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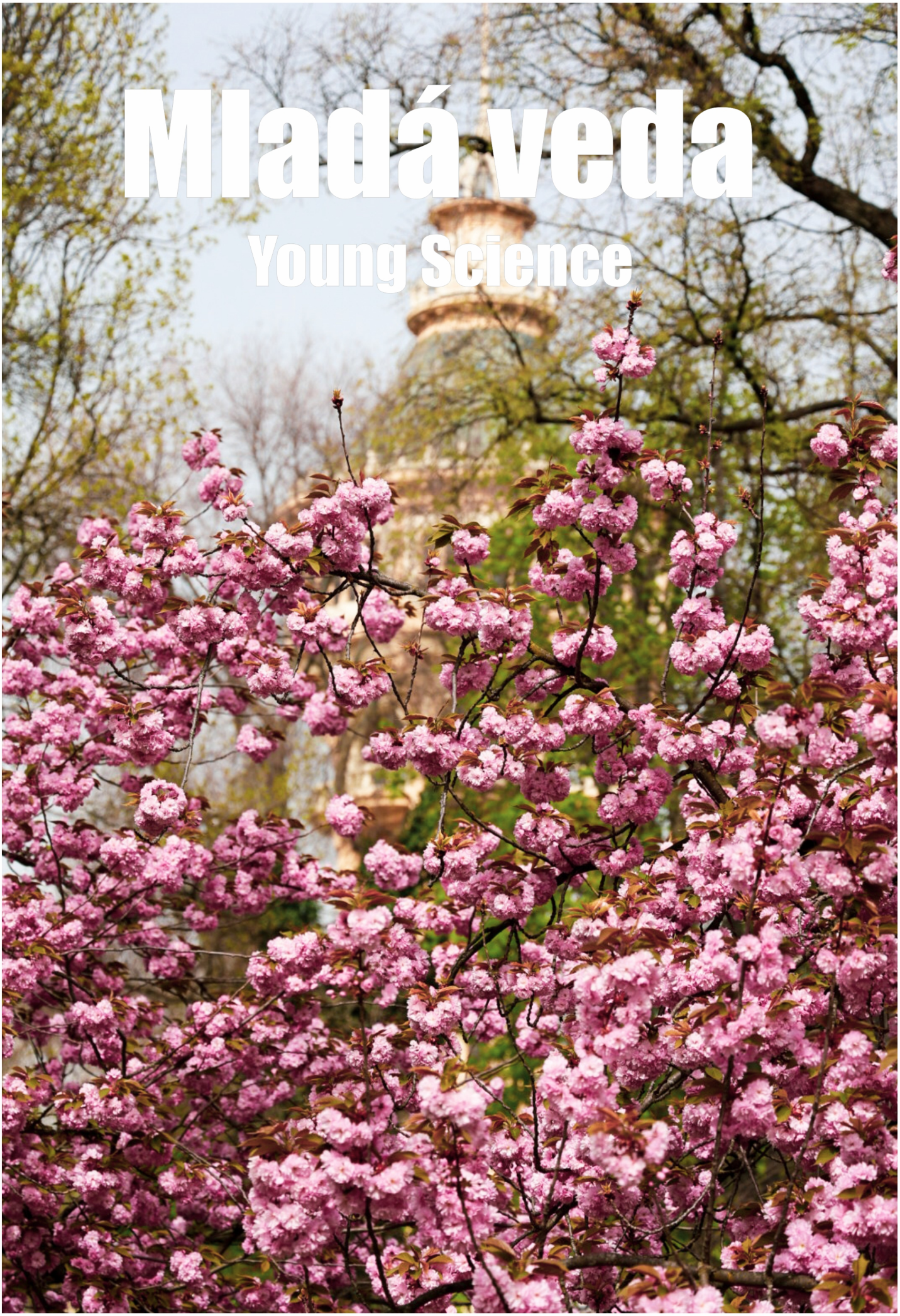

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POSTURAL ALIGNMENT OF PERFORMING ARTS STUDENTS IN RELATION TO BMI

DRŽANIE TELA U ŠTUDENTOV MÚZICKÝCH UMENÍ V ZÁVISLOSTI OD BMI INDEXU

Gabriel Bujdoš, Michal Marko, Štefan Adamčák [1]

