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PERCEIVED STRESS IS INVERSELY CORRELATED WITH BODY FAT IN LITHUANIAN FEMALE NURSES

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Annotation. According to the position of the American Institute of Stress, the human population is currently facing a mental health crisis. The study aimed to assess the correlation perceived psychological stress and body fat percentage (BF%) in clinical nurses working in Lithuanian healthcare institutions. In October-November 2024, a single cross-sectional study was performed using the confidential survey method. The final analysis of the study sample included 121 female nurses with the mean age of 40.8 ± 10.3 years. Both the Reeder Stress Inventory along with the Spanish-developed predictor for the body fat percentage, namely, Clínica Universidad de Navarra-body adiposity Estimator (CUN-BAE) were applied to evaluate the levels of perceived psychological stress and body composition in Lithuanian clinical nurses. This study identified as many as 74% of female nurses who were overweight or obese. The increased level of perceived stress was found among 45% of nurses, too. The BF% (41.4 ± 8.5%, 95% confidence interval (CI): 37.1; 45.8%) of nurses with low-level perceived stress was statistically significantly higher compared to developed BF% in nurses with moderate or high-level psychological stress (35.3 ± 5.8%, 95% CI: 33.7; 36.9% and 36.2± 6.6%, 95% CI: 34.4; 38.0%) (F = 5.7, p = 0.004). Although the study highlighted the issues related to overweight and obesity as well as the increased levels of perceived stress in a sample of female nurses working in Lithuanian healthcare institutions, that in turn should serve as a starting point for instigating two-way preventive initiatives in order to strengthen the mental health in nurses and reduce the incidence of obesity.

Keywords: body fat; clinical nurses; mental health; perceived stress

INTRODUCTION

According to the position of The American Institute of Stress, the global population is currently facing a mental health crisis. Projections indicate that over the next few years this mental health crisis may lead to serious adverse consequences, with the total number of people experiencing psychological stress reaching 35% (The American Institute of Stress, 2023). It is important to note that stress is a nonspecific physiological response to any kind of change, or in other words, to psychological, physical, or emotional strain. When individuals experience short-term but acute psychological stress, their usual functioning is not disrupted due to resilience mechanisms (World Health Organization, 2023). However, when psychological stress becomes recurrent and long-term, it may eventually result in adverse health-related outcomes. Thus, as social and economic demands in contemporary society continue to increase and the balance between work and personal life becomes disrupted, not only does the level of perceived psychological stress rise, but the likelihood of occupational burnout also increases (Kopp et al., 2008; Woo et al., 2019).

In a global context, it is also necessary to consider populations that over the past eight years have faced challenges and threats not only to national but also to global security (COVID-19, the Russian invasion of Ukraine), which has undoubtedly increased levels of perceived psychological stress. More specifically, current scientific research has revealed that nearly 35% of individuals worldwide experienced high psychological stress during the coronavirus pandemic, and, according to studies conducted in 17 European countries, a significant decline in well-being across Europe was observed following the day of the Russian invasion (Blasco-Belled et al., 2024; Scharbert et al., 2024). Although the mechanisms underlying the impact of psychological stress on the progression of chronic diseases are not yet fully understood, it is widely acknowledged that elevated levels of perceived psychological stress may contribute not only to the development of serious mental health disorders but also to impaired physical health. This includes an increased risk of diabetes, chronic obstructive pulmonary diseases, autoimmune diseases, and cardiovascular diseases, which may, indirectly, influence unfavorable population mortality indicators (Ilchmann-Diounou & Menard, 2020; Ingrosso et al., 2022; Hockey et al., 2022; McLachlan & Gale, 2018). Furthermore, perceived psychological stress may negatively affect lifestyle behaviors, leading to poor dietary habits, insufficient physical activity, sleep disturbances, and the use of psychoactive substances such as alcohol and tobacco. It is believed that such health-adverse behaviors contribute to the development of obesity and subsequently increase the risk of chronic non-communicable diseases.

An increased prevalence of overweight and obesity has also been reported recently in a report prepared by the World Health Organization (WHO), which explicitly stated that overweight and obesity affect nearly 60% of the adult population (World Health Organization, 2022).

Ultimately, perceived stress, acting through multiple psychological processes, may disrupt the homeostasis of the human body. For example, scientific studies have confirmed the influence of elevated levels of psychological stress on the development of leaky gut syndrome, systemic inflammatory response, and gut microbiota dysbiosis (Wiley et al., 2022; Wu et al., 2023). The health-adverse effects of perceived psychological stress have also been linked to disturbances in the metabolism of substances such as amino acids, lipids, and carbohydrates (Bi et al., 2020; Geng et al., 2020; Helman et al., 2022; Manting et al., 2011). On the other hand, the potential impact of perceived psychological stress on the anthropometric parameters of healthy populations, particularly nurses who are continuously exposed to work-related psychological stress, has not yet been investigated in Lithuania.

