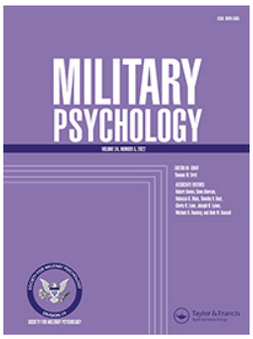

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Perceived stress and hair cortisol levels amongst conscripts during basic military training: A repeated measures study

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ABSTRACT

The aim was to examine hair cortisol levels and self-reported stress amongst conscripts during their basic military training, and how they are related to four types of theory-derived determinants. The following prediction was made: lower levels of perceived stress and hair cortisol will be associated with: (1) higher levels of emotional stability (the individual nonmilitary aspect); (2) a lower degree of private life problems (the contextual nonmilitary aspect); (3) more positive attitudes toward the military, higher engagement in military service, and higher adaptability to military conditions (the individual-military aspect); and (4) stronger group cohesion and better leadership (the contextual-military aspect). The sample consisted of a total of 107 male Lithuanian conscripts. Assessments were made at the beginning of their basic military training, in the middle, and at the end. Established instruments were used on all self-reported scales. Hair cortisol levels were established through analyses of hair samples. Low to moderate levels of stress were found throughout the basic training period regarding perceived stress levels. Hair cortisol levels were mainly unrelated to the self-rating scales. Regarding perceived stress, the prediction was fully confirmed. The future value of the theoretical model is discussed.

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Perceived stress; hair cortisol; basic military training; conscripts; repeated-measures design

What is the public significance of this article?—Self-reported stress amongst Lithuanian conscripts during their basic military training was related to: lower emotional stability, more private life problems, more negative attitudes towards the military, lower engagement in military service, lower adaptability to military conditions, weaker group cohesion and poor leadership. Hair cortisol levels were unrelated to self-reported stress.

How stressful is it for young adults to take part in compulsory military service and what contributes toward higher or lower levels of stress? These questions merit further study when several nations, such as the Baltic and Nordic countries, are rebuilding their military (and civilian) defense organizations following a deteriorated security situation in many parts of the world (Deverell et al., 2019). Bourne (1967), suggested that four distinct adaptational stages could be identified amongst conscripts during compulsory basic military training: (1) a period of environmental shock; (2) a period of engagement; (3) a period of attainment; and (4) a period of termination. High stress levels were noted in the first two stages as a result of recruits experiencing a profound uprooting from their accustomed environment, including being stripped of the personal and cultural attributes of ordinary civilian life. Buško and Kulenović (2003) described compulsory military basic training as a low-control situational context. A recent study of 10 weeks of basic military training showed an increase of perceived stress but no effect on hair cortisol concentration levels (Boesch et al., 2015).

Following rapid societal changes during the last few decades, the current relevance of the studies by Bourne (1967) and Buško and Kulenović (2003) can be questioned. The relevance of the Boesch et al. (2015) study is also limited because of the short training period. A literature search revealed no other study which addressed the two general questions posed above.

Given the lack of relevant research, we decided to review studies from complementary areas of research. By cross-tabulating the categories of "individual-focused studies" and "context-focused studies," as well as "non-military-focused studies" and "military-focused studies," four research areas were identified (see Figure 1). The

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	Non-military-focused research	Military-focused research
Individual-focused research	Personality, especially Emotional stability	Attitudes Engagement Adaptability
Context-focused research	Work-private life interaction, especially Private life problems	Group cohesion Leadership

Figure 1. Model of aspects which are assumed to be of importance to stress levels in conscripts during their military service period.

division of individual- and contextual-focused studies draws on the person-by-situation interactional paradigm (Endler & Magnusson, 1976). The two categories "non-military-focused studies" and 'military-focused studies stem from the literature on the interaction between private life and military service (Britt & Dawson, 2005). The concepts being presented in each of these areas represent aspects assumed to be of importance in the stress levels of conscripts during their basic military training and are described below.

In the upper left corner of Figure 1, "individual, non-military-focused studies," the bipolar dimension of "Neuroticism – Emotional stability" (McCrae & Costa, 2008) was regarded as being potentially important to the levels of stress being experienced by conscripts. This dimension has shown strong associations with a multitude of cognitive, emotional, behavioral, and physiological stress reactions across different populations (Gross, 2007) and with cognitive and behavioral performance in military settings (Miles & Haider-Markel, 2018).