Gabriel Bujdoš je doktorand na Fakulte telesnej výchovy, športu a zdravia Univerzity Mateja Bela. Jeho výskum sa zameriava predovšetkým na správanie študentov v oblasti pohybovej aktivity, vývoj a implementáciu intervenčných programov a podporu zdravého životného štýlu. Michal Marko pôsobí ako odborný asistent na Fakulte múzických umení Akadémie umení. Jeho vedecké záujmy sa sústreďujú na hodnotenie úrovne pohybovej aktivity, analýzu posturálnych charakteristík (vrátane držania tela a postavenia nôh) a skúmanie využívania voľného času študentmi. Štefan Adamčák pôsobí ako docent na Fakulte telesnej výchovy, športu a zdravia Univerzity Mateja Bela. Jeho výskum zahŕňa vzorce pohybovej aktivity rôznych vekových skupín, vplyv spánkových návykov a voľnočasové aktivity študentov.

Gabriel Bujdoš is a doctoral student at the Faculty of Sports, Science and Health, Matej Bel University. He focuses his research on physical activities of students, intervention programmes and healthy lifestyle. Michal Marko works as an assistant professor at the Faculty of Performing Arts at the Academy of Arts. His research interests focus on assessing the level of physical activity, analyzing postural characteristics (including posture and foot positioning), and examining students' use of leisure time. Štefan Adamčák works as an associate professor at the Faculty of Physical Education, Sport, and Health at Matej Bel University. His research includes patterns of physical activity in different age groups, the impact of sleep habits, and students' leisure activities.

Abstract

Proper posture plays a crucial role in the lives of students in music and other artistic disciplines, as their activities often lead to static and asymmetrical postural positions, potentially contributing to the development of musculoskeletal disorders. This study aims to analyse posture and its individual segments in relation to Body Mass Index (BMI) among female students of performing arts. The research sample consisted of 107 female students from the Faculty of Performing Arts, divided into two groups based on BMI: students with optimal

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weight (BMI 18.5–24.99) and underweight students (BMI < 18.5). Posture was assessed using the methodology of Klein and Thomas, modified by Mayer. Statistical analysis was conducted using the chi-square test and Spearman's correlation. Statistically significant differences were found between BMI categories in abdominal and pelvic posture ($p < 0.05$) and overall posture ($p < 0.05$). Evaluation of spinal curvature revealed that underweight students more frequently exhibited pronounced or flattened curvature (66.67%) compared to students with optimal weight (60.81%). No statistically significant association with BMI was observed in other body parameters such as head posture, chest posture, and shoulder position ($p > 0.05$). Underweight students achieved a higher proportion of good to nearly perfect posture (57.58%) compared to students with optimal weight (33.78%). The findings highlight the necessity for an individualized approach to students based on their BMI and the implementation of targeted physical interventions to improve postural habits. Regular monitoring and educational activities can enhance the health and well-being of students in artistic disciplines, thereby promoting the achievement of optimal postural balance.
Keywords: BMI index, diagnostics, performing arts, spinal mobility, students

Abstrakt

Vhodné držanie tela predstavuje kľúčový faktor v živote študentov hudobných a iných umeleckých odborov, nakoľko ich činnosti často vedú k statickým a asymetrickým posturálnym polohám, čo môže prispievať k vzniku muskuloskeletálnych porúch. Cieľom štúdie je analyzovať držanie tela a jeho jednotlivé segmenty v súvislosti s indexom telesnej hmotnosti (BMI) u študentiek múzických umení. Výskumný súbor tvorilo 107 študentiek Fakulty múzických umení, rozdelených na základe BMI do dvoch skupín: študentky s optimálnou hmotnosťou (BMI 18,5–24,99) a študentky s podváhou (BMI < 18,5). Držanie tela bolo hodnotené podľa metodiky Kleina a Thomasa, modifikovanej Mayerom. Na štatistickú analýzu výsledkov boli použité chí-kvadrát test a Spearmanova korelácia. Medzi kategóriami BMI boli zistené štatisticky významné rozdiely v držaní brucha a panvy ($p < 0,05$) a v celkovom držaní tela ($p < 0,05$). Pri hodnotení zakrivenia chrbtice sa ukázalo, že študentky s podváhou mali častejšie výrazné alebo sploštené zakrivenie (66,67 %) v porovnaní so študentkami s optimálnou hmotnosťou (60,81 %). V ostatných telesných parametroch, ako sú držanie hlavy, hrudníka a poloha ramien, nebola preukázaná štatisticky významná asociácia s BMI ($p > 0,05$). Študentky s podváhou dosiahli vyšší podiel dobrého až takmer dokonalého držania tela (57,58 %) oproti študentkám s optimálnou hmotnosťou (33,78 %). Výsledky poukazujú na potrebu individuálneho prístupu k študentom na základe ich BMI a na zavedenie cielenej pohybovej intervencie s cieľom zlepšiť posturálne návyky. Pravidelné monitorovanie a edukačné aktivity môžu prispieť k zlepšeniu zdravia a pohody študentov umeleckých odborov, čím podporia dosiahnutie optimálnej posturálnej rovnováhy.
Kľúčové slová: BMI index, diagnostika, múzické umenie, pohyblivosť chrbtice, študenti

