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Psychological prediction of stress-related hair steroid hormone levels in young men: a person-centered approach

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Abstract

The aim was to: (1) identify individual profiles in young men regarding personality and cognitive appraisal style employing easy-to-use instruments, and (2) to explore how such profiles relate to biological stress indicators. The sample consisted of 173 male Lithuanian conscripts. An assessment was made after one month into their basic military training. Levels of cortisol, cortisone and testosterone were established through analysis of hair samples. Psychological assessments included the Big Five model of personality as well as cognitive appraisal style and perceived stress during the previous month of service. Four unique personality profiles were identified in a cluster analysis that differed significantly as theoretically expected on the Perceived Stress Scale. Statistically significant between-profile differences were found on cortisol and cortisone but not on testosterone. The personality profile with the highest scores on all three biological markers was characterized by high scores on Extraversion and Openness and low scores on Agreeableness. Second, three distinct cognitive appraisal style profiles emerged. They were related as theoretically expected to perceived stress, but they were unrelated to the hair steroid hormone concentration levels. Third, the combination of the most psychologically vulnerable personality profile, which included low scores on Emotional stability, and the most stressed cognitive appraisal style profile, yielded the clearest result and showed that it was possible to detect individuals with significantly higher stress-related hair steroid hormone levels using psychological instruments. Practical potential implications include identification of individuals who are most psychologically vulnerable and in need of close monitoring.

Keywords: person-centered approach, personality, cognitive appraisal style, perceived stress, hair stress-related steroid hormones, military

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The stress reaction includes both psychological and physiological aspects. A common finding in low to moderately demanding situations is that there is a weak or nearly zero correlation between perceived stress and stress-related hair steroid hormone levels (Gao et al., 2013; citation omitted). In highly stressful situations on the other hand, the two sets of stress reactions tend to covary positively (Wester & van Rossum, 2015). However, what is often missed in group-level-based correlations is the issue of individual differences. Thus, even in situations appraised by most as moderately stressful, there may be individuals with strong physiological stress reactions. These individuals, possibly needing support, run a risk of being neglected in variable-centered group-level research.

An alternative is to use a person-centered analytical approach, which focuses on the heterogeneity among subgroups of individuals, instead of the relationships between variables in a whole sample. A person-centered approach makes use of such differences and allows the study of groups, or profiles, of individuals exhibiting similar variation in some key dimensions (Howard & Hoffman, 2018).

The present study draws on the person-centered approach and explores the question of whether it is possible to identify individuals with stronger stress-related hair steroid hormone reactions by using psychological assessment tools that are easy to administer, yet rest on a solid theoretical ground. Two psychological concepts will be applied in the present study, personality and cognitive appraisal processes. A challenge when applying these two concepts in settings where lots of people need to be scanned rapidly, military selection constitutes an example, is to find easy-to-use instruments without jeopardizing a solid theoretical ground and the instruments' validity.

The setting of the present study was compulsory basic military training for conscripts. This has been described as a low-control context (Buško & Kulenović, 2003). It is also recognized as a heavily male-dominated environment characterized by masculinity norms (Elder et al., 2017). Masculinity norms encompass a range of traits such as achievement-oriented behavior, status-seeking, emotional stoicism, and aggressiveness, among others (Rogers et al., 2021). These norms are often associated with a rejection of femininity, which can be perceived as sign of weakness or victimhood and may manifest itself as reluctance to seek help (Gueta & Shlichove, 2022). It may lead to the formation of hegemonic masculinity, which is a significant configuration of practices that represents the idea of being superior in a particular social context (Wedgwood et al., 2023). This may especially be the case in a male-dominated environment such as the military, where established norms can push men beyond their limits (Richard & Molloy, 2020). From this point of view, an unanswered question is how the psychological concepts personality and cognitive appraisal processes are associated with steroid hormone levels under these conditions.

Research on personality has been dominated by the Big Five model for decades (Costa & McCrae, 2014). The relationship between the five personality dimensions and stress has been extensively explored. Lower scores on Emotional stability (or higher scores on the negative pole Neuroticism) have repeatedly been associated with various negative health outcomes. High scores on Introversion, Openness and Agreeableness have also indicated increased vulnerability although the results are mixed (John & Robins, 2021).

The gold standard method in Big Five model application is the NEO-PI-R (Costa & McCrae, 2014), but it has a drawback. It is extensive and is, therefore, impractical to use in many applied contexts. Thus, shorter versions have been developed and one example is the Ten-Item Measure of Personality Gosling et al., 2003). Although such short versions cannot match the richness provided by longer scales, the instrument constructors have presented reasonably high correlations between the long and the short versions.

