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Abstract

The MAM-20 is an occupation-based assessment of manual ability. Manual ability is defined as the capacity to manage daily activities using one's hands (Chen & Bode, 2010). The purpose of this study was to explore the convergent validity of the MAM-20. The research question asked: is there a relationship between perceived pain, as measured by the visual analog scale (VAS) and the MAM-20? As occupation-based assessments are created, we need to scrutinize their psychometrics.

We analyzed the data collected from a retrospective, chart review. Records were obtained from an outpatient occupational therapy clinic and included persons aged 21+ who received OT for upper extremity diagnoses (i.e., arthritis, trauma). A Pearson correlational analysis between the initial MAM-20 scores and initial pain in affected hand(s) (n=121) resulted in a negligible correlation of r=-.13 (p=.17). Discharge MAM-20 scores and discharge pain (n=52) correlation was a moderate correlation of r=-0.55 (p=.001).

Perceived manual ability at initial evaluation is not related to perceived pain; however, by discharge, perceived pain is more strongly associated with perceived manual ability accounting for about 30% of variability. Manual ability appears to involve factors beyond pain, such as age and hand strength. We suggest that occupational therapists document pain in addition to manual ability, especially at initial evaluation, as there does not appear to be overlap between these concepts at initial evaluation. A study limitation includes the lack of discharge data for many patients.

Convergent Validity: The Relationship between Pain Levels and the Manual Ability Measure (MAM-20)

Throughout the day, individuals use their hands to perform and complete many occupations. Hands are constantly used to feed, dress, turn on faucets, open bottles and doors, type on the computer, and countless other occupations. Hand's ability or manual ability to complete occupations can decrease due to trauma, disease process, surgery, or even aging. These events impact level of strength and pain in the hands which may cause difficulty with many occupations (Rice, Leonard, & Carter, 1998; Chen, Granger, Peimer, Moy, & Wald, 2005; Dahaghin, Bierma-Zeinstra, Reijman, Pols, Hazes, & Koes, 2003). When an individual has difficulty completing occupations, it has been assumed that occupational performance may not meet the individual's standards thus lowering the individual's quality of life (Chen, Granger, Peimer, Moy, & Wald, 2005) and are often referred to occupational therapy. There is even a specialized certification for Occupational therapist to work as Hand therapists. Patients are referred to hand therapy for a variety of reasons and diagnosis, but the common connection for all individuals participating in hand therapy is the desire to improve their manual ability. During the initial hand therapy evaluation, assessments commonly used include strength and level of pain and very little focus on assessments that examine the roles and occupations of the patient. Christine Chen over the past decade has developed a new hand-focused assessment tool that looks at the patient's perceived manual ability of their hands for common occupations. This assessment, called the Manual Ability Measure (MAM-20), has been examined in a variety of settings and with a variety of diagnoses to determine reliability and validity (Chen, 2011) of items. This study wants to further examine the validity of the study and its relevance to hand clinics for Occupational Therapists.

Occupational therapist's role is to provide the client with interventions that improve the client's performance in occupations identified as problematic. Occupational therapists use a variety of approaches when assessing and treating clients but numerous hand clinics use the biomechanical approach (Chen, et. al, 2005). This approach emphasizes range of motion measurements, grip and pinch strength assessment procedures, and physical dysfunction. Commonly, therapists use other standardized assessments that focus on function of the hand. These assessments, such as the Purdue Pegboard, and the Jebsen Test of Hand Function, have been found to be repetitive and do not represent natural movement of the hands (Chen, Granger, Peimer, Moy & Wald, 2005). Grip strength, range of motion testing, the Purdue Pegboard, and the Box and Block test do not strongly relate to an individual's functional ability and success in occupational performances when completing activities of daily living (ADLs) (Chen & Bode, 2010). Chen thought it was essential to create an assessment which focuses on the extent of disability in the upper extremities, more specifically known as manual ability.

Manual ability is the person's capacity or perceived capacity to manage daily activities requiring the use of the upper limbs and hands (Durez, Fraselle, Houssiau, Thronnard, Nielens, & Penta, 2007; Chen & Bode, 2010). However it can be assume the lack of or decrease of manual ability is the result of a disability. Chen defines disability as a loss of function that is often the consequence of the interaction between impairments and other contextual factors such as the person's attitude, the ability to adapt, and his or her environment (Chen, et. al., 2005). The World Health Organization (2001) defines disability as an umbrella term for impairments, activity limitations, and participation restrictions. Disability is affected by interpersonal, social, and environmental factors (World Health Organization, 2001). Chen took over a decade to develop an assessment that focuses upon everyday occupations to determine the extent of

disability of the upper extremity**.** The purpose of this current study is to examine the psychometric properties of Chen's assessment called the Manual Ability Measure 20 (MAM-20). This 20 item semi-structural interview assesses common everyday occupations and the degree of difficulty individuals have in completing the occupation.

The Purpose and Use of the MAM

The outcome of the MAM-20 should be of interest to therapists because functional abilities are most meaningful to patients (Chen & Bode, 2010). Function, as defined by World Health Organization (2001), includes: body function (physiological and psychological), the ability of the individual to execute an activity, and the individual's involvement in a given life or social situation. Chen (2011) stated, "Occupational therapists are the experts in reducing the effect of disability on people's occupational performance. My challenge was to create an assessment that was ability- rather than impairment-focused, and one that can quantify ability (p.12)." By having the MAM focus on functional ability, it can be used as a starting point to discuss the role and occupations that are most meaningful to the patient; the start to a client-centered treatment process.

The MAM's psychometric properties have been assessed with many specific diagnoses such as multiple sclerosis, traumatic hand injuries, arthritis, carpal tunnel syndrome, and neurological conditions. Many of these studies took place in hand clinics located in Australia, the United States, and Canada (Chen, 2011; Chen, et. al., 2005; Chen & Bode, 2010; Chen, Kasven, Karpatkin,& Sylvester, 2007) . When completed as a semi-structural interview, The MAM assesses the extent of perceived manual ability without the use of assistive devices or compensation techniques (Chen, n.d).

