Taxonomic classification of mental disorders

Abstract

Objective
Current classifications of mental disorders ICD-10, DSM-5, as well as the new ICD-11 being developed, do not show interrelations in pathogenesis between groups of mental disorders. This is a weak point of these classifications, although they serve a good purpose in relation to medical statistics and encoding requirements.
Methods
Taxonomic classification of mental disorders proposed in this empirical study reveals interrelations between diagnostic categories of mental disorders. Classification as an object of this empirical study is initially developed on author's observation of psychopathology in clinical practice. It also relies on scientific data of genetics and neurobiology of mental disorders.
Results
The classification is based on two axes system. First axis reflects the time of damage of neural tissue in specific stage, i.e., neuron body genesis, neuron growths genesis, synaptic pruning or further neural information modeling. The second axis is connected with resilience. The two axes system includes in one continuum and connects into one classification table almost all diagnostic groups from ICD-10 or DSM-5 (with two exclusions: "organic" type mental disorders and pathology of myelination process).
Conclusions
This empirically derived new concept of classification could be used in clinical practice in differential diagnosis, discovering heterogeneities in patients with same diagnostic "code", planning treatment strategies, predicting course of mental disorders. This new concept could also be useful in the molecular psychiatry area, hereby connecting molecular psychiatry findings to clinical psychopathology.

Keywords: mental disorders, classification, ICD-10, ICD-11, DSM-5, taxonomy.

Introduction

The current International Classification of Diseases 10 (hereinafter referred to as "ICD-10") and the Diagnostic and Statistical Manual 5 (hereinafter referred to as "DSM-5"), as well as the new ICD-11 classification of mental disorders being developed, are of descriptive-syndromological nature and do not link isolated groups of mental disorders. These two classifications, which are widespread throughout the world, are well suited to medical statistics, where the institutions supervising the work of mental health professionals require that the mental disorder being treated and some kind of diagnostic-statistical category be necessarily "inserted". Another feature of ICD-10 and DSM-5 is that groups of mental disorders are distinguished based on different criteria that characterize that group. Looking for a common classification criterion for all groups, we should describe these classifications as "incoherent": some mental disorders are grouped according to their origin (e.g., ICD-10 "F0 – Organic, including symptomatic, mental disorders", ICD-11 "6A0 – Neurodevelopmental disorders"), the second ones are grouped according to prevalent psychopathology (e.g., "F3 – mood disorders"), and the third ones –

according to the time of their occurrence (e.g., "F9 – Behavioural and emotional disorders with onset usually occurring in childhood and adolescence"). These weak aspects of ICD-10 and DSM-5 have been discussed in scientific articles [1].

Looking at the classification of mental disorders from a historical point of view, it can be seen that a certain artificial dichotomous approach was sown by the ideas offered in the works of E. Kraepelin in 1883-1899. E. Kraepelin stated that affective disorders and certain forms of mental disorders now attributed to schizophrenia are separate mental disorders (in the original writings of E. Kraepelin, these two separate groups of disorders are called manic-depressive insanity and *dementia praecox* [2]). However, the lack of clear boundaries between mental disorders and the question of the continuum of these disorders have arisen for many researchers in psychopathology – for example, it was raised by K. Conrad (1950) [3], G. Gross and G. Huber [4]. Other researchers who have studied large groups of people with mental disorders have found a genetic link between the disorders [5].

The boundaries artificially drawn by experts between groups of mental disorders may be more convenient for mental health professionals in their clinical work, but they do not reflect the pathogenetic relatedness of mental disorders.

The first criterion for taxonomic classification: the time of damage to the central nervous system

In nature, there is a general principle of biological development – the development of the individual, which has started since the emergence of zygote, takes place at a faster pace, then slows down exponentially [6]. The earlier the lesion, the more pronounced and stable the pathological changes in the body. This principle is universal in nature – for example, if the tree is damaged at the seedling stage, pronounced deformations may persist throughout the observed structure of the grown tree. The time of damage to the central nervous system (CNS) would be the first of the two criteria of the classification scheme proposed in the article.

I will remember the evolution of neurons in the CNS – see Figure 1.