Introduction

Proper posture plays a crucial role in the lives of music students, as many spend extended hours in static or asymmetrical positions during lessons and instrument practice. This can lead to both physical and psychological challenges. Research by Blanco-Piñeiro et al. (2015) identified the

most common postural errors among conservatory students, including incorrect positioning of the shoulders, head, and torso. Such misalignments contribute to pain and reduced mobility, which negatively impact performance and overall quality of life (Blanco-Piñeiro et al., 2015).
Shoebridge et al. (2017) emphasize that optimal posture is not merely a physical consideration but involves coordination between the body and mind. Their study highlights interdisciplinary approaches, such as the Alexander Technique, which aids students in achieving a balanced posture and minimizing effort during musical performance. This method supports dynamic postural alignment, which is vital for maintaining health and artistic excellence (Shoebridge et al., 2017).

Williamon and Thompson (2006) reported that conservatory students face both physical and psychological challenges, with high stress levels often correlating with postural issues. Their findings suggest that students frequently turn to their instructors for support rather than seeking professional healthcare, leading to inadequate management of health problems (Williamon & Thompson, 2006).
Fernández Paz et al. (2020) conducted a systematic review of 14 studies from four databases to analyse the impact of posture on musculoskeletal disorders and performance quality in musicians. Their findings indicate that posture is a significant risk factor for musculoskeletal issues and performance quality. However, each instrument imposes unique postural demands, which complicates the generalization of results (Fernández Paz et al., 2020).

Blanco-Piñeiro et al. (2018) examined the relationship between poor posture and musculoskeletal disorder risks across various instruments. Using 11 postural variables assessed by four experts, the study revealed significant associations between instrument groups and posture, particularly in pelvic alignment, spinal curvature, and head tilt. Instruments such as bagpipes, percussion, and string instruments were linked to better postural quality compared to instruments like the cello or flute (Blanco-Piñeiro et al., 2018).

Araújo et al. (2017) explored the lifestyle and health habits of music students in a study involving 483 participants from ten conservatories. Despite facing significant physical and psychological demands, the students exhibited suboptimal health behaviors, such as poor sleep quality, high perfectionism, and limited stress-management strategies. The authors underscore the need for improved health education and mental skills training to help musicians cope with the pressures of performance (Araújo et al., 2017).

Posture is also influenced by body composition. Smith et al. (2011) observed that adolescents with higher BMI frequently displayed hyperlordotic and exaggerated postural patterns due to uneven musculoskeletal load. Molina-García et al. (2020) confirmed that increased BMI affects head, lumbar, and thoracic spine positioning, leading to postural strain and long-term musculoskeletal problems (Smith et al., 2011), (Molina-García et al., 2020).

Similarly, Bogdanović and Čolović (2011) found a high prevalence of kyphotic posture among overweight children, particularly boys. However, their statistical analysis did not reveal a significant correlation between kyphotic posture and BMI (Bogdanović & Čolović, 2011).

Coelho et al. (2013) investigated the effects of nutrition and physical activity on children's posture, using photogrammetry to assess asymmetry. While physical activity was associated with greater shoulder and overall asymmetry, nutritional status showed no significant influence. However, low BMI was linked to reduced muscle stability and weaker

postural mechanisms, highlighting the importance of muscular activation for balance (Coelho et al., 2013).

