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Peculiarities of the age-related changes in the organization of brain activity of the servicemen, which determine the functional motility of nervous processes

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One of the individual-typological qualities of a person characterizing the processes of inhibition and excitation in the central nervous system is the level of functional motility of nervous processes (FMNP). The degree of its development largely determines individual differences in adaptive capabilities, the speed of orientation in new conditions, and the ability to adapt one's behavior to changing environmental factors. Therefore, this characteristic is crucial for professional selection and monitoring of professional efficiency. Our work aimed to determine the level of FMNP in three age groups of representatives of different military specialties and to study the peculiarities of the functioning of neural networks in the brain that are formed during the FMNP test. During the original computer tests to assess FMNP, electroencephalograms (EEG) were recorded with subsequent coherent analysis. *Group 1* (18-23 years old) had the lowest level of FMNP and differed significantly from *group 3* (35-54 years old). A coherent analysis of EEG showed that the neurophysiological basis for a higher level of FMNP during passing tests for its determining by the participants of the *group 3* could be a higher level of motivation and selective attention to visual stimuli due to δ-band coherence in the fronto-parietal regions, better synchronization of the distant neural clusters due to the developed neural network in the θ-band (in the parietal, fronto-parietal and temporal-central areas), higher level of the occipital-central (i.e. visual-motor) integration and blocking of distracting information due to more connections in α-band range. Since most differences were found in the α-band, it could be assumed that the α-activity is of crucial importance for the successful passing of the FMNP test by the older age group.
Key words: functional motility of nervous processes; coherence; neural networks; electroencephalogram; age-related changes.

INTRODUCTION

Functional motility of neural processes (FMNP) forms the physiological basis for the dynamic characteristics of the nervous system, such as the speed of changes in excitation and inhibition centers in various brain structures, their stability, concentration, and balance. These factors significantly influence the effectiveness of complex analytical-synthetic operations and the level of adaptive responses of the organism [1]. For an individual, FMNP characterizes the speed of alternation between excitatory and inhibitory processes, closely related to cognitive rigidity. This refers to the ability to quickly or slowly respond to changing task conditions and situations, or in other words, the ability to adapt behavior according to the changing environmental conditions. Individuals with a higher level of functional motility exhibit behavioral flexibility, adapt more rapidly to new conditions, and establish better cooperation with others [2]. Therefore, this indicator is particularly important in personalized and specialized education. The level of FMNP characterizes a military service member's ability to quickly orient themselves in new situations and adapt to them, as well as their capacity to assess others' reactions and respond appropriately swiftly [3].

It is known that the level of FMNP affects the efficiency of both mental and physical activities. For example, in a study by Golyak et al. [4], it was shown that a high level of FMNP corresponds to more effective sports performance, whereas athletes with a low level of this trait demonstrate lower sports qualifications. Furthermore, a comparison of the workload performed by subjects from different groups showed that individuals with a high level of FMNP had significantly higher mental performance than those with medium and low gradations of this trait ($P < 0.001$) [5]. However, under conditions of a slow pace of information load, individuals with a higher level of FMNP exhibited a lower productivity index [6]. Other studies have found that students with high FMNP have higher levels of thinking and brain performance and better academic success [7]. FMNP is a genetically determined trait of higher nervous activity. Although neuronal circuits in some brain regions related to visual-motor information processing are the same in different people, the connection patterns with other brain areas, such as the frontal cortex, may vary [6]. Thus, it is crucial to study the formation of neural networks in individuals with different FMNP levels. Moreover, it has been shown that higher productivity in individuals with a high level of FMNP is ensured by increased tension in regulatory mechanisms. Therefore, considering FMNP levels can be used to predict the risk of cardiovascular diseases and organize preventive measures [8].

For military professionals, where every mistake can have fatal consequences, effective professional selection and monitoring systems of professional suitability with age are particularly important. Therefore, our study aimed to investigate age's influence on the fundamental changes in brain neural network activity related to FMNP in representatives of different military specialties to objectify the procedure of control and assessment of compliance with professional requirements specifically for military personnel.

METHODS

The study involved 47 volunteers (including 9 women) aged 18-54 years without any health complaints. The participants represented various military professions, such as mechanics, shooters, drivers, radar station operators, anti-aircraft missile service members, communication specialists, plotters, pilots, and conscripts. They were divided into three age groups: group 1 (18-23 years, n = 16, including 3 women); group 2 (24-34 years, n = 19, including 3 women); group 3 (35-54 years, n = 12, including 3 women). All participants received detailed information about the research procedures, with their voluntary written consent being a mandatory condition for participation. The study was conducted in accordance with the ethical standards and principles of the Helsinki Declaration.