"Contextual, non-military studies" research was selected which focused on bidirectional influences between work and private life. Military service includes nonstandard work schedules and high expectations of obedience and loyalty, aspects which have been found to affect private life negatively in other professions (Kalil et al., 2010; Vuga & Juvan, 2013). It has also been shown amongst military officers that international missions risk amplifying preexisting health, relationship, and economic problems (Pethrus et al., 2019). Therefore, we found pre-existing private-life problems to be potentially relevant for the present research purposes.

In the research area "individual, military-focused studies," the selected phenomena were attitudes toward military service, engagement in military service, and adaptation to military service. Attitudes toward and engagement in something in which one is involved – basic military training in this case – was assumed to have an effect on perceived stress levels. Lazarus (1991, 1999) proposed stress theory indicates attitudes and values are belief systems. These are "cold" cognitive aspects which reflect our view of how the world is, that world in this case being one of military service. A military example is presented by Girsh (2019) which shows the relevance of attitudes toward military service.

Using the theoretical framework by Lazarus (1991, 1999), engagement constitutes a facet of commitments. These are "hot," emotionally loaded cognitions which in general reflect motivation, and in this specific case positive or negative feelings about one's own military service. However, extant military writings focus on engagement in war (e.g., Levy, 1995) and no text was found which was related to conscript training.

Adaptability was assumed to be important to the stress levels and performance levels of conscripts (Tucker et al., 2007). Ployhart and Bliese (2006) conceptualize adaptability as an individual's ability to change according to different tasks, social and environmental contexts. Adaptability has been found to be

positively related to emotional stability (LePine, 2003), group cohesion and group climate (Tilson et al., 2005), and negatively associated with perceived stress (Gross, 2007; Lazarus, 1991).

Finally, in the research area "contextual, military-focused" studies, the phenomena group cohesion and leadership were selected. Regarding group cohesion, an often-used conceptualization is formulated by Griffith (1988), Griffith and Vaitkus (1999), and Severt and Estrada (2015). They differentiate between horizontal or peer bonding versus vertical or leader-subordinate bonding, and instrumental or task support versus affective or emotional support. This opens up for a cross-tabulation of four interrelated types of cohesion, all of which must be positive in order to have a cohesive unit (Griffith & Vaitkus, 1999).

Griffith and Vaitkus (1999) describe cohesion as a coping mechanism at the social-psychological level for mitigating the effects of stress. It has been shown that group cohesion, when combined with the individual's own coping resources, can help to reduce negative stress reactions (Driskell et al., 2015).

Eatough et al. (2015) point to increased trust amongst group members in groups which have high cohesion, and to an improvement in their self-efficacy. Zaccaro et al. (1995) report that high task-cohesive teams devote more time to planning and information exchange during the planning period, and communicate task-relevant information more frequently during the performance period than do low task-cohesive teams.

The available literature on group cohesion in the military context broadly covers two outcome domains, mental health and team performance. No study was found which focused on biomedical outcome measures such as stress hormones or blood pressure. Studies in the mental health area (see, e.g., Du Preez et al., 2011; Kanesarajah et al., 2016; Williams et al., 2016), were regarded as having limited relevance for conscripts during basic training. Turning to performance indicators, high group cohesion has been shown to be positively associated with basic military training outcomes such as graduation, passing the Army Physical Fitness Test, and Basic Rifle Marksmanship (Williams et al., 2016), a higher quality of decision-making (Zaccaro et al., 1995), and higher perceived individual and group combat performance levels (Griffith, 1997).

Research on leadership and stress is extensive. Favorable leadership behaviors tend to co-vary with lower stress levels and more favorable health and performance outcomes, while poor leadership behaviors co-vary with the opposite indicators (see for example, Bass & Bass, 2008; Yukl, 2010). In the military context, Gal and Jones (1995) postulated that the leader functions as a lens, having a strong level of impact on how the soldiers perceive a given situation. The leader's information about a given situation can magnify or reduce stress appraisals and make the situation either more ambiguous or more clear. Therefore, the same encounter can evoke different degrees of stress in subordinates, depending upon the leader's sense-making of the situation and sense-giving to the followers (Larsson & Berglund, 2019).

