



Prediction of the prognosis of somatoform disorders using the Minnesota Multiphasic Personality Inventory (MMPI)

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1 **Prediction of the prognosis of somatoform disorders using the Minnesota**

2 **Multiphasic Personality Inventory (MMPI)**

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1 ABSTRACT

2 *Objective:* To elucidate the possibility of using the Minnesota Multifaceted Personality
3 Inventory (MMPI) to predict the prognosis of somatoform disorders, which are often
4 treatment-resistant, we investigated the prognosis of somatoform disorders predicted
5 using the MMPI.

6 *Methods:* During the period from January 1, 2013, to December 31, 2017, 125 cases of
7 somatoform disorder were diagnosed in the psychiatric department of Fukushima
8 Medical University Hospital, among which, 67 were consultation-liaison psychiatry
9 cases and 58 cases were only psychiatric cases. Clinical information, MMPI scores, and
10 prognosis information were collected from medical records in each case, and then
11 statistical analysis was performed.

12 *Results:* The results showed that the unchanged group had significantly higher scores
13 than the improved group on only the Hy scale. Receiver operating characteristic
14 analysis of the Hy scale scores of the improved and unchanged group was then
15 conducted to calculate a cutoff value. The cutoff point was 73.5 with a sensitivity of
16 0.557 and a specificity of 0.717.

17 *Conclusion:* For patients diagnosed with somatoform disorder who had an MMPI Hy
18 scale score higher than the cutoff value, improvement with conventional supportive

1 psychotherapy or drug therapy was predicted to be difficult. Therefore, the cutoff point
2 identified in this study appears to be an important index for selecting treatment for
3 somatoform disorders.

4

5 *Keywords:*

6 Hy score

7 consultation-liaison psychiatry

8 Minnesota Multifaceted Personality Inventory (MMPI)

9 Prognostic predictor

10 Somatoform disorders

11 Treatment-resistant

12

1 **1. Introduction**

2 Somatoform disorders are included in the traditional clinical classification of
3 neuroses and are also classified as neurotic disorders according to the 10th revision of
4 the International Classification of Diseases (ICD-10) [1] and the Diagnostic and
5 Statistical Manual of Mental Disorders, fourth edition, text revision (DSM-IV-TR) [2,3].
6 Chronic pain is classified into nociceptive pain, neuropathic pain, and psychogenic pain
7 [4]. Among these types, psychogenic pain is classified as persistent somatoform pain
8 disorder among the somatoform disorders in the ICD-10, and as chronic pain disorder in
9 the DSM-IV-TR [5]. In addition to the distress of experiencing the symptoms
10 themselves, chronic pain is likely to cause secondary disorders such as psychiatric
11 problems and a decreased ability to carry out activities of daily living. Therefore,
12 chronic pain is a serious disorder that cannot be overlooked, especially economically, as
13 it can lead to labor loss in the productive population and increased medical expenses
14 because of repeated medical examinations and long-term treatment [6].

15 As pharmacotherapy, selective serotonin reuptake inhibitors (SSRIs), antipsychotic
16 drugs, and benzodiazepine anxiolytics have been considered to be useful to some extent
17 for somatoform disorders[7]. However, although research elucidating the neural basis of
18 somatoform disorders is currently in progress, no effective treatment has been

1 established. Therefore, recovery from somatoform disorders is often difficult and
2 largely dependent on psychosocial treatment [8].

3 Since 1996, consultation-liaison psychiatry services, which consist of medical teams
4 including orthopedists, psychiatrists, and other co-medical staffs such as nurses,
5 physical therapists, clinical psychologists, clinical pharmacists, and social workers, have
6 been conducted in Fukushima Medical University Hospital(FMUH). These conferences
7 are held once a month and involve discussions on how to deal with the psychosomatic
8 problems of patients diagnosed with somatoform disorder. Owing to these conferences,
9 we have accumulated substantial MMPI data for these cases. It has been considered that
10 many patients who have psychosocial personality problems or psychiatric disorders
11 have previously consulted an orthopedist because of chronic pain and numbness or have
12 not been satisfied with conventional orthopedic treatment [5,9]. The multidisciplinary
13 nature of this conference is based on recognition that “team medical care,” in which
14 related medical staffs cooperate and provide patient-centered medical care, is essential
15 to promote effective treatment and solve various problems. This liaison psychiatry
16 approach is characterized by a basic policy of the orthopedist remaining involved in
17 treatment because even if the patient has psychiatric, psychological, or social problems,
18 the chief complaint is a physical symptom [5,9].