The "Test for Determining Functional Motility of Nervous Processes (FMNP)" was conducted using a specialized computer program [9]. This test implements the method for measuring the critical frequency of light flashes. The critical fusion frequency is the maximum frequency of light flashes or sounds that the participant can still perceive as separate flashes or sounds. Beyond this threshold, the perception changes to continuous light or sound. According to Khilchenko's method, FMNP is determined by the shortest exposure time and the fastest presentation rate of stimuli that the individual can accurately differentiate [3]. This measure depends on both the speed of nerve processes and the speed of restoring the functional readiness of the reflex apparatus for a new reaction, as well as the nervous system's ability to assimilate the rhythm. Khilchenko's method requires differentiation of stimuli in the sensory domain and reactions in the motor domain: for one stimulus, the participant presses a button with the right hand; for another, with the left hand, with fingers already placed on the buttons to eliminate searching time. An important advantage of this method is the presence of both excitatory and inhibitory stimuli, which allows assessment of the participant's ability to quickly switch from one positive reaction to another and from inhibition to excitation, and vice versa [10]. In the program, the participant was presented with three types of images on the computer monitor in random order: a circle, a square, and a triangle. Upon seeing a square, the participant had to press the "/" key as quickly as possible; for a triangle, the "x" key was in the Latin registry and did nothing when a circle appeared. Stimuli started being presented at 500 ms intervals. Each correct response reduced the presentation time by 10 ms, while each error increased it. The first 30 stimuli were for adaptation, affecting the stimulus presentation rate, but were not counted for error calculation. The program stopped when the error rate in the last 10 responses reached 50%. The values of the last 10 responses were discarded, and the FMNP indicator was determined as the average value of the preceding 10 response latencies.

Statistical analysis was performed using the Statistica 8.0 software package (StatSoft, USA). A significance level of 0.05 was considered critical when testing statistical hypotheses. Since the distribution of FMNP deviated from normal according to the Shapiro-Wilk test ($P < 0.05$), the median (Me) was used to assess central tendency and interquartile range [25%; 75%] to assess dispersion. Further age factor influence and pairwise differences were analyzed using the Kruskal-Wallis and Mann-Whitney tests.

EEG recording and analysis were conducted using the Neuron-Spectrum-4/VP system (NeuroSoft). The recording was made in a soundproof room, monopolar, at a quantization frequency of 500 Hz, with reference electrodes placed on the earlobes. Silver-plated bridged electrodes were applied according to the international 10-20 system, forming 19 leads: Fp1, Fp2, F3, F4, F7, F8, Fz, C3, C4, Cz, T3, T4, T5, T6, P3, P4, Pz, O1, O2. Using the Neuron-Spectrum program, coherence values were calculated for each electrode pair within the EEG frequency bands: δ (0.5-3.9 Hz), θ (4.0-7.9 Hz), α (8.0-13.9 Hz), β1 (14.0-19.9 Hz), and β2 (20.0-35.0 Hz).

The distant synchronization of brain areas during test tasks was determined using coherence analysis. The average coherence function value depends on the noise level in the signals. If it exceeds 30-40%, it becomes problematic to distinguish the signal from noise, making it challenging to assert high synchronization across different leads. Additionally, for each harmonic at the boundary of two neighboring epochs being analyzed, side peaks arise due to the spectrum leakage effect, which can exceed 40% of the central peak's amplitude. This effect influences the phase coherence value and, hence, the coherence value. Therefore, the coherence coefficient tends to overestimate the degree of process synchronization. As a result, during test tasks, reliable synchronization was determined only for those electrode pairs where the median coherence was ≥0.7 [11].

RESULTS AND DISCUSSION

A comparative analysis of FMNP among three groups of examined military personnel using the Kruskal-Wallis test revealed significant differences (Kruskal-Wallis test: $H (2, N = 49) = 6.576$; $P = 0.0373$), demonstrating the influence of age on the level of FMNP. The Mann-Whitney U test showed that the FMNP in the group 3 was significantly lower than in the group 1 ($P < 0.05$;Fig. 1). In contrast, no significant differences were found between the groups 1 and 2, as well as groups 2 and 3 ($P = 0.13$ and $P = 0.17$, respectively). Thus, FMNP remains at an appropriate level with age. The FMNP indicator was the lowest in group 1 (Fig. 1). This may be due to the fact that military personnel in groups 2 and 3 underwent natural selection during their service, with those having insufficient levels of FMNP being filtered out. This is the argument that FMNP is a parameter more dependent on individual characteristics of the central nervous system (CNS) rather than age.

