BRIEF REPORT

Reliability of the Box and Block Test of Manual Dexterity for Use With Patients With Fibromyalgia

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OBJECTIVE. The aim of this study was to determine the reliability of the Box and Block (B&B) Test of Manual Dexterity for upper-extremity function in patients with fibromyalgia and to compare their results with those of healthy control participants.

METHOD. We assessed reliability of the B&B Test within and between testers using the intraclass correlation coefficient (ICC). We compared fibromyalgia patient \( (n = 30) \) and control group \( (n = 30) \) scores using analysis of variance and population-based normative data.

RESULTS. The B&B Test was reliable with ICCs of .90 to .85. Fibromyalgia patients' B&B Test scores were significantly lower (more impaired) than those of the control group and standardized norms.

CONCLUSIONS. The B&B Test is a reliable measure of upper-extremity function in fibromyalgia patients and is able to reveal a reduction in upper-extremity function in these patients compared with both healthy control participants and normative scores.


KEY WORDS
• disability evaluation
• fibromyalgia
• hand
• motor skills
• reproducibility of results

Fibromyalgia syndrome (FMS) is characterized by widespread musculoskeletal pain, multiple tender points, easy fatigue, and exacerbation of pain with activity. The etiology of the muscular pain has yet to be conclusively determined, and hypotheses are moving away from peripheral causes, such as local muscle ischemia and microtrauma (Simms, 1998), toward etiologies that may involve central sensitization and lowered pain thresholds (Bennett, 1996; Crofford & Demitrack, 1996; Weigent, Bradley, Blalock, & Alarcon, 1998). Nevertheless, some investigators still hold fast to the belief that muscle dysfunction plays a central role in the development and continuance of some symptoms associated with FMS (Veierstad, Westgaard, & Andersen, 1993).

Among the various symptoms associated with FMS, stiffness is one of the most common complaints, after pain and fatigue (Mannerkorpi, Svantesson, Carlsson, & Ekdahl, 1999). No joint pathology that would explain this stiffness, however, has ever been found in patients with FMS. What is its source? One could consider stiffness to be a result of central sensitization and altered somatic sensation. Conversely, one could consider it to result from resistance to movement in the muscles or other connective tissues. Investigators have pointed to poor muscle-firing patterns as a possible source of this resistance to movement (Madeleine, Lundager, Voigt, & Arendt-Nielsen, 1999; Sterling, Jull, & Wright, 2001); a common clinical observation is that FMS patients exhibit multiple muscle co-contraction patterns resulting in nonsmooth movements and reduced range of motion (ROM; Donaldson, Snelling, MacInnis, Sella, & Mueller, 2002).
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search of the literature did not identify
cians for assessing function, an extensive
cal approach to assessing function, given the
12 months of exercise. The protocol of
measured change in function after 6 and
function using the 6-min walk test and
Richardson (1999) defined an increase in
ROM, and shoulder endurance to be a
hand grip strength, upper-extremity active
et al. (1999) found the combined 6-min
and weight-matched controls. Mannerkorpi
have lower functionality scores than age-
patients with fibromyalgia were found to
shoe, and picking up scarves. In this study,
ing a jacket, putting a Velcro strap over a
performance of tasks such as pouring water
Scale Physical Functional Performance Test
(2006) compared 29 women with FMS to
and component performance. Panton et al.
(2006) compared 29 women with FMS to
those without FMS using the Continuous-
level; and still oth-
ers have combined both task performance
and component performance. Panton et al.
(2006) compared 29 women with FMS to
these scores with documented
Ross (2006) was the only study that com-
pared patient scores with documented
subtest (Cromwell, 1976). Further valida-
lished at a 6-month interval and found
.98 for the right hand (Cromwell, 1976).
Convergent validity was supported using
a Minnesota Rate of Manipulation Test
Test–retest reliability was estab-
45 min), and is inexpensive to purchase
or can even be handmade (Mathiowetz,
test involves grasping and moving 1-in.
square wooden blocks from one side of an
8-in. square box to the other by passing
them over a wooden partition 5 in. high.
The patient is scored according to the num-
er of blocks passed from one side to the
other in 1 min. Lower scores correspond
to greater upper-extremity impairments.
Normative data for the B&B Test have
been documented for adults on the basis
of 628 people without disabilities between
ages 20 and 70+ years (Mathiowetz et al.,
1985). Test–retest reliability was estab-
lished at a 6-month interval and found
to be high at .94 for the left hand and
.98 for the right hand (Cromwell, 1976).
Convergent validity was supported using
a Minnesota Rate of Manipulation Test
subtest (Cromwell, 1976). Further valida-
tion of the test targeted more specific cli-
ents, including elderly adults (Desrosiers et
al., 1994), patients with multiple sclerosis
(Paltamaa et al., 2005), and patients with
Charcot–Marie–Tooth disease (Svensson
& Häger-Ross 2006). Svensson and Häger-
Ross (2006) was the only study that com-
pared patient scores with documented
norms, with patient scores being signifi-
cantly lower than the norms. We found no
studies, however, describing the use of the
B&B Test in patients with FMS.