(Fig. 1. **Development of cerebral neurons**)

The reference years of the periods are approximate because the CNS develops non-homogeneously, e.g., pyramidal neurons are fully formed before human birth, while interneuron formation continues after birth [6]. In one area of the CNS, axons may grow in a certain period of time, and in another, synapses may already form [7]. Individual differences in the CNS development schedule are also possible (e.g., gender depended). From the emergence of zygote to birth, marked in Figure 1 as "0 years", neuronal bodies develop – let's call this process neurosomatogenesis. In 0-3 years, neuronal outgrowth branches, i. e. neurites (axons and dendrites) – neuritogenesis occurs. In 3-6 years, new neuronal synapses, interneuronal network are formed – synaptogenesis takes place. In 6-14 years, synapses are restructured, a part of them is removed – synaptodeletion takes place. During this period, there is an intense process of synaptic "pruning", during which about 2/3 of the former synapses remain in the CNS [8,9]. By about 14 years of age, the CNS neural network has already been formed, and further modeling of the stored information in the formed neurons is underway. Special mention should be made of

the process of myelination of the nervous system, which, in contrast to the genesis of neuronal bodies and growths, only accelerates in childhood [6].

Thus, one, and perhaps essential, criterion on which CNS activity will depend later in life is the period (neurosomatogenesis, neuritogenesis, synaptogenesis, synaptodeletion, or information modeling) in which the damage was caused by stressogenic factors. This would be the first of the two criteria for the classification scheme proposed in the article. Severe lesions occurring within the intrauterine stage almost completely block the further development of the CNS – it stops completely in the early stages of development. Subsequent ones, meanwhile, do not have such an all-encompassing deterrent effect, but direct the development of the CNS in a pathological direction. Subsequent stressogenic events in life amplify this effect to clear clinical forms.

The second criterion of taxonomic classification: CNS resilience

The second criterion of the classification scheme presented in the article is the resilience of the CNS to stressogenic factors. This resilience could be divided into two opposing subcategories: the strength of stressogenic factors, their intensity *versus* the ability of neurons to repair stress-induced neurotransmitter deficiency (it may be a genetically predisposed trait) [10].

Thus, four combinations of resilience subcategories are possible: intense, strong harmful effects and low neuronal recovery reserve (neuronal damage is greatest and beyond a certain damage threshold may be irreversible), weak harmful effects and high neuronal recovery reserve (damage will be minimal); and intermediate variants – strong harmful effect against strong neuronal recovery reserve and weak harmful effect against weak neuronal recovery reserve. However, in order to simplify this classification and avoid its three-dimensional representation (this would give three axes: evolutionary axis, axis of strength of stressogenic factors, neuronal recovery potential axis), the strength of stressogenic factors and neuronal recovery potential are combined into a common "resilience" axis.

The article refers to the stage of decompensation of changes in the body caused by stressogenic factors damaging CNS or other organ systems during stress. Describing non-specific reactions of the body to harmful factors, H. Selye named this stage as "distress" [11]. Harmful effects of of stressogenic factors are understood here as a stage of prolonged stress, depleting the biological resources of the CNS, including neurotransmitters (serotonin, dopamine, noradrenaline, etc.) and a reserve of growth factors in neurons. Pre-natal stressogenic factors are mostly biological. The intrauterine influence of psychological factors is also unquestionable, however, more data are still lacking on how exactly they affect fetal development. After birth, psychosocial factors contribute to biological harmful factors, and biological ones in turn cause psychosocial stress to the individual.

To illustrate the phenomenon of resilience, I will use a picture from S. M. Stahl's book "*Stahl's Essential Psychopharmacology*" – see Figure 2 [12].