Previous studies have shown that the synchronization of neuronal oscillations plays a crucial role in effective communication between

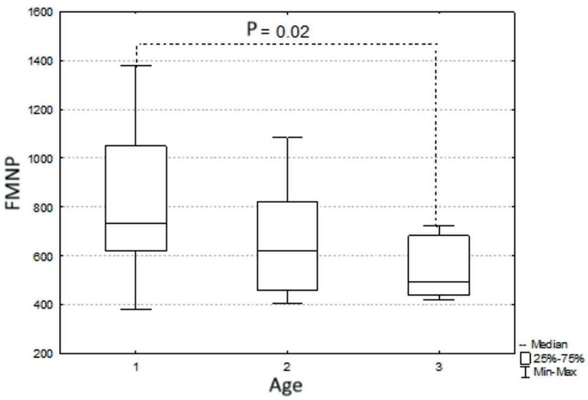

Fig. 1. Functional motility of nervous processes (FMNP) in three age groups: group 1 – 18-23 years (n = 16); group 2 - 24-34 years (n = 19); and group 3 - 35-54 years (n = 12)

functionally different brain regions [12]. We analyzed the coherence between all EEG electrodes to investigate age-related differences in the neural network in the brain in different frequency bands.

In the δ-band, the effect of age was found for the PzFz electrode pair (H (2, N = 30) = 6.604, P = 0.0368), with significant synchronization observed only in group 3 (Fig. 2C). According to the Mann-Whitney test, we found significant differences for this electrode pair between groups 1 and 3 (P = 0.020).

While δ-rhythms are most commonly associated with unconscious states (e.g., slow-wave sleep, anesthesia, early developmental stages), pathological conditions, or developmental disorders, there is also evidence suggesting that coherent oscillations in the δ range reflect connectivity between distant parietal and frontal cortical chains during decision-making processes [13]. Many studies indicate the involvement of δ-oscillations in motivation [14]. These oscillations increase during hunger, sexual arousal, and the intake of psychoactive substances. They also intensify during panic attacks and chronic pain. In the cognitive realm, δ-oscillations are associated with attention, detection of salient features, and subconscious perception. Indeed, extensive psychological data show that mental activity in humans is inextricably linked to motivation and emotions, with the involvement of δ-oscillations in cognitive processes primarily limited to the function of detecting stimulus significance, which is undoubtedly connected to the brain's motivational circuits. The generation of δ-oscillations depends on the activity of the ventral tegmental area, nucleus accumbens, medial prefrontal cortex, and thalamic reticular nucleus, all involved in the brain's reward system.