Our purpose in this study was to assess
the test–retest reliability of the B&B Test
and its utility in identifying upper-extremity
dysfunction in patients with FMS.

Method

Research Design

This study was an inter- and intratester,
test–retest design reliability study with the
addition of comparisons between a control
group and an experimental group consist-
ing of FMS patients. We assessed the reli-
ability of the B&B Test within and between
testers using the intraclass correlation co-
efficient (ICC) and compared control and
experimental group scores using analysis of
variance and population-based normative
data. A convenience sample of 30 women
with FMS and 30 women in good health
without FMS participated in this study in
the Mayo Clinic’s biofeedback clinic. The
B&B Test data used in this study were col-
clected as part of a larger study examining
surface electromyography information.

Participants

We recruited 30 female patients from
the Fibromyalgia Treatment Program at the
Mayo Clinic. Patients attending the
program had the diagnosis of FMS con-
firmed by a physician using the American
College of Rheumatology 1990 criteria
(Wolfe et al., 1990) before enrollment
in the program. Thirty-two participants
were identified and agreed to take part;
however, 2 were not able to complete the
testing because of scheduling conflicts. The
healthy control group was a convenience
sample consisting of staff members working
in Mayo Clinic’s Fibromyalgia Treatment
Program and Pain Rehabilitation Center.
All volunteers were pain free, had no mus-
culoskeletal pain requiring medication in
the previous month, and had no history of
neuromuscular disease. Baseline data
collected included age, height, and weight.
This study was approved by the Mayo
Clinic Institutional Review Board, and all
participants completed a consent form
before enrollment in the study.

Procedure

Each participant was asked to sit comfort-
ably at a table and complete the B&B Test
using the dominant upper extremity. The
raw score was recorded as the number of
blocks passed over the divider within 1 min.
Each participant performed the test three times—twice on the same day with the same examiner and once the next day with a second examiner. We calculated ICCs within examiner (ICC[2]) and between examiners (ICC[1]) for the 30 patients with FMS and the 30 control participants (Fleiss, 1981). Each participant’s mean score for the three trials was determined and used in the between-groups comparison using an unpaired t test. Finally, we compared both groups’ scores to normative data collected by Mathiowetz et al. (1985), using each participant’s average score.

Results

Demographics

The average age of patients was 46.9 years (range = 20–68). The average age of healthy control participants was significantly younger at 41.2 years (range = 29–52). Of the 30 participants in each group, 29 were right-hand dominant. Groups showed no statistically significant differences on weight or body mass index (see Table 1).

Reliability

For this study, we defined fair reliability as an ICC of .4 to .6, good reliability as an ICC of .6 to .75, and excellent reliability as an ICC of .75 to 1.00. We found ICCs for the raw score on the B&B Test to be excellent, ranging from .80 to .98 for both within- and between-examiner trials (see Table 2).

Between-Group Comparisons

The average B&B Test score for the FMS patients was significantly lower than that for the control group (61.8 and 71.1, respectively; unpaired t = 5.2154, df = 58, p = .0001). When compared with the normative values provided by Mathiowetz et al. (1985), the FMS patients’ average score was 3 standard deviations below and the control group’s average score was 1.9 standard deviations below the age-matched mean. Table 3 shows the raw score comparisons between the two groups.

