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BIOLOGICAL AND PSYCHOLOGICAL ASPECTS OF AGING IN YOUNG WOMEN IN THE CONDITIONS OF MILITARY AGGRESSION

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This study examines the impact of wartime stress on the aging process in 95 young women in Ukraine, exploring the relationship between their chronological, biological, and psychological ages. Utilizing comprehensive assessment methods, including the measurement of biological age, psychological age, aging rate, anxiety levels, stress resilience, and positive mental health, the research highlights how prolonged stress accelerates biological aging. It was found that chronological age has a stronger connection with psychological age than with biological age, with significant differences in aging rate among groups. Specifically, the group with accelerated aging shows a higher biological age but a lower psychological age, which may indicate less awareness of aging or an optimistic tendency to assess one's health. Meanwhile, high stress resilience in this group may indicate adaptation to stress at the expense of physiological resources, leading to rapid aging. The findings underline the need for developing strategies to support mental health and counteract biological aging in stressful conditions, pointing to the complexity of the interaction between stress and aging.

Key words: biological age, psychological age, aging rate, psychological stability, accelerated aging.

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БІОЛОГІЧНІ ТА ПСИХОЛОГІЧНІ АСПЕКТИ СТАРІННЯ МОЛОДИХ ЖІНОК В УМОВАХ ВІЙСЬКОВОЇ АГРЕСІЇ

Дослідження аналізує вплив воєнного стресу на процес старіння у 95 молодих жінок в Україні, вивчаючи зв’язок між їх хронологічним, біологічним та психологічним віком. Застосовуючи комплексні методи оцінки, включно з вимірюванням біологічного віку, психологічного віку, швидкості старіння, рівней особистісної та реактивної тривожностей, стресостійкості та позитивного ментального здоров'я, дослідження підкреслює, як тривалий стрес прискорює біологічне старіння. Виявлено, що хронологічний вік має сильніший зв'язок з психологічним віком, ніж з біологічним, із значними різницями в швидкості старіння між групами. Зокрема, група з прискореним старінням відзначається вищим біологічним віком, але нижчим психологічним, що може свідчити про меншу усвідомленість старіння або оптимістичну тенденцію в оцінці власного здоров'я. Водночас, висока стресостійкість у цієї групи може бути індикатором адаптації до стресу за рахунок фізіологічних витрат, що сприяє швидкому старінню. Висновки підкреслюють необхідність розробки стратегій для підтримки психічного здоров'я та протидії біологічному старінню в умовах стресу, вказуючи на складність взаємодії між стресом і старінням.

Ключові слова: біологічний вік, психологічний вік, швидкість старіння, психологічна стійкість, прискорене старіння.

The study is a fragment of the research project “High- and low-intensity phenotypes of the systemic inflammatory response: molecular mechanisms and new medical technologies for their prevention and correction”, state registration No. 0124U000092.

In the context of global challenges and warfare, the study of the impact of stress on aging is critically relevant. The war in Ukraine highlights the chronic stress effects on biological aging. This research examines Ukrainians' biological and psychological age and aging rate during wartime, emphasizing the importance of resilience mechanisms.

Persistent stress compromises motivation for healthful activities, and profoundly influences the physiological underpinnings of the aging process [3, 7]. It also acts as a trigger and exacerbator of various diseases and pathological conditions, underscoring the vulnerability of individuals in stress-laden environments [15]. Moreover, stress-related telomere shortening, a primary aging marker, suggests that stress significantly contributes to cellular aging by affecting DNA sequences protecting chromosome ends [6].

Individuals with post-traumatic stress disorder (PTSD) exhibit heightened health risks due to accelerated biological aging, leading to illness, disability, and reduced life expectancy [2]. Recent research indicates that effective stress management heavily depends on the individual's ability to employ personal psychological resources, particularly in developing health-preserving competencies during prolonged trauma [14].

Prolonged stress disrupts both innate and adaptive immune responses, promoting chronic inflammation and impairing immune defence cells' functionality leading to a chronic condition [4, 5].

