PSYCHOLOGICAL CHARACTERISTICS OF THE NEO-FFI AND THE TREE DRAWING TEST IN PATIENTS WITH THYROID DISEASE

Chihiro HASEGAWA¹⁾, Kotaro UMEMURA²⁾, Madoka KAJI³⁾, Noriko NISHIGAKI⁴⁾,
Toshio KAWAI¹⁾, Mika TANAKA⁵⁾, Yumi KANAYAMA²⁾, Haruko KUWABARA⁶⁾,
Atsushi FUKAO⁷⁾, and Akira MIYAUCHI⁵⁾

¹⁾*Uehiro Kokoro Studies, Kokoro Research Center, Kyoto University, Japan*

²⁾*Faculty of Clinical Psychology, Kyoto Bunkyo University, Japan*

³⁾*National Hospital Organization Osaka National Hospital Research Resident,
Japan Foundation for AIDS Prevention, Japan*

⁴⁾*Juntendo University Hospital, Japan*

⁵⁾*Kuma Hospital, Japan*

⁶⁾*Faculty of Education, Okayama University, Japan*

⁷⁾*Ibaraki City Public Health Medical Center*

Patients with thyroid disease have been reported to develop psychiatric symptoms. However, the specific psychological mechanism underlying their development remains unknown. This paper examined the psychological features of patients with thyroid disease using both the Japanese version of the NEO Five-Factor Inventory and the Tree Drawing Test. A total of 64 patients with Graves' disease, 38 with Hashimoto disease, and 68 with Nodule Goiter were examined, and compared with 22 neurotic patients. The following results were obtained: (1) While patients with thyroid disease obtained standard scores on the Japanese version of NEO Five-Factor Inventory, they drew less structured trees regarding boundary compared with the neurotic patients; and (2) patients with Nodular Goiter exhibited more notable weakness of the boundary than patients with Graves' disease. The implications of these results are discussed in comparisons with the levels of psychological adjustment according to objective and projective personality tests.

Key words: Thyroid disease, NEO-FFI, Tree Drawing Test

INTRODUCTION

The thyroid gland is a large endocrine gland in the neck that secretes thyroid hormones to regulate growth and development through increasing the rate of metabolism. Among the patients with thyroid disease, there are some who exhibit psychiatric symptoms, such as anxiety and dysphoria, emotional lability, nonspecific and ill-defined complaints and at times, ideas of reference and frank paranoia (Whybrow & Bauer, 2005a, 2005b). While patients are referred for psychotherapy in those cases in which the symptoms become severe enough that doctors recognize the necessity of mental care (Kuma, 2001), to date, only a few studies have explored the psychological mechanisms in such patients. The present study examined the psychological features of patients with

Correspondence concerning this article should be addressed to C. Hasegawa, Kokoro Research Center, Kyoto University, 46 Shimoadachi-cho, Yoshida Sakyo-ku, 606-8501 JAPAN (e-mail: hasegawa-ch@educ.kyoto-u.ac.jp).

thyroid diseases, from the perspective of clinical psychology, through both objective and projective personality tests.

Psychological Problems of Patients with Thyroid Disease

Among the thyroid diseases, it is well known that Graves' disease, a primary factor of hyperthyroidism with excess production of thyroid hormones, may exhibit some psychological problems in addition to somatic dysfunction, since Parry first reported psychiatric symptoms accompanied with hyperfunction of the thyroid gland in 1825 (Whybrow & Bauer, 2005a). Alexander (1950) considered Graves' disease as a typical psychosomatic disease, and described the patients' psychodynamics, i.e., emotional factors prior to onset and mother-infant relations in babyhood. As advances in physiology have been made, such psychiatric symptoms have come to be generally regarded as an outgrowth of thyroid dysfunction; thus, the psychodynamic hypothesis is no longer fully accepted. However, the understanding of the origins and aspects of mental symptoms in Graves' disease has changed again, because recent investigations have documented that such symptoms are not always associated with thyroid dysfunction. Winsa et al. (1991) conducted a population-based case-control study of about one million individuals in order to assess the possible association between psychological stress and the onset of Graves' disease. They compared 208 patients with newly-diagnosed Graves' disease and 372 controls matched for age, sex, and country residence, and reported that negative life-event scores of the patients were significantly higher than those of controls in every 12 months preceding the diagnosis. The findings suggested that negative life events might be related to the onset of Graves' disease from an epidemiological perspective. Since then, Kung (1995), and Yoshiuchi et al. (1998) have performed similar case-control studies, and demonstrated that patients with Graves' disease reported experiencing more stressful life events than the control groups. Stern et al. (1996) investigated neuropsychiatric symptoms before and after the onset of Graves' disease in 137 patients using a questionnaire. Approximately one-third of the patients reported residual mood or emotional complaints, even after they had undergone medical treatment for Graves' disease. Fahrenfort, Wilterdink, and van der Veen (2000) quantified the somatic and mental discomfort in 303 patients with hyperthyroidism using a questionnaire. With regard to the association between the remission of hyperthyroidism and complaints, euthyroid patients (having normal thyroid gland function) had fewer complaints than dysthyroid patients (having defective thyroid gland function). However, some euthyroid patients persistently complained of residual symptoms, such as avoiding large social gatherings, changing moods, or the need for rest. These reports suggest that mental complaints not only reflect the effects of thyroid dysfunction but they might also be related to psychological factors. Based upon these findings, there is currently a movement under way to reconsider the psychological problems associated with Graves' disease.