Turning to models of cognitive appraisal processes, the cognitive-phenomenological theory says that the way a person appraises a situation causally contributes to his or her emotional reaction (Lazarus, 1991). These appraisal processes occur at different levels of consciousness and are difficult to observe directly. However, as cognitive appraisal processes tend to affect immediately following emotional reactions, they can be assessed indirectly through our emotions. This means that each given emotion is preceded by a particular appraisal of the situation which results in a specific emotion (Lazarus, 1991; Monroe, 2008; Obbarius et al., 2021). Thus, by observing an individual's emotional reaction in a given situation, we should be able to reconstruct the meaning he or she has ascribed to the situation through cognitive appraisal processes. The interdependence between the different aspects has also been highlighted. This has sometimes been referred to as reciprocal determinism, which describes the interdependency of personal, behavioral and environmental factors and how this affects how individuals appraise a situation (Zhao et al., 2020).

Physiological stress reactions are increasingly measured using the end products of the hypothalamic-pituitary-adrenocortical axis (HPA). The HPA is the main system which mediates the body's hormonal response and releases the endocrine hormones (Russell & Lightman, 2019). One of such hormones, hair cortisol is widely used in various studies as a chronic stress biomarker (Staufenbiel et al., 2013), including military environment-related research. Results from the studies on military veterans and active-duty soldiers deployed to war zones show that hair cortisol levels correlate positively with stress-related symptom scores (Groer et al., 2015).

Other steroids are also implied in the stress response. Cortisol can be converted into inactive cortisone, which has recently emerged as a superior surrogate marker for serum free cortisol compared to salivary cortisol (Bae et al., 2019). Assessing hair cortisone in parallel to hair cortisol may give even more insight into the cumulative amount of active and inactive corticosteroids in the body (Zhang et al., 2013). Furthermore, it has been shown that stress affects not only the activity of the HPA axis but also the activity of the hypothalamic-pituitary-gonadal axis (Choi et al., 2012; Guo et al., 2018). Acute stress lowers the most abundant hormone of the human adrenals testosterone concentration mainly temporarily (Pasquali, 2012) and can help adapt to stressful situations. However, lower testosterone levels under chronic stress conditions often correlate with a higher risk for stress-related symptoms (Reijnen et al., 2015). The major limitation of blood and salivary hormone measurements is the rapid daily concentration fluctuations. Therefore, analysis of a broader spectrum of steroid hormones in hair is increasingly used in chronic stress-related research to obtain retrospective data on hormone secretion (El-Farhan et al., 2017) and may provide more precise information on long-term stress exposure.

The aim of the study was to: (1) identify individual profiles regarding personality and cognitive appraisal style employing easy-to-use instruments, and (2) to explore how such profiles relate to biological stress indicators (stress-related hair steroid hormone levels) in an environment dominated by men and masculinity norms.

Method

Participants

The sample consisted of all male conscript soldiers in six Lithuanian army platoons who were carrying out their basic military training in 2020-2021 (spending a total of nine months at the task). All attending soldiers ($n = 184$) agreed to participate. All four female soldiers

were excluded from the analysis because of the low number of female participants. An additional seven conscripts could not participate on the assessment occasion because of temporal illness, leaving a final sample of 173 male conscripts. The mean age of the responders was 20.3 years ($SD = 1.6$), ranging from 18 to 26. Most of them (92%) had completed secondary school, vocational school, or high school and two per cent had a university education. Before entering compulsory military service, 73% were studying or had been employed.

Design and data collection

Data was collected after the first four weeks of service (the earliest possible time for practical reasons). Self-report details were collected using paper-and-pen questionnaires. The information collection process took place in military lecture rooms and was led by military psychologists attached to the platoons. Samples of hair were collected by personnel from the Military Academy of Lithuania.