Positive associations have repeatedly been shown between leadership quality and subordinates' level of trust (Collins & Jacobs, 2007; Dirks & Ferrin, 2002; Fors Brandebo et al., 2013; Lapidot et al., 2007). A military illustration indicating possible mechanisms (Larsson et al., 2001) pointed to the following five key factors related to trust and stress levels in subordinates: (1) visibility; (2) the respectful treatment of individuals; (3) the creation of a climate in which subordinates felt free to speak their minds; (4) values, morals, courage, and sincerity; and (5) task-related competence. The first four factors show clear resemblances with transformational leadership behaviors, which are derived from the globally dominating leadership model of the past few decades (Bass & Riggio, 2006). The competence factor is part of several leadership models (Larsson et al., 2003, 2018; Bass & Bass, 2008; Mumford et al., 2000; Yukl, 2010).

The present study focuses on long-term reactions rather than responses to an acute situation. Two aspects of long-term stress were explored in relation to basic military training: perceived stress and hair cortisol concentration. An advantage of hair cortisol analysis, when compared to, for instance, 30-day integrated salivary measures, is the relative stability of the sample, the single sampling procedure and the more accurate reflection of overall cortisol output relative to other metrics for salivary cortisol (Short et al., 2016).

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 symptom scores for post-traumatic stress disorder (PTSD; Groer et al., 2015).

The aim of the current study was to undertake a repeated-measures study of how the aforementioned theory-related concepts (see Figure 1) are related to self-reported stress levels and a biological stress indicator (hair cortisol levels) amongst conscripts during their basic military training. The following prediction was made: lower levels of perceived stress and hair cortisol will be associated with the following: (1) higher levels of emotional stability (the individual, nonmilitary aspect); 2) lower levels of private life problems (the contextual, nonmilitary aspect); 3) more positive

attitudes toward the military, higher levels of engagement in military service, and higher adaptability levels to military conditions (the individual, military aspect); and 4) stronger group cohesion and more favorable leadership behaviors (the contextual, military aspect).

Method

Participants

The sample consisted of all male conscript soldiers in four Lithuanian army platoons who were carrying out their basic military training in 2020–2021 (spending a total of nine months at the task). All but three soldiers agreed to participate. An additional five conscripts could not participate in one or two of the assessment occasions because of illness, leaving a final sample of 107 male conscripts. The mean age of the responders was 20.4 years (*SD* = 1.6), ranging from 18 to 26. Most of them (90%) had completed secondary school, vocational school, or high school, while 73% were studying or had been employed before entering compulsory military service. Due to the Covid-19 pandemic, the battalion was conducting its training in a "bubble fashion," with task activities being organized in platoons and squads which were isolated from external contact, while contact between platoons was minimized.

Design and data collection

A repeated-measures design was used with the following three assessment points, closely corresponding to Bourne's (1967) adaptational stages: (1) T1, after the first four weeks of service (the earliest possible time for practical reasons); (2) T2, in the middle of the service period (after 18 weeks); and (3) T3, two weeks before the end of service (after 36 weeks). 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 battalion. Samples of hair were collected by personnel from the Department of Physiology, Microbiology and Laboratory Medicine, Institute of Biomedical Sciences, Faculty of Medicine, Vilnius University.

Measures

Emotional stability

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

Private life stressors during the past month

This was assessed using the following six "Yes-No" items which were related to events during the past month: Little or no money; Disease or injury; Sleeping disorders; Quarrels with my partner; A relationship which ended; and Other strong negative experiences. These aspects were derived from the literature on military work-private life interaction (Britt & Dawson, 2005) and Salo's (2008) research on Finnish conscripts. A scale score was computed by counting the number of "Yes" responses and could range from 0 to 6.

Attitude toward military service

This was measured with six items which were taken from Salo's (2008) questionnaire. A sample item: "It is important for me to perform well in the military." Each item had a 7-point Likert response scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). A scale score was computed by adding the raw scores and dividing the total by six. Cronbach alpha: T1: .80; T2: .82; and T3: .87.

Personal engagement in military service

A 9-item scale was adopted from the shortened version of the Utrecht Work Engagement Scale (UWES-9; Balducci et al., 2010) and was modified for the military context. The instruction read: "Please read each statement carefully and decide if you ever feel this way about your military service" (the scale was also described). A sample item follows: "At my military service, I feel bursting with energy." Each item had a 7-point Likert response scale ranging from 0 (*never*) to 6 (*always*). A scale score was computed by adding the raw scores and dividing the total by nine. Cronbach alpha: T1: .92; T2: .94; and T3: .95.