It is also known that patients with Hashimoto disease, a primary factor of hypothyroidism, may also exhibit some kinds of disturbances in cognition, i.e., slowing of thought and speech, decreased attentiveness, poor concentration, and diminished interest in and responsiveness to others (Whybrow & Bauer, 2005b). Formerly, in 1888, the

Clinical Society of London described that most of hypothyroid patients exhibited some mental disturbances, ranging from irritability and agoraphobia to dementia and melancholia. Because of these symptoms, the diagnosis could be confused with that of a depressive mood stage. Indeed, hypothyroidism may induce a specific melancholic disorder in some patients (Whybrow & Bauer, 2005b). In terms of the other subtypes of thyroid diseases, i.e., Nodular Goiter, Malignant Goiter, etc., there have been clinical case reports of patients developing psychiatric symptoms (Fujinami & Ito, 1983). However, in contrast to Graves' disease, there have been several quantitative surveys dealing with psychological factors of such patients. Martin-du pan (1998) examined a possible association between stressful events and the development of Hashimoto disease and benign thyroid nodules, and could not find any associations between them. Mizokami, Wu Li, El-Kaissi, and Wall (2004) reviewed these studies and considered that because the onset and course of Hashimoto disease are often insidious, the patients experience difficulty in evaluating the role of stress in the onset and course of the disease. The relationship with their psychological characteristics remains an unresolved question.

Personality Assessment of Patients with Thyroid Disease

In Japan, investigations of the psychological features of patients with thyroid disease have been conducted mainly for Graves' disease through the use of personality questionnaires, including the Japanese-language version of the Yatabe-Guilford Personality Inventory (Suematsu, 1969), the Japanese-language version of the Cornell Medical Index (Esaki et al., 1978; Ishii, Kobayashi, & Kobayashi, 1988; Suematsu, 1969) and the Japanese-language version of the Maudsley Personality Inventory (Yamamori, 2001). Fukao et al. (2003) examined an association between personality traits and the prognosis of antithyroid drug-treated hyperthyroidism. They found that scores of four personality factors of the Japanese-language version of the Minnesota Multiple Personality Inventory (i.e., hypochondriasis, depression, paranoia and psychasthenia) were significantly higher in the relapsed Graves' disease group than those of the remitted group. These findings based on studies conducted in Japan suggested that some kinds of patients' personality traits are associated with the onset, aggravation, or prognosis of Graves' disease. However, opinions are divided between these studies.

In order to assess personality features of the patients with thyroid disease, this investigation used one of the projective methods, i.e., the Tree Drawing Test (TDT). The Tree Drawing Test, devised by Koch (1957), assesses personality traits by analyzing the structure of a tree drawn by the subject, and is widely used today in a variety of clinical settings for patients with somatic diseases, as well as neurotic and psychotic diseases. In particular, TDT is one of the more frequently employed methods for clinical evaluation of the level of personality functioning. Kernberg (1975) proposed the idea of "pathological levels" and assumed the following three levels according to the personality structure: "psychotic", "personality disorder", and "neurotic" and considered these distinctions in personality functioning important in conducting psychodynamic psychotherapy. The TDT provides us with some clues for the assessment of the "psychotic" level. Saito and Ohwada (1969) found that schizophrenia patients often drew trees with open-ended

trunks. Yamanaka (1976) pointed out that open-ended trunks appeared frequently in patients with schizophrenia especially when accompanied by hallucinations and delusions, and thought that it might represent a weakened ego boundary. Matsushita (2005) endorsed Yamanaka's clinical observation through a qualitative examination of more than 600 trees drawn by schizophrenic patients. Inadomi, Tanaka, and Ohta (2003) and Kaneda et al. (2010) confirmed quantitatively that schizophrenic patients drew more trees with open-ended trunks than healthy controls. As a result of these studies, an open-ended trunk has gained recognition as one of the signs associated with a "psychotic" level. With regard to trees drawn by patients with thyroid diseases, Yamamori, Hashimoto, and Doi (2001) and Yamamori (2002, 2003) administered the TDT to patients with Graves' disease. In a comparison of healthy controls, patients with eating disorder, and patients with atopic dermatitis, the patients with Graves' disease drew more trees with open-ended trunks, one-stroke trunks, and one-stroke branches. Yamamori (2002, 2003) suggested that patients with Graves' disease might have a problem of weak ego boundary close to the "psychotic" level.