Measures

Personality

The Big Five model dimensions were measured using the positively worded items (one item per dimension) from the "Ten-Item Personality Inventory" scale (Gosling et al., 2003). An illustration, the item designed to measure Emotional stability read: "I see myself as calm, emotionally stable." A 7-point Likert response scale was used ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

Cognitive appraisal style

The Emotional Stress Reaction Questionnaire (ESRQ) (citation omitted) was developed drawing on the emotional-appraisal interconnection in Lazarus' (1991) cognitive-phenomenological theory. The instrument consists of 14 emotion words (see the Method section) designed to reflect the main appraisal categories presented by Lazarus (1991): irrelevant, benign–positive, challenge, and harm, threat, or loss. After a practice session the ESRQ can be answered in less than one minute. The response can give an instant "snapshot" of the respondent's psychological stress level in a specific situation, and it can also be used to map how a person has usually felt during a given time period, for example the last month. This last-mentioned application draws on the finding that people tend to develop relatively stable appraisal *styles*. This refers to dispositions to appraise a given type of conditions consistently over time and across situations (Lazarus, 1991).

The Emotional Stress Reaction Questionnaire (ESRQ) (citation omitted) was used to measure cognitive appraisal style. The ESRQ consists of the following 14 emotion words, designed to measure the different cognitive appraisal categories as follows. Irrelevant: indifferent; Benign-positive: relaxed, pleased, and glad; Challenge: alert, focused, concentrated, and energetic; and Harm, threat, or loss: uncertain, concerned, disappointed, heated, mad, and angry.

The response format is a 4-point Likert scale with the following anchors: The word does not correspond to how you felt then (1); The word partly corresponds to how you felt then (2); The word fairly well corresponds to how you felt then (3); The word completely corresponds to how you felt then (4). The instructions were: "Below is a list of words describing

different emotions. Beside each word are four response choices. Circle the choice which best describes how you have felt the first month of the military service. Respond with the alternative that first comes to your mind!"

Scoring of the ESRQ consisted of summing the raw scores on items representing each kind of cognitive appraisal and dividing that total by the number of items in the category. The following Cronbach alpha coefficients were obtained: Benign-positive: .75, Challenge: .86 and Threat, harm or loss: .80 (the appraisal category Indifferent only contains one item).

Perceived stress

The "Perceived Stress Scale" (PSS) (Cohen et al., 1983) was used to assess perceived stress levels during the first month of service. A sample item: "In the last month how often have you been upset because of something that happened unexpectedly?" A 5-point Likert response scale was used, ranging from 0 (never) to 4 (very often). A scale score was computed by adding together all ten raw scores, with a figure which could range between 0 and 40. Cronbach alpha: .86.

Hair cortisol, cortisone and testosterone

For the hair hormone analysis, the first centimeter of scalp hair was taken from posterior vertex region, as close to the scalp as possible. This length represents approximately on month of hair growth and the number of hormones accumulated during this period. Samples were stored in foil at room temperature before analysis, avoiding direct sunlight exposure. The hair hormone extraction procedure was carried out using the modified Gao et al. (2013) method. Cortisol, cortisone and testosterone concentrations were determined by the ultra-high performance liquid chromatography-tandem mass spectrometry (UHPLC-MS/MS) system (Shimadzu Corporation, Kyoto, Japan). The UHPLC column was a YMC- Triart Bio C4 column (3.0×100 mm, 1,9 μm). The column temperature was set at 50 °C. The method utilized a binary gradient with mobile phases containing methanol and water which had been acidified with 0.05% acetic acid at a flow rate of 0.4 ml a minute. The injection volume was 10 μl. Data acquisition was carried out with Shimadzu LabSolutions software (version 1.20). The results concerning the validation procedure can be summarized as follows: the calibration curve's correlation coefficient was higher than 0.994 for cortisol and cortisone, and testosterone showing linearity between 1 and 500 ng/g. The detection limits were determined by decreasing the cortisol, cortisone and testosterone concentrations to obtain a signal-to-noise ratio of 3. Hair cortisol, cortisone and testosterone recovery were $94.0 \pm 4.1\%$, $97.4 \pm 2.0\%$ and $92.2 \pm 3.2\%$ respectively. Full details of the steroid hormones extraction procedure and analysis conditions used in this study have been reported elsewhere (Mažeikienė et al., 2021).

Statistics

SPSS Statistics version 25 was used in the statistical analyses. Skewness and kurtosis test were performed to check the response distribution on all above-mentioned scales. The outcome was evaluated as indicating approximate normality. A cluster analysis (K-means) based on nearest centroid sorting of the personality scales and the appraisal style scales respectively, was used to identify profiles of response patterns. Comparisons between profiles

according to the stress-related hair steroid hormones concentrations (ng/g) and perceived stress levels were made using chi-square tests, *t*-tests and one-way analysis of variance. The sets of profiles were also compared (chi-square tests) on the following background variables: age, education, habitation before the military service, work/study situation before the military service, sport activities and smoking habits.