As we navigate the urgency of investigating the relationship between stress and aging in the Ukrainian context, it's imperative to consider biological age and the rate of aging during the harrowing circumstances of war. Investigating the dynamics of aging in extreme wartime adversity conditions may unravel new insights into the aging mechanics and devise strategies to fortify mental and physical well-being.

The purpose of the study was to determine biological age and the aging rate, and to analyze their associations with psychological age, anxiety, stress resilience, and positive mental health among women aged 18–28 years.

Materials and methods. The research was conducted from September to December 2023, involving a sample of 95 females. The age range of participants varied from 18 to 28 years (19.84±2.14).

Inclusion criteria:

– Age between 18 and 28 years.

– Psychological stability and the ability to independently complete the questionnaire.

Exclusion criteria:

– History of psychiatric disorders.

– Presence of serious physical illnesses.

We have developed a special questionnaire to conduct the study. The questionnaire includes questions aligned with validated methodologies, enabling the assessment of aging rate, functional age, and the psychological state of each participant. The following methods were employed:

– Determination of biological age and rate of aging by the method of Polyakov O. [12]. The value rate of ageing more than 1.10 reflects the acceleration of the ageing rate in a person; the ageing rate less than 1.00 – means the slowed-down ageing rate, the value 1.00–1.10 – reflect the physiological ageing rate.

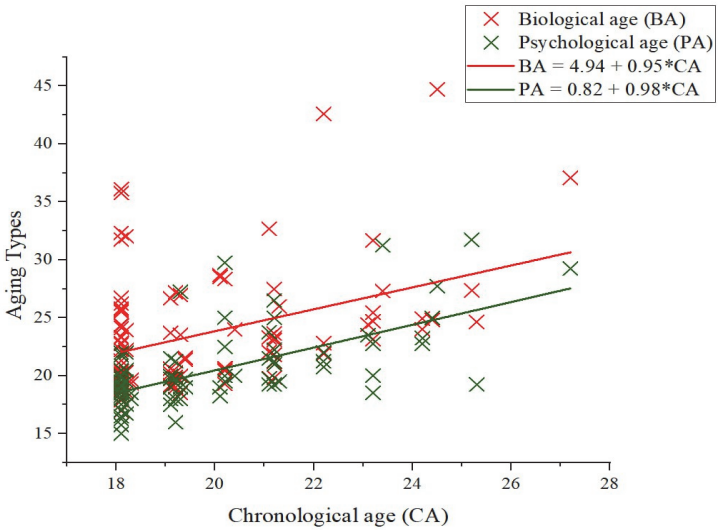

Fig. 1. Relationship between chronological, biological age and psychological age. X-axis – years.

– The scale by Robert Kastenbaum (1972) to assess subjective (psychological) age.

– The level of reactive and personal anxiety was assessed using the State-Trait Anxiety Inventory, a 40-item self-completed questionnaire, developed by Charles D. Spielberger (1983). Reactive and personal anxiety levels are categorized based on the results: up to 30 points – low anxiety level, 31–45 points –moderate, and over 45 points – high anxiety level.

– The test to measure stress resilience consists of 18 questions. Interpretation of results is as follows: 43–54 – low, 31–42 – moderate, and 18–30 – high stress resilience [1].

– The Positive Mental Health Scale (PMH-scale) includes 9 statements. Interpretation of results is as follows: the low level of the positive mental health indicator corresponds to the range of 9–24 points, the average level – 25–29 points, and the high level – 30–36 points [1, 9].

All statistical calculations were performed using Microsoft Office Excel and Prism 10 software, while data processing and visualization by OriginPro (2018).

Results of the study and their discussion. According to the data collected and analyzed, the average age of the group of young women was 19.84±2.14 years, the average biological age – was 23.69±5.20 years, aging rate – 1.19±0.23.

The psychological age had an average value of 20.31±3.27 years. The anxiety levels of participants demonstrated a high level of personal anxiety (45.28±11.66) and a moderate level of reactive anxiety (42.44±12.35).

In the current study sample, the resilience to stress was characterized by an average value of 34.93±6.42 (31–42 – moderate resilience to stress). The established level of positive mental health is 27.42±5.38 (the average level – 25–29 points).