Adaptability

This was measured using seven items taken from Salo's 2008 questionnaire. A sample item follows: "I have become used to living in barracks." Each item had a 7-point Likert response scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). A scale score was computed by adding the raw scores and dividing the total by seven. Cronbach alpha: T1: .87; T2: .93; and T3: .90.

Squad cohesion

To measure squad cohesion, fourteen items were taken from research by Hedlund et al. (2015) on multinational military staff exercises, six items coming from the Group Cohesion Scale – which was revised by Treadwell et al. (2001), and six items from the conscript research by Salo

(2008). The total of 26 items were factor-analyzed (utilizing principal axis factoring with oblique rotation) for each measurement occasion. Oblique rotation was selected because we assumed that participants would respond to an array of interrelated aspects regarding squad cohesion. An analysis which called for a two-factor solution was regarded as the most meaningful on each measurement occasion. Here, almost all items in a given factor had a loading of at least .40 and, at the same time, no other items had loadings of .30 or higher in the factor in question. Five items were dropped due to mixed factor loadings. The total amount of explained variance was as follows: T1: 41.9%; T2: 39.4%; and T3: 54.0%. Fairly similar results were obtained on all three assessments and the T1 solution was used throughout the study (see, Table 1).

Factor 1 was labeled *Instrumental-related cohesion*, consisting of sixteen items. A sample item: "My squad works together to achieve a set goal." Factor 2 was labeled *Affective cohesion*, and was built up by five items. A sample item: "The squad members feel comfortable in expressing disagreements in the group." Each item had a 7-point Likert response scale ranging from 1 (*strongly disagree*) to 7 (strongly agree). Factor scale scores were computed by adding the raw scores and dividing the total by the number of items in the factor. Cronbach alphas: *Instrumental-related cohesion*, T1: .92; T2: .86; and T3: .95, and *Affective cohesion*, T1: .87; T2: .91; and T3: .90.

Leadership

A four-item scale taken from Salo (2008) was used to assess the perceptions of the squad and platoon leaders' leadership behaviors respectively. A sample item: "My platoon (or squad) leader has set an example." Each item had a 7-point Likert response scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Scale scores were computed by adding the raw scores and dividing the total by four. Cronbach alphas: *Platoon leadership*, T1: .86; T2: .93; and T3: .90, and *Squad leadership*, T1: .96; T2: .96; and T3: .96.

Perceived stress

The "Perceived Stress Scale" (PSS; Cohen et al., 1983) was used to assess perceived stress levels during the last 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: T1: .86; T2: .86; and T3: .89.

Hair cortisol

The hair cortisol extraction procedure was carried out using the modified Gao et al. (2013) method. Cortisol concentrations were determined from the first centimeter of hair proximal to the scalp by the ultra-high performance liquid chromatography (UHPLC) system (Shimadzu Corporation, Kyoto, Japan) coupled with a triple quadrupole tandem mass spectrometer (LCMS-8060, Shimadzu). 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

Table 1. Factor loadings on items designed to measure squad cohesion.

Item	Cohesion-instrumental factor	Cohesion-affective factor
My current squad has a really good esprit de corps	**.93**	−.09
At war my squad members would help me even if it might put them in danger	**.81**	−.01
If a soldier fails during an exercise, the entire squad assists him	**.79**	−.08
My squad works together to achieve the set goal	**.78**	.01
If the squad's achievements are poor, then everyone in the squad feels responsible	**.74**	.04
Squad soldiers are involved as we carry out the task	**.74**	.04
I do not like the way this squad solves its tasks (R)	**.70**	−.03
I do not think the squad has a sufficiently strong will to complete tasks in the best way (R)	**.63**	−.08
The quality of task performance provided by this squad is improving over time	**.59**	.15
In my squad, we easily accomplish tasks	**.57**	.02
In case of war, I would like to be in my current squad	**.56**	.19
Soldiers in this squad positively accept criticism	**.53**	.04
Our squad finds innovative ways to achieve the set goal	**.49**	.08
People would be concerned when a group member is absent from the group	**.47**	.03
Most group members contribute to decision making in the group	**.44**	.20
Group members usually feel free to share information	**.42**	.21
Here I can show my abilities	−.03	**.83**
It is safe to take a risk in this squad	.01	**.79**
Squad soldiers feel comfortable expressing disagreements in the group	.01	**.78**
No-one in this squad would deliberately act in a way that undermines my efforts	.04	**.73**
In my squad, everyone can ask questions and problems	.01	**.68**

N = 107. The extraction method was principal axis factoring with an oblique (oblimin) rotation. Factor loadings above .40 are in bold. Reverse-scored items are denoted with (R).