The aim of the study is to determine the association between the level of perceived psychological stress and body fat mass percentage in a cohort of nurses working in Lithuanian healthcare institutions.

MATERIALS AND METHODS

During the organization of the study, a representative sample size (n = 150) was calculated and determined using the official OpenEpi software, with 8% precision and 95% confidence, according to the following formula:

$n = [DEFF \times Np (1 - p)] / [(d^2 / Z^2_1-\alpha/2 \times (N - 1) + p \times (1 - p)]$,

where N represents the size of the target population (nurses and midwives) (N = 23,160), DEFF denotes the design effect, p is the expected frequency of the event analyzed in the equation, and Z is the quantile of the Gaussian distribution ($Z^2_1-\alpha/2$).

A cross-sectional study was conducted between September and December 2024 using a confidential questionnaire-based survey method. In total, 121 female nurses working in healthcare institutions in major Lithuanian cities (Vilnius, Kaunas, Panevėžys, and Šiauliai) were examined. The mean age of the participants was 40.8 ± 10.3 years. More specifically, the level of perceived psychological stress among participants was assessed using the Reeder Stress Scale, translated and adapted into Lithuanian in 1972 by Prof. A. Goštautas (Metcalfe et al., 2003). Based on seven statements evaluated on a four-point Likert scale (from 1 to 4; maximum total score = 28), the level of perceived psychological stress was classified as follows:

(1) 7–14 points – high level of psychological stress;
(2) 15–21 points – moderate level of psychological stress;
(3) 22–28 points – low level of psychological stress.

In addition, information on participants' sociodemographic characteristics (age, education, marital status, average monthly income, and type of work) and anthropometric parameters (height (cm) and body weight (BW) (kg)) was collected.

At the initial stage of data analysis, body mass index (BMI) was calculated. Based on BMI values, participants were categorized into four groups:

(1) underweight (BMI < 18.5 kg/m²);
(2) normal weight (BMI 18.5–25 kg/m²);
(3) overweight (BMI 25–30 kg/m²);
(4) obese (BMI ≥ 30 kg/m²).

Second, considering the growing need to assess body composition among Lithuanian nurses, the study employed the CUN-BAE (Clínica Universidad de Navarra–Body Adiposity Estimator), developed at the University of Navarra Clinic (Spain). Accordingly, based on participants' age, biological sex, and BMI values, body fat mass percentage (BF%) was calculated during secondary data analysis using the following equation (Gómez-Ambrosi et al., 2012):

BF% = −44.988 + (0.503 × age (years)) + (10.689 × sex (female = 1; male = 0)) + (3.172 × BMI (kg/m²)) − (0.026 × BMI² (kg/m²)) + (0.181 × BMI (kg/m²) × sex (female = 1; male = 0)) − (0.02 × BMI (kg/m²) × age (years)) − (0.005 × BMI² (kg/m²) × sex (female = 1; male = 0)) + (0.00021 × BMI² (kg/m²) × age (years)).

In subsequent stages of the study, based on BF% values, nurses were categorized into three groups:

(1) normal body fat mass (≤30%);
(2) excessive body fat mass (30.1–35%);
(3) obese (>35.1%).

Next, the Fat-Free Mass Index (FFMI) of nurses was calculated using the equations proposed by Hull et al. (2011), Okorodudu et al. (2010), and Schutz et al. (2002), respectively:

1. FFM (kg) = BW (kg) − (1 − BF% / 100);
2. FFMI = FFMI (kg) / Height (m)^2;
3. $FFMI_{adj}$ = FFMI (kg/m^2) + 6.1 × (1.8 – Height (m)).

Accordingly, FFMIadj was evaluated and classified as follows: (1) very low (<15 kg/m²); (2) average (15–17 kg/m²);(3) above average (17–18 kg/m²);(4) excellent and very high (≥19 kg/m²).

Statistical data analysis was performed using SPSS (the Statistical Package for the Social Sciences; IBM SPSS Statistics, version 25.0 for Windows (Armonk, NY: IBM Corp., USA)). For the analysis of selected study variables, percentages (%), arithmetic means, standard deviations (SD), and 95% confidence intervals (95% CI) were calculated. One-way ANOVA (analysis of variance) was employed as a reliable statistical method to identify significant differences between the means of variables. In addition, the level of statistical significance was set at alpha (α) = 0.05.