(Fig. 2. **Resilience vs harmful factors**)

The strength of the bridge structure would correspond to the resilience of the CNS (S. M. Stahl writes in his book that they are mainly gene-dependent), and the weight of the car or truck driving on the bridge would correspond to the strength of the stressogenic effect, a heavier

vehicle would correspond to a stronger harmful effect. Thus, Figure 2.1. depicts a condition in which the "bridge" of CNS neurons is strong enough and the object passing through it is relatively light – therefore there is no potential for damage. Figure 2.2. would correspond to the condition when the bridge is resistant, but a particularly heavy object passes through it – a damage to the integrity of the bridge occurs, but the bridge, although with deformations, still withstands it. Figure 2.3. would correspond to the condition when the defect of the bridge structures is sufficiently pronounced and a light object passes through it – as in the case of Figure 2.2, a damage occurs, but the bridge withstands the harmful effects with deformations. Figure 2.4. illustrates the bridge that has lost its strength and at the same time is exposed to a severe damaging factor. In this case, the CNS "bridge" structure is severely damaged, even irreversible damages are possible.

Description of the classification scheme

The proposed taxonomic classification scheme for mental disorders, presented in Figure 3, is based on the system of the two axes described above. One axis reflects the effect of stressors on CNS development, the other axis reflects CNS resilience.

(Fig. 3. **Taxonomic classification scheme for mental disorders**)

In contrast to ICD-10 or DSM-5, these two axes become a common criterion for almost all mental disorders. The exception would be mental disorders of organic origin (neoplastic, traumatic, ischemic-infarct, neuroinfectious, etc., see below) that can begin at any age. A distinction should also be made between activity and attention disorders, for the pathogenesis of which the CNS myelination process is important (see below). In both the horizontal and vertical directions, mental disorders are interrelated and form horizontal and vertical continuums. In the case of a continuum of disorders, the cell boundaries of the classification scheme are conditional, in reality there are no such clear boundaries. Viewed in the horizontal direction, mental disorders are related qualitatively, i. e. linked by "overlapping" psychopathology, while in the vertical direction they are related quantitatively – linked by the severity and intensity of symptoms. This results in 8 main groups of disorders. During neurosomatogenesis, there is a clinical onset of mental disorders of the group of intellectual development disorders and severe forms of childhood autism. The neurobiological basis of autism, childhood forms of schizophrenia, lies in the period of neuritogenesis. During the period of synaptogenesis characterized by intense changes in the neural network – the basis of later forms of schizophrenia, milder disorders of the schizophrenia spectrum, delusional disorder, obsessive-compulsive and bipolar affective disorder, and later – unipolar depression, anxiety disorders. At the end of the "pruning" phase of synapses, the psychopathology of personality disorders ceases to form.

As in the case of the ten main groups of ICD-10, the eight main groups of the taxonomic classification ar further subdivided into subgroups of mental disorders. In this classification scheme, each of the eight groups has three levels. These three levels are distinguished by the severity of group-specific psychopathology. Each level-box of the classification scheme includes several ICD-10 distinguishable mental disorders. The scheme cells of all ICD-10 diagnostic units with their characteristic predominant psychopathological symptoms are not presented, as the aim of Figure 3 is to show the interconnectedness of the eight main groups. For example, a

schizoaffective disorder would include a depressive, manic, or mixed type of disorder, and, for example, a "box" of episodic anxiety includes panic disorder, specific phobias, etc.

The CNS disorders occurring in the intrauterine period and in the earliest period after birth cause a congenital intellectual disability. As other organ systems are formed at the same time, they can also be damaged, such as defects in the face, eyes, heart septum and valves. The stronger the harmful factors and the weaker the regenerative properties of the CNS, the earlier the development of the CNS stops, the more severe the intellectual development disorder will be. Later we observe more severe forms of childhood autism spectrum disorders that also begin in early childhood. Their expression will depend on the balance of harmful factors: strength *versus* neural regeneration. During the branching period of neuronal axons and dendrites, the roots of autism and earlier ("core" schizophrenia) and more severe (which will cause schizophrenic personality defect in the future) schizophrenia are likely to lie. During the period of synaptogenesis, episodic schizophrenia, schizotypal, schizophrenia-like (schizophreniform) disorders, schizoaffective disorders, early forms of obsessive-compulsive disorder, and later groups of affective and anxiety disorders associated with overlapping affective psychopathology may develop in the presence of harmful factors. Their severity will depend on the individual's CNS resilience to harmful factors. In contrast to the cases of damage during the stages of neurosomatogenesis and neuritogenesis, the neurobiological basis of mental disorders formed during synaptogenesis does not yet lead to the development of psychopathological symptoms during the damage period. Clear clinical symptoms appear later when an individual is exposed to a recurrent stronger stressogenic factor, usually in adolescence or early adulthood. These recurrent stressogenic factors (usually psychosocial) also "trigger" episodic schizophrenia, obsessive compulsive, affective, or anxiety disorders. This is also influenced by the process of "pruning" of synapses in adolescence. It is possible that the pathology of synaptogenesis later leads to synaptic "pruning" disorders.