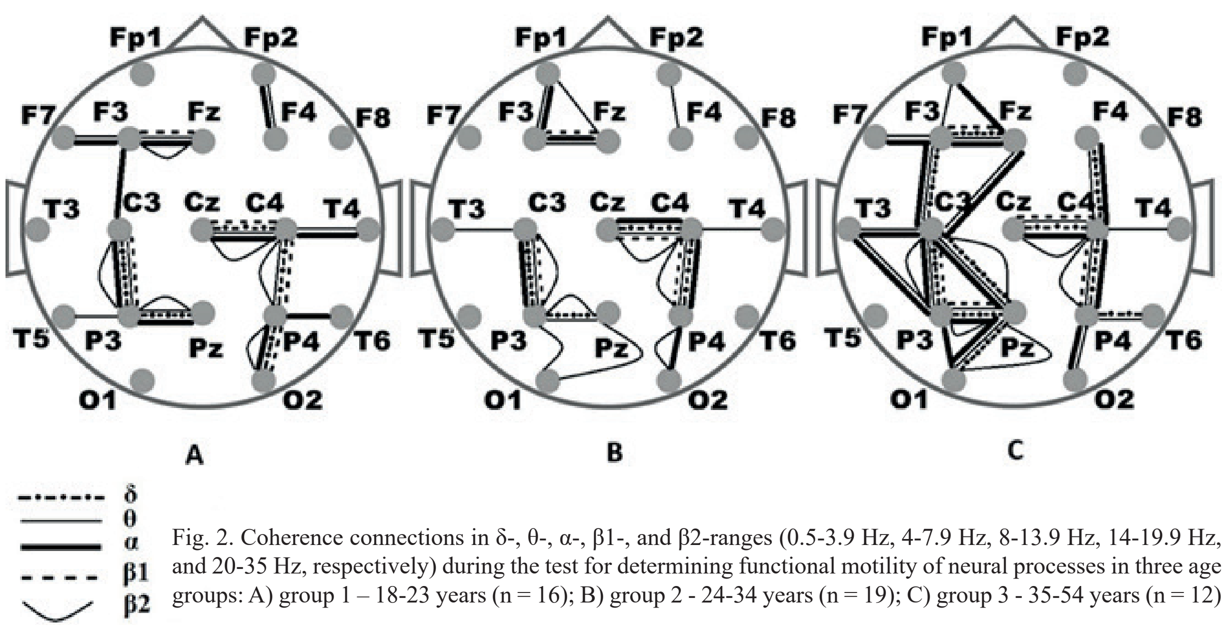

Fig. 2. Coherence connections in δ-, θ-, α-, β1-, and β2-ranges (0.5-3.9 Hz, 4-7.9 Hz, 8-13.9 Hz, 14-19.9 Hz, and 20-35 Hz, respectively) during the test for determining functional motility of neural processes in three age groups: A) group 1 – 18-23 years (n = 16); B) group 2 - 24-34 years (n = 19); C) group 3 - 35-54 years (n = 12)

Additionally, evidence suggests that δ-oscillations in the cortex are a key mechanism for selective attention to rhythmic auditory or visual stimuli [14]. In our study, the stream of visual stimuli also had a certain rhythm, albeit irregular. Therefore, it can be argued that one of the reasons for the superior performance of the FMNP test by participants in group 3 is a higher level of motivation and selective attention to visual stimuli due to the established fronto-parietal connections in the δ-range. Interestingly, a recent combined fMRI and EEG study showed that resting state networks (RSNs) associated with higher cognitive functions such as self-reflection, working memory, and language exhibit a positive correlation with higher EEG frequency bands but a negative correlation with δ- and θ-frequencies. Conversely, RSNs delineating sensory cortices, such as the somatosensory, auditory, and visual cortices, have a positive correlation with lower and a negative correlation with higher EEG frequencies [14]. Numerous studies indicate that δ-waves are linked to autonomic processes and may play a role in integrating cerebral activity and homeostatic processes. Previously, we showed that the stress index of regulatory systems during the FRNP test performance was significantly higher for the group 3 compared to the group 1 ($P < 0.01$) and did not differ significantly between the group 1 and group 2 or between the group 2 and group 3 ($P = 0.16$ and $P = 0.9$, respectively) [15]. This correlates with data from another study indicating that the highest vascular blood flow rates in the vessels of various calibers are noted in people with a high level of FMNP. This is based on lower latency values, likely due to higher activity of cortical neurons involved in regulating and controlling voluntary motor responses to visual stimuli. High activity of cortical neurons stimulates intensified metabolic processes and changes in the level of autonomic support [16].

When analyzing the correspondence between the electrode leads where differences were found and the brain regions they correspond to, the Fz lead covers Brodmann area 8 in the left hemisphere (part of the prefrontal cortex, lateral and medial supplementary motor area) [17]. In addition to motor and speech functions, this area also involves executive control of behavior, planning, visuospatial and visuomotor attention, and working memory [18]. The Pz lead corresponds to Brodmann area 7 in the right hemisphere [17] (secondary sensorimotor cortex, secondary associative sensorimotor cortex (superior parietal lobule)), which is mainly related to visuospatial processing, including perception of personal space and spatial images, motor functions, working and visuospatial memory, visuomotor attention, emotion processing, and self-reflection during decision-making [18]. Thus, synchronization between these areas may indicate increased executive control and attention, leading to faster decision-making and motor response to a given stimulus (pressing a key with the left/right hand or not pressing at all).