1 Numerous studies have reported personality tendencies in patients with somatoform
2 disorders based on the MMPI [10–18]. However, to our knowledge, no studies have
3 assessed the utility of the MMPI as an prognostic predictor of somatoform disorders,
4 and only a few reports have used it to predict outcomes of surgical treatment for chronic
5 back pain [19–22]. In FMUH, the MMPI has been continuously conducted, and data
6 have been accumulated on the cases discussed in the liaison conferences for the purpose
7 of evaluating whether patients with chronic pain suffer from latent paranoia, depression,
8 or other psychiatric disorders, as well as whether their personality may affect their
9 symptoms [23,24].

10 Although the MMPI has mainly been used for diagnosis and assessment, if it could
11 be used for the prediction of prognosis of somatoform disorders, treatment would be
12 expected to proceed more smoothly because more effective interventions could be
13 started at an early stage, and the patient could recognize the therapeutic effects sooner.
14 In addition, considering that MMPI takes quite much time to be completed due to a
15 large number of question items, over 500, if key items predicting negative outcome
16 could be identified, it should be more useful and reduce psychological burden of target
17 patients.

18 The present study has two purposes; one is to clarify psychological and biological

1 factors associating with negative outcome of somatoform disorders, another is to
2 identify key items of MMPI predicting negative outcome. Therefore, we collected the
3 data from patients who all had received MMPI in clinical settings, classified them into
4 two groups (improvedgroup vs. unchanged group) based on the chart review, and
5 examined two groups.

6

7 **2. Methods**

8 *2.1. Design and study population*

9 During the period from January 1, 2013, to December 31, 2017, 125 cases of
10 somatoform disorder were diagnosed at the psychiatric department of Fukushima
11 Medical University Hospital based on the ICD-10 [1]. Among these cases, 67 were
12 associated with the consultation-liaison psychiatry approach, and 58 with only the
13 psychiatric approach. Also among these cases, 80 were classified as Persistent
14 somatoform pain disorder, 31 were as Somatization disorder, 8 were as Undifferentiated
15 somatoform disorder, 4 were as Somatoform autonomic dysfunction, and 2 were as
16 Other somatoform disorders. All these cases were treated conventional supportive
17 psychotherapy or pharmacotherapy.

18

1 2.2. *Measurements and procedures*

2 The Minnesota Multifaceted Personality Inventory (MMPI) is a standardized
3 psychometric test of adult personality and psychopathology based on the questionnaire
4 method developed by Hathaway and McKinley of the University of Minnesota in the
5 late 1930s [25,26]. The MMPI is composed of 550 items, and hundreds of additional
6 scales have been developed. In the United States, a re-standardization of the MMPI
7 began around the end of the 1980s because of problems with the wording of the item
8 text and inadequate standardization procedures in the original version. The second
9 version, the MMPI-2, maintained continuity with the original. The Japanese version of
10 the MMPI was published in 1963, but mistranslations and problems with
11 standardization procedures were apparent from the beginning, and efforts to resolve
12 these problems began around 1990. The New Japan Version of the MMPI was published
13 in 1993, and is still currently used in Japan [25,26]. The original purpose of the MMPI
14 was to provide objective information necessary for psychiatric diagnosis. Subsequently,
15 the purpose shifted to personality assessment, and thus, it is now one of the most
16 frequently used personality tests around the world [25,26]. Actually, more than 12,000
17 papers have been published on the MMPI and MMPI-2 since the late 1940s [27].

18 From medical records from May 1, 2019 to July 31, 2019, we collected

1 information on factors that may affect the prognosis of somatoform disorders for each
2 case, including age, gender, duration of illness, the comorbidity of developmental
3 disorders, decreased cerebral blood flow, history of surgery, MMPI profile, and presence
4 of the conversion V pattern on the MMPI. Then, we identified patients indicating
5 negative outcome based on the following information obtained from the charts : (1)
6 Subjective estimation regarding pain, (2) Social function including ADL. This group
7 was named “improved group (IG)” and others named “non-improved group (NIG)”.