Many occupational therapy assessments regarding hand function are self-reported (such as the Disabilities of Arm, Shoulder, and Hand questionnaire (DASH), Patient-rated Wrist-Hand evaluation questionnaire, and the Michigan Hand Outcome questionnaire) and direct (such as dynamometers and goniometers). It is suggested that therapist utilize both forms of assessments to achieve an accurate view of an individual's manual ability. In a systematic review assessing 148 studies that assessed the correlation between self-report assessments and direct assessments in regard to physical activity; a low-moderate correlation (r=.37, SD=.25) was discovered (Prince, Adamo, Hamel, Hardy, Corber, Tremblay, 2008). Thus it is suggested not to use a self-report measure and direct assessment interchangeably.

The MAM has two diagnostic versions: Neuromuscular and Musculoskeletal (Chen, 2011, p. 12). The neuromuscular version is appropriate for diagnoses such as brain injuries, multiple sclerosis, and spinal cord injuries. The musculoskeletal version is appropriate for individuals diagnosed with arthritis, acute upper extremity orthopedic trauma, chronic upper extremity orthopedic trauma, or those with upper extremity complex syndromes.

The MAM-20 consists of 20 items that are scored on a scale of 1 "cannot do" to 4 "easy to do." Another scoring option is N/A "almost never did the task even before my condition," for those who never participate in some occupations. The scoring method quantifies the qualitative information gathered from the semi-structural interview. Some of the 20 items include: wring a towel, tying shoes with laces, turning a key, using hand to eat a sandwich, and opening a bottle (see Appendix B for an example MAM-20 for patients with musculoskeletal conditions).

Scoring the MAM requires simple addition and very little time. When scoring the MAM after the interview, the therapist would sum together all the scores and using the chart provided

match the “Sum Score” with the “MAM Measure”. The “MAM Measure” is a Rash-derived equivalent of the “Sum Score” which presents the outcome on a scale from 0 (no ability) to 100 (high ability). Thus, a higher score indicates greater perceived manual ability. After finding the “MAM Measure” you can also compare the observe score with expected scores based from a research sample in a plot chart also provided.

The Development and Psychometric Properties of the MAM

Chen created the Manual Ability Measure (MAM), in 1999, to focus on daily function and disability, due to the lack of occupation based assessments. During a pilot study, data from three rounds of data collections, input from a panel of hand surgeons and hand therapists, and interviews with 115 patients, reduced the size of the MAM from 83 items to 16 items (Chen et al., 2005). Items in the original MAM-83 were similar to the Disability of Arm Shoulder and Hand (DASH). The DASH asks about occupations such as: opening a new or tight jar, doing heavy household chores, carrying a shopping bag, writing, turning a key, making a bed, and many more occupations (Institute for Work and Health, 2012). The DASH asked about stiffness of shoulder, arm and hand and other limitations possibly experienced due to pain or stiffness in these areas. Because some activities included in the DASH use the arm and shoulder and not just the hand, these items were removed. Examples of items removed include gardening, laundry, and sport activities because they did not adhere well with other items to form the construct of the MAM (Chen et al., 2005). Input from the panel of hand surgeons and hand therapist confirmed that the MAM-16 was clinically relevant. The 115 patients ensured the MAM was clear and had an acceptable level of usability through semi-structured interviews.

Other psychometric properties were evaluated during the initial development of the MAM-16. Chen, Granger, Peimer, Moy, and Wald (2005) originally hypothesized the MAM to

be moderately related to pain levels, physical functioning, emotional wellbeing and general health status. The hypothesis was supported and Chen et al.(2005) found that the MAM-16 correlated moderately with other health-related constructs. The MAM-16 was sensitive enough to show differences in scores for those within diagnostic groups. There were significant differences among scores for those with impairments of neurological diagnoses and musculoskeletal diagnoses (Chen et al., 2005).

Due to the difference among impairments, the ranking of occupations from hardest to easiest is different for the two versions. Items that were commonly found to be hard for those with musculoskeletal disorders include: combing hair, washing hands, turning a door knob, turning a key, opening a wide mouth jar, opening a childproof medicine bottle, and wringing a towel. Items found to be hard for individuals with a neurological disorder include: opening an envelope, counting money and coins, taking identification cards and credit cards out of a wallet, folding laundry, zipping a jacket, tying shoes, and cutting nails with a nail clipper. This reflected logical reasoning to create separate scoring forms for the two diagnostic populations (Chen & Bode, 2010). Chen responded by developing two diagnostic versions of the MAM-16: musculoskeletal and neurological assessments. The scoring forms are the specific scoring charts with the "Sum Score" and Rasch- derived "MAM Measure." Chen and Bode (2010) found that the neuromuscular group assessments showed lower manual ability when compared to the musculoskeletal group. This contributes to the MAM's content and criterion related validity.

Chen felt the MAM-16 needed to be expanded to increase the applicability of the MAM to a general rehabilitation population (Chen, 2011). Chen increased the items of the MAM from 16 to 36 creating the MAM-36. She assessed the psychometric properties of the MAM-36 with 44 clients with multiple sclerosis. Chen found that the Rasch reliability estimate for this sample

size was .94 suggesting that the MAM-36 could reliably separate participants into several levels of manual ability. The study also showed the average score among patients with less severe disease process were significantly higher than that of patients with more severe disease. This was to be expected because the lower the score on the MAM-36 the lower the patient's manual ability. This contributes to the validity of the MAM-36.

Chen and Giustino (2007) examined associations between grip strength and pinch strength of both hands to the MAM-36. Chen discovered associations between MAM-36 and grip and pinch strengths had a moderate correlation that were significant ($r=.51$, $p\leq.05$). However, Chen noted a stronger correlation between MAM-36 and the right hand strength ($r=.59$). Chen suggests that functional use of hand is related to but not completely dependent on hand and finger strength (Chen et al., 2007).

Chen and Bode (2010) stated that "the MAM-36 showed acceptable unidimensionality and psychometric properties" for the general clinical population after a study including 337 community-dwelling outpatients participating in hand clinics (p. 419).

Even with acceptable psychometric properties, clinicians and therapists were not consistently using the MAM-36. Clinicians at the hospitals reported that they would not use it consistently in the clinic due to the length of the assessment and the amount time it took to administer (Chen, 2014). During further development and testing 300 sets of data, the MAM-36 was shortened to 20 items, the MAM-20. Person-separation reliabilities and item separation reliabilities of the MAM-36 and the MAM-20 were found to be .93 and .99 respectively. Chen kept several domains found in the MAM-36 in the MAM-20. Some of the domains include: food

related, dressing related, ADL related. Chen states that the MAM-20 and MAM-16 did not have mis-fitting items and a small standard error of associated with each item (Chen & Bode, 2010).

