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The MultiDimensional Symptom Index: User Manual and Quesionnaire

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The MultiDimensional Symptom Index

User and Interpretation Manual

Revision History: This version updates the prior manual dated 2020 with new information

BACKGROUND

The MultiDimensional Symptom Index (MSI) is a patient-reported outcome measure (PROM) that uses a health valuation-weighted scaling system and novel data visualization to give clinicians and their patients different ways to explore and talk about the impact of pain and related symptoms. Initially developed by Dr. David Walton at Western University in London Ontario, Canada, with the support of Dr. Jacquelyn Marsh also at Western, the MSI comprises 10 symptom-related questions each with two patient-centred scales. The 10 symptoms were generated through focus groups[1] and conversations with people living with chronic pain. Through both empirical (statistical) and conceptual (sense-making) strategies, the 10 symptoms can be classed into two categories each with their own subscale:

1. symptoms considered 'somatic' such as sharp or dull pain, weakness, or stiffness
2. symptoms considered 'non-somatic' (sometimes called 'central') like environmental sensitivity, nausea, and low mood.

These symptoms represent those considered problematic by a majority of patients, and that collectively contribute to the overall experience and burden of living with pain.

The response options for the two patient-centred rating scales were also generated through patient input. The first relates to the *frequency* with which each of the 10 symptoms is experienced (never, rarely, often, always), and the second relates to how much each of the experienced symptoms are *bothersome* (or *interfere with*) daily function. The properties of the MSI, including test-retest reliability, structural, discriminative, and prognostic validity, and responsiveness have been tested in two independent samples of over 300 patients and have been reported in two peer-reviewed scientific journal reports available here.

TO USE

The MSI can be used for the following purposes:

1. To evaluate change over time in a pain-related condition, or to evaluate the effectiveness of an intervention between treatment sessions.
2. To identify people with acute pain that are most likely to recover in a timely manner or those who are more likely to report persistent ongoing symptoms.
3. To identify people who might also have comorbid depressive disorder and would benefit from further diagnostic workup by a trained mental health professional.
4. To develop a profile, or phenotype, of a person's pain experience, and identify those symptoms that seem to have the greatest contribution or impact on that experience. The highest impact symptoms should be the highest priority areas for intervention.

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[1] Walton DM, MacDermid JC, Taylor T, ICON. *The Open Orthopaedics Journal* 2013:7

SCORING

There are several metrics that can be extracted from a single administration of the MSI. The first 3 are relatively easy to calculate:

1. Total number of symptoms experienced = simple sum of all symptoms experienced at all (more than 'never'). This is a score out of 10.
2. Mean frequency of symptoms experienced = sum of the 'frequency' scores divided by the number of symptoms experienced. This will be a score from 0.0 to 3.0.
3. Mean interference of symptoms experienced = sum of the 'interference' scores divided by the number of symptoms experienced. This will be a score from 1.0 to 4.0.

Since each of these 3 scores are on a different scale (0-10, 0.0-3.0, 1.0-4.0) we recommend interpreting them as a percentage out of 100 (percent of max possible score) to put them all on the same scale. This means that the lowest score on the Interference scale is 25%, though that only holds as long as the respondent indicates experiencing at least one symptom. If no symptoms are experienced, all scores will be 0%.

Note that the mean frequency and mean interference are standardized to the number of symptoms experienced. This means that even if the respondent endorses experiencing a single symptom, they may still indicate that they experience that one symptom 100% of the time or it is 100% interfering with function.

From here the other scores that can be extracted from responses require a computer-supported scoring algorithm but are also more informative. The requirement of computer support is because the subsequent scores using a scoring matrix rather than simple mathematical functions. Conceptually, each combination of symptom + frequency + interference is given a score of 0-12 but that is based on a matrix of 120 individual health valuations that we created after asking ~100 study volunteers to rank each combination against a theoretical continuum of worst health status to best health status, and we used those rankings to create the matrix scores. A link to different tools for doing the scoring is provided in this manual. Those tools will facilitate creation of:

4. The Radar Plot of pain experience phenotype. Scores on each of the 10 symptoms are reported on a plot that synthesizes both the Frequency and Interference metric scores into a single score from 0 to 12. The visual representation allows rapid identification of the most problematic symptom types, and can itself function as a subscore to track change in just that symptom over time or with treatment.
5. The 'Somatic Symptoms' subscale, which is a sum of the composite scores of the *sharp pain*, *dull ache*, *weakness or giving way, stiffness or restricted movement*, and *numbness or pins and needles* symptoms. The scale range is 0 to 60, and a percentage is once again recommended for reporting and easier interpretation.
6. The 'Non-Somatic Symptoms' subscale, which is a sum of the composite scores of the *Sensitivity to light, noise, odor or temperature*, *Fatigue*, *Fogginess*, *Poor appetite or nausea*, *Nervousness, anxiety or sadness*, and *numbness or pins and needles* symptoms. The scale includes one additional item so ranges from 0 to 72. Note that the *numbness or pins and needles* item features on both the Somatic and Non-Somatic Symptoms subscales. This is both a statistical and theoretical consideration. The factor structure of the scale showed that this item, and only this item, loaded on both scales, and also the construct of 'numbness' could indicate either a neuropathic type phenomenon, or detachment and emotional numbing.

The 4th, 5th, and 6th metrics described here require the dedicated application to properly score as the conversion matrix is not intuitive.

INTERPRETATION

Single-item Metrics

Individual Symptoms

The dedicated app will provide a number of metrics and interpretations thereof. The first and perhaps most useful initially is the visual representation of the patient's synthesized symptom impacts. The use of a radar plot is particularly valuable here as, when used as intended, it acts as a sort of compass pointing the clinician and patient towards those symptoms that represent the greatest relative contribution to their overall pain experience. The alliance of clinician and patient can use this information to work together towards effective intervention strategies to address the burden of those high-contribution symptoms. The individual symptom scores can then be used to monitor the effectiveness of the intervention. A change of about 2 to 3 points (out of 12) can be considered evidence that the intervention strategy is targeting the right issues.

The **Number of Symptoms** (out of 10) is likely to be one of the less responsive to change, as it requires a symptom to essentially resolve completely before it is not experienced even rarely. It should be noted however that due to this stability, the random noise, and hence the minimum detectable change at the 90% confidence level, as an indicator of change needed to overcome noise, is proportionately smaller for this subscale.

Number of symptoms: MDC_{90} = 1.8 symptoms (18% of the total scale)

In other words, a respondent who indicates they experience 2 fewer symptoms between measurements can be interpreted as at least 90% likely to have changed greater than statistical noise.

The **Mean Frequency** and **Interference** subscales offer alternative indicators for monitoring treatment effectiveness. Frequency is particularly interesting here, as many patients have told us that it is not so much the intensity or severity of their symptoms that is bothersome, but it is their constant or near-constant nature. Frequency of symptoms experienced is rarely captured in pain evaluation tools. The dedicated app will provide a target for change in each of these metrics that should be achieved for confidence that the score indicates true change beyond random noise. The minimum detectable change at the 90% confidence level has been estimated to be:

- Mean Frequency: 0.9 points (30% of the total scale)
- Mean Interference: 1.0 points (33% of the total scale)

Somatic and Non-Somatic Symptoms Subscores

The two composite subscales of the MSI offer considerable value for clinical or research purposes. Of all the MSI metrics, the Somatic Symptoms subscore is most closely associated with the widely-used Brief Pain Inventory and its two subscales: Pain Severity and Pain Interference (r = 0.50 and 0.60, respectively). Of all MSI metrics the Non-Somatic Symptoms subscore is most closely related to the PHQ-9 depression screen at r = 0.80 (almost perfect association).