Discussion

Patients with FMS often experience loss of function as a result of the variety of symptoms associated with the syndrome. These symptoms include widespread musculoskeletal pain, more fatigue than usual, activity intolerance, and joint stiffness. The symptom of stiffness has not been studied in any detail. Marques et al. (2004) described morning stiffness; however, they focused their evaluation on flexibility testing and quality of life via the Fibromyalgia Impact Questionnaire. Adams and Sim (2005) identified principal rehabilitative approaches to FMS, finding that exercise combined with a psychologically based treatment such as cognitive–behavioral therapy is becoming more frequently used without any specific mention of treatments for stiffness. When rehabilitation efforts include occupational therapy, emphasis is placed on improving the patient’s ability to perform functional activities (Lindberg, 2002).

A key issue leading to the initiation of this study was that FMS patients attending our treatment program often complain of decreased upper-extremity function, including complaints of slowed fine motor performance and “dropping things,” yet we have not adopted any formal testing procedures to assess muscle coordination. Unfortunately, we found no studies specifically targeting assessment or treatment of muscle incoordination in FMS. This lack of focus on upper-extremity coordination may result from several reasons, including lack of attention to upper-extremity function during the evaluation process. Hints that the problem exists come from findings on some assessment tools that identify difficulty with ADLs (Lindberg, 2002) and from studies of more localized muscle pain syndromes such as neck and shoulder pain (Madeleine et al., 1999).

Although many forms of evaluative tools for measuring gross and fine motor coordination can be found in the literature, they have not been used in patients with FMS. Our purpose in this study was to determine whether the B&B Test, chosen because of its ease of administration with minimal equipment, can be used to measure the upper-extremity performance of patients with FMS.

The authors of a study establishing reliability and validity of the B&B Test with elderly people underscored the importance of “measuring the reliability of an instrument with the targeted clientele” (Desrosiers et al., 1994, p. 754). The B&B Test as described by Mathiowetz et al. (1985) was shown in our study to be reliable in both healthy control participants and FMS patients whether repeated by the same examiner or a different examiner, thus supporting its use in patients with FMS.

The B&B Test also successfully discriminated between FMS patients and the control group, lending some credence to the common patient complaint of upper-extremity dysfunction and to the use of the B&B Test to measure upper-extremity dysfunction in FMS patients.

Limitations and Future Research

This study was completed in a clinical treatment setting in which clinical concerns were given priority over research. Consequently, some errors in data collection may have occurred that would not occur in a laboratory-based research project. Because the study did not include...
male participants, it is not clear whether the B&B Test would have the same reliability with them.

Our control group consisted of a convenience sample of health care workers recruited from the tertiary clinical setting where this study was conducted. Because this sample may not be representative of the normal population, its accuracy must be considered before judgments can be made. In the same way, the FMS patients referred to the treatment program may not represent the population seen in a community-based setting. The information for this research project was gathered as part of a larger study. The information for this research project was gathered as part of a larger study. For this reason, we made no direct comparison to other upper-extremity coordination tests; therefore, we can make no convergent validity judgments. Other tests in the literature used to evaluate this population are more functionally based; there does not appear to be a gold standard assessment tool for measuring coordination problems in people with FMS. Construct validity is supported by the success in distinguishing between the control group and patients with FMS using the B&B Test.

As mentioned, the B&B Test was one of the activities used in a larger study. For this reason, we made no direct comparison to other upper-extremity coordination tests; therefore, we can make no convergent validity judgments. Other tests in the literature used to evaluate this population are more functionally based; there does not appear to be a gold standard assessment tool for measuring coordination problems in people with FMS. Construct validity is supported by the success in distinguishing between the control group and patients with FMS using the B&B Test.

Another variable that may have influenced outcomes was the motivation to succeed at a performance test rather than a functional test. Moving blocks from one place to another may not have the same inherent reward offered by other functional tasks. Related to this, the B&B Test requires rapid movements, which may add a stress component not found in more routine tasks. We selected the B&B Test for this study because of its ease and speed of delivery in contrast to other tests that require increased time and effort to administer. Further research comparing the validity of this test to that of a variety of other tests of upper-extremity coordination in patients with FMS is recommended.

### Conclusion

FMS is characterized by multiple subjective symptoms. The B&B Test appears...
to represent a reliable and objective measure of one of those symptoms, decreased upper-extremity function. Future work should seek to correlate the findings from the B&B Test with other measures of severity and with treatment outcomes. Ideally, the test would aid in directing more specific and appropriate treatment for those with FMS.

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References