Chen's development of an assessment that focuses on occupational ability for day to day tasks and strong psychometric properties, allows occupational therapists to feel confident when utilizing the MAM-20. We have chosen to use the MAM-20 in this study due to the ease of usability, the reliability and validity associations, and because of the relevance to occupational therapy.

The Relationship between Pain Levels and the Manual Ability Measure

Pain is a common factor that restricts participation in occupations. Practitioners know that if there is pain, completing assessments or participating in treatment sessions can be difficult for the client. The three most common causes of pain, whether chronic or acute, arise from musculoskeletal disorders, neurological disorders, and tumors (Dahaghin et al., 2003). Dahaghin and colleagues (2003) reported a prevalence of hand or wrist pain reaching to 26% of the general population (Dahaghin et al., 2003). Pain, however, is a complex and subjective factor in client treatment.

There are others factors that could influence the perception of pain, such as gender, acute vs chronic pain, and self-efficacy. There are few studies that examine the ability, or the client's perceived ability, to perform various occupations when experiencing pain. Dahaghin (2003) found that women reported higher levels of pain and reported greater amounts of disability in the hand compared to men. Individuals with a higher sense of self efficacy or control over their pain generally reported less pain than patients who reported having less personal control over their pain. (Toomey, Mann, Abashian, & Thompson-Pope, 1991).

Pain and Disability

Dahaghin et al. (2003) reported that pain is one of the five determinants for people to be able to use their hands effectively. Studies that have investigated the correlation between pain and disability have shown that there is a moderate correlation between the level of perceived pain and the extent of disability in an individual (Dahaghin et al., 2003; MacDermin, Turgreon, Richards, Beadle, & Roth, 1998). MacDermid and colleagues reported that "Moderate correlations were observed between directly measured impairments (grip strength, range of motion, dexterity) and patient-reported pain and disability" (MacDermid, Turgeon, Richards, Beadle, & James, 1998, p.584). According to this study, pain moderately correlates to client factors that quantify the extent of a disability.

Dahaghin et al.(2003) measured manual ability by a semi-structured interview and form that quantified the amount of hand disability called the Stanford health assessment questionnaire (HAQ). This process is similar to the protocol of the MAM-20 as suggested by Chen (n.d). The mean score of eight questions related to hand function defined the extent of perceived hand disability. Other measures used included the visual analog pain scale, and hand x-rays and medical history to assess the extent of actual hand damage that limits function labeled as hand disability. After a study with 7983 community-dwelling older adults, Dahaghin (2003) stated, "hand pain showed nearly the same relation to hand disability and to the overall disability index (r= .83) (p. 102)." However, Dahaghin (2003) suggests that both of these measures showed nearly the same relation to hand pain. The hand pain had an odds ratio of 2.6 and 2.3 to hand disability and overall disability index respectively, suggesting that pain and hand disability have a weak relationship to each other (compared to the odds ratio 6.4 of age to hand pain).

While examining the psychometric properties of the MAM-36 with patients with multiple sclerosis Chen et al.(2005) looked at the relationship between pain and the MAM-36. The MAM-36 had a moderate correlation (r=.45) with hand pain and perceived manual ability (Chen et al., 2005). Further study is needed to assess the relationship of perceived pain to the MAM-20.

The Relationship between Strength and Manual Ability

This study is also investigating the relationship between strength and manual ability. It is safe to assume that hand strength is an important factor for performing and completing occupations of daily living (ODLs). Hand strength is needed to overcome gravity and any resistance an object is presenting, such as turning a faucet or lifting an object. Decrease in hand strength would lead to individuals experiencing difficulties in completing tasks like opening a jar, turning a faucet and brushing hair. Multiple researchers have stated that manual ability declines with age due to a variety of factors including decrease in hand strength (Rantanen, Era, & Heikkinen, 1997; Rice, Leonard, & Carter, 1998; Flunn, Trombly-Latham, & Podolski, 2007; Rand & Eng, 2010). Rand and Eng (2010) conducted a correlation study, which asked if the amount of hand usage throughout the day, measured by accelerometers, decreased due to less hand strength measured by dynamometers. They found a low correlation that was only statistically significant for the right dominant hand ($r=.33$, $p<.001$). This study reported that grip strength "was not found to be a determinant of hand use (pp. 882)" during daily occupations.

Some studies have reported weaker correlations between hand strengths and manual ability in hands. Rice, Leonard, & Carter, (1998) found a weak relationship between grip and pinch strengths, measured by dynamometers and pinch meters, and forces generated in accessing 6 household containers, measured by force sensing resisters placed on the containers. However,

Rice et al. did not control for hand placement. Rahman, Rice, Thomas, (2002) extended on Rice et. al (1998)'s study to include the well-elderly population. A low to moderate correlation (r=.31 to .44) was found between forces used to open larger bottles and operating an aerosol spray can however a negligible to low correlation (r=-.03 to .25) was found for forces used to open smaller containers and pinch strengths. The correlations were not found to be statistically significant and the researchers could not conclude that greater hand strength would afford greater performance in opening containers (Rahman, Rice, & Thomas 2002). Previously, Rice et al. (1998) stated, "This disparity in dynamometry performance (men having significantly greater strength than women) suggests that in a normal population, greater grip strength does not necessarily improve a person's ability to open the types of containers selected for this study (p.624)."

Chen and colleagues mirrored Rice's statement in a more recent study. Chen, Kasven, Karpatkin, & Sylvester (2007) found a moderate correlation when comparing the MAM 36 to hand and pinch strength in participants diagnosed with multiple sclerosis (r=.51 to .59; p<.01). Chen et al., (2007) stated that the findings suggested "that functional use of the hand is related to but not completely dependent on the hand and finger strength (p. 796)."