Also being metrics with wider scale ranges, both the Somatic and Non-Somatic Symptoms subscores can be used to evaluate treatment effectiveness or change over time in the same patient. Here, the Minimum Detectable Change at the 90% confidence level for each are:

- Somatic Symptoms: MDC_{90} = 7.5 points (out of 60), or 12.5% of total scale range
- Non-Somatic Symptoms: MDC_{90} = 6.1 points (out of 72), or 8.5% of total scale range

OTHER FUNCTIONS

Screening for Depressive Disorder

Some of the MSI subscores can be used as an ultra-rapid screen for major depressive disorder, as defined by concurrent PHQ-9 scores. The first is the 'Number of Symptoms' subscore . The table below presents useful cut scores in case clinicians should wish to use the MSI as a depression screen, though caution is urged if using *only* the Number of Symptoms subscore as we have not provided the screening utility for each of the 10 symptoms. For example, the 'Nervousness, Anxiety, or Sadness' item should probably be interpreted on its own especially if the radar plot of individual symptoms shows it to be in the upper quarter of the scale (e.g., score of 8-12). As can be seen in the table below, 8 or more symptoms offers 88% sensitivity and 76% specificity for likely MDD, and is probably a good place to suggest respondents seek additional diagnostic workup.

| Cut Score	% of sample over threshold[1]	Sn	Sp	PLR	NLR
	Number of Symptoms				
≥4	74.4%	0.96	0.20	1.19	0.20
≥5	59.6%	0.92	0.34	1.40	0.23
≥6	48.8%	0.92	0.55	2.03	0.14
≥7	40.9%	0.90	0.67	2.73	0.14
≥8	32.0%	0.88	0.76	3.72	0.15
≥9	18.2%	0.78	0.84	4.75	0.25

The Non-Somatic Symptoms subscore is the most useful of the MSI metrics for screening likely major depressive disorder (MDD), as shown in the table below. With a total subscore range of 0 to 72 points, those scoring 10 or less are *very unlikely* to be positive for MDD, while those scoring 21 or greater are *very likely* to be presenting with comorbid MDD and would benefit from further workup or referral to a mental health professional for proper diagnosis. Those with scores falling between these two thresholds would benefit from additional screening measures to help rule in/out MDD.

Non-Somatic Symptoms Cut Score	% of sample over threshold[1]	Sn (for MDD)	Sp (for MDD)	PLR	NLR
≥10	**47.1%**	**0.94**	**0.65**	**2.69**	**0.09**
≥11	42.6%	0.88	0.67	2.67	0.18
≥13	39.7%	0.86	0.76	3.64	0.18
≥15	36.8%	0.84	0.78	3.89	0.20
≥17	31.9%	0.80	0.83	4.59	0.24
≥19	27.0%	0.77	0.86	5.30	0.27