The current study also generated a battery of questions that forms a questionnaire. We adopted the Japanese version of the NEO Five-Factor Inventory (NEO-FFI) (Shimonaka, Nakazato, Gondo, & Takayama, 1999). The NEO-FFI and the TDT are complementary to each other, and provide us with a more thorough assessment of patients' personality traits from different perspectives.

Comparison of Patients with Thyroid Disease and Patients with Neurosis

In clinical practice at hospitals that specialize in thyroid disease, patients with all subtypes of thyroid diseases, as well as Graves' disease, visit psychiatry clinics and undergo psychotherapy, after developing psychiatric symptoms, such as anxiety, depressive mood, and emotional lability (Fujinami & Ito, 1983; Tanaka et al., 2008). Kuma (2001), a surgeon who specializes in thyroid disease, argued that those who have latent psychological problems, e.g., those who have difficulties in relationships with family members or colleagues premorbidly, are in need of psychotherapeutic treatment. Mental care is an important theme across a broad range of patients with thyroid diseases. Moreover, among the patients with thyroid diseases, there may be a variety of personality traits according to their subtypes. Thus, identifying the subtle personality differences would be useful in clinical practice. In this study, we investigated possible differences in Graves' disease, as well as other subtypes of thyroid disease.

In order to more clearly establish the personality traits of patients with thyroid disease, we compared these patients with neurotic patients suffering from psychological conflicts. Thyroid disease patients are sometimes regarded as "neurotic", because they exhibit anxiety, depressive mood, or irritation. However, earlier questionnaire-based studies did not necessarily find "neurotic" factors, and an investigation using the TDT (Yamamori et al., 2001; Yamamori, 2002, 2003) suggested that thyroid disease is different from "neurosis" with respect to the pathological level. Depth psychology first came into being through the treatment of neurotic patients, and its theories of personality structure were also based on neurotic patients. As the patient population has been extended to

include those with psychotic disorder, personality disorder, and psychosomatic disease, new theories have been constructed for them based on those theories developed for neurotic patients. In the case of thyroid disease, it may be useful to compare the differences with neurotic patients in order to understand their personality structure and explore practical approaches for their psychotherapy.

The Present Research Purpose

The purpose of this investigation was to assess the personality traits of patients with thyroid disease and compare them with those of neurotic patients, through the administration of the Japanese version of the NEO-FFI and the TDT.

METHOD

Participants

A total of 311 patients with thyroid disease, who visited a hospital that specialized in thyroid disease for the first time, were examined in this study. These patients were classified into three groups based upon the diagnosis. The breakdown was: 64 Graves' disease patients (GD) (12 males and 52 females; mean age = 36.9 years, SD = 10.58), 38 Hashimoto disease patients (HD) (3 males and 35 females; mean age = 48.6 years, SD = 12.06), and 68 Nodular Goiter patients (NG) (11 males and 57 females; mean age = 51.0 years, SD = 11.87), ranging from 20 to 69 years of age. Other subtypes (Plummer disease, Papillary Carcinoma of the Thyroid, Sub-acute Thyroiditis) were excluded from the comparison because there were 6 patients or less and they were considered to be less homogeneous than the other groups. Furthermore, a total of 29 mental disease patients, who visited a psychiatric clinic for the first time, were also examined. A comparison group was composed of 22 Neurotic patients (NE) (6 males and 16 females; mean age = 38.8 years, SD = 14.24), ranging from 22 to 66 years of age. The diagnosis of "neurosis" is not adopted in the DSM-IV-TR and is variously assimilated into classifications that include mood disorder, anxiety disorder, adjustment disorder, etc. However, the perspective of the pathological level is still routinely used today in the clinical setting, because estimating the psychological mechanism (s) underlying the symptoms remains important. In the current study, the comparison group (NE) included those who were diagnosed as having adjustment disorder, anxiety disorder, depressive disorder, dissociative disorder, agoraphobia, and panic disorder based on DSM-IV-TR, and were classified as "neurotic" level from the viewpoint of the pathological level by a psychiatrist and four clinical psychologists. Table 1 shows the breakdown of the patients.