Conti (1998) explains the weak to moderate correlation between hand strength and manual ability. The hand has 39 muscles available for use and there is only one standardized hand posture used for testing grip strength, which may not test the strength and ability of all 39 muscles. Thus, hand strength may not be a good determinant of manual ability (Conti 1998). Even with weak hand muscles, clients can be taught and shown different hand grasp patterns or use of the body to open, turn, or use tools needed to complete occupations. Adaptations such as hand placement or utilizing other tools to access containers or complete an occupation may be needed. For example, an individual with arthritis may grasp a bottle with his or her knees,

instead with one hand, and use a larger grip pad to open a bottle verses with a bare hand to open the bottle. However, the MAM-20 assessment is focused on completing the occupation without the use of tools or assistive devices or methods to complete an occupation.

Manual ability has been compared to other role-based and health focused assessments. Chen and Giustino (2007) compared MAM-36 scores to the results of the SF-36, grip strength, and Beck Depression Inventory with 14 participants. Chen and Giustino (2007) found that manual ability demonstrated a high correlation between the SF-36 Role Physical domain and MAM-20 ($r=.76$, $p<.01$) and with the General Health domain of the SF-36 and MAM-20 ($r=.70$, $p<.01$). Chen states that this strong correlation "suggests that manual ability is associated with one's ability to participate in everyday activities and assume life roles" (p.13). While the MAM-36 did not have a significant correlation to grip strength, the General Health subtest of the SF-36 and grip strength had high correlation ($r=.70$, $p<.01$). Chen and Giustino (2007) reported that this finding "is not surprising since there are inconsistent findings in the literature with regard to the associations between impairment, functional limitations, and disabilities. As mentioned above, Prince et al. (2008) found that there were low to moderate correlations between self-reported assessments and direct assessments when assessing an individual's physical activity.

Hypothesis and Research Questions

The primary research question of the present study asks: is there a relationship between the amount of perceived pain, as measured by visual analog pain scale at admission and discharge, and the level of perceived manual ability, as measured by the MAM-20, at admission and discharge? However, pain is not the only factor that may contribute to decrease function in the hands. The secondary research question asks whether there is a relationship between the hand

and pinch strength, as measured by Jamar Dynamometer and B&L pinch gauges, and the MAM-20 score at admission?

Methods

Sample

The study design was a retrospective chart review. No patients were recruited for the study. Inclusion criteria for medical records included: patients referred to occupational therapy for a hand or upper extremity diagnosis, presence of a perceived manual ability scores from the MAM-20 at admission, and patients who were 21 years of age or older. Medical records that were excluded were those with missing data for MAM-20 score at admission or if the patient was under the age of 21. Medical records information collected for analysis included: age, gender, ethnicity, diagnosis, hand dominance, grip and pinch strength measurements at admission, VAS scores at admission, VAS scores at discharge, and MAM-20 score at admission and, when available, MAM-20 scores at discharge. Discharge strength scores were not recorded.

Medical records selected for examination included admission dates from June, 2012 through September, 2013. Following approval by the IRB, access to medical records was provided to us through the University of Toledo Medical Center (UTMC) Hand Clinic. The UTMC occupational therapists provided a list of patients they felt met our inclusion/exclusion criteria. We proposed examining a total of 150 medical records. Because the demographics, diagnoses and conditions varied substantially amongst patients, we needed a large sample size in order to have the power to see the strength of the relationships.

Instrumentation

Hand and pinch strength assessments were completed through a standardized process and used the Jamar Dynamometer and B&L pinch gauge. Due to its long history of use, standardized

norms and reliability and validity data are available for the Jamar Dynamometer and B&L pinch gauge (Mathiowetz, Kashman, Volland, Weber, Dowe, & Rogers, 1985).

The manual ability of participants was measured by the MAM-20 provided by Christine Chen. Currently the MAM-20 is not published but is available by request to Christine Chen. Chen emphasizes the use of a semi-structural interview format when completing the MAM-20 (Chen, 2011).

Pain was measured with a visual analog scale (VAS). The VAS is a 10 cm line in which only the numbers and words signifying 0 for "no pain" and 10 "for worst pain ever" are included as anchors on each end of the VAS. Standardized procedures for the VAS state that the participant is to point or mark the spot on the line indicating his or her level of pain. In this study, participants marked on the VAS with a pen. The occupational therapists measured the distance in centimeters (cm) from the zero marked on the scale to the point or mark and recorded the VAS results in the participant's chart. The measurement ranged from 0 to 10cm and indicated the amount of perceived pain the patient was experiencing (Bodian, Freedman, Hossain, & Eisenkraft, 2001). During follow-up and discharge assessments participants simply verbalized how much pain they were in on a scale from 0-10.

Procedure

The University of Toledo Biomedical Institutional Review Board approved the study and all procedures. The data collector was trained in the data collection process and attended a HIPAA certification course prior to data collection. We developed a data collection sheet (see Appendix A) that included MAM-20 scores, hand and pinch strengths, pain levels and the demographic information such as age, ethnicity, and diagnosis. After data collection, the information from the

data sheets was entered in an Excel spreadsheet at the research lab. Following any use, the data collection sheets and the USB drive containing the spreadsheet were then immediately returned to a locked file cabinet at the research lab.

Data Analyses

The data were normally distributed and a Pearson's correlation coefficient was used to determine the strength of the relationship between pain self-ratings and manual ability scores. An analysis of correlations was used to test the strength of relationships between MAM-20 scores to hand strength, pinch strengths, and pain scores. Specific terminology was used to describe the strength of the relationships found using the Pearson correlational coefficients. Correlations ranging from 0 to .20 are termed a *negligible* correlation, correlations ranging from .20 to .40 are termed a *low* correlation, correlations ranging from .40 to .60 are termed a *moderate* correlation, correlations ranging from .60 to .80 are termed a *high* correlation, and correlations ranging from .80 to 1.00 are termed a *very high* correlation (Tomita, 2006).

Results

Participants

We analyzed the data from 122 medical records. The ages of participants ranged from 21 to 78 with a mean of 50 years old (SD= 15.28) and median age of 51. The sample included 72 females (59%) and 50 males (41%). Hand dominance in the sample showed that 87 participants (71.3%) were right handed, 10 participants (8.2%) were left handed and 25 participants (20.5%) were either not asked or dominance was not recorded in their medical charts. The demographics of the sample are as follows: 81 participants (66.4%) were Caucasian, 31 participants (25.4%) were African American, 3 participants (2.5%) were Hispanic, 3 participants (2.5%) who were

reported as "other," 2 participants (1.6%) were Asian decent, and 2 participants (1.6%) had unspecified demographics. We coded the diagnoses into seven categories including: arthritis, carpal tunnel, trigger release, cysts, trauma, upper extremity nerve involvement, and generalized pain and/or weakness.