In the θ-range, we found the influence of age for coherent connections between the PzP3 electrodes ($H (2, N = 30) = 5.999$, $P = 0.0498$), which had significant synchronization in all groups (Fig. 2). At the same time, the medians and interquartile ranges had some differences: group 1 - 0.7 (0.7; 0.7), group 2 - 0.7 (0.6; 0.8), group 3 - 0.8 (0.8; 0.8) and were significantly higher for group 3 compared to group 1 ($P = 0.0444$). We found no age-related influence for the PzF7 and T6Cz electrodes, but there were significant differences between groups 1 and 3 ($P = 0.0477$ and $P = 0.0273$, respectively). In both cases, significant synchronization between these pairs of electrodes was observed only in group 3 (Fig. 2B). Thus, the neural networks in the θ-range were most developed in the subjects of group 3.

Numerous pieces of evidence suggest that during θ-activity, distant neural groups synchronize to form networks of spatially restricted neuronal clusters at specific time intervals during task performance. Specific θ-synchronization that develops in space and time can serve as a critical correlate underlying decision-making during goal-directed behavior [19]. Each cluster of neurons is believed to function as a computational unit [19], requiring information from other clusters for local operations. Thus, the operations of the neuronal microcircuit depend on remote computational outputs, which become a temporal template for coordinating and structuring information exchange through spiking activity. The structural processing of neuronal information depends on the overall state of rhythmic θ-activity, which meets all the main criteria of general integrative mechanisms [19]: (i) θ-activity is pervasive in neural systems, present in almost all brain regions from subthalamic nuclei to the thalamus, limbic system (including the hippocampus), striatum, and neocortex; (ii) θ-rhythm is generated and maintained at the cellular membrane level in many classes of neurons; (iii) the θ-cycle structures the synchronization of spikes among many neurons; (iv) θ-phase synchronized spike output conveys specific information that exceeds the average firing activity of neurons; (v) moreover, local θ-rhythms synchronize between distant areas, indicating that excitatory long-distance projections functionally unite local and remote computations; (vi) θ-synchronization can occur specifically in space and time, capable of filtering and cutting off out-of-phase neuron groups and initiating high-frequency coherent activity in the γ range. Therefore, a better-formed global neural network in the θ-range may be associated with a higher level of attention and coordination between different brain regions to achieve higher FMNP values when passing tests by participants in group 3.

The P3 lead corresponds to Brodmann area 39 in the left hemisphere [17] (part of the inferior parietal lobule, caudal edge of the intraparietal sulcus, angular gyrus, part of the Wernicke's area), playing a role in spatial attention focusing, executive control of behavior, and sequence processing [18]. Thus, synchronization of the PzP3 leads may indicate increased attention concentration during task performance. Additionally, the angular gyrus is a cortical area involved in cross-modal association between somatosensory information (body information), auditory information, and visual information, which is also crucial for successful task completion.

The F7 electrode corresponds to Brodmann area 47 in the left hemisphere [17] (orbital part of the inferior frontal gyrus), which is involved in semantic processing and encoding, as well as executive functions [18]. The coherent connection PzF7, which was present only in group 3, may indicate that the subjects were internally verbalizing the names of the figures before making a choice.

The T6 electrode corresponds to Brodmann area 37 in the right hemisphere [17] (posterior inferior temporal gyrus, middle temporal gyrus, and fusiform gyrus), associated with language functions (semantic categorization, word retrieval, attention to semantic relationships, word generation, gesture language, letter processing, metaphor understanding, orthographic-phonological referencing), memory (recognition of true and false memories, episodic memory encoding), visual functions (face recognition, visual motion processing, visual fixation, structural assessments of familiar objects, sustained attention to color and form), and some other functions (associating faces with names, attributing intentions to others, deductive reasoning, drawing, motion aftereffect) [18]. Lead Cz corresponds to Brodmann area 5 in the left hemisphere [17] (secondary sensorimotor cortex; secondary associative sensorimotor cortex; superior parietal lobule); its functions are related to chaotic pattern processing, spatial imagination, deductive reasoning, perception of personal space, gesture processing when using tools, motor imagination, movement execution, mirror neurons, and some other functions [18]. The presence of the T6Cz connection in the representatives of group 3 may indicate enhanced spatial attention during task performance.