Material

The Japanese version of the NEO-FFI (Shimonaka et al., 1999), originally developed by Costa and McCrae (1992), is a self-reported questionnaire based on a Five-Factor model of personality. Shimonaka, Nakazato, Gondo, and Takayama (1998) demonstrated that the Japanese version of the NEO-FFI has sufficient reliability and validity based upon data from a mixture of two samples of 245 college undergraduates and 232 elderly people. The NEO-FFI is composed of five domains, each of which is composed of 12 items. The five factors are: Neuroticism (N), Extraversion (E), Openness (O), Agreeableness

Table 1. Patients

	Graves' disease	Hashimoto disease	Nodular goiter	Neurosis
Number (Male/Female)	64 (12/52)	38 (3/35)	68 (11/57)	22 (6/16)
Age (SD)	36.9 (10.58)	48.6 (12.06)	51.0 (11.87)	38.8 (14.24)

Table 2. Five Factors of the NEO-FFI

Neuroticism (N)
maladjustment, emotional instability, sensitivity to psychological distress, unrealistic ideas, excessive craving or urges, and maladaptive coping responses to stress
Extraversion (E)
sociability, liking interpersonal relationship, high activity level, need for stimulation, cheerful spirits, energetic, and optimistic
Openness (O)
imagination, sense of beauty, sensitivity, appreciation to diversity, intellectual curiosity, and uniqueness of judgement
Agreeableness (A)
altruistic and sympathy to others
Conscientiousness (C)
ability of self-control and independency

Shimonaka et al. (1999)

Table 3. Average and Standard Deviation of the NEO-FFI (Adult) (Shimonaka et al., 1999)

	Mean	SD
Neuroticism (N)	23.4	6.9
Extraversion (E)	25.2	5.8
Openness (O)	28.4	5.5
Agreeableness (A)	30.9	4.7
Conscientiousness (C)	28.1	5.5

Shimonaka et al. (1999)

(A), and Conscientiousness (C). Table 2 presents an explanation of the five factors. The subjects evaluated their own personality traits according to the five scales. Scores for each factor were calculated by the sum of 12 items. The NEO-PI-R, the NEO-FFI Manual for the Japanese version (Shimonaka et al., 1999) proposed drawing a profile according to a deviation score based upon the mean score and standard deviation of 335 Japanese adults. The mean scores and standard deviations by Shimonaka et al. (1999) are reported in Table 3. Deviation scores are categorized into the following five levels: “very high”, “high”, “standard”, “low”, or “very low”. Table 4 presents the conversions of the scale scores and deviation scores.

The Tree Drawing Test requested each participant to perform the following: “Draw a tree that bears fruits”. The morphological features of the trees were analyzed according to 38 indices. The indices were established as follows: “crown”, “base”, “trunk”, “branch”, “fruit”, “size”, “stroke”, and “others”, based upon former studies (Kuniyoshi, Hayashi, Ishitani, Tsuda, & Saito,1980, Yamamori et al., 2001). These indices were used to evaluate the performance of the TDT. Table 5 presents the explanation of each of the indices. The indices were independently assessed by three certified clinical psychologists. The final assessment was determined based upon agreement between two of the three assessors.

Procedure

The NEO-FFI and the TDT were administered to both thyroid patients and neurotic patients. Thyroid patients completed the tests after medical preexaminations. Neurotic patients completed the tests as part of the preliminary examinations. Seven of 22 neurotic patients could not complete the NEO-FFI due to time constraints.

Table 4. Conversion Table: Scale score-deviation score

Deviation Score	~34.5	34.5~44.5	44.5~55.5	55.5~65.5	65.5~
Five Levels	very low	low	standard	high	very high
Neuroticism (N)	~12.7	12.7~19.6	19.6~27.2	27.2~34.1	34.1~
Extraversion (E)	~16.2	16.2~22.0	22.0~28.7	28.7~34.2	34.2~
Openness (O)	~19.9	19.9~25.4	25.4~31.4	31.4~36.9	36.9~
Agreeableness (A)	~23.6	23.6~28.3	28.3~33.5	33.5~38.2	38.2~
Conscientiousness (C)	~19.6	19.6~25.1	25.1~31.1	31.1~36.6	36.6~

Note. Calculation based on the mean score and standard score by Shimonaka et al. (1999)

Data Analysis

Comparisons were made between the comparison group (NE) and the three subtypes of patients with thyroid disease (GD, HD, and NG). To compare the mean NEO-FFI scores for each of the five factors among the four groups, we conducted analysis of variance and Tukey’s HSD test for post-hoc analysis. For comparison of the frequency ratio for the indices of TDT among the four groups, we used Fisher’s exact test.