8 We profiled four validity scales (P, L, F, K; Table 1) and 10 clinical scales (Hs, D,
9 Hy, Pd, Mf, Pa, Pt, Sc, Ma, Si; Table 2) as basic scales for the MMPI [9,28]. The
10 interpretation of the conversion V pattern is shown in Table 3. Decreased cerebral blood
11 flow was defined as when a radiologist reported that “there was low blood flow(Vd less
12 than 30ml/ml by ARG method)” based on N-isopropyl-(¹²³I)*p*-iodoamphetamine
13 computed tomography, regardless of the brain region. The comorbidity of
14 developmental disorders was defined as when a psychiatrist noted autism spectrum
15 disorder (ASD), attention deficit hyperactivity disorder (ADHD), or pervasive
16 developmental disorder in a patient’s medical records. A history of surgery was defined
17 as any descriptions of orthopedic surgery in a patient’s medical records. This study was
18 approved by the Ethics Committee of Fukushima Medical University (approval No.

1 2941).

2

3 *2.3. Statistical analysis*

4 We descriptively compared each factor between the IG and NIG groups. Differences
5 between groups were analyzed using the Mann–Whitney U test, the Student *t*-test, and
6 the chi-squared test. Among the MMPI scales, receiver operating characteristic (ROC)
7 curves that showed a significant difference between the IG and NIG were created for the
8 Hy scale. The area under the curve (AUC) and 95% confidence intervals (CIs) were
9 calculated, as was the cutoff value using Youden’s index. Statistical analysis was
10 performed using SPSS ver. 26 (SPSS, Chicago, IL, USA), and *p* values < 0.05 were
11 considered statistically significant.

12

13 **3. Results**

14 In total, 125 patients (49 males, 76 females; mean age ± standard deviation [SD],
15 51.9 ± 17.4 years) participated in this study.

16

17 *3.1. Prognostic comparison of the participants’ basic characteristics (Table 4)*

18 No significant differences in age, gender, duration of illness, the comorbidity of

1 developmental disorders, decreased cerebral blood flow, or history of surgery were
2 observed between the IG and NIG. The mean age \pm SD of the IG and NIG were $49.3 \pm$
3 17.8 and 53.8 ± 17.5 , respectively ($p = 0.167$). Regarding the gender ratio, 16 (34.6%)
4 males and 30 females (65.2%) were in the improved group, and 33 males (41.8%) and
5 46 (58.2%) females were in the unchanged group ($p = 0.44$). The median duration of
6 illness in the IG was 35 months (25th–75th percentile = 24–91), and that in the NIG was
7 54 months (25th–75th percentile = 24–120; $p = 0.168$). The numbers of patients with
8 decreased cerebral blood flow were 14 (51.9%) in the IG and 30 (57.7%) in the NIG (p
9 $= 0.62$). The numbers of patients who had a history of surgery were 15 (32.6%) in the
10 IG and 26 (32.9%) in the NIG ($p = 0.972$).

11 No significant differences were found in the presence of the conversion V pattern
12 between the IG and NIG (17.4% vs. 17.7%, respectively; $p = 0.963$). Regarding the
13 presence of developmental disorders, the comorbidity rate of developmental disorders
14 was 10.9% in the IG and 25.3% in the NIG; this rate tended to be higher in the
15 unchanged than in the improved group, but this difference was not significant ($p =$
16 0.051).

17

18 *3.2. Prognostic comparison of each MMPI scale (Table 5)*

1 Regarding the results of the Student *t*-test for each scale of the MMPI, the NIG
2 group showed a significantly higher value than the IG on the Hy scale (IG, 66.2 ± 15.4
3 vs. NIG, 73.5 ± 12.4 ; $p = 0.04$). The scores on the ? scale were 45.4 ± 11.1 for the IG
4 and 49.0 ± 9.3 for the NIG; although the IG tended to have lower scores, this difference
5 was not significant ($p = 0.051$).

6

7 *3.3. ROC curves of the Hy score for all participants (Figure 1)*

8 The results of the ROC analysis performed using the Hy scores of all participants
9 indicated a significant difference between the IG and NIG groups, with an AUC (95%
10 CI) of 0.652 (0.55–0.753). The cutoff point was 73.5 with a sensitivity of 0.557 and a
11 specificity of 0.717.

12

13 **4. Discussion**

14 The MMPI can identify the personality of subjects from multiple aspects based on
15 answers to questions assessing, for example, hypochondriac, obsessive, and compulsive
16 tendencies. A configuration in which the Hypochondriasis (Hs) and Hysteria (Hy) scale
17 are $T = 70$ or more and the T score of these two scales is 10 or higher than that of the
18 Depression (D) scale is called the “conversion V” pattern. The conversion V pattern

1 suggests that subjects tend to “replace” their psychological problems with socially
2 acceptable ones, such as physical complaints. Tendencies to escape from a situation
3 through physical complaints, to try and control others, and to suppress or deny the
4 problem are then presumed [9,10].