The obtained results underscore significant variability in both physiological and psychological aspects of the participant's condition.

Analysis of the relationship between chronological, biological age and psychological age has shown that there is a clear positive relationship between chronological and biological age (Fig.1).

These results indicate that relationship between chronological age and psychological age is comparable to the relationship between chronological age and biological age.

Participants were grouped into three distinct groups based on their aging rate characteristics:

– slowed aging rate (less than 1.0),

– normal aging rate (1.00–1.10),

– accelerated aging rate (more than 1.10) (Table 1).

Table 1

Physiological and psychological parameters at different levels of aging rate (M – mean value, SD– standard deviation)

	Slowed aging rate (n=14),		Normal aging rate (n=32)		Accelerated aging rate (n=49)	
	M	SD	M	SD	M	SD
Age, years	20.68	2.39	20.18	2.15	19.37	1.99
Aging rate	0.97	0.02	1.03	0.03	1.35	0.23
Biological age, years	20.15	2.45	21.12	2.43	26.37	5.68
Psychological age, years	21.21	3.39	21.13	3.39	19.51	2.99
Personal anxiety, points	46.35	12.83	46.19	12.53	44.39	10.88
Reactive anxiety, points	44.21	12.29	42.97	14.02	41.59	11.3
Stress resilience, points	36.07	5.41	36.16	6.56	33.80	6.51
Positive mental health, points	29.21	5.37	26.47	5.98	27.53	4.93

Out of the total of 95 investigated women, the distribution across the aging groups in percentages is as follows:

1. Slowed aging rate: 14.37 % (14/95).
2. Normal aging rate: 33.68 % (32/95).
3. Accelerated aging rate: 51.58 % (49/95).

The comprehensive data analysis presented in Table 1 reveals significant insights into the aging process under stress conditions induced by war. The average chronological age is approximately the same across all three groups. The slowed aging group shows the lowest average aging rate (0.97), the normally aging group is slightly higher (1.03), and the accelerated aging group is significantly higher (1.35), with a statistically significant ($p<0.001$) difference found between the groups. There are considerable differences in biological age between the groups, with the accelerated aging group having a significantly higher average biological age. Despite a higher biological age, the accelerated aging group has a lower average psychological age, which may indicate less awareness of aging or an optimistic tendency to assess one's health. The slowed aging group shows higher average personal anxiety, potentially reflecting greater sensitivity or reflection on their health and aging, though the differences between the groups are not significant. The highest average value for positive mental health is observed in the slowed aging group. According to the methodology, lower scores indicate higher stress resilience and the accelerated aging group has the highest resilience (33.80±6.51). This might suggest that the accelerated aging group could be better "armed" to deal with stress, which might have a protective effect on their overall physiological state. Such an interpretation aligns with the health paradox, where despite a higher biological rate of aging, some individuals may have better stress-coping mechanisms that help them maintain a higher level of functionality.

The comprehensive analysis of psychological indicators across groups with different aging rate has revealed distinct patterns that highlight the psychological diversity inherent in the aging process (Table 2).

Table 2

Anxiety levels and stress resilience across aging rate groups

Psychological parameters	Aging rate group	Low level of the index	Moderate level of the index	High level of the index
Personal anxiety	Low (n=14)	7.14 % (1/14)	35.71 % (5/14)	57.14 % (8/14)
	Normal (n=32)	3.12 % (1/32)	53.12 % (17/32)	43.75 % (14/32)
	Accelerated (n=49)	10.20 % (5/49	44.90 % (22/49)	44.90 % (22/49)
Reactive Anxiety	Low (n=14)	7.14 % (1/14)	50.00 % (7/14)	42.86 % (6/14)
	Normal (n=32)	9.38 % (3/32)	56.25 % (18/32)	34.38 % (11/32)
	Accelerated (n=49)	8.16 % (4/49)	59.18 % (29/49)	32.65 % (16/49)
Stress resilience	Low (n=14)	14.29 % (2/14)	71.43 % (10/14)	14.29 % (2/14)
	Normal (n=32)	21.88 % (7/32)	62.50 % (20/32)	15.62 % (5/32)
	Accelerated (n=49)	18.37 % (9/49)	51.02 % (25/49)	30.61 % (15/49)
Positive mental health	Low (n=14)	21.43 % (3/14)	21.43 % (3/14)	57.14 % (8/14)
	Normal (n=32)	37.50 % (12/32)	31.25 % (10/32)	31.25 % (10/32)
	Accelerated (n=49)	18.37 % (9/49)	44.90 % (22/49)	36.73 % (18/49)