RESULTS AND DISCUSSION

NEO-FFI

Table 6 presents the mean scores for each of the five factors of the NEO-FFI. The analysis of variance revealed significant main effects of group for “Neuroticism” ($F_{(3, 181)} = 8.18, p < .01$), “Extraversion” ($F_{(3, 181)} = 10.06, p < .01$) and “Conscientiousness” ($F_{(3, 181)} = 5.80, p < .01$). Tukey’s HSD test confirmed that the NE group exhibited higher scale score of “Neuroticism”, and lower scale scores of “Extraversion” and “Conscientiousness” than the GD, HD, and NG groups. With respect to the five levels, in the NE group, the mean score of “Neuroticism” was categorized as “very high”, the mean scores of “Extraversion”, “Agreeableness”, and “Conscientiousness” were categorized as “low”, and “Openness” was categorized as “standard”. For the GD, HD, and NG groups, every mean score of five factors was ranked as “standard”, respectively.

In neurotic patients, as expected, the score of “Neuroticism” was “very high”, whereas the scores of “Extraversion” and “Conscientiousness” were low, which suggests that they are emotional, sensitive, and vulnerable to psychological distress, but have less interest in social relationships, ambition, and achieving objectives. Neurotic patients tend to direct their energy toward the inner world, rather than the outside world. In patients with Graves’ disease, Hashimoto disease, and Nodular goiter, each of the mean scores was classified as “standard”. The personality traits of the thyroid patients measured by the NEO-FFI showed neither a strong nor weak tendency for each of the five factors. The results showed that the self-assessments of the patients with thyroid disease were quite standard.

Table 5. Indices of the Tree Drawing Test

crown	1	crown	A tree with a crown edge line.
	2	closed crown	A tree with a crown, which does not have any openings.
	3	open crown	A tree with a crown, which has some space.
	4	discontinuities in the stroke	A tree with a crown. The stroke of the crown edge line is discontinuous.
	5	discontinuities between the crown and trunk	A tree with a crown. The connection between the crown and trunk is discontinuous.
	6	multiple stroke	A tree with a crown. The stroke of the crown edge line is multiple.
	7	radiating branches in the crown	A tree with a crown. The branches are radiating in the crown.
	8	crown of a coniferous tree	A tree with a crown of a coniferous tree.
	9	circular crown	A tree with a circular crown.
	10	crown hanging down	A tree with a crown falling down on the trunk.
without crown	11	trunk and branch end open	A tree without a crown edge line. The top ends of the trunk and branches are open.
	12	radiating branches only	A tree without a crown edge line. The branches are radiating.
base	13	trunk end open at the bottom	The trunk end is open at the bottom.
	14	root	A tree with roots.
	15	ground line	There is a ground line.
	16	without root nor ground line	A tree without roots or a ground line.
	17	vague boundary between trunk and root	A tree whose boundary between the trunk and root is vague.
	18	base of trunk set on the edge of the paper	Base of the trunk is set on the edge of the paper.
	19	trunk standing on a flowerpot	Trunk stands on a flowerpot
trunk	20	too thick trunk	Trunk is too thick.
	21	one stroke trunk	Trunk is draw using a one-stroke line.
	22	trunk widened toward the open end	Trunk is getting wider toward the open end
branch	23	branch	A tree with branches.
	24	branch end open	Branch end is open
	25	one stroke branch	Branch is draw by one-stroke line.
	26	discontinuity between the trunk and branch	The connection between the trunk and branch is discontinuous.
	27	branch hanging down	Branch is hanging down.
	28	branch or fruit outside the crown	Branch or fruit are outside the crown.
fruit	29	too many fruits	There are too many fruits.
	30	too big fruits	Fruits are too big.
	31	strange connection of fruits	The connection of the fruit is strange.
size	32	too big tree	The tree is too big.
	33	too small tree	The tree is too small.
stroke	34	deep line	The stroke is deep line.
	35	wavy line	The stroke is a wavy line.
others	36	accessories	A tree with accessories i.e., birds, insects, and landscape.
	37	uncommon or not tree	An uncommon tree or an item that is not a tree is drawn. E.g., tulip.
	38	real tree: not imagined	A real tree is drawn. E.g., a real tree in the garden.

