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Do biometric parameters of the hand differentiate schizophrenia from other psychiatric disorders? A comparative evaluation using three mental health modules

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ABSTRACT

The link between schizophrenia and anomalies in the distal upper limb is well documented. Preliminary studies have identified a number of biometric parameters of the hand by which schizophrenics can be distinguished from matched controls. The current study seeks to determine whether patients with schizophrenia can be singled out from a disparate group of other mental disorders by using the same parameters. We studied three groups, totaling 134 men: 51 diagnosed with schizophrenia, 29 with anxiety and mood disorders, and 54 comprising a control group. Seven parameters were studied: the proximal interphalangeal joint, the eponychia of the middle and ring digits, two dermatoglyphic features, and two constitutional factors. Examiners evaluated the parameters based on photographs and prints. An initial Mann Whitney comparison showed no significant difference between the control group and those identified with anxiety and mood disorders. We therefore accounted for them as a single group. In a discriminant analysis, an overall accuracy of 78.4% was established with a sensitivity of 80.4% (schizophrenics identified correctly) and a specificity of 77.1% (controls identified correctly). These results suggest that the biometric parameters employed may be useful in identifying patients with schizophrenia from a disparate group of other mental disorders.

1. Introduction

Schizophrenia comprises a complex group of disorders the manifestations of which include severe disturbances in cognition, affect, and behavior. The pathogenesis of this condition remains unclear, but there is general agreement that both genetic and environmental factors are involved (Van Os, 2009). More recently, neurodevelopment reflecting inherent genetic vulnerability coupled with possible intrauterine insult has been implicated in the etiology of the disorder (e.g., Murray and Lewis, 1987; Weinberger, 1987; Lewis and Levitt, 2002; Fatemi and Folsom, 2009).

The distal upper limb has been considered a surrogate of possible neurodevelopmental anomalies (e.g., Cummins, et al., 1950; Achs et al., 1966; Johnson and Opitz, 1973; Qazi et al., 1980). The most fundamental link between the distal upper limb and the central nervous system is their simultaneous cytological development from the ectoderm of the fertilized ovum (Bracha et al., 1991). In this regard, there is considerable evidence linking genetic disorders and intrauterine environmental disturbances to the morphology and dermatoglyphic patterns of the hand (e.g., Shiono and Kadowaki, 1975; Reed and Opitz, 1981; Seema et al., 2012). Much of the relevant literature focuses specifically on schizophrenia and closely related disorders, where prominent features include abnormal palmar flexion creases (APFC) (e.g., Bracha et al., 1991; Rosa et al., 2002; Fatjo-Vilas et al., 2008) and several minor physical anomalies of the hand (e.g., Green et al., 1989; Gourion et al., 2004). None of these, however, have been subjected to rigorous analysis under controlled conditions which would permit a conclusion regarding their reliability and specificity as markers of the disorder.

In the search for markers distinguishing schizophrenia, it was

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Table 1
List of seven hand parameters that were examined.

Parameter	Location	Information source	Scale
Proximal interphalangeal joint-PIP	Middle digit	Photograph	3=Poorly defined skeletal borders to 1=Well-defined skeletal borders
Eponychium of the middle digit	Distal phalanx of middle digit (nail)	Photograph	1= Growth extending over the lunula and beyond 0=Normal
Eponychium of the ring digit	Distal phalanx of ring digit (nail)	Photograph	1= Growth extending over the lunula and beyond 0=Normal
Proximal transverse crease-PTC	Proximal palmar flexion crease	Print	1= shortened and/or fragmented in at least one hand 0=normal
Thenar crease-TC	Thenar Crease	Print	1=ill defined in at least one hand 0=normally distinct
Texture of the skin on the dorsum of the hand	The dorsum of the hand	Photograph	3= delicate, "childlike" dorsum to 1= non delicate texture
Digital flexibility	Digits	Manual examination	3=rigid to 1=very flexible (about 90°)

found that the predictability of the disorder was far more reliable using a combination of features than when any single feature was evaluated on its own. In a preliminary study three specific features of the hand were identified that when seen together were able to distinguish between schizophrenia patients and a control group (Shamir et al., 2013). These included the proximal interphalangeal joint, the proximal transverse crease, and the eponychium of the middle digit. When seen together these features had an overall accuracy of 81.2% with 76.3% of the schizophrenia patients and 85.7% of the controls being identified correctly.