5 Then, We carefully discuss each result in detail as follows.

6

7 *4.1. Comparison between the improved and unimproved prognosis groups*

8 We selected basic characteristics such as age, gender, duration of illness, the
9 comorbidity of developmental disorders, decreased cerebral blood flow, history of
10 surgery, and the conversion V pattern on the MMPI as factors that may affect the
11 outcome of somatoform disorders. An analysis of each outcome group did not reveal any
12 significant differences. Regarding the cerebral blood flow, it has been reported to be
13 decreased in patients with chronic pain[29]. But no significant differences were found in
14 this study. But the NIG was more likely to have developmental disorders. It has been
15 reported that among developmental disorders in children, both ASD and ADHD are
16 associated with a high rate of chronic pain [30,31]. For ASD and ADHD, it is said that a
17 therapeutic effect can be obtained by combining psychosocial treatment in addition to
18 pharmacotherapy [32,33]. Therefore, when the comorbidity of developmental disorders

1 is recognized, it is thought that somatoform disorders could be improved by performing
2 a therapeutic intervention particularly for developmental disorders. In addition,
3 analysis of each scale of the MMPI showed that only the Hy scale had a significant
4 difference, indicating that the NIG had higher scores on the Hy scale than the improved
5 group. We discuss about what this result mean in detail as follows.

6 *4.2. Significance of high scores on the Hy scale*

7 A high score on the Hy scale indicates a tendency to avoid responsibilities related to
8 psychological conflicts by converting these to physical symptoms (a tendency to use
9 conversion symptoms). It also means that individuals with a high Hy score tend to be
10 immature and lack self-insight, indicating that their relationships with other people are
11 often superficial, even though they may appear to be appear to be socially well adopted
12 [9]. A significant difference was observed between the IGand NIG only in this Hy scale
13 score. Therefore, ROC analysis was performed on the Hy score for the IG and NIG,
14 resulting in a cutoff score of 73.5. Previous studies have reported that patients with
15 chronic pain show higher Hy scores [34,35]. On the other hand, when scores on the K
16 and Hs scales are low, only a high Hy scale score is considered insufficient to consider
17 whether the pain is psychogenic [36,37].

18 However, even if only a high Hy scale score is insufficient to determine whether

1 the pain is psychogenic, a high Hy score is still considered to indicate a remarkably
2 severe degree of distress in terms of physical symptoms. In addition, all cases analyzed
3 in this study had already been diagnosed as somatoform disorder. Few reports have been
4 published on the outcome viewpoint of the MMPI for somatoform disorders, and no
5 reported cases have shown meaningful profiles or characteristics for each scale [38].

6 The cutoff point calculated in this study was 73.5, which was even higher than the
7 score generally considered to be abnormal (70). If the Hy scale score of a patient
8 diagnosed with a somatoform disorder is higher than this cutoff value, he or she is
9 considered difficult to treat with conventional supportive psychotherapy or
10 pharmacotherapy. In such cases, it may be necessary to consider psychiatric
11 “multidisciplinary” treatment, which is a further enhancement of conventional
12 treatments [39–43], e.g., psychosocial treatment such as cognitive behavioral therapy
13 [44–48] or mindfulness therapy [49], pharmacotherapy, and environmental adjustments.
14 Therefore, this cutoff point appears to be an important index for treatment selection in
15 patients with somatoform disorder. However, since this was a retrospective study, if the
16 Hy scale score exceeds the cutoff point, prospective studies are needed to compare the
17 prognoses of the following two groups: one that is provided with therapeutic
18 interventions such as augmented pharmacotherapy and psychotherapy, psychosocial

1 treatment, and environmental adjustments, and another that receives standard therapy
2 (general pharmacotherapy and supportive psychotherapy).

3

4

5 *4.3. Limitations*

6 The classification of the outcome of somatoform disorder among the current group
7 used in this study was based on only the chart review not more reliable ways such as
8 diagnostic (structured) interviews or self-administered questionnaires.

9

10 *4.5. Conclusions*

11 In this study, we performed a basic examination regarding the possibility of
12 predicting the prognosis of patients with somatoform disorders based on the MMPI. The
13 results suggested that the Hy scale score might influence the prognosis. The cases
14 exceeding the cutoff point based on ROC analysis are considered difficult to treat with
15 conventional supportive psychotherapy or pharmacotherapy. Therefore, this cutoff point
16 could be an important index in considering treatment options for improving the
17 prognosis of patients with somatoform disorders.