Table 6. Scores for Each Scale of the NEO-FFI

	GD		HD		NG		NE		<i>F</i> =	<i>df</i> =	
	N = 64		N = 38		N = 68		N = 15				
	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>			
Neuroticism (N)	27.0	7.41	25.9	6.25	24.8	7.79	35.0	6.65	8.18**	(3, 181)	GD, HD, NG < NE
Extraversion (E)	25.4	5.82	26.2	6.35	25.0	5.19	17.1	6.51	10.06**	(3, 181)	GD, HD, NG>NE
Openness (O)	28.6	5.67	27.9	5.32	27.8	5.12	25.7	5.01	1.25	(3, 181)	n.s.
Agreeableness (A)	30.9	5.16	31.6	5.02	31.3	4.99	27.9	5.40	2.08	(3,181)	n.s.
Conscientiousness (C)	27.1	5.00	26.9	6.02	28.0	4.33	22.0	5.46	5.80**	(3, 181)	GD, HD, NG>NE

Note. GD = Graves' disease, HD = Hashimoto disease, NG = Nodular goiter, NE = Neurosis
+ *p* < 0.10, * *p* < .05, ** *p* < .01

TDT

Table 7 presents the frequency and proportion of the indices “crown”, “base”, “trunk”, “branch”, “fruit”, “size”, “stroke”, and “others” from the TDT. Fisher’s exact test showed several significant differences among the groups. Trees drawn by the NE group were more likely to have a “closed crown”, and less likely to have “too big tree” than the other three groups. Trees drawn by the GD group were more likely to have a “crown”, “open crown”, and “too big tree”, and less likely to have “trunk and branch end open”, “radiating branches in the crown”, “radiating branches only”, “ground line”, “branch”, “one stroke branch”, “discontinuity between the trunk and branch”, “branch hanging down”, or “strange connection of fruits” than the other three groups. Trees drawn by the HD group were more likely to have “radiating branches in the crown”, “one stroke branch” and “discontinuity between the trunk and branch” than the other three groups. Trees drawn by the NG group were more likely to have the “trunk and branch end open”, “radiating branches only”, “ground line”, and “branch end open”, and were less likely to have a “crown” and “root” than the other three groups.

In Figs.1, 2, 3 and 4 we presented sample trees drawn by the patients with each disease, and discussed their psychological traits below. The main trait of the trees drawn by neurotic patients was that they exhibited a more “closed crown” than those drawn by patients with Graves’ disease, Hashimoto disease, or Nodular Goiter. How the patients draw the top end of the trunk is one of the criteria indices for the pathological level. According to Yamanaka (1976) and Kishimoto (2002), the closed form in the top end of the trunk is related to the psychological “boundary”. Figs.1a and 1b show two examples drawn by neurotic patients. Both of the NEO-FFI scale scores of “Neuroticism” are above the “standard”. The trees in Figs. 1a and 1b have a crown edge line. The tree in Fig. 1a is closed completely by the crown. In Fig. 1b, there is some space between the trunk and the crown, but the tree is closed completely by two stroke branches. The crown and two stroke branches form a fixed boundary between the inner space and the outer space of the trees. The closed line of the crown and branches is considered to represent “the boundary

Table 7. Frequency and Proportion of Each of the Indices of the Tree Drawing Test

			GD		HD		NG		NE		Fisher
			64		38		68		22		
			No.	%	No.	%	No.	%	No.	%	
crown	1	crown (in cloud or ball style)	57+	89.1	26	68.4	43–	63.2	20	90.9	**
	2	closed crown	19	29.7	11	28.9	16	23.5	13+	59.1	*
	3	open crown	38+	59.4	16	42.1	27	39.7	7	31.8	+
	4	discontinuities in the stroke	21	32.8	11	28.9	15	22.1	5	22.7	n.s.
	5	discontinuities between crown and trunk	30	46.9	13	34.2	20	29.4	6	27.3	n.s.
	6	stroke separated into parts	3	4.7	1	2.6	2	2.9	3	13.6	n.s.
	7	radiating branches in the crown	0–	0.0	6+	15.8	3	4.4	2	9.1	**
	8	crown of a coniferous tree	2	3.1	2	5.3	1	1.5	2	9.1	n.s.
	9	circular crown	3	4.7	6	15.8	7	10.3	3	13.6	n.s.
	10	crown hanging down	6	9.4	3	7.9	7	10.3	0	0.0	n.s.
without crown	11	trunk and branch end open	2–	3.1	7	18.4	12+	17.6	0	0.0	**
	12	radiating branches only	1–	1.6	4	10.5	8+	11.8	0	0.0	*
base	13	trunk end open at the bottom	44	68.8	27	71.1	44	64.7	12	54.5	n.s.
	14	root	23	35.9	10	26.3	11–	16.2	10	45.5	*
	15	ground line	11–	17.2	7	18.4	26+	38.2	6	27.3	*
	16	without root nor ground line	34	53.1	17	44.7	26	38.2	6	27.3	n.s.
	17	vague boundary between trunk and root	1	1.6	0	0.0	5	7.4	0	0.0	n.s.
	18	base of trunk set on the edge of the paper	5	7.8	0	0.0	3	4.4	1	4.5	n.s.
	19	trunk standing on a flowerpot	2	3.1	1	2.6	1	1.5	0	0.0	n.s.
trunk	20	too thick trunk	7	10.9	2	5.3	7	10.3	1	4.5	n.s.
	21	one stroke trunk	2	3.1	2	5.3	4	5.9	1	4.5	n.s.
	22	trunk widened toward the open end	6	9.4	2	5.3	4	5.9	0	0.0	n.s.
branch	23	branch	28–	43.8	24	63.2	45	66.2	14	63.6	+
	24	branch end open	9	14.1	7	18.4	21+	30.9	2	9.1	+
	25	one stroke branch	12–	18.8	17+	44.7	23	33.8	6	27.3	*
	26	discontinuity between the trunk and branch	2–	3.1	8+	21.1	6	8.8	1	4.5	*
	27	branch hanging down	2–	3.1	6	15.8	10	14.7	3	13.6	+
	28	branch or fruit outside the crown	7	10.9	2	5.3	6	8.8	1	4.5	n.s.
fruit	29	too many fruits	15	23.4	10	26.3	14	20.6	4	18.2	n.s.
	30	too big fruits	10	15.6	3	7.9	10	14.7	2	9.1	n.s.
	31	strange connection of fruits	2–	3.1	7	18.4	12	17.6	4	18.2	*
size	32	too big tree	15+	23.4	4	10.5	10	14.7	0–	0.0	*
	33	too small tree	7	10.9	4	10.5	7	10.3	5	22.7	n.s.
stroke	34	deep line	13	20.3	7	18.4	11	16.2	3	13.6	n.s.
	35	wavy line	6	9.4	5	13.2	11	16.2	2	9.1	n.s.
others	36	accessories	2	3.1	2	5.3	5	7.4	1	4.5	n.s.
	37	uncommon tree	5	7.8	2	5.3	5	7.4	1	4.5	n.s.
	38	real tree: not imagined	2	3.1	2	5.3	6	8.8	0	0.0	n.s.