The current study extends the previous findings by enlarging the number of study subjects and determining whether a combination of these biometric markers can be used to identify and distinguish schizophrenic patients from a disparate group of other psychiatric disorders.

Since sexual dimorphism exists in the hand features of schizophrenic patient's (Fatjo-Vilas et al., 2008; Mellor, 1968) the study was limited to men.

2. Methods

2.1. Subjects

Three groups totaling 134 subjects were recruited, 51 with a diagnosis of schizophrenia, 29 with anxiety and mood disorders, and 54 comprising a control group. Admission to the study was limited to adult males. A complete physical examination was performed on every patient included in the study but not on control subjects. Along with medical history and systems inventory in all subjects confounding variables including associated arthritic conditions and developmental abnormalities were excluded to the extent possible. Subjects were excluded with medical conditions that could influence the appearance or function of the hand (e.g. arthritis) including malformations (e.g. absent fingers, hypoplastic thumbs, trauma, surgery). Subjects with somatic diseases known to have increased neurodevelopmental markers (e.g. diabetes, psoriasis, spina bifida etc.) were also excluded. One subject in the control group had type 1 diabetes, a non familial disorder. Exclusion criteria for control subjects included a personal history of mental disorders although two control subjects had first degree relatives (fathers) with bipolar disorder. Diagnoses other than schizophrenia included Bipolar Disorder 24% ($n=7$), Dysthymic Disorder and Depressive Disorder NOS 28% ($n=8$), OCD 17% ($n=5$), PTSD 21% ($n=6$), and Adjustment Disorder 10% ($n=3$). All diagnoses were consistent with DSM-IV-TR criteria. Schizophrenia was additionally confirmed by referencing hospital charts and conducting a SCID-I clinical interview (First et al., 2002). Patients were recruited from the Abarbanel Government Psychiatric Hospital at Bat-Yam, Israel. The control group consisted of members of the hospital staff, university students, and volunteers. All the participants were informed as to the nature of the study and each signed a letter of consent (Helsinki).

The age of the participants ranged between 19 and 65. A one way ANOVA showed no statistically significant age differences between the three groups (schizophrenics $M=37.59$, SD=11.076, anxiety and mood disorders $M=41.21$, SD =11.875, and controls $M=38.37$, SD=11.756; $F(2,133)=0.954$, $p=0.391$).

All the subjects were Israelis, Caucasian and of Jewish heritage. A further differentiation was made between Ashkenazi and non-Ashkenazi subjects. A chi-square test for independence found no significant differences in the ethnic composition of the three groups $\chi^2(2)=0.826$, $p=0.662$.

2.2. Tools

An evaluation of the features of the subjects' hands was made using photographs and water based ink-prints. The photographs were taken with a hand held digital camera in accord with printed illustrations pertaining to background, angle, and distance. Six to eight photographs were taken of the hands of each subject in various positions.

Photographs and prints of the hands were examined for six of seven possible anomalies thought to be linked to mental health disturbances (Holtzman, 1983, 2004, 2012). (See Table 1). These anomalies included an ill defined proximal interphalangeal joint (PIP) (Fig. 1), an extended eponychium (proximal nail fold) of the middle digit (Fig. 2), as well as that of the ring digit, abnormality in the proximal transverse crease (PTC) which was described either a as shortened crease terminating in the middle of the palm and not entering beyond the midline of the ring digit, and\or a broken crease and\or a fragmented crease (Fig. 3A,B) and\or a simian crease on at least one of the hands, (judges were advised to distinguish the abnormally short proximal transverse crease from any line, however indirect, extending across the palm), an ill defined thenar crease (TC) (Fig. 3C), and texture characteristics of the skin on the dorsum of the hand. A seventh, limited digital flexibility, was evaluated by one of the authors (A.L.) who collected the data.

2.3. Procedure

To assure a blind evaluation of the information collected, three examiners were selected. One of them designated the expert was considered the Gold Standard (G.S.). All were unaware of the sources either of the photographs and prints, or of the purpose of the study. Examiners received preliminary instruction to familiarize them with the identification and rating of the relevant features. Each of the examiners received all 134 files, which were coded and randomly sorted. Table 1 shows the scale by which each feature was rated.