List-wise deletion of missing responses was used in the cluster analyses and subgroup comparisons. Due to missing values, these analyses are based on somewhat fewer cases than 173 (see each table in the Result section). Statistical significance was assumed at $p < .05$.

Ethics

The project was approved by the Vilnius Regional Biomedical Research Ethics Committee, protocol No 2020/10-1275-754. All participants provided written informed consent.

Results

The participants' scores on the five personality scales were entered into a cluster analysis (K-means). Four unique profiles regarded as meaningful were identified. A one-way analysis of variance for each of the five variables was run and significant *F* values ($p < .001$) were obtained. This indicates that the means of the profiles differ significantly on all five scales. The same type of analysis was performed on the cognitive appraisal style scales. Three unique profiles were obtained, and also here the profiles differed significantly on all four appraisal style indices. The personality and appraisal style profiles are shown in Table 1.

Table 1. Personality and appraisal style profiles of participants – mean scores.

Personality profiles				
Personality scales[a]	1. Stable, warm, conventional ($n = 37$)	2. Most resourceful profile ($n = 90$)	3. Socially outgoing, cold ($n = 14$)	4. Most vulnerable profile ($n = 32$)
Extraversion	4	6	6	4
Conscientiousness	5	6	5	4
Openness	4	6	6	4
Agreableness	6	6	2	5
Emotional stability	6	6	5	3

Appraisal style profiles			
Appraisal scales[b]	1. Most stressed appraisal style ($n = 35$)	2. Medium stressed appraisal style ($n = 60$)	3. Least stressed appraisal style ($n = 76$)
Irrelevant	3.20	1.62	1.42
Benign-positive	1.68	1.96	3.08
Challenge	2.27	2.45	3.39
Threat, harm, loss	2.68	2.03	1.70

[a]Scores could range between 1 (strongly disagree) and 7 (strongly agree) on all variables.

[b]Scores could range between 1 (the word does not correspond to how you felt then) and 4 (the word completely corresponds to how you felt then) on all variables.

Table 1 shows four different individual patterns across the five personality scales. Profile 1 is characterized by high scores on Agreeableness and Emotional stability and moderate scores on Openness was labeled "Stable, warm, conventional." The second profile members score high on all five scales and was labeled "Most resourceful personality profile." The third profile shows a high mean score on Extraversion and Openness and a low score on Agreeableness and was labeled "Socially outgoing, cold." The fourth profile finally, has moderate scores on all scales, Emotional stability in particular, and was called "Most vulnerable personality profile."

Turning to the cognitive appraisal style scales, the three profiles reflect gradually lower stress appraisals. Profile 1 was labeled "Most stressed appraisal style," profile 2 "Medium-stressed appraisal style and profile 3 "Least stressed appraisal style." The personality profiles and the cognitive appraisal style profiles were compared on the Perceived Stress Scale and the biological stress markers. The result is shown in Table 2.

According to Table 2, there are statistically significant mean score differences between the four personality profiles on all scales except for testosterone. "The most resourceful personality profile" shows the lowest perceived stress scores and the lowest cortisol and cortisone levels. The higher mean scores on all the biological markers noted in the personality profile "Socially outgoing, cold" should be noted. On cortisone, the scores of "Socially outgoing, cold" were significantly higher than the scores of the profiles "Stable, warm, conventional" and "Most resourceful profile." Post-hoc tests also reveal several pair-wise differences, particularly on the Perceived Stress Scale where "The most vulnerable personality profile" score higher than the rest.

Table 2 shows significant mean differences between the three cognitive appraisal style profiles on the Perceived Stress Scale. Thus, "The most stressed appraisal style" profile scored highest, followed by "The medium-stressed appraisal style" profile. Lowest perceived stress is reported by the individuals in "The least stressed appraisal style" profile. The three profiles did not differ significantly from each other on any of the biological scales.

A "Most resourceful combination" was developed which included all individuals who were members of "The most resourceful personality profile" as well as of "The least stressed appraisal style profile" ($n = 56$). A "Most vulnerable combination" was created by including all members of "The most vulnerable personality profile" as well as "The most stressed appraisal style profile" ($n = 15$). These two combination subgroups were compared and the results showed that "The most resourceful combination" showed significantly lower perceived stress and lower biological stress values than "The most vulnerable combination" (*t*-tests, Table 3). The mean score for the whole sample on the Perceived Stress Scale (not shown in the Table) was 16.7 ($SD = 7.31$).