Note. GD = Graves' disease, HD = Hashimoto disease, NG = Nodular goiter, NE = Neurosis

* $p < 0.10$, * $p < .05$, ** $p < .01$

Fig. 1a. A tree drawn by a neurotic patient and the patients' NEO-FFI factor scores.

N	E	O	A	C
36	26	30	30	25

Fig. 1b. A tree drawn by a neurotic patient and the patients' NEO-FFI factor scores.

N	E	O	A	C
33	16	24	30	21

Fig. 2a. A tree drawn by a patient with Graves' disease and the patients' NEO-FFI factor scores.

N	E	O	A	C
13	36	25	36	22

Fig. 2b. A tree drawn by a patient with Graves' disease and the patients' NEO-FFI factor scores.

N	E	O	A	C
22	27	30	34	24

Fig. 3a. A tree drawn by a patient with Hashimoto disease and the patients’ NEO-FFI factor scores.

N	E	O	A	C
19	22	33	28	27

Fig. 3b. A tree drawn by a patient with Hashimoto disease and the patients’ NEO-FFI factor scores.

N	E	O	A	C
21	28	17	36	27

Fig. 4a. A tree drawn by a patient with Nodular Goiter and the patients’ NEO-FFI factor scores.

N	E	O	A	C
15	24	28	35	31

Fig. 4b. A tree drawn by a patient with Nodular Goiter and the patients’ NEO-FFI factor scores.

N	E	O	A	C
26	27	32	34	26

between oneself and others, or inner vs. outer reality” (Kishimoto, 2002). The closed crown suggests that neurotic patients manage to establish a complete contour of the self. Because of this clear boundary, neurotic patients might experience conflicts between oneself and others or inner vs. outer reality.

The trees drawn by patients with Graves’ disease were characterized by an “open crown”; i.e., the crown edge line was not totally closed, but had some openings. It is thought that the psychological boundary is somehow vague in Graves’ disease patients, compared with that of neurotic patients. The vague boundary was observed visually, as less “branch” and a “ground line”. Despite the vagueness of the borderline, patients with Graves’ disease generally attempted to define the boundary. Furthermore, the Graves’ disease patients exhibited fewer defective morphological traits, i.e., completely open form, one stroke trunk, discontinuity between the trunk and the branch. Figs. 2a and 2b show two examples drawn by patients with Graves’ disease. While variation arises in the NEO-FFI scale scores of Fig. 2a, those of Fig. 2b are close to “standard”. Both trees maintained a good balance and have a crown edge line. However, because they have some openings between the crown and the trunk, the trees are not closed completely.