Personality disorders in the classification scheme are marked at the 6-14 year synapse restructuring- synaptic deletion period. Clearly, personality (i.e., stable, "recorded" patterns of an individual's relationship) develops from the moment an individual is begun. From the beginning, an individual is always in a real relationship: first in a symbiotic, later in a diadic, even later in a triadic, and so on. Therefore, the taxonomic classification of personality psychopathology should be separate, perhaps also aligned with the stages of CNS development. In the scheme of this article, the 6-14 year period more reflects the stage of "completion" of the neurobiological basis of the personality.

In terms of the relationship between psychopathological symptoms and personality structure, severe, early-onset mental disorders inevitably affect all further development of the human personality (e.g., a person with autism or early onset of schizophrenia will automatically become introverted, extraversion becomes impossible for him). Meanwhile, the relationship between later mental disorders and the personality is the opposite – these disorders themselves "flow" from the pathological structure of the personality. When a conflict or deficit of personality with external psychosocial factors occurs, anxiety reactions arise, and as they prolong and deplete the reserve of certain neurotransmitters, accompanying affective psychopathology begins. Such a process is called decompensation of personality traits with the resulting anxiety and mood-affective disorders. In the presence of CNS damage at the synaptogenic stage, i. e. with a predisposition to the psychopathology of the schizophrenia spectrum, acute transient, polymorphic psychotic disorders are possible during decompensation of personality traits.

As already mentioned, ICD-10-named “organic” type factors that structurally damage nerve tissue can occur at any time during CNS development. A clinical picture of a localization-dependent damage would be more appropriate for psychopathology induced by organic type factors than a damage time and resilience scheme, so there are no organic structural mental disorders in this classification scheme. Clearly, according to the same principle of development mentioned above, organic brain damage in the early stages of development will inhibit all further mental development.

The various psychosomatic symptoms and syndromes, some of which are separated into individual diagnostic categories in the ICD-10 classification, are listed in the generalized anxiety box in this taxonomic classification scheme for simplicity. This combination of various psychosomatic symptoms is based on the assumption that the activity of the vegetative CNS centers in the hypothalamus and thalamus is significantly altered during prolonged anxiety (i.e., the distress mentioned above [11]). These vegetative CNS centers regulate various body functions – cardiac activity, vascular, urogenital system, gastrointestinal, respiratory tract tone, appetite, sleep, libido, perception of pain and other sensations, etc. (and possibly immune system reactivity). In some cases, the state of pathological generalized anxiety in the limbic system and its associated hypothalamus and thalamus is “converted” (i.e., the conversion mechanism) into symptoms felt in the body: various forms of somatoform autonomic dysfunction of inner organs, somatoform pain disorder, functional muscle spasms, and tics occur. In other cases, a dissociation mechanism opposite to conversion occurs: a certain function of the body is “turned off” by increased anxiety – thus dissociative disorders develop. And the third mechanism of development of psychosomatics – the state of generalized anxiety significantly impairs other functions of the body, such as sleep, appetite, sexual function, causing the corresponding disorders of sleep, sexual function and appetite. Clearly, bodily symptoms of mental disorders occur not only during generalized but also during episodic (paroxysmal-panic, phobic, obsessive) anxiety. As mentioned, the box boundaries of the classification scheme are conditional, the symptoms of adjacent boxes overlap, and thus, the psychosomatic symptoms also pass into the cells of the group of depressive disorders.

There is no position of attention and activity disorder of children in this scheme. It may be related to the process of myelination, the evolution of which is different from the development of neuronal bodies, growths, or synapses [6,13].