Feldman (2016) emphasized that individuals with low BMI often experience diminished muscle mass, compromising postural stability. These findings align with research by Granata & Silon (2001) on trunk stability, which demonstrated that reduced muscle strength impairs spinal stability and weakens neuromuscular responses, ultimately affecting balance adjustment (Feldman, 2016), (Granata & Wilson, 2001).

Research Objective

The objective of the study was to analyse posture and its individual segments in relation to BMI within a group of students specializing in artistic disciplines, specifically interpretative performance and composition. The research was conducted as part of the VEGA grant project 1/0512/24.

Materials and Methods

The research sample consisted of full-time female students from the Faculty of Performing Arts at the Academy of Arts in Banská Bystrica. Based on the study's objective, participants were divided into two groups. The first group included 74 students with a BMI ranging from 18.5 to 24.99, categorized in the results section as having "optimal weight." The second group comprised 33 students classified as underweight (BMI < 18.5), referred to in the results section as "underweight." Prior to conducting somatometric assessments and posture evaluations, all participating students signed informed consent forms, agreeing to voluntary participation in the study. The assessments were carried out at the end of the summer semester of the 2023/2024 academic year and the beginning of the winter semester of 2024/2025.

Posture assessment adhered to the methodology of Klein and Thomas, modified by Mayer (Lenková et al., 2018). This method evaluates five key body areas: head and trunk posture, chest shape, abdominal contour and pelvic tilt, overall spinal curvature, and shoulder height and scapular positioning. Each parameter is scored on a scale from 1 to 4, with higher scores indicating greater deviations from the norm. The scores are summed to provide a comprehensive evaluation, classifying posture into four categories: excellent, good, weak, and poor. Statistical analysis of the results was performed using the chi-square test at significance levels of $p < 0.01$ and $p < 0.05$, as well as Spearman's correlation.

Results

Table 1 provides an evaluation of head posture in relation to the BMI categories "optimal weight" and "underweight." The results indicate that the majority of students in both groups exhibit a forward head posture. Specifically, 48.65% of students with optimal weight and 51.52% of students in the underweight category display a slightly forward head posture. A moderately forward head posture was observed in 31.08% of students with optimal weight and 30.30% of students with underweight, reflecting a similar distribution of this postural characteristic across both groups. Small differences were noted in the categories of upright head posture (6.76% for optimal weight and 6.06% for underweight) and significantly forward head posture (13.51% for optimal weight and 12.12% for underweight).

Evaluation Scale	*Optimal Weight*	*Underweight*
Upright Head	6.76%	6.06%
Slightly Forward Head Tilt	31.08%	30.30%
Moderately Forward Head Posture	48.65%	51.52%
Significantly Forward Head Posture	13.51%	12.12%

Table 1 - Assessment of Head and Trunk Posture Based on BMI
Source: Author's own research

he assessment of chest posture in relation to BMI is presented in Table 2. The largest proportion of students, regardless of BMI category, exhibit a slightly flattened chest, with 47.30% of students in the optimal weight category and 48.48% of students in the underweight category classified in this group. A higher prevalence of expanded chest was observed among underweight students (39.39%) compared to those with optimal weight (32.43%), highlighting differences in postural characteristics between the groups. Conversely, the flat chest category was more frequently represented among students with optimal weight (20.27%) compared to underweight students (12.12%).

Evaluation Scale	*Optimal Weight*	*Underweight*
Expanded Chest	32.43%	39.39%
Slightly Flattened Chest	47.30%	48.48%
Flat Chest	20.27%	12.12%

Table 2 - Assessment of Chest Posture Based on BMI
Source: Author's own research

The most significant difference in abdominal and pelvic posture among students was observed in the group with a relaxed abdomen, present in 44.59% of students with optimal weight but only 27.27% of underweight students (Table 3). Underweight students exhibited a higher prevalence of retracted abdominal posture, with 45.45% displaying a partially retracted abdomen and 27.27% showing a fully flat, retracted abdomen. This may reflect better muscle tension or distinct postural characteristics. The occurrence of a protruding abdomen was observed exclusively among students with optimal weight (6.76%) and was entirely absent in the underweight group.