Statistical Analysis

Out of the 122 medical charts reviewed, 118 participants completed the MAM-20 during the initial evaluation. The mean for initial MAM-20 scores was 58.01 (SD=12.81). The minimum initial MAM-20 score was 13 and the maximum initial MAM-20 score was 100 (range of 87.0).

Out of 122 medical records 121 participants were able to rate their pain at initial evaluation using the VAS. The mean initial pain score from the VAS was 3.7 out of 10 (SD=2.8). The initial pain score on the VAS (n=121) had a minimum rated hand pain score of 0 out 10 and the maximum rated hand pain score was 10 out of 10 (range=10).

The initial MAM-20 scores and initial pain VAS scores were found to have a negative but negligible correlation (r= -.128) and no statistical significance (p=.168). Pain scores contributed less than 2% to the initial MAM-20 scores (r^2=.016). A negative correlation is to be expected between initial MAM-20 and initial VAS because a higher score on the MAM-20 represents greater manual ability while a higher score on the VAS represent more pain.

The occupational therapists collected hand strength via the Jamar dynamometer and lateral and 3-jaw chuck pinch strength via the B&L pinch gauge. Approximately half of the sample had strength measurements collected to assess hand strength (n=69), lateral pinch (n=62), and 3-jaw chuck (n=64) at initial evaluation. Strength measurements were not taken when the

patient recently had surgery or trauma resulting in a broken or fractured bone. Initial hand strength of the affected hand had a mean strength of 33.14 pounds (SD= 22.17). The minimum affected hand strength recorded was 0 pounds and the maximum affected hand strength recorded was 90 pounds. The affected hand's initial lateral pinch strength (n=62) had a mean of 11.97 pounds (SD=5.21) and a range of 28 pounds. The minimum initial lateral pinch strength for the affected hand was 2 pounds and the maximum lateral pinch strength for the affected hand was 30 pounds. The affected hand initial 3-jaw chuck strength was recorded in 64 records. The mean of the initial affected hand 3-jaw chuck pinch strength was 9.75 pounds (SD=4.81). The range of the 3-jaw chuck strength for the affected hand was 22 pounds with the minimum strength of 2 pounds and the maximum recorded strength of 24 pounds.

The relationship between the initial MAM-20 score and the affected hand strength resulted in a low correlation (r=.254), but statistical significance was found (*p*=.035). Affected hand strength contributed about 6% to the initial MAM-20 score (r^2=.06).

Initial MAM-20 score and affected hand lateral pinch had a negligible correlation (r=.119) with no statistical significance. Lateral pinch strengths contributed about 1% to the MAM-20 scores (r^2=.014). The affected hand 3-jaw chuck strength and the MAM-20 scores were found to have a low correlation (r=.205) with no statistical significance (*p*=.105) . Initial affected hand 3-jaw chuck contributed to about 4% (r^2=.042) of variability to the MAM-20 scores.

Discharge MAM-20 scores were available for 52 participants out of the 122 medical records. The mean of the discharge MAM-20 scores was 68.65 (SD=12.02). The minimum discharge MAM-20 score was 43.40 and the maximum discharge MAM-20 score was 100 with a range of 56.60.

Out of the 122 medical records, 43 participants rated their pain at discharge. Discharge pain scores for the affected hand had a mean of 2.73 out of 10 (SD=2.36). The minimum reported discharge pain score was 0 out of 10 and the maximum pain score reported was 9 out of 10 (range= 9)

A correlational analysis was completed on participants whose charts had both the discharge MAM-20 scores and the discharge pain levels from the VAS. A moderate correlation was found between the discharge MAM-20 scores and the discharge reported VAS scores (r= -.554) with statistical significance (*p*=.001). VAS scores contributed to slightly over 30% (r^2=.307) of the variability in discharge MAM-20 scores.

Two regression analyses were conducted to examine the extent to which independent variables may have been predictive of the participants' initial MAM-20 scores and another regression analysis examined discharge MAM-20 scores. Variables that were considered as factors for the first regression analysis included: age, initial pain VAS score, affected hand initial strength, affected 3-jaw chuck initial strength and affected lateral pinch initial strength. The model summary showed the five variables together account for about 15% of variability in the initial MAM-20 scores (r=.394, r^2=.155). There was not a significant effect from pain, hand strength, 3-jaw and lateral pinch strengths, and age on the MAM-20 scores (df 5, F= 2.017, *p*=.090). For the second regression analysis, variables considered included: age and initial VAS scores. The model summary showed that the two variables contributed to about 7.5% of variability in the initial MAM-20 scores (r=.274, r^2=.075). .For discharge MAM-20 scores the regression model looked at the extent to which independent variables (discharge pain and age) may have been predictive of the participants discharge MAM-20 scores. The model summary

showed the two variables together accounts for about 44% of the variability in the discharge MAM-20 scores with a significant effect (r= .665, r^2=.442, *p*=.001).

Discussion

The purpose of this study was to examine the relationship between perceived pain ratings, as measured by the VAS, and perceived manual ability, as measured by the MAM-20 at initial evaluation and at discharge from occupational therapy. Secondarily, we examined the relationship between hand strength, as measured by the Jamar dynamometer and the B&L pinch gauge, and perceived manual ability represented by MAM-20 scores. The primary research question was: is there a relationship between the amount of patients' perceived pain, as measured by visual analog pain scale at admission and discharge, and the level of perceived manual ability, as measured by the MAM-20, at admission and discharge? The secondary research questions asked: is there a relationship between MAM-20 scores and hand strength, measured by Jamar dynamometer and B&L pinch gauge, at admission?