Accelerated aging group is special in sense that there are notable variations in categories such as personal anxiety, reactivity to anxiety, and stress resistance.

For instance, in the slow aging group, despite a high level of personal anxiety observed in 57.14 % (8/14) of individuals, a majority of 71.43 % (10/14) exhibit a moderate level of resistance to stress. This suggests an effective adaptation to stress despite prevalent anxiety.

Conversely, the accelerated aging group demonstrates a less uniform distribution across categories, with a significant portion of individuals showing moderate to high levels of reactive anxiety – 59.18 % (29/49) and 32.65 % (16/49), respectively. Interestingly, a substantial fraction of accelerated aging group – 30.61 % (15/49) also shows a high resilience to stress, indicating the presence of diverse adaptive mechanisms to stress within this group.

The normal aging group primarily represents individuals with a moderate level of personal anxiety at 53.12 % (17/32) and a predominant moderate resistance to stress in 62.50 % (20/32) of participants. This pattern may reflect a general emotional equilibrium within this group.

The results of the study indicate the presence of certain tendencies regarding the aging process depending on the factors that influence it, but further scientific research is needed to substantiate these mechanisms.

According to research by Ukrainian gerontologists, chronic war-related stress accelerates the cardiometabolic processes of aging in women [11]. Trauma and PTSD may accelerate biological aging, which could help explain the increased risk for poor health observed among people with PTSD [2].

The association between stress and accelerated aging can be largely attributed to the physiological stress response, including activation of the HPA axis and subsequent cortisol release, which has been implicated in telomere shortening and cellular aging [6]. This biological cascade underscores the critical need to understand stress's multifaceted impact, not only on psychological well-being but also on the biological markers of aging. Recent studies confirm that psychosocial stress contributes to accelerated immune aging, particularly through the reduction in naive T cells and the increase in terminally differentiated T cells, which may lead to elevated health risks [8]. These changes in the immune system, associated with stress factors such as discrimination and chronic stress events, are crucial for understanding tissue-specific aging and overall health status.

At the same time, no significant associations were found between subjective perception of stress and increase in stress biomarker level [10]. This highlights the complexity and multifaceted impact of stress on the body, which is also confirmed by our results regarding biological and psychological age.

The distinct impact of stress on young women in our cohort points to the necessity of exploring gender-specific resilience and coping strategies. This observation aligns with research suggesting that women may experience stress differently, both physiologically and psychologically [13], which necessitates tailored approaches to stress mitigation in clinical settings.

The research opens new directions for further studies on aging mechanisms and the development of targeted interventions aimed at reducing the negative impact of stress on aging. The results can be used to shape support programs for populations experiencing crises.

Conclusions

1. The study demonstrates a notable correlation between chronological age and psychological age, suggesting that as chronological age increases, there is a correspondingly significant increase in psychological age among young women experiencing stress due to wartime conditions.

2. There is a distinct variation in biological aging rates indicating that prolonged stress may contribute to faster biological aging, despite no significant difference in chronological age across groups of different aging rate.

3. The enhanced stress resilience observed in the group with accelerated aging may indicate a complex adaptive response where psychological coping mechanisms operate at the potential cost of increased physiological aging rates. This inverse relationship hints at a possible physiological compromise for maintaining psychological health in the face of chronic stress, which warrants further investigation into the delicate balance between mental resilience and long-term physiological health outcomes.

4. The findings highlight the complexity of the aging process under stress, emphasizing the need for targeted interventions to support mental health and biological aging, particularly in populations affected by prolonged stressors such as a war.

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