≥21	25.0%	0.77	0.91	8.24	0.26

Predicting Recovery Trajectory after Acute Injury

The MSI appears to also offer utility as a tool for identifying the patient with acute MSK pain who can be expected to recover quickly and differentiate them from the patient who can be expected to have a more challenging or slower path towards recovery and may develop persistent programs. For context, the recovery trajectories shown below were derived from a sample of research participants who entered a study on acute post-trauma musculoskeletal injuries and were followed for 12 months to see who recovered, who didn't, and how quickly. The outcome used is oriented such that a higher score means more interference with daily activities due to pain, reported as a percentage (%) out of 100. As you can see there were three trajectories that we found in those data, which pretty closely matches work from other researchers conducting similar analyses:
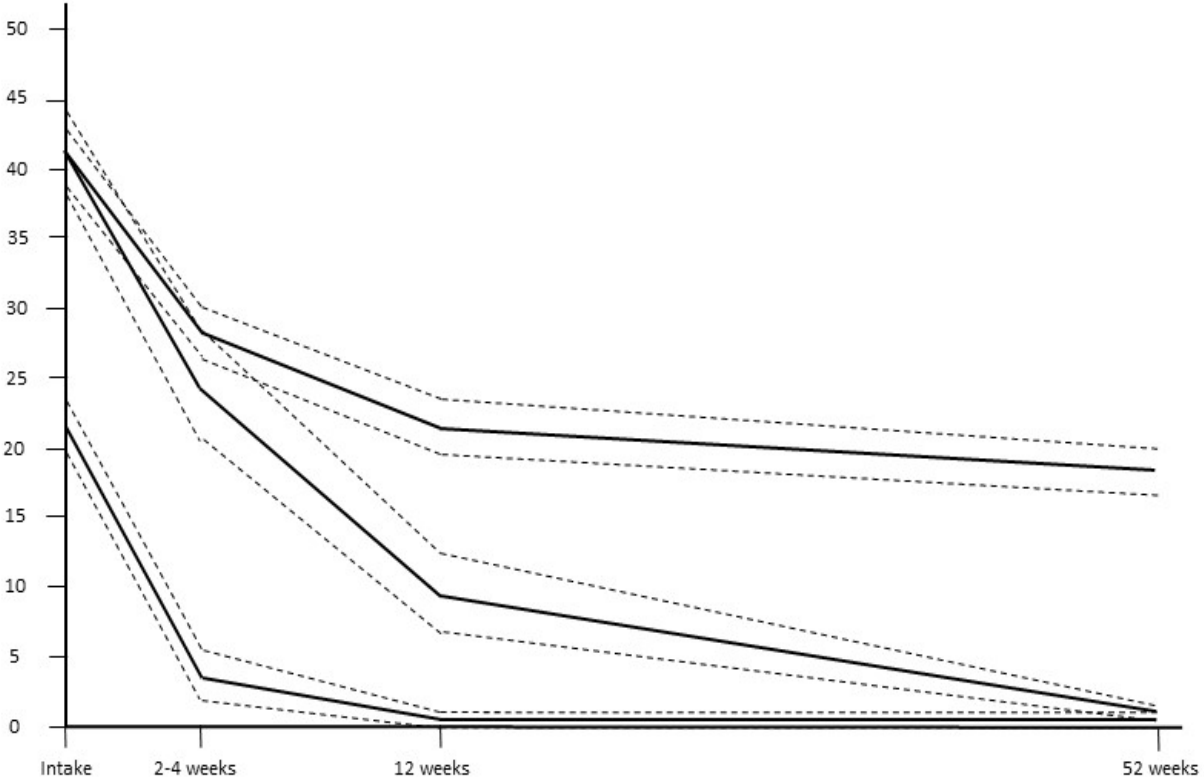
One group of people recovered quickly, by 12 weeks post-injury were no longer reporting any notable functional interference. A second group started out more impaired, took a longer time to get there, but by 12 months they too reported no ongoing problems. The third group started off more impaired, recovered a little bit but even at 12 months continued to report an average of about 25% functional interference, enough to be problematic on a day-to-day basis.

The <u>Mean Interference</u> subscale score, and the <u>Non-Somatic symptoms</u> score seem to be useful for predicting the *most likely* trajectory an injured person is going to take, even when measured within the first 3 weeks from injury. The table below shows some useful cut-scores for the Mean Interference subscore. For example, when measured within the first 3 weeks from injury someone with a Mean Interference score of 1.9 or less (out of 4.0) is not very

likely to be in the 'non-recovery' (develop chronic pain) group, while some who scores 3.0 out of 4.0 or higher is quite likely to be in the non-recovery group.

Cut Score	% of sample over threshold	Sn	Sp	PLR	NLR
Mean Interference					
>1.9	**65.6%**	**0.94**	**0.39**	**1.54**	**0.15**
>2.1	39.7%	0.71	0.64	1.96	0.46
>2.5	**17.6%**	**0.35**	**0.84**	**2.21**	**0.77**
>2.9	3.8%	0.19	0.95	2.35	0.93

That <u>Non-Somatic Symptoms</u> subscore is also one the most useful of the MSI metrics for identifying those with acute pain least likely to report rapid recovery. Per the table below, those scoring 2 or less (out of 72) within the first 3 weeks are very *unlikely* to report persistent or chronic problems 12 months later, while those who score over 21 are much *more likely* to follow the non-recovery path. Users should note that while those who score >21 very likely to follow a poor recovery trajectory, the very low sensitivity indicates that the tool catches only 18% of those who do not recovery quickly. As is the case with most prognostic tools, we are more confident saying that respondents who score very low are most likely to recovery quickly, but are less confident saying those who score very high are not likely to recover well. Which is a good thing, because it suggests that poor future outcomes are very subject to other forces and to changing prognoses.