The basic phases of CNS development also correlate with the stages of personality development determined by psychodynamic theories – the fundamental attachment from birth (J. Bowlby), schizoid-paranoid in the 1–3-year period, depressive stage from 3 years (M. Klein), and separation-individuation in the period of 0-5 years (M. Mahler) [14].
In addition to the mental disorder scheme, a table of normal mental development is provided for comparison.

The practical significance of this classification proposal – general principles

Fig. 1 shows the development of the human CNS starting from the zygote. The origin of a large part of mental disorders lies precisely in the initial, most intensive stages of CNS development, which last until the end of adolescence. These disorders can be called "neurodevelopmental," or "neural developmental" disorders.

However, as mentioned in this empirical study, other mental disorders develop at later, non-related (?) to CNS developmental periods. These disorders are called neurodegenerative, "organic" or secondary mental disorders (e.g., various forms of dementia).

Another separate group of mental disorders are personality disorders, the origin of which is not related to changes in the structure of the CNS, but to information stored in CNS neurons, i.e., certain (pathological) behaviour patterns. Thus, personality disorders are considered to be "psychiatric" disorders, but not "neuropsychiatric" disorders.

Taking this into account, all (without exceptions) mental disorders can be grouped into three large groups – see Fig. 4.

(Fig. 4. **Three major groups of mental disorders from a neuropsychiatric point of view**)

Disorders of one of the three major groups of mental disorders do not eliminate the possibility of disorders of the remaining two groups. Thus, the same individual may develop neurodevelopmental, personality, and neurodegenerative psychopathology.

Based on such classification of all mental disorders into three major groups, the treatment of mental disorders should be planned accordingly. In the case of neurodevelopmental disorders, the ideal treatment approach would be one that allows the identification of mental disorders at the initial stages of origin (before the end of adolescence) and the appropriate treatment measures at that time, which would stop the further progression of the mental disorder. If the treatment is administered later, after the CNS neuronal network has already formed, it becomes more a consequence of the disorder than a treatment of the cause.

The treatment of the second group of neurodegenerative disorders should be aimed at stopping the process of neurodegeneration in the CNS.

Since the basis of the third group of personality disorders is not related to neuropsychiatric changes in the structure of the CNS, but is instead related to the information patterns stored in the neurons of the CNS, neurobiological treatment methods for personality disorders (such as pharmacotherapy) should be abandoned. However, neurobiological treatments may be used to treat symptoms of anxiety and depression that accompany personality disorders.

The practical significance of this classification proposal – clinical aspects

In the daily work of a doctor psychiatrist, mental disorders must inevitably be coded according to ICD-10 or DSM-5, as it is required by the authorities supervising the work of mental health professionals. Of course, these classifications, which are well adapted to medical statistics and accounting, are necessary and useful. However, it is always useful to look at the patient's mental health problems in a broader sense – such a broader approach is the taxonomic classification of mental disorders. The clinician should not be surprised by overlapping symptoms, i.e., psychopathological symptoms characteristic of a group other than the coded by ICD-10. For example, in the case of bipolar affective disorder closer to the group of schizoaffective disorders, typical symptoms of schizophrenia are also "allowed". Symptoms of the schizophrenia spectrum may also include childhood-onset obsessive-compulsive disorder. The course of childhood-onset schizophrenia may be characterized by autism spectrum psychopathology and stable cognitive impairment.

It is possible that some of the mental disorders identified in the ICD-10 classification are combinations of several taxonomic classifications of mental disorders. For example, addiction to psychoactive substances – these would consist of personality psychopathology (emotional instability, narcissistic personality traits, poor impulse control, etc.) together with anxiety and mood disorders, for the suppression of which the use of psychoactive substances is chosen. E. Bleuler states in the 1934 textbook of psychiatry that "many morphinists *ab ovo* are psychopaths" [15]. There is currently no clear answer as to whether the use of psychoactive substances (PAS) can cause psychotic disorders in any person using them. E. Bleuler, the creator of the term schizophrenia, described alcohol-induced psychoses in the aforementioned psychiatric manual and suggested that such patients were also likely to have chronic symptoms of the schizophrenia spectrum [15]. This would be in line with the approach presented in this article: in the case of a CNS damage, e.g., at the stage of synaptogenesis, and later until clear clinical symptoms, the mental disorder may be "triggered" by a variety of harmful factors, including the use of PASs.