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).

Statistics

Analyses-of-variance, repeated-measures design, which were complemented by *t*-tests (paired) in case of an overall significant difference of means, were used in order to assess mean changes on the study variables across the three measurement occasions. Bivariate associations (Pearson) followed by a power analysis and multiple relations between the variables (regression analysis) were computed on each occasion. In the regression analyses, self-reported stress levels (the PSS score) and hair cortisol levels were used as dependent variables. The number of missing values for individual questions was low, ranging from zero to eight individuals. However, due to missing responses, the total number of respondents is lower than 107 on some scales. Statistical significance was assumed at $p < .05$.

Ethics

The study was conducted according to the guidelines of the Declaration of Helsinki, and was approved by The Vilnius Regional Biomedical Research Ethics Committee protocoll # 2020/10-1275-754. Informed consent was obtained from all subjects involved in the study.

Data availability

The questionnaire (English translation from Lithuanian) and the data file (SPSS) can be obtained from the corresponding author.

Results

Development of study variables across time

The outcome of the ANOVA tests, repeated-measures design, accompanied by *t*-tests (paired), is shown in Table 2.

Table 2 shows that there are overall mean score differences across the three measurement occasions for all study variables except for Private-life problems, Leadership platoon and Perceived stress. The ratings of military attitude, engagement, and adaptation are more favorable at the beginning and end of the service period. In absolute terms, the ratings for the platoon and squad leaders are high throughout their military service, although a gradual lowering of the scores is noted. Hair cortisol levels lowered with each measurement, but significantly so between T1 and T3, and similarly between T2 and T3. Mauchly's test (not shown in the table) indicated that the assumption of sphericity was violated on the Cohesion affective and Cortisol scales and the significance tests on these scales should be interpreted with caution.

Correlation and multiple regression analyses

The bivariate correlations (Pearson) between the PSS score and hair cortisol levels were: T1 .11; T2 .09; and T3 .05. The correlations (Pearson) between the model-derived scales and the PSS and hair cortisol levels at each measurement occasion are shown in Table 3.

Table 3 shows that all of the model-derived variables co-vary significantly in the predicted direction with perceived stress on all assessments. Hair cortisol levels are more weakly associated with the model-derived variables. However, significant correlations in the predicted direction are found with the T2 measurements of

Table 2. Means, standard deviations, and ANOVA, repeated-measures design, for study variables.

	1. After four weeks of service		2. Middle of service (18 weeks)		3. Two weeks before end (36 weeks)				Hypothesis	Error		Paired *t*-test[a]		
Model-derived scales	*M*	*SD*	*M*	*SD*	*M*	*SD*	Pillai's trace	*F*	*df*	*df*	*p*	1–2	1–3	2–3
Emotional stability[b]	5.23	1.52	Not measured		Not measured									
Private-life problems[c]	1.81	1.44	2.04	1.78	1.67	1.55	.038	2.09	2	105	.129			
Military attitudes[b]	4.74	1.40	4.10	1.52	4.22	1.56	.187	11.12	2	97	**.000**	A	B	
Military engagement[d]	3.87	1.27	3.22	1.31	3.59	1.43	.186	10.84	2	95	**.000**	A	B	C
Military adaptation[b]	4.84	1.38	4.55	1.63	5.00	1.51	.062	3.11	2	94	**.049**			C
Cohesion-instrumental[b]	5.09	1.00	4.52	1.01	4.56	1.28	.209	11.64	2	88	**.000**	A	B	
Cohesion-affective[b]	5.41	1.30	4.85	1.32	4.98	1.48	.130	7.10	2	95	**.001**	A	B	
Leadership platoon[b]	5.89	1.28	5.70	1.45	5.67	1.43	.014	0.681	2	98	.508			
Leadership squad[b]	5.68	1.76	5.11	1.81	5.04	1.97	.113	6.23	2	98	**.003**	A	B	
Perceived stress[e]	17.56	7.05	18.48	6.65	17.14	7.44	.056	2.48	2	84	.090			C
Cortisol[f]	4.27	2.26	3.73	2.14	3.13	1.49	.226	14.27	2	98	**.000**		B	C

N = 107. ANOVA = analysis of variance. Paired *t*-tests: A = significant difference time 1–2, B = significant difference time 1–3, C = significant difference time 2–3. [c]Scores could range from 1 to 7. [d]Scores could range from 0 to 6. [e]Scores could range from 1 to 6. [f]Scores could range from 0 (lowest stress) to 40 (highest stress). [g]Scores show ng/g.