Evaluation Scale	*Optimal Weight*	*Underweight*
Relaxed Abdomen	44.59%	27.27%
Partially Retracted Abdomen	40.54%	45.45%
Flat, Retracted Abdomen	8.11%	27.27%
Protruding Abdomen	6.76%	0.00%

Table 3 - Assessment of Abdominal and Pelvic Posture Based on BMI
Source: Author's own research

The spinal posture assessment based on BMI is presented in Table 4. Only a small proportion of students demonstrate spinal curvature within the physiological range—1.35% of students with optimal weight and 3.03% of underweight students. A significant portion of students in both groups exhibit pronounced or flattened spinal curvatures, accounting for 60.81% of

students with optimal weight and 66.67% of underweight students. The category of enlarged or more flattened spinal curvatures includes 37.84% of students with optimal weight and 30.30% of underweight students. These results suggest that students, regardless of BMI, tend to display varying degrees of spinal curvature deviations, with pronounced curvatures being particularly prevalent among underweight students.

Evaluation Scale	*Optimal Weight*	*Underweight*
Spinal Curvature Within Physiological Range	1.35%	3.03%
Spinal Curvatures Are Enlarged or More Flattened	37.84%	30.30%
Spinal Curvatures Are Pronounced or Flattened	60.81%	66.67%

Table 4 - Assessment of Spinal Posture Based on BMI
Source: Author's own research

The assessment of shoulder and scapular alignment based on BMI (Table 5) indicates that only 14.86% of students with optimal weight and 24.24% of underweight students exhibit symmetrical shoulders and scapulae, where the scapulae do not protrude, suggesting better alignment in this area among underweight students. In contrast, significant deviations, characterized by uneven shoulders and significantly protruding scapulae, were observed in 31.08% of students with optimal weight and 24.24% of underweight students. The largest group consists of students with asymmetrical shoulders and slightly protruding scapulae, representing 54.05% of students with optimal weight and 51.52% of underweight students.

Evaluation Scale	*Optimal Weight*	*Underweight*
Shoulders and Scapulae Are Symmetrical, Scapulae Do Not Protrude	14.86%	24.24%
Shoulders Are Uneven, Scapulae Protrude Significantly	31.08%	24.24%
Shoulders Are Asymmetrical, Scapulae Protrude Slightly	54.05%	51.52%

Table 5 - Assessment of Shoulder and Scapular Posture Based on BMI
Source: Author's own research

Table 6 summarizes the overall posture of students based on the modified Klein and Thomas method, highlighting differences between the "optimal weight" and "underweight" categories. Underweight students demonstrate a higher proportion of good to nearly perfect posture (57.58%) compared to students with optimal weight (33.78%). Conversely, weak posture was more commonly observed among students with optimal weight (66.22%) compared to underweight students (42.42%). These differences may be attributed to factors such as muscle strength, tension, and postural alignment.

Evaluation Scale	*Optimal Weight*	*Underweight*
Good to Nearly Perfect Posture	33.78%	57.58%
Weak Posture	66.22%	42.42%

Table 6 - Summary Assessment of Posture According to Klein and Thomas, Modified by Mayer
Source: Author's own research

The results of the chi-square tests reveal a statistically significant relationship at the $p<0.05$ level between BMI categories ("optimal weight" and "underweight") and the attributes of "abdomen and pelvis" ($\chi^2 = 10.08$, df = 3, $p = 0.018$) as well as "overall posture" ($\chi^2 = 4.40$, df = 1, $p = 0.020$). In contrast, no significant associations with BMI categories were found for the attributes of head ($\chi^2 = 0.093$, df = 3, $p = 0.993$), chest ($\chi^2 = 1.18$, df = 2, $p = 0.554$), spine ($\chi^2 = 0.834$, df = 2, $p = 0.659$), or shoulders ($\chi^2 = 1.53$, df = 2, $p = 0.466$), as all p-values exceeded 0.05.

The analysis of the correlation matrix using Pearson's correlation coefficient yielded the following results:

- The strongest positive correlation was observed between spinal alignment and overall posture (correlation coefficient ≈ 0.65), indicating a significant linear relationship, where improved spinal alignment directly contributes to the optimization of posture.
- A moderate positive correlation was identified between shoulder position and overall posture (correlation coefficient ≈ 0