As in the case of addiction to psychoactive substances, the group of eating disorders would consist of a certain personality psychopathology, accompanied by marked specific autoaggression against body itself.

Obsessive compulsive disorders (OCD), which I would say would be reasonably excluded in separate DSM-5 classification group, appear to include several different groups of mental disorders in clinical practice. An early onset, which started in childhood or adolescent, in the taxonomic classification is closer to the group of schizoaffective disorder. Early-onset OCD may also be characterized by features of the schizoaffective spectrum – chronic course, pronounced compulsive rituals, possible delusional inclusions, loss of critique of obsessive thoughts, and concomitant affective waves. The later onset form of OCD is associated with a variety of anxiety disorders; it is more common in personalities of an anancastic type. This subgroup of OCD is not characterized by features of the schizophrenia spectrum.

Borderline personality disorder, manifested in problems of perception of one's identity, self-harm, specific experiences of the "emptiness" affect, is often accompanied by waves of affect. Such fluctuations in affect, "poles", raise the question of the relationship between borderline personality psychopathology and bipolar affective disorder. However, there is more evidence that borderline personality disorder and bipolar disorder are separate mental disorders that are not directly linked by pathogenesis [16].

Somatization disorder in ICD-10 belongs to the group of anxiety disorders, but rather it is a combined psychopathology of a certain type of personality, "supplemented" during decompensation by various, polymorphic (phobic anxiety, generalized anxiety, etc.) psychopathology of anxiety disorders with abundant psychosomatic symptoms. "*Psychodynamic Diagnostic Manual (PDM-2)*" by V. Lingiardi and N. McWilliams distinguishes the type of "somatizing personality" [17].

The diagnosis of mixed anxiety and depressive disorder (ICD-10 code F41.2) rather often used in diagnostics would fall into the classification "gap" between unipolar affective and anxiety disorders.

The taxonomic classification scheme "allows" the occurrence of several individual mental disorders in one individual, as there may be more than one harmful factor in the time scale of development. For example, damage to the CNS in the early stages of development can lead to a disorder of the schizophrenia spectrum, and damage in the later stages of development can lead to exogenous depression. Thus, against the background of schizophrenic

psychopathology, there will be symptoms of unipolar depression – and these may be two separate mental disorders. Clearly, in this case, unipolar depression will develop already in the background of schizophrenia, not *de novo*, and will be characterized by specific psychopathology. Or, if the psychopathology of depression is strong enough – as a provocative factor it will lead to an exacerbation of schizophrenic psychosis.

Thus, some mental disorders have separate diagnostic codes in ICD-10 or DSM-5 but belong to one "shelf" of taxonomic classification (e.g. a number of somatoform disorders). Some diagnostic categories from ICD-10 or DSM-5 may have similar psychopathology, but belong to different taxonomic group according to pathogenetic process (e.g. obsessive-compulsive disorder and anancastic personality disorder). Some diagnostic categories belong to different sections of ICD-10 or DSM-5 but they are interrelated by pathogenetic process (e.g. bipolar I, II and III types; severe forms of autism and early onset schizophrenia). Some separate diagnostic categories from ICD-10 or DSM-5 are combinations of two or more mental disorders (e.g. dependencies to psychoactive substances, somatization disorder).

I hope that this article will stimulate a discussion among professionals about the benefits and attractiveness of such a classification, and will complement it with new insights or data from neurobiology research.

Instead of the end – from the fairy tale "Sleeping Beauty" [18]

<…> "The fairies began handing out magical gifts to the princess.

The youngest fairy gave her beauty, the second – mind, the third - grace, the fourth – the ability to dance, the fifth – to sing, the sixth – to play music. Finally it was the turn of the old fairy. She said:

- The young princess will one day prick her finger on a spindle of a spinning wheel and die.

All the people gathered began to tremble. But the seventh fairy, who had not given a gift, said:

- I cannot remove the incantation, the princess will prick her finger in the spindle, but she will not die, she will fall asleep and sleep for a hundred years. Eventually the prince will come and wake her up." <…>

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