RESULTS AND DISCUSSION

The study sample consisted of female nurses aged 40.8 ± 10.3 years working in healthcare institutions located in the cities of Vilnius (64.5%), Kaunas (64.5%), Panevėžys (13.2%), and Šiauliai (4.9%). According to hospital department, nurses were distributed as follows: internal medicine (34.7%), emergency medical care (4.1%), intensive care

(25.6%), surgical (13.2%), rehabilitation (16.5%), and neurology (5.8%) departments. With respect to work shifts, 53.7% of nurses worked day shifts and 46.3% worked night shifts. A more detailed description of the study participants is presented in Table 1.

Table 1

The categorization of nurses depending on the sociodemographic and occupational traits (n = 121)

Variables	**Total**	
	n	**%**
Education levels		
Post-secondary non-tertiary	27	22.3
College	55	45.5
University	39	32.2
Marital status		
Single	21	17.4
In a relationship or married	82	67.8
Divorced	18	14.9
Net average monthly salary (in Euro (EUR))		
≤1000 EUR	35	28.9
1001–2000 EUR	72	59.5
≥2001 EUR	14	11.6
Nursing shifts		
Non-shift work	65	53.7
Shift work	56	46.3

Table 2 presents the anthropometric data of the nurses. The mean body weight of the nurses was 73.1 ± 15.4 kg. Overweight and potential obesity among the nurses were estimated using both BMI and BF% measures, which were 26.1 ± 5.3 kg/m² and 36.2 ± 7.5%, respectively.

Table 2

Body composition of clinical nurses (n = 121)

Variables	**Mean ± SD**	**Min**	**Max**
Standing height (cm)	167.2 ± 5.7	152	188
Body weight (kg)	73.1 ± 15.4	44	126
BMI (kg/m^2)	26.1 ± 5.3	16.4	45.6
$BF_{CUN-BAE}$ (kg)	27.5 ± 11.3	8.5	54.5
$BF_{CUN-BAE}$ (%)	36.2 ± 7.5	18.6	47.9
FFM (kg)	45.6 ± 4.8	34.6	61.5
FFM (%)	63.8 ± 7.5	42.1	81.4
$FFMI_{adj}$ (kg/m^2)	17.1 ± 1.4	13.6	24.5

Specifically, based on BF% values, 54% of the nurses were classified as obese and 24% as overweight (Figure 1). At the same time, the nurses' fat-free mass corresponded to an above-average level (FFMIadj = 17.1 ± 1.4 kg/m²).

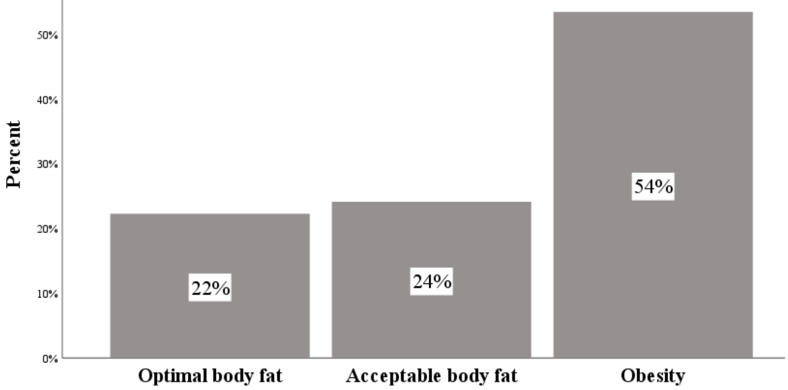

Figure 1. **Distribution of nurses according to BF%**

According to the study data presented in Figure 2, the nurses were distributed by perceived psychological stress level as follows: 45% experienced high stress, 41% moderate stress, and 14% low stress.