Synchronization between electrode pairs, for which age effects were observed in the α-band, including P3F3 ($H(2, N = 30) = 6.076$, $P = 0.0479$), PzF3 ($H(2, N = 30) = 7.883$, $P = 0.0194$), C3Fz ($H(2, N = 30) = 6.841$, $P = 0.03$), P3Fz ($H(2, N = 30) = 8.362$, P = 0.0153), was significant in groups 1 and 3. However, their medians were significantly higher in group 3 (P = 0.0444, P = 0.0208, P = 0.0077, and P = 0.0097, respectively) (Fig. 2A, B). Among the pairs of electrodes PzFp1 (H (2, N = 30) = 8.594, P = 0.0136), O1F3 (H (2, N = 30) = 5.929, P = 0.0516), O1Fz (H (2, N = 30) = 7.798, P = 0.0203), PzC3 (H (2, N = 30) = 6.15, P = 0.0462), O1Pz (H (2, N = 30) = 7.935, P = 0.0189), which also showed a significant age effect, statistically significant coherence was observed only for group 3.

Although we found no age effect for the coherences between the pairs O1C3 and O1P3, they were present only in group 3 and significantly differed from group 1 (P = 0.0394, P = 0.0182, respectively) and group 2 in the case of O1P3 (P = 0.0485). The connections PzFz and PzP3 were present in both, groups 1 and 2, but the medians were significantly higher in group 3 (P = 0.0057, P = 0.0159, respectively). Interestingly, in the group 3, the PzFz connection was formed by two pathways (Pz-P3-C3-F3-Fz and Pz-C3-Fz), while in group 1, there was only the more extended pathway (Pz-P3-C3-F3-Fz). The O1Fp1 connection was present only in group 3 and significantly differed from group 2 (P = 0.0437), while C3F3 was present in both groups 1 and 3 with significant differences between the groups 2 and 3 (P = 0.0437). Thus, the greatest number of age-related and intergroup differences were recorded for synchronous activity between electrode pairs in the α-band.

Previous studies have shown that higher occipital-central (i.e., visuomotor) coherence is associated with better task performance [12]. Since visuomotor integration is an essential component in the FMNP test, it can be inferred that the group 3 had the highest FMNP, partly due to more developed connectivity in the occipital-central regions of the cortex in the α-band. Another study demonstrated that the amplitude of fronto-central α-rhythms was higher in experienced golfers during successful strokes than unsuccessful ones, reflecting the role of amplitude regulation of fronto-central α-synchronization in the physiological mechanism involved in motor control and task performance [20]. The α-band is also associated with an inhibitory role in attention, namely protecting against distracting information [21], which allows better task focus. Thus, it can be assumed that the spatial attention focus in groups 1 and 3 was better due to blocking excessive irrelevant information, as evidenced by the coherent connections in the α-band.

Lead Fp1 corresponds to Brodmann area 10 in the left hemisphere [17] (middle frontal gyrus) and is involved in executive behavior control, error detection, and processing [18], so the coherence between electrodes PzFp1, present only in group 3, may indicate more active involvement of the strategic system of target selection and decision-making [22] compared to the groups 1 and 2. Furthermore, previous studies have shown that the role of frontal control during movements increases with age [23]. Lead F3, as well as Fz, corresponds to Brodmann area 8 in the left hemisphere, which functions were described above.

The presence of the O1F3 connection in group 3 may indicate an increased role of visual cortex areas in planning and executing the FMNP test. In addition to visual processing, the secondary visual cortex (Brodmann area 18, corresponding to the O1 and O2 leads, middle occipital gyrus) [17] is involved in pattern detection, finger gesture recognition (O2), maintaining sustained attention to color and shape [18]. According to functional studies, it is also involved in other vision-related functions, such as visual priming [18]. Therefore, it can be assumed that the system of selecting informative features (left visual cortex) gains more significance with age in the FMNP test performance. The whole-image perception system (right visual cortex) is activated across all three age groups.

In the β1- and β2-bands, we found no age effect or intergroup differences for electrode pairs with statistically significant synchronization. A possible explanation for the lack of differences in these bands is that higher frequency oscillations require a smaller cortical area of high coherence, making them harder to detect with existing research methods. For example, in a study on the effect of age on EEG synchronization, the most significant changes were noted in the α-band (8-12.5 Hz), while coherence in the β-band (13-29.5 Hz) showed borderline statistical values, and in the γ-band (30-60 Hz), no significant differences were found [24].