This present study found a negligible to low correlation between initial reported pain and the initial MAM-20 scores. In 2007, Chen and Giustino investigated the construct validity of the MAM-36 by assessing correlations and their strengths between a wide number of variables (grip strength, pain on the visual analog scale, blood pressure, mental health, and vitality test) in individuals with osteoarthritis. The authors reported a negligible correlation between initial pain and the initial MAM-36 even when the sample reported more pain than the general population. These similar results show how initially there are multiple factors that contribute to decreased manual ability, including pain. This finding seems consistent for the MAM-36 and the MAM-20. A possible explanation for the low correlation between the initial reported pain and the initial

MAM scores could be the individuals' perception of their pain and their manual ability. They may have entered into the assessment with decreased pain due to medications, perceiving a higher manual ability in their injured hand. The patients may have an inaccurate perception of their manual ability because they are able to use their opposite uninjured hand functionally. Another reason for the low correlation could be that people may not have tried many of the MAM items at the time of initial evaluation since the injury or diagnosis. The patients will be utilizing their imagination, which could result in inaccurate perception of their manual ability.

Discharge MAM-20 scores and discharge pain scores resulted in a moderate correlation ($r = -.554$) with statistical significance ($p=.001$). The stronger correlation shows that pain contributes to perceived manual ability to a greater extent at discharge ($r^2=.31$) than at initial assessment ($r^2=.016$). This finding is important because it shows that pain does play a role in MAM-20 scores at discharge. The decrease in pain and increase in MAM-20 scores could be a result of many possibilities. One reason there is a decrease in pain and increase in MAM-20 score could be due to receiving occupational therapy that addressed client factors that are limiting manual ability (dexterity, coordination, strength, mental confidence, and pain). Another explanation for the stronger correlation between the two variables is the possibility of patients developing a more accurate perception of how their pain is impacting their manual ability. From initial assessment to discharge, the patient has had multiple visits and therapeutic experiences that truly show the manual abilities of the injured hand. At discharge, when compared to the initial evaluation, the patient will be able to see through personal experience his or her manual ability. Yet another possibility could be the rate and/or perception of the natural healing process. Patients may notice that there is a difference between their ability at the initial evaluation and at the discharge evaluation. The desire to express improvements over time may lead the patient to be biased in his

or her results. However, the rater could be truly expressing the changes that occurred over time accurately. This is an advantage of the semi-formal interview. The occupational therapist may be able to determine if there is bias from the patient or if the score he or she is stating is accurate.

In this study, the relationship between grip strength for the affected hand and initial MAM-20 scores resulted in low correlation (r=.254) that was statistically significant (p=.05). Chen, Kasven, Karpatkin, and Sylvester (2007) discovered a similar result when they compared the MAM-36 to various hand strengths in persons with multiple sclerosis (MS). The average right hand grip strength of individuals with MS was 44.06 (SD=25.47, n=39) compared to the established norm right hand grip strength of 65.8 (SD=11.6). The correlations between hand grip strengths for right and left hands and MAM-36 were low but statistically significant (r=.36 and .33 respectively, $p \leq .05$). Our study's initial MAM-20 scores and Chen's, et al. (2007) study shows that strength does not appear to contribute a significant amount to manual ability.

In regard to the relationship between pinch strengths and MAM-20 scores at initial evaluation, we found a low correlation between the MAM-20 scores and the 3-jaw chuck (r=.205, p=.05) and a negligible correlation between lateral pinch strength and MAM-20 scores (r=.119, p=.05). Chen, Kasven, Karpatkin, and Sylvester (2007) discovered a stronger yet moderate relationship between current pinch strengths and MAM-36 in participants with a diagnosis multiple sclerosis. The authors did not compare admission and discharge strength, but collected data at one point in time. Right hand tip, lateral, and palmar pinch measurements and the MAM-20 scores resulted in moderate but statistically significant correlations (r=.59, .52, .54 respectively, $p \leq .0001$). Conti (1998) explains the weak to moderate correlation between hand strength and manual ability. She notes that the hand has 39 muscles available for use and there is only one standardized hand posture used for testing grip strength, which may not test the strength

and ability of all 39 muscles. Thus, hand strength alone may not be a good determinant of manual ability (Conti 1998). The present study reinforces Chen, Kasven, Karpatkin, and Sylvester's conclusion that manual ability is not greatly dependent on hand and finger strength and that there are other variables that may contribute to manual ability (Chen, Kasven, Karpatkin, Sylvester, 2007).

This study's results could also suggest that the MAM-20 displays responsiveness. The average initial MAM-20 scores and initial VAS scores were 58.01 (SD=12.81) and 3.7 respectively and the average discharge MAM-20 scores and discharge VAS scores were 68.65 and 2.73, respectively, showing an increase in manual ability and a decrease in perceived pain from initial evaluation to discharge. Chen, Palmon, and Amini (2014) focused a study on the responsiveness of the MAM-36. For 46 participants in outpatient hand therapy, they found a significant change in the mean of MAM-36 scores between the initial and discharge scores ($t = 8.03$, $p<.0001$). There was a gain in manual ability total score at discharge that ranged from 1.9 to 76 points. The mean amount of change for each item of MAM-36 from initial to discharge ranged from .5 points to 1.5 points. Both the current study and Chen, Palmon, and Amini's (2014) study suggests that patients rated items on the MAM to suggest more difficulty during the initial evaluation and then rated the items at discharge reflecting less difficulty with those same items at discharge. Responsiveness of an assessment is important. The amount of change documented by an assessment can be used to compare the effectiveness of interventions, and for research purposes.

Even with weak hand muscles, clients can be taught or shown different hand grasps or alternate ways to use the body to open, turn, or use tools needed to complete occupations. Adaptations such as hand placement or using tools to access containers or complete an

occupation may be needed. The MAM-20 assessment asks patients to rate their ability to complete the occupations without the use of tools or assistive devices, thus creating a baseline of manual ability. Occupational therapist will then provide the client with modalities, interventions, assistive devices, and compensatory techniques to improve participation in ADL's. The occupational therapist will focus goals on increasing hand strength and decreasing pain through the various techniques mentioned above. The purpose of the discharge MAM-20 is to provide a quantitative assessment of functional improvements over the course of occupational therapy, especially when compared to the initial MAM-20 scores. Chen (2011) stated, "No matter where I worked, I almost always evaluated the hand abilities of my clients. I quickly realized that it is not the change in range of motion of the wrist and fingers, or a pound or two increase in grip and pinch strength that matter most to them, but whether they are able to do things that are meaningful ─ activities they do every day, activities that make them happy (e.g., a hobby), and/or activities that allow them to be who they are (i.e., a child, a parent, a spouse, a worker, etc.) (p.12)."