Table 3. Correlations between model-derived scales and stress measures (N = 107).

Model-derived Scales	Perceived stress after four weeks of service	Perceived stress at the middle of service	Perceived stress two weeks before end	Cortisol after four weeks of service	Cortisol at the middle of service	Cortisol two weeks before end
Emotional stability[a]	−.42***	-	-	−.02	-	-
Private-life problems	.50***	0.60***	0.52***	.01	.13	.01
Military attitudes	−.47***	−.30**	−.32**	−.07	−.15	−.16
Military engagement	−.68***	−.43***	−47***	−.08	−.22*	−.08
Military adaptation	−.69***	−.45***	−.47***	−.07	−.24*	−.08
Cohesion-instrumental	−.47***	−.42***	−.52***	−.12	−.16	−.05
Cohesion-affective	−.48***	−.42***	−.49***	−.11	−.17	−.11
Leadership platoon	−.32**	−.21*	−.29**	−.06	−.14	−.27**
Leadership squad	−.28**	−.41***	−.29**	.08	−.23*	.09

[a]Not measured at middle of service or two weeks before end of service. * $p < .05$; ** $p < .01$; *** $p < .001$.

military engagement, military adaptation, and perceived squad leadership. On the last measurement occasion, the hair cortisol levels co-varied significantly in the predicted direction with perceived platoon leadership. In the absence of prior estimates of effect size, and given the number of study participants, most of the statistically significant correlations indicate a medium to large effect size for a power of .80 and a significance level of .05 (Polit & Beck, 2008).

Hierarchical multiple regression analyses were carried out with the PSS score and hair cortisol levels as dependent variables. The model-derived predictor variables were entered in the following order: Step 1, Emotional stability; Step 2, Private life problems; Step 3, Military attitudes, Military engagement, and Military adaptation; and Step 4, the two Cohesion and Leadership scales.

Table 4 shows the outcome of the T1 analysis with the PSS score as the dependent variable. A comparatively high adjusted R^2 (.60) was obtained, and the first three steps made significant contributions to the equation model. In the final model, the scales for private life problems, military engagement, and military adaptation made significant contributions in the predicted direction. The pattern was fairly similar in the analyses which was carried out on T2 and T3 information with perceived stress as the dependent variable. However, the adjusted R^2 coefficients were lower: T2: .45 and T3: .41.

The three analyses which used hair cortisol levels as the dependent variable yielded weak and largely insignificant results. The following adjusted R^2 coefficients were noted: T1: −.01; T2: .01; and T3: .16.

Table 4. Regression analysis – predictors on the perceived stress scale at time 1 (N = 107).

Step/Predictors	*b*	SE β	*F*	*p*
STEP 1				
Emotional stability	−1.87	0.44	18.04	.000
STEP 2				
Emotional stability	−1.53	0.42	13.21	.000
Private-life problems	1.69	0.44	15.09	.000
STEP 3				
Emotional stability	−0.72	0.33	4.72	.033
Private-life problems	0.75	0.35	4.67	.033
Military attitudes	0.04	0.43	0.01	.920
Military engagement	−1.79	0.55	10.78	.001
Military adaptation	−2.00	0.45	19.56	.000
STEP 4				
Emotional stability	−0.68	0.35	3.94	.051
Private-life problems	0.75	0.36	4.33	.041
Military attitudes	0.09	0.47	0.04	.850
Military engagement	−1.85	0.58	10.11	.002
Military adaptation	−1.71	0.49	12.34	.001
Cohesion-instrumental	0.39	0.71	0.30	.588
Cohesion-affective	−0.80	0.44	3.30	.073
Leadership platoon	−0.04	0.43	0.01	.933
Leadership squad	−0.04	0.30	0.02	.893

Final model $R^2 = .64$, adjusted $R^2 = .60$.