Thus, age-related differences were found in the δ-band in the central fronto-parietal region (PzFz), in the θ-band in the left parietal region (PzP3), but the most differences were found in the α-band frequencies: in the prefrontal-parietal (PzFp1), fronto-parietal (P3F3, PzF3, P3Fz), occipito-frontal (O1F3, O1Fz), fronto-central (C3Fz), parietal-central (PzC3), and occipito-parietal (O1Pz) regions of the left hemisphere. Therefore, it can be assumed that coherence in the δ-, θ-, and α-bands is crucial for successful FMNP test performance by the older age group. The best result was likely achieved due to optimal visuomotor integration in the δ- and θ-bands and the blocking of distracting irrelevant information in the α-band, allowing for the maximum speed of alternating excitatory and inhibitory processes.

CONCLUSIONS

Our study revealed that older service members exhibited the highest levels of functional motility of nervous processes (FMNP) compared to their younger counterparts. These results suggest that FMNP is more closely linked to individual characteristics of the central nervous system than to age. We found age-related differences in coherences between electrode pairs in the δ- (PzFz), θ- (PzP3), and α-frequency ranges (PzFp1, P3F3, PzF3, P3Fz, O1F3, O1Fz, C3Fz, PzC3, O1Pz). The neurophysiological foundations of higher FMNP in the older group appear to include enhanced motivation and selective attention to visual stimuli, supported by established fronto-parietal connections in the δ-range; improved synchronization of distant neural clusters, due to more developed neural network in the θ-range, particularly within parietal, fronto-parietal, and temporo-central regions; better occipito-central (visuomotor) integration and more effective filtration of irrelevant information, ensured by α-range synchronization. The lack of age-related effects on coherences in the β1- and β2-frequency ranges might be because higher frequency oscillations require smaller cortical areas of high coherence, making them difficult to reveal with current methods.

Given that the most significant differences were observed in the α-frequency band, it can be inferred that α-activity is crucial in determining FMNP in older individuals. Understanding of the individual-typological properties of higher nervous activity, particularly the formation of brain neural networks that underlie FMNP, may be used in developing new methodologies for effective professional selection and monitoring professional suitability across the lifespan.

The authors of this study confirm that the research and publication of the results were not associated with any conflicts regarding commercial or financial relations, relations with organizations and/or individuals who may have been related to the study, and interrelations of co-authors of the article.

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ОСОБЛИВОСТІ ВІКОВИХ ЗМІН ОРГАНІЗАЦІЇ МОЗКОВОЇ ДІЯЛЬНОСТІ ВІЙСЬКОВОСЛУЖБОВЦІВ, ЯКІ ВИЗНАЧАЮТЬ ФУНКЦІОНАЛЬНУ РУХЛИВІСТЬ НЕРВОВИХ ПРОЦЕСІВ

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Однією з індивідуально-типологічних якостей особистості, що характеризує швидкість переходу нервових клітин від стану збудження до гальмування й навпаки є рівень функціональної рухливості нервових процесів (ФРНП). Ступінь його розвитку багато в чому визначає індивідуальні відмінності в адаптаційних можливостях, швидкості орієнтації в нових умовах та здатності адаптувати свою поведінку відповідно до мінливих умов навколишнього середовища. Метою нашої роботи було дослідження особливостей формування нейронних мереж мозку, які визначають ФРНП, у військовослужбовців різного віку. Для цього одночасно з виконанням оригінальних комп'ютерних тестів оцінки ФРНП у всіх обстежуваних реєстрували електроенцефалограму (ЕЕГ) з подальшою обробкою її методами когерентного аналізу. Було виявлено, що у молодшій віковій групі (18–23 роки) рівень ФРНП був достовірно нижчим порівняно з обстежуваними старшої вікової групи (35–54 роки). Когерентний аналіз ЕЕГ показав, що нейрофізіологічною основою більш високої ФРНП в осіб старшої вікової групи є вищий рівень мотивації та вибіркової уваги до візуальних стимулів через сформовані фронто-парієтальні зв'язки у δ-діапазоні, краща синхронізація віддалених нейронних кластерів завдяки більш розвиненій нейромережі у θ-діапазоні (парієтальні, фронто-парієтальні та скронево-центральні ділянки), вища потилично-центральна (тобто зорово-моторна) інтеграція та блокування відволікаючої нерелевантної інформації завдяки синхронізації у α-діапазоні. Оскільки найбільше відмінностей було виявлено в α-смузі частот, можна припустити, що саме α-активність має вирішальне значення для забезпечення максимальної швидкості почергової зміни збудливого й гальмівного процесів, тобто найвищої ФРНП у старшій віковій групі.

Ключові слова: функціональна рухливість нервових процесів; когерентність; нейронні мережі; електроенцефалограма; вікові зміни.

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