18

1

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9

10 **Declaration of Competing Interests**

11 The authors have no competing interests to report.

12

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10 **Figure legend**

11

12 **Fig. 1.** Receiver operating characteristic (ROC) curves of the Hysteria (Hy) scale score
13 on the Minnesota Multiphasic Personality Inventory (MMPI) for all participants. ROC
14 analysis was performed using the Hy scale scores for all participants that showed a
15 significant difference between the improved and unchanged groups; the area under the
16 curve (AUC) (95% confidence interval) was 0.652 (0.55–0.753), as calculated using
17 Youden’s index, with a cutoff value of 73.5.

18

19

1 **Table 1**

2 Interpretation of the validity scales.

Scale and abbreviation	Scale name	Interpretation of score
?	Cannot say	A tally of omitted items. High scores may be due to obsessiveness, defensiveness, difficulty in reading, confusion, hostility, or paranoia. More than 10 left unanswered may be of clinical significance. Twenty or more left unanswered should be considered significant.
L	Lie	Tendency to create a favorable impression as a response bias, conventional, rigid, moralistic, repression, denial, and insightlessness. A high L can mean anything from a very well-mannered normal wanting to give a good impression, to a compensated paranoid. A high L will submerge scales of obvious psychopathology and inflate scales of healthy functioning such as the Ego Strength scale. Low: (< Raw 3). Admitting to minor faults and shortcomings, independent, self-reliant.
F	Infrequency	Very high (> T99) possible random, exaggerated, or mis-scored profile. Very high scores (T > 90) commonly found with psychotic patients. High scores (> T70), best measure of overall psychopathology, resentment, acting out, moodiness. Mostly elevations in the F scale are due to psychopathology; high item overlap with scale 8. Low scores (T < 45), possible fake good profile.
K	Defensiveness	If there are signs of psychopathology in the history, then high K indicates defensiveness, insightlessness, intolerance, dogmatism, and being controlling. Very high scores are usually a sign of defensiveness. High scores are common in individuals who are well

adjusted and well educated, and tend to be in control of their lives. Low (< T46). Guarded prognosis for any insight therapy since their ego strength is low; masochistic confessors, poor self-concept, distrustful, and angry. A very low K could often be the only indication of psychopathology in an MMPI profile.

1 MMPI, Minnesota Multiphasic Personality Inventory.

2

1 **Table 2**

2 Interpretation of the clinical scales.

Scale and abbreviation	Scale name	Interpretation of an elevated score
Hs	Hypochondriasis	Excessive preoccupation with the body and physical symptoms
D	Depression	Sadness, discomfort, and dissatisfaction with life
Hy	Hysteria	Feeling overwhelmed by stress
Pd	Psychopathic deviance	Rebellion, difficulty adhering to standards of society
Mf	Masculinity-femininity	Lack of stereotypic masculine interests (in men; high scores are rare among women)
Pa	Paranoia	Excessive sensitivity, hostility, and suspiciousness (very high scores indicate psychotic behavior)
Pt	Psychasthenia	Anxiety, tension, worry, and obsessive-compulsive disorder tend to score high
Sc	Schizophrenia	Confusion, disorganization, unusual thought processes
Ma	Hypomania	High energy and agitation, overactivity, unrealistic self-appraisal, and mania
Si	Social introversion	Shy, insecure, timid, and introverted

3

4

1 **Table 3**

2 Interpretation of conversion V.

Condition	Description
The Hs and Hy scales are T = 70 or more, and are T = 10 or more higher than the D scale.	This suggests that patients tend to “replace” their psychological problems with socially acceptable ones, such as physical complaints, including a tendency to escape from situations set by physical complaints or to control others. It is presumed that the problem is suppressed or denied.