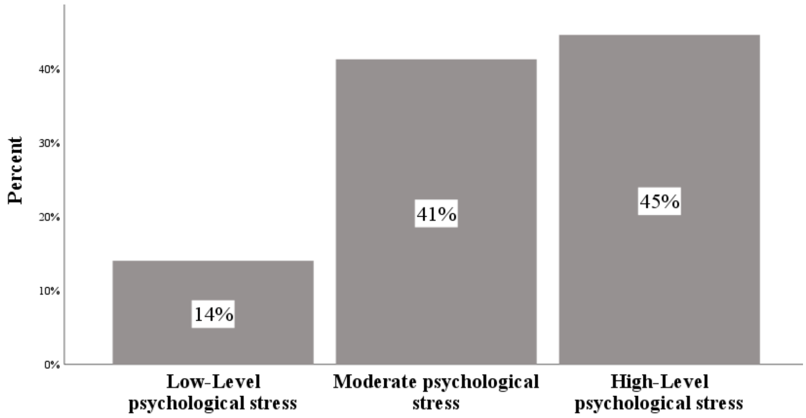

Figure 2. **Psychological stress perceived by clinical nurses**

Using ANOVA (analysis of variance), it was found that nurses' perceived psychological stress was associated with BF% (Figure 3). Specifically, nurses experiencing low psychological stress had a BF% of 41.4 ± 8.5% (95% confidence interval (CI): 37.1–45.8%), which was statistically significantly higher than that of nurses experiencing moderate and high psychological stress, whose BF% were 35.3 ± 5.8% (95% CI: 33.7–36.9%) and 36.2 ± 6.6% (95% CI: 34.4–38.0%), respectively (F = 5.7, p = 0. 004).

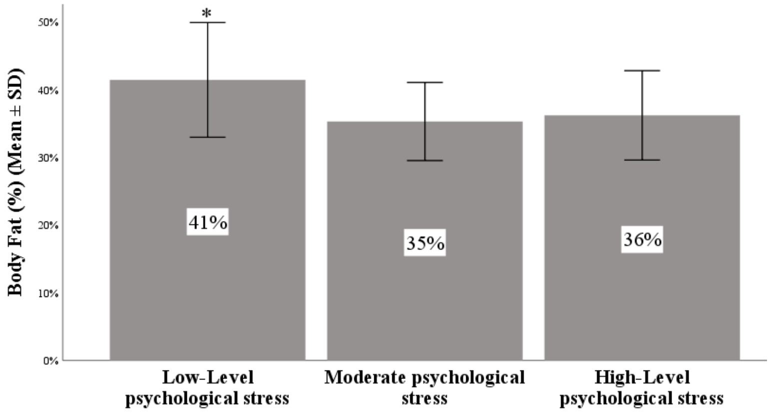

Figure 3. **The correlation between perceived psychological stress and BF% in a sample of clinical nurses**
Note: *—*p*-value ≤ 0.05.

In summary, this study identified that 74% of the female nurses, with an average age of 40.8 years, were affected by overweight or obesity. When these findings are compared with BF% values in young Lithuanian adults, where only 42% of young adults were found to have an unhealthy excess of body fat, it can be inferred that nurses fall into a group at increased risk of overweight and obesity (Baranauskas et al., 2025). This highlights an urgent need to implement overweight and obesity prevention measures within the Lithuanian nursing cohort.

On the other hand, according to the study data, although elevated perceived stress levels were observed in 45% of the nurses, an association between excessive BF% and perceived psychological stress was also identified, but this relationship was inverse. Specifically, nurses perceiving higher psychological stress had lower BF%.

These findings were surprising and inconsistent when compared with four previous studies reporting a positive association between BF% and perceived stress levels (De Vriendt et al., 2012; Isasi et al., 2015; Patel et al., 2019; Yamamoto et al., 2007). Nevertheless, the results of this study were consistent with a 2024 meta-analysis, which similarly reported an inverse relationship between perceived psychological stress and body lipid content (Rog et al., 2024). Attention should be drawn to the fact that perceived psychological stress is a complex phenomenon that may act in two directions, either increasing or decreasing body fat depending on individual physiological characteristics and situational factors. The authors of this study can only speculate that repeated episodes of short-term psychological stress in nurses may activate the sympathetic nervous system, promoting lipolysis, mobilization of free fatty acids into the bloodstream, possibly fatty acid oxidation, and consequent body mass reduction. On the other hand, when perceived psychological stress becomes chronic and long-term, hormonal disturbances may occur, which can contribute to and promote the development of obesity.

CONCLUSIONS

This study highlighted the issues of overweight and obesity, as well as elevated levels of perceived psychological stress, in a cohort of nurses working in Lithuanian healthcare institutions. These findings should serve as an initial reference point for implementing dual preventive measures aimed at improving nurses' mental health and reducing the prevalence of obesity.

Moreover, the study identified an inverse relationship between perceived psychological stress and lower body fat percentage in the examined sample of nurses. Considering that well-controlled studies in the scientific literature have reported the opposite association, suggesting that chronic perceived psychological stress increases body fat, this research warrants further investigation. Future directions should focus on more detailed analyses, taking into account the duration of perceived psychological stress (acute vs. chronic), and examining mental health outcomes in larger samples of nurses.