The sets of profiles were also compared on the following six background variables: age, education, habitation before the military service, work/study situation before the military service, sport activities and smoking habits. No statistically significant differences between proportions of the personality profile members, the appraisal style members or the combined profile members were found on any of the background variables (chi-square tests).

Discussion

The first aim of the study was to identify individual patterns across the Big five personality dimensions as well as across four cognitive appraisal style categories. Cluster analyses resulted in four unique personality profiles and three cognitive appraisal style profiles.

Table 2. Comparisons of profiles on perceived stress and biological stress markers.

Personality profiles											
	1. Stable, warm, conventional ($n = 37$)		2. Most resourceful profile ($n = 90$)		3. Socially outgoing, cold ($n = 14$)		4. Most vulnerable profile ($n = 32$)				
Stress variables	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*P*	Scheffé [a]
Perceived stress[b]	17.8	6.7	14.1	6.5	16.2	8.1	23.5	6.0	16.31	.000	A,C,E,F
Cortisol[c]	4.93	3.23	4.62	3.67	8.20	8.05	6.11	5.69	3.03	.031	
Cortisone[c]	16.11	6.48	15.87	5.89	23.31	12.79	18.04	9.44	4.35	.006	B,D
Testosterone[c]	0.60	0.36	0.62	0.55	1.00	0.86	0.66	0.51	2.21	.089	

Appraisal style profiles									
	1. Most stressed appraisal style ($n = 35$)		2. Medium-stressed appraisal style ($n = 60$)		3. Least stressed appraisal style ($n = 70$)				
Stress variables	M	SD	M	SD	M	SD	F	P	Scheffé[a]
Perceived stress[b]	24.6	6.2	18.1	5.5	12.4	5.6	53.60	.000	A,B,D
Cortisol[c]	5.73	4.73	5.14	4.08	5.15	4.98	0.22	.801	
Cortisone[c]	18.45	9.69	16.98	5.99	16.15	7.98	1.05	.351	
Testosterone[c]	0.74	0.52	0.66	0.60	0.61	0.51	0.65	.525	

[a]A = Significant difference between profiles 1 and 2. B = Significant difference between profiles 1 and 3. C = Significant difference between profiles 1 and 4. D = Significant difference between profiles 2 and 3. E = Significant difference between profile 2 and 4. F = Significant difference between profiles 3 and 4. bScores could range between 0 (*lowest stress)* to 40 (*highest stress).* cScores show ng/g.

Table 3. Comparison of "the most resourceful combination" and "the most vulnerable combination."

Combined personality and appraisal style profiles						
	1. Most resourceful combination (personality profile 2 and appraisal style profile 3) ($n = 56$)		2. Most vulnerable combination (personality profile 4 and appraisal style profile 1) ($n = 15$)			
Stress variables	M	SD	M	SD	t	p
Perceived stress[a]	11.9	5.5	27.2	5.0	−9.40	.000
Cortisol[b]	4.22	3.08	7.47	6.48	−2.79	.007
Cortison[b]	14.69	5.56	21.33	11.65	−3.16	.002
Testosterone[b]	0.53	0.36	0.81	0.63	−2.19	.032

[a]Scores could range between 0 (*lowest stress)* to 40 (*highest stress).*

[b]Scores show ng/g.

Personality profile 2 was interpreted as the most resourceful profile with high mean scores on all Big five dimensions. Profile 4 can be regarded as the most vulnerable profile, with a low mean score on Emotional stability in particular. Profile 3 scored high on Extraversion and Openness and low on Agreeableness. This could be interpreted as a socially outgoing, cold "hegemonic masculine" type. Personality profile 1 finally, scored higher on Agreeableness and Emotional stability and somewhat lower on Extraversion and Openness. We labeled this profile "Stable, warm and conventional." The labels of the personality profiles 3 and 1 were created to capture the dominant personality characteristics in short form.

When the personality profiles were related to perceived stress, the most resourceful profile scored lowest and the most vulnerable profile reported significantly higher scores than all the other profiles. We consider this result to be in line with what could be theoretically expected given the profile characteristics (John & Robins, 2021).

