also explore technological aids and develop guidelines to standardize treatment approaches.

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