Discussion

According to the normative values for the PSS (Cohen et al., 1983), the mean self-reported stress levels were low to moderate throughout the basic training period. The result does not support earlier findings which stated that compulsory military service causes high stress levels due to the major everyday differences from ordinary civilian life (Bourne, 1967; Buško & Kulenović, 2003). Possible reasons include modern conscripts possibly being better informed and mentally prepared for military life, and military organization, training and exercises having undergone major changes which have swung the situation toward a more democratic and less authoritarian direction. However, as four weeks of basic training had been completed before the first measurement occasion, this conclusion must be made with caution.

In our study group, the mean hair cortisol concentration level showed a gradual decrease over time. It's essential to indicate the fact that different modifications of enzyme-linked immunosorbent assays and liquid chromatography analysis are used to detect hair cortisol concentrations; however, what is still required is the optimization and standardization of the extraction and quantification of cortisol contents (Greff et al., 2019). Due to existing methodological modifications and protocol variations, a unified

range of reference values has not yet been established, making a comparison and interpretation of the hair cortisol concentration results of different studies complicated. Therefore, repeated-measures designs are more potent because individuals serve as their own stress controls, eliminating interpersonal variability (Stetler & Guinn, 2020).

The mean scores on the scales which have been designed to measure private life problems, attitudes to the military, military engagement, military adaptation, and cohesion were more favorable at the beginning and at the end of the service period. The mid-point drop could indicate boredom, with the novelty stage having passed and a significant amount of time still remaining in the service time. The more favorable values toward the end of service could reflect a positive evaluation, one in which relief is experienced that it will soon be over. In addition, at the end of the service period, conscripts were busy with their final exercises and assessments, which could also increase their motivation and positive attitude toward military service. Conscript ratings for the leadership behaviors shown by platoon and squad leaders are high, although the mean figures get successively lower. Historically, quality of leadership has been an important determinant in terms of the reactions of those under their command in military contexts (Gal & Jones, 1995), and a recent replication is reported among military Veterans (anonymous, specified if the manuscript is accepted). Therefore, the comparatively low stress levels may, at least partially, be related to favorable experiences of leadership.

The importance of military service being conducted in a "bubble fashion" is difficult to evaluate. On the one hand it may have contributed to a level of boredom and negative attitudes thanks to reduced home visits and social contact within the battalion. On the other hand, being part of a special situation may lead to stronger cohesion (Hogg, 1992).

The prediction was fully met on all three measurement occasions when it comes to the relationship between the model-derived variables and perceived stress levels. The comparatively high adjusted R^2 coefficients point in the same direction. Our interpretation is that the theoretical model (Figure 1) worked well. This means that in order to understand perceived stress during military service, one must pay attention to personality factors, private life situations, attitudes toward the military, and military engagement and adaptations, as well as group cohesion and quality of leadership. All these aspects can contribute favorably or unfavorably toward the perceived stress levels of soldiers.

The biological stress marker for hair cortisol levels was mainly unrelated to the self-rating scales. It should also be noted that hair cortisol levels and perceived stress scores were close to being completely unrelated at each measurement occasion. The lack of coherence between biological and self-reported stress measures is in line with previous studies which failed to find the aforementioned association (Stalder et al., 2017). However, other studies reported conflicting results: some studies have found hair cortisol concentration levels to be associated with increased perceived stress (Kalra et al., 2007), while others have linked hair cortisol levels with decreased perceived stress (Karlén et al., 2011). This heterogeneity could be determined by the diverse composition of the study group, along with how recent and severe any psychological stressor may be and any possible origins for that stressor (Wester & van Rossum, 2015).

Methodologically, the repeated-measures design, the development of a theoretical model (Figure 1), the use of established scales which show high levels of reliability, being able to combine biological and self-reported data, and the limited occurrence of missing values all serve as study strengths. It should also be noted that it was possible to analyze stress hormones using samples from very short hair, as the male norm amongst conscripts was to cut it short. The lack of population-based norm values for the adopted analysis method is a weakness. It would also have been desirable to have female participants within the study group.

Additional suggestions for future research include replications utilizing other groups of conscripts including women in more countries which also make use of the compulsory conscription system. It would also be interesting to be able to make similar kinds of assessments plus performance indicators in connection with severely stressful encounters.

The support of the predictions which are based on the theoretical model means that increased attention should be paid to personality and private life situation at the selection stage where these qualities are typically examined. Military beliefs, commitments, and adaptation skills bidirectionally influence group cohesion and leadership, and the study confirms the importance of working with these issues to improve military basic training.

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