3

1 **Table 4**

2 Basic characteristics of all participants (comparison by prognosis).

	Improved n = 46	Un-improved n = 79	<i>p</i>
Age (years)	49.3 ± 17.8	53.8 ± 17.5	0.167
Gender			
Male	16 (34.8)	33 (41.8)	0.440
Female	30 (65.2)	46 (58.2)	
Duration of illness (months)	35 (24–91)	54 (24–120)	0.168
Comorbidity of developmental disorders			
Yes	5 (10.9)	20 (25.3)	0.051
No	41 (89.1)	59(74.7)	
Decreased cerebral blood flow			
Yes	14 (51.9)	30 (57.7)	0.620
No	13 (48.1)	22 (42.3)	
Conversion V			
Yes	8 (17.4)	14 (17.7)	0.963
No	38 (82.6)	65 (82.3)	
History of surgery			
Yes	15 (32.6)	26 (32.9)	0.972
No	31 (67.4)	53 (67.1)	
Treatment approach			
Liaison psychiatry	23 (34.3)	44 (65.7)	0.538
Only psychiatric	23 (39.7)	35 (60.3)	

3 Values are expressed as mean ± standard deviation, median (25th–75th percentile), n
4 (%).

5 Data for decreased cerebral blood flow were missing for 46 cases.

6 No significant differences were found between the improved and un-improved groups in
7 age, gender, duration of illness, the comorbidity of developmental disorders, decreased
8 cerebral blood flow, history of surgery, or the conversion V pattern. Regarding the
9 presence of developmental disorders, the comorbidity rates of developmental disorders
10 were 10.9% in the improved group and 25.3% in the un-improved group. Although this
11 difference was not significant, the rate in the un-improved group tended to be higher
12 than that in the improved group ($p = 0.051$).

13

Table 5

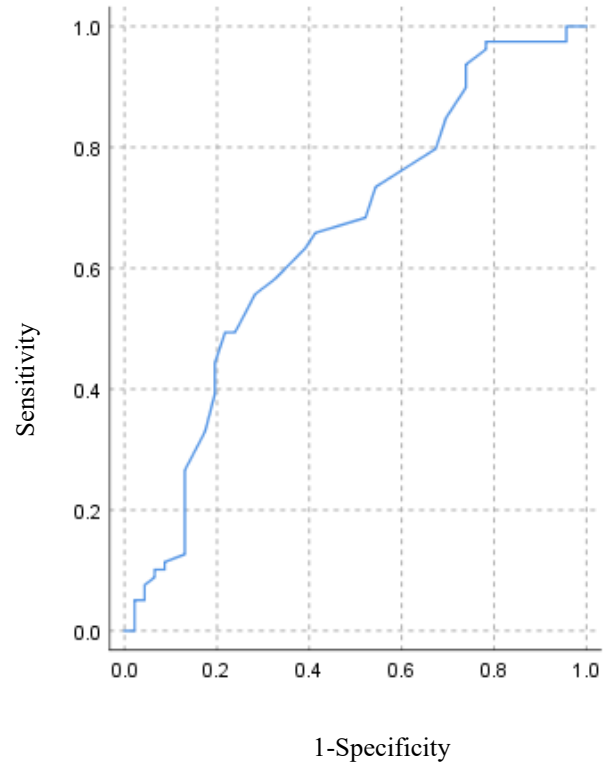
Prognostic comparison in each MMPI scale.

	Improved (n = 46)	Un-improved (n = 79)	<i>p</i>
?	45.4 ± 11.1	49.0 ± 9.3	0.051
L	54.1 ± 13.2	55.2 ± 11.4	0.615
F	55.8 ± 17.8	59.2 ± 17.8	0.308
K	51.2 ± 11.5	53.8 ± 12.4	0.235
Hs	58.6 ± 19.6	63.8 ± 18.0	0.137
D	66.1 ± 14.8	70.9 ± 16.6	0.105
Hy	66.2 ± 15.4	73.5 ± 12.4	0.004*
Pd	53.8 ± 15.3	55.1 ± 15.3	0.661
Mf	49.5 ± 11.8	49.1 ± 12.6	0.859
Pa	55.9 ± 15.8	60.9 ± 15.5	0.087
Pt	47.9 ± 22.3	47.2 ± 25.8	0.875
Sc	47.9 ± 23.4	50.8 ± 26.0	0.528
Ma	46.7 ± 14.6	46.0 ± 11.5	0.769
Si	54.2 ± 13.3	52.7 ± 12.3	0.525

As a result of a Student *t*-test for each scale of the MMPI, the un-improved group showed a significantly higher value than the improved group on the Hy scale (improved group, 66.2 ± 15.4 vs. un-improved group, 73.5 ± 12.4; *p* = 0.04). The ? scale scores were 45.4 ± 11.1 in the improved group and 49.0 ± 9.3 in the un-improved group, which were not significant, but the improved group tended to have lower scores (*p* = 0.051).

1

2 **Figure.1**



3

4

5

AUC (95% confidence interval)	<i>p</i>	Cutoff value
0.652 (0.55–0.753)	0.004	73.5