Manual ability depends on many factors. This study found that pain, hand strength, 3-jaw chuck strength, lateral pinch strength, and age together contribute a small amount to the prediction of the initial MAM-20 scores (15%). This study also found that pain at time of initial evaluation and age contributed very little to the variability initial MAM-20 scores (7.5%). However, the study found that at discharge pain and age together contributed 44% to the variability of discharge MAM-20 scores. The increase in variability accounted for by pain and age at discharge is expected due to the stronger correlation between discharge pain and discharge MAM-20 scores. The regression analyses resulted in the variables (age and pain scores) contributing less than 50% to the initial MAM-20 scores and discharge MAM-20 score. This

shows that there are other factors contributing to the initial and discharge MAM-20 scores. Additional factors that could contribute to the MAM-20 scores may include the individual's role, dexterity of the affected hand, and/or gender.

Implications for Occupational Therapists

There is a need to assess all areas of the person: strength, pain, and manual ability. While the MAM-20 assesses occupation-based areas of a person's function it does not identify the potential reasons behind the decrease function, such as pain, or strength deficits. I suggest that the MAM-20 is meant to be used in conjunction with other assessments. This study shows the need for occupational therapists to use a reasonable number of assessments that cover the entire person holistically. Occupational therapists need to assess the whole patient to determine what is causing his or her dysfunction (such as: strength, endurance, mental status, and pain). All of the aforementioned client factors contribute to the level of dysfunction in the hand. The MAM-20 at initial evaluation, demonstrated weak convergent validity in regards to pain and strength of the hand, however, the convergent validity at discharge improved. The MAM-20 is very occupational and provides a unique perspective on patients' perceptions of their manual ability. Previous studies show strong convergent validity between the MAM-36 with other occupation-based assessment such as the DASH and role restriction assessments (Chen et al., 2005; Chen & Giustino, 2007; Chen et al., 2007).

Limitations

Limitations to the study could have impacted the outcome and can be drawn upon for future research. One limitation was the lack of discharge MAM-20 scores for many participants. There were 35 discharge MAM-20 scores compared to the initial 121 MAM-20 scores obtained. The lack of discharge MAM-20 scores was caused by multiple factors. Some factors were based

on human error such as simply forgetting to administer the MAM-20 at discharge. Other reasons for lack of discharge MAM-20 scores were out of the occupational therapist's control, such as, clients who did not attend their discharge visits or patients who were going to surgery and for whom occupational therapy would be continued in the future.

Future Research

Future research could assess the convergent validity of the MAM-20 to occupationally-based assessments like the DASH or the Functional Independence Measure. The DASH appears closer in construct to the MAM-20 especially in regards to items such as eating, dressing, and hygiene (Ali, 2010). Continued research on the convergent validity of the MAM-20 is important. Testing psychometric properties on an assessment shows the reliability and validity of an assessment. With tested psychometric properties, occupational therapists can be confident that their clinical judgments seen in goal writing and occupational therapy implementation, are based on a reliable and valid assessment.

Future research studies should look for other independent variables that could add to the predictability of MAM-20 scores. Variables may include other role related assessments and time between diagnosis and assessment or length of disability.

A change was observed between initial MAM-20 scores and discharge MAM-20 scores. This change could be reflective of increased manual ability. A future research study could assess the degree of sensitivity to change in the MAM-20.

Since direct measures such as strength and pain contributed little to the initial MAM-20 scores, future studies could also examine demographic factors that may contribute to the MAM-20 scores. The present study found age contributed 2% to the variance of the MAM-20 scores.

Biological factors such as gender were not considered as possible variables contributing to the MAM-20 score variability. Gender differences regarding perceived pain and MAM-20 scores should also be investigated.

Conclusion

The purpose of this study was to further establish psychometric properties of the MAM-20. Psychometric properties such as convergent validity are important to evaluate to ensure the assessment's outcomes are what the therapist desires to measure. This study asked if there is a relationship between the amount of perceived pain, as measured by visual analog pain scale at admission and discharge, and the level of perceived manual ability, as measured by the MAM-20, at admission and discharge. The initial MAM-20 scores and initial pain in affected hand(s) resulted in a negligible correlation. Discharge MAM-20 scores and discharge pain resulted in a moderate correlation. This moderate correlation supports convergent validity of the MAM-20. The decrease in pain and increase in manual ability may be attributed to participation in occupational therapy and the natural healing process. Due to the low correlation between pain, strength and MAM-20 scores at initial evaluation and the moderate correlation between pain and MAM-20 scores at discharge, we suggest that occupational therapists assess pain levels and grip and pinch strengths in conjunction with the MAM-20, especially at initial evaluation. A future research study on the relationship between age, pain, and MAM-20 is recommended. Other assessments such as pain and strength should be used with the MAM-20 to obtain a holistic picture of the patient.

References

Ali, D. (2010). *Rehab measures: Functional independence measure.* Retrieved from: http://www.rehabmeasures.org/Lists/RehabMeasures/DispForm.aspx?ID=889

Bodian, C. A., Freedman, G., Hossain, S., Eisenkraft, J. B. (2001). The visual analog scale for pain. *Anesthesiology, 95*, 1356-1361.

Chen, C. (2011). The Manual Ability Measure: An occupation-based hand assessment. *Advance for Occupational Therapy Practitioners, 27*(25). Retrieved from http://occupationaltherapy.advanceweb.com/Archives/Article-Archives/The-Manual-Ability-Measure.aspx

Chen, C. (2014) MAM-20 question [letter to research assistant].

Chen, C. (n.d). MAM-20 interest letter [letter to research advisor].

Chen, C. C., & Bode R. K. (2010). Psychometric validation of the manual ability measure-36 in patients with neurologic and musculoskeletal disorders. *Archives of Physical Medicine and Rehabilitation, 91,* 414-420.

Chen, C.C, & Giustino, J. (2007). Grip strength, perceived ability, and health status in individuals with arthritis: An exploratory study. *Occupational Therapy in Health Care, 21* (4), 1-18.

Chen, C. C., Granger, C. V., Peimer, C. A., Moy, O. J., & Wald, S. (2005). Manual ability measure (MAM-16): A preliminary report on a new patient-centered and task-oriented outcome measure of hand function. *Journal of Hand Surgery, 30* (2), 207-216.