The second aim of the study was to explore how the above-mentioned profiles relate to hair stress-related hair steroid hormone levels in an organizational environment dominated by men and masculinity norms. Statistically significant differences between the four personality profiles were found on cortisol and cortisone, but not on testosterone. The profile "Socially outgoing, cold" scored higher than the profiles "Stable, warm, conventional" and "Most resourceful profile" on cortisone. If our "hegemonic masculinity" interpretation is valid, it means that individuals with this personality pattern secrete more stress-related steroid hormones, cortisone in particular, than persons with the other personality profiles. Possibly they find themselves more often in a "fighting mood" coherent with a masculinity norm (Elder et al., 2017; Wedgwood et al., 2023). This assumption remains tentative, as there have not been any studies of cortisol/cortisone - personality links based on large samples and examining the major dimensions of personality. However, our findings are consistent with the literature showing that personality traits that have traditionally been associated with greater psychopathology were found to be associated with blunted hypothalamic-pituitary-adrenal (HPA) axis responses to stress - blunted cortisol responses were associated with lower scores on the Extraversion dimension, as well as with lower scores on three of its facets (Warmth, Activity and Positive Emotion) (Oswald et al., 2006). The members of the "most vulnerable personality profile" scored second highest on all three stress hormone scales, although the differences were small.

Turning to the cognitive appraisal style profiles, the result on perceived stress was logical. The individuals in the "most stressed appraisal style profile" scored considerably higher than the others and the conscripts in the "least stressed appraisal style profile" reported a notably lower mean score. In contrast to the personality profiles, the three cognitive appraisal style profiles turned out to be unrelated to the three stress-related steroid hormone markers. One possible explanation is that the perceived stress level was too low to affect the stress hormone level. According to the normative values for the Perceived Stress Scale (Cohen, 1983), the reported mean scores in the present study were all low to moderate, also in the" most stressed appraisal style profile." The lack of coherence between biological and self-reported stress measures is in line with previous studies which failed to find such an association (Stalder et al., 2017). Had the perceived stress level been higher, the results may have been different. The following assumption can be based on the findings of the study where perceived stress was negatively correlated to increased hair cortisol levels in a study group that experienced serious life events (Karlén et al., 2011). Another possibility is the fact that the emotional indicators of cognitive appraisals, as well as the stress hormone scores, were related to "the first month of military service." This could cause episode-specific relationships to be hidden in monthly overall scores.

The idea behind the combination of the theoretically assumed most favorable and unfavorable personality profiles and cognitive appraisal style profiles respectively, was to optimize the probability of finding significant differences on the stress hormone markers given the limited sample size. The comparison resulted in significant differences on the Perceived Stress Scale as well as on all three stress hormone markers. The results should be interpreted with care as the most vulnerable combination consisted of 15 persons only. However, we think this result is interesting and indicates that by combining two psychological instruments which, together, take less time than ten minutes to complete, one can identify a potential stress hormone risk group even when the perceived stress level is moderate. Replication studies are needed but, if repeated, the short, easy-to-use psychological screening employed here can be used to identify individuals who may be at risk regarding stress hormone levels and where further tests of this could be called for.

The use of a person-centered profile approach is a methodological strength (Oberski, 2016). Further strengths include the use of established scales which showed high levels of reliability, being able to combine biological and self-reported data and the limited occurrence of missing data. We also argue that the differentiation of three theory-based cognitive appraisal style scales is a study strength. Patterns across these scales provide a richer picture compared to a single sum score.

As a study limitation, it should be noted that it was only possible to analyze stress-related steroid hormones using samples from very short hair (1 cm long), as the male norm amongst conscripts was to cut it short. This reduces the possibility of comparing the results of the hormone concentration with the findings of previous studies that used longer hair samples. In addition, the lack of population-based norm values for the adopted stress-related steroid hormone analysis method is a weakness. Although this study adds to the limited research on young men performing mandatory military training, it could be considered a limitation that changes in masculinity norms in society at large may not align with those in the military due to the unique nature of military norms (Richard & Molloy, 2020). In addition, the conscription service environment is special and there may be differences both

within and between countries regarding military culture. There is obviously also a need for replication studies, preferably longitudinal with varying expected perceived stress levels, in different organizational and non-organizational contexts.

Practical implications include potential future implementation of the easy-to-use psychological instruments in large-scale screening contexts such as the military. The simplicity of the hair-based data collection procedure providing measures of mean stress-related steroid hormone secretion compared to collecting daily blood or urine samples should also be noted. However, the generalization limitations discussed above point to a need of additional studies.

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Data availability

The questionnaire (English translation from Lithuanian) can be obtained from the corresponding author. The data supporting reported results are archived in the National Open Access Research Data Archive (MIDAS) at www.midas.lt

Disclosure statement

No potential conflict of interest was reported by the authors.

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