Cut Score	% of sample over threshold	Sn (for non-recovery)	Sp (for non-recovery)	PLR	NLR
>2	**50.4%**	**0.88**	**0.56**	**2.01**	**0.21**
>3	46.2%	0.77	0.59	1.87	0.40
>4	42.7%	0.71	0.62	1.86	0.47
>12	13.7%	0.29	0.89	2.67	0.79
>18	6.8%	0.18	0.95	3.53	0.87
>21	**5.1%**	**0.18**	**0.97**	**5.88**	**0.85**

TO SCORE

The best way to interpret the scores right now are to have the patient complete the MSI in paper-and-pencil (hard copy) format and then enter their scores into a dedicated Google Sheet available at this link. That 'app' will provide all of the information presented here in an easy to use and easy to record fashion. It is recommended that patient results be printed in hard copy and attached to the chart or saved as a PDF for electronic charting. To print only the first page, first highlight the cells from A1:K61, the select 'File' -> 'Print', and select 'Fit to height' under the Scale dropdown menu. From there click 'Next' and you can save as a PDF file or print to your local printer.

Note that the spreadsheet does not store responses other than what is on the screen at the time. You should highlight and delete the scores you entered in B4:C13 after printing but before leaving the sheet. No personal information is required to use this scoring algorithm.

ENGLISH

Multidimensional Symptom Index

When answering, please consider only those symptoms that <u>you believe</u> are due to the condition for which you are seeking treatment.

	Do this part first ⇩ How often does this bother you?				**Then this part** ⇩ When it occurs, how intense is it? If you never experience that symptom, don't circle a number here			
Does your condition cause:	Never	Rarely	Often	Always	Barely noticeable, doesn't really bother me	Intense enough that I notice it, but can usually carry on without much effort	Quite intense, requiring real effort or support to push through it	So intense I have to stop what I am doing and seek relief
1. Sharp or shooting pain	0	1	2	3	1	2	3	4
2. General dull achiness	0	1	2	3	1	2	3	4
3. Stiffness or restricted movement	0	1	2	3	1	2	3	4
4. Weakness, clumsiness or giving way	0	1	2	3	1	2	3	4
5. Increased sensitivity to light, noise, certain odors or temperature	0	1	2	3	1	2	3	4
6. Numbness or pins & needles	0	1	2	3	1	2	3	4
7. Fatigue	0	1	2	3	1	2	3	4
8. Fogginess (difficulty concentrating or remembering things)	0	1	2	3	1	2	3	4
9. Poor appetite or nausea	0	1	2	3	1	2	3	4
10. Nervousness, anxiety or sadness	0	1	2	3	1	2	3	4

FRENCH-CANADIAN

SIIR Index des symptômes

Lorsque vous répondez, ne considérez que les symptômes que vous associés à la condition pour laquelle vous sollicitez un traitement.

Complétez cette section en premier   **Complétez cette section en deuxième**

	À quelle fréquence cela vous dérange-t-il?				Lorsque cela se produit, quelle est l'intensité? Si vous n'avez jamais ressenti ce symptôme, ne pas encercler de chiffre ci-dessous			
	Jamais	Rarement	Souvent	Toujours	À peine perceptible, ne me dérange pas vraiment	Assez intense que je le remarque, mais je peux continuer sans problème	Assez intense, exigeant des efforts additionnels pour continuer	Si intense que je dois arrêter ce que je fais et rechercher une méthode de soulagement
11. Douleur aiguë ou élancement	0	1	2	3	1	2	3	4
12. Douleur sourde et diffuse	0	1	2	3	1	2	3	4
13. Raideur ou mouvement limité	0	1	2	3	1	2	3	4
14. Faiblesse, maladresse ou dérobade	0	1	2	3	1	2	3	4
15. Sensibilité à la lumière, le bruit, les odeurs ou la température	0	1	2	3	1	2	3	4
16. Engourdissement ou picotement	0	1	2	3	1	2	3	4
17. Fatigue	0	1	2	3	1	2	3	4
18. "Être dans les nuages" (difficulté de concentration ou de mémoire)	0	1	2	3	1	2	3	4
19. La perte d'appétit ou nausée	0	1	2	3	1	2	3	4
20. Nervosité, anxiété ou tristesse	0	1	2	3	1	2	3	4