Chen, C. C., Kasven, N., Karpatkin, H. I., & Sylvester, A. (2007). Hand strength and perceived manual ability among patients with multiple sclerosis. *Archives of Physical Medicine and Rehabilitation, 88*, 794-797.

Chen, C. C., Palmon, O., & Amini, D. (2014). Responsiveness of the Manual Ability Measure—36 (MAM–36): Changes in hand function using self-reported and clinician-rated assessments. *American Journal of Occupational Therapy*, *68,* 187–193.

Conti, G. E. (1998). Clinical interpretations of grip strengths and required forces in accessing everyday containers in a norm population. *American Journal of Occupational Therapy, 52*(8), 626-628.

Dahaghin, S., Bierma-Zeinstra, S. M. A., Reijman, M., Pols, H. A. P., Hazes J. M. W., & Koes, B. W. (2003). Prevalence and determinants of one month hand pain and hand related disability in the elderly. *Ann Rheum Dis, 64*, 99-104. doi:10.1136/ard.2003.017087

Durez, P., Fraselle, V., Houssiau, F., Thonnard, J. L., Nielens, H., & Penta, M. (2007). Validation of the ABILIHAND questionnaire as a measure of manual ability in patients with rheumatoid arthritis. *Ann Rheum Dis, 66,*1098-1105. doi: 10.1136/ard.2006.056150

Flunn, N. A., Trombly-Latham, C. A., & Podolski, C. R. (2007). Assessing abilities and capacities: Range of motion, strength and endurance. In M. V. Radomski & C. A. Trombly-Latham (Eds.), *Occupational therapy for physical dysfunction* (6th ed.) (p. 91–186). Philadelphia: Lippincott Williams & Wilkins.

Institute for Work and Health. (2012). The DASH. Retrieved from: http://www.dash.iwh.on.ca/home

.

MacDermid, J .C., Turgeon, T., Richards, R. S., Beadle, M., & James, H. R. (1998). Patient rating of wrist pain and disability: A reliable and valid measurement tool. *Journal of Orthopedic Trauma, 12* (8), 577-586.

Mathiowetz, V., Kashman, N., Volland, G., Weber, K., Dowe, M., & Rogers, S. (1985). Grip and pinch strength: Normative data for adults. *Archives of Physical Medical Rehabilitation, 66*, 69-74.

Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Gorber, S. C., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 5*(56).

Rahman, N., Thomas, J. J., & Rice, M. S. (2002). The relationship between hand strength and the forces used to access containers by well elderly persons. *American Journal of Occupational Therapy 56*(1) 78-85.

Rand, D., & Eng, J. J. (2010). Arm–hand use in healthy older adults. *American Journal of Occupational Therapy, 64*, 877–885. doi: 10.5014/ajot.2010.09043

Rantanen, T., Era, P., & Heikkinen, E. (1997). Physical activity and the changes in maximal isometric strength in men and women from the age of 75 to 80 years. *Journal of the American Geriatrics Society, 45*, 1439–1445.

Rice M. S., Leonard, C., & Carter, M. (1998). Grip strength and required forces in accessing everyday containers in a normal population. *American Journal of Occupational Therapy 52*(8), 621-626.

Tomita, M. R. (2006). Methods of analysis: From univariate to multivariate statistics. In G. Kielhofner (Ed.), *Research in occupational therapy: Methods of inquiry for enhancing practice* (p.243-280). Philadelphia, PA: F.A. Davis Company.

Toomey, T. C., Mann, J. D., Abashian, S., & Thompson Pope, S. (1991). Relationship between perceived self-control of pain, pain description and functioning. *Pain 45*, 129-133

World Health Organization. (2001). *International classification of functioning, disability and health (ICF)*. Geneva, Switzerland: Author.

Appendix A

Data collection sheet

Participant #_____ IRB #_____

Assigned version date:_____

Principle Investigator: Julie Jepsen Thomas

Data Collection Sheet

Patient diagnosis/ impairment:

Hand Dominance: R____ L____

Hand strength: R_____ L_____

Pinch Strength:

Lateral Pinch: R_____ L_____

Two Point pinch: R_____ L_____

Three-Jaw Chuck: R_____ L_____

Age:_____ Gender: M_____ F_____

Ethnicity/ race: Caucasian_____ African American_____ Hispanic/ Latino_____

Asian_____ Native American_____ Other_____

Patient's self-reported pain level: _____

Location of pain:

Date(s) of MAM given: Initial MAM date: Score_____

Follow-up MAM date: Score_____

MAM-20 For Patients with Musculoskeletal Conditions

Patient ID _____ DOB _____/_____/_____ Gender _____ Dx _____ Today's Date: _____/_____/_____
(Month) (Day) (Year) (Month) (Day) (Year)

Dominant Hand: Right, Left, Both **(Circle One)** **Affected Hand:** Right, Left, Both **(Circle One)**

1= cannot do	2=Very hard to do	3=A little hard to do	4=Easy to do
Impossible for me to do it	**I usually ask others to do it for me unless no one is around to help me**	**I can do it, but it requires longer time and effort; sometimes it gives me pain/discomfort, or makes me tired.**	**No problem, I can do it easily**

0=NA=Almost never do the task, even before I had my condition.

How easy or how hard for you to do the following tasks regardless which hand you use and without using an adaptive equipment?	
Rating	Choose only one number (definitions above)
( )	1. wring a towel
( )	2. open a medicine bottle with a child proof cap/top
( )	3. cut nails with a nail clipper
( )	4. open a wide-mouth bottle previously opened
( )	5. cut meat on a plate
( )	6. tie shoes with laces
( )	7. button clothes (medium sized buttons)
( )	8. pick up a ½ full water pitcher
( )	9. zip jacket
( )	10. write 3-4 lines legibly
( )	11. turn key (to open a door)
( )	12. take things/cards out of a wallet
( )	13. squeeze toothpaste onto a toothbrush
( )	14. handle/count money (bills and coins)
( )	15. brush or comb hair
( )	16. wash hands
( )	17. use spoon or fork
( )	18. brush teeth
( )	19. dial or key in telephone numbers
( )	20. use hand(s) to eat a sandwich

How much pain do you have in a typical day? Please indicate your pain on the average.

(No Pain) _____ (Severe Pain)

Note: This scholarly project reflects individualized, original research conducted in partial fulfillment of the requirements for the Occupational Therapy Doctorate Program, The University of Toledo