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SOMATOTYPE MAGNITUDE IN ASSOCIATION WITH NUTRITIONAL INTAKE AMONG LITHUANIAN PROFESSIONAL ROAD CYCLISTS

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Annotation. Optimal nutrition goals are undoubtedly associated with general health, fitness, and somatotype in athletes. The primary aim of this single cross-sectional study was to determine the somatotype profiles in relation to nutritional profiles among Lithuanian high-performance road cyclists (n = 50). The nutritional status of athletes and body composition along with the somatotype profiles were performed using a battery of both the 3-day food record analysis and the multiple frequency bioelectrical impedance analysis (BIA). The central tendency values for the somatotype components of endomorphy, mesomorphy and ectomorphy in male and female athletes playing cycling sports were 4.3–5.1–3.5 and 4.2–4.4–3.2, respectively. In the athletes' cohort under analysis, high-level mesomorphs were prone to consume low-carbohydrate (β –0.1, 95% confidence interval (CI): –0.1; –0.01, p = 0.036) and high-protein diets (β 0.3, 95% CI: 0.2; 0.6, p = 0.047). Contrastingly, the professional road cyclists with a higher expression of ectomorphy were on high-carbohydrate (β 0.1, 95% CI: 0.01; 0.2, p = 0.049) diet. Finally, although nutrition goals as a mediator can play a key role in undergoing the maintenance of balance between the optimal body composition for athletic performance and the development of an ecto-mesomorphic somatotype, the professional male cyclists with higher levels of mesomorphy value should be aware of lowering the body fat percentage coupled with dietary fat reduction and higher protein plus carbohydrates intakes. Also, the somatotyping as an additional assessment approach can be utilized in choosing correct coaching techniques.

Keywords: athletes; body composition; cycling sports; nutrition; somatotype

INTRODUCTION

In the United States, the term somatotype was introduced by psychologist W. H. Sheldon and incorporated into a system for classifying human body types. According to the somatotype classification system, individuals are categorized based on three core components: endomorphs (rounded), mesomorphs (muscular), and ectomorphs (slender) (Oluwaseyi et al., 2024). Today, somatotyping remains an important factor influencing not only physical fitness but also overall health.

While scientific literature presents varying perspectives on the potential influence of different somatotypes on sports success, the development of a body type, together with factors such as training regimen, nutrition that promotes adaptation to physical loads, and psychological preparedness, is particularly important for ensuring a successful athletic career, encapsulating the notion that an "athlete is both born and made" (Tanner et al., 1960).

It is noteworthy that the application of anthropometry is crucial for athlete selection (for example, forming a prospective Olympic cohort) and for continuously monitoring physical performance parameters at later stages of development. Thus, to comprehensively assess athletes' body fat, muscle, and mineral distribution, and to identify the dominant somatotype, periodic evaluation of body composition has become highly significant in sports medicine. Assessing athletes' body composition and somatotype helps reveal the interaction between genetic factors and specific physiological and metabolic demands, which in turn depend on the nature of physical activity and corresponding nutritional requirements.

Somatotype assessment can be particularly useful for athletes in sports where body type may influence the effectiveness of specific movements (Massidda et al., 2013; Vucetić et al., 2008). During training, athletes representing various sports also modify individual body characteristics, such as body mass and upper and lower limb proportions (Gutnik et al., 2015). Therefore, in optimizing athlete development programs, somatotype research and anthropometric measurements of specific body segments have become increasingly important, as the dynamics of certain body shape developments depend on the specificity of the sport practiced.

Scientific findings support the influence of the practiced sport on somatotype expression, showing that athletes tend to be more mesomorphic and less endomorphic. However, somatotypes can vary depending on the sport. For example, a higher expression of the mesomorphic component has been observed in combat athletes, weightlifters, swimmers, and rowers (Kutseryb et al., 2017; Lewandowska et al., 2011).

Meanwhile, the somatotype of high jumpers more often corresponds to a balanced ectomorph (Kutseryb et al., 2017), whereas athletes in cyclic sports most commonly exhibit an ecto-mesomorphic somatotype (Seydalieva & Khairullaeva, 2024).

There is scientific evidence suggesting an association between somatotype and nutritional status. For example, previous studies (Gordon et al., 1987) reported a relationship between endomorphy and elevated blood cholesterol levels. In addition, depending on carbohydrate intake, endomorphs exhibit increased sensitivity to insulin secretion (Elliot, 2020). Therefore, a low-glycemic diet is recommended for endomorphs to better control blood glucose levels while ensuring adequate intake of dietary protein. In contrast, mesomorphs, compared to ectomorphs, are more prone to both skeletal