One distinguishing trait of the trees drawn by the patients with Hashimoto disease was observed in the connection between the parts; i.e., “radiating branches in the crown” and “discontinuity between the trunk and branch”. Figs. 3a and 3b show two examples drawn by patients with Hashimoto disease. The NEO-FFI scales scores are close to “standard” except the score of “Openness” in fig. 3b. In Fig. 3a, one-stroke branches are spreading in all directions from a two-stroke trunk. In Fig. 3b, the branches reach out crossing a crown edge line. Both trees show discontinuity between the parts. Thus, some of the trees somehow provide a strange impression. While the parts were drawn well, it would be difficult to construct an intact body by combining the parts from a single viewpoint. Furthermore, patients with Hashimoto disease drew more “one-stroke branches” than the other groups. Kaneda et al. (2010) and Matsushita (2005) reported that schizophrenia patients often draw a “one-stroke trunk”. Elderly people also often draw “one-stroke trunk” and “one-stroke branches” (Kobayashi, 1990). According to Matsushita (2005), the one stroke line is related to a decline in the state of inner energy. Patients with Hashimoto disease, which is characterized by a deficit of thyroid hormones, often develop depressive mood and decline of cognitive functions (Whybrow & Bauer, 2005b). Thus, the “one-stroke branches” drawn by patients with Hashimoto disease may reflect such a decline of inner energy.

One unique feature of the patients with Nodular Goiter was that the trees exhibited less of a “crown”. The top end of the trunk tended to be open without a crown; i.e., the inner and outer spaces were mixed within the trees. Figs. 4a and 4b show two examples drawn by patients with Nodular Goiter. The NEO-FFI scales scores are close to “standard”, while the score of “Neuroticism” of Fig.4a is low. The trees do not have crown edge line. The boundary between the inner space and outer space of the tree is vague. In Fig. 4a, while the branches and fruits have been drawn, a top-end of the tree remains open. In Fig. 4b, one-stroke branches radiate from a two-stroke trunk. An open-ended trunk has been observed in psychotics (Inadomi et al., 2003; Kaneda et al. 2010;

Saito & Owada, 1969; Yamanaka, 1976), serious somatic diseases (Kishimoto, 1999), and psychosomatic diseases (Kawai, 2008). As pointed out by Yamanaka (1976), this phenomenon implies weakness of the ego function. It is thought that some of these patients have difficulty in defining the boundary between oneself and others or inner vs. outer reality. Regarding the lower part, the trees are less likely to have “root” and more likely to have a “ground line”. The root of the tree represents to the relationship with outer reality (Takahashi & Takahashi, 2010). Thus, the lack of roots somehow suggests unstable relationship with the outer reality. However, patients with Nodular Goiter are rooted directly into the outer reality by drawing a ground line instead of drawing the roots themselves.

CONCLUSION

In this study, we investigated the psychological features of patients with thyroid disease, using two personality assessment techniques; the NEO-FFI and the TDT.

The results from the NEO-FFI and the TDT showed a discrepancy, i.e., while patients with thyroid diseases exhibited quite standard scores for the NEO-FFI, they drew less structured trees compared with the comparison group. One main trait of the trees drawn by the thyroid groups is the vagueness between the inner space and the outer space, which is observed mainly in the open form in the “apical termination” (Fujioka & Yoshikawa, 1971). “Apical termination”, named by Fujioka and Yoshikawa (1971), is the way that the subjects draw the top end of the trunk. Apical termination requires the greatest energy in drawing of the tree, and therefore tends to reflect weakness of the drawer (Kishimoto, 2002). It has been reported that psychotics often draw an “open-ended trunk” (Inadomi et al., 2003; Kaneda et al.; 2010; Matsushita, 2005; Saito & Ohwada, 1969; Yamanaka, 1976). Koch (1957) pointed out that an open-ended trunk indicated a lack of clear distinction between self and non-self. The boundary of the tree is considered to represent the psychological boundary. It is believed that the boundary between oneself and others or inner vs. outer reality is somehow vague in patients with thyroid disease.

Secondly, an unexpected finding was that patients with Nodular Goiter, which has been regarded as a pure physical disease, exhibited more notable weakness of boundary than patients with Graves’ disease, which has been considered to be a psychosomatic disease. From the viewpoint of the pathological level, we conclude that the so-called psychosomatic diseases i.e., Graves’ disease, could be considered as being closer to the neurotic level, whereas pure somatic disease i.e., Nodular Goiter, may have a more serious concern regarding boundary.

As demonstrated by the NEO-FFI results, patients with thyroid disease are likely more adapted at the conscious level compared with neurotic patients. At the same time, we need to take notice of the weakness of the boundary underlying the psychological adaptation. These observations can be revealed through the projective method as well as through listening closely to them during the surface narrative.

The present results suggest the importance of cross-validating the various personality measures and identifying factors contributing to differential results derived from different types of personality tests and clinical observations. Assessment of the levels of psychological adaptations is also important to develop appropriate psychotherapies for patients with different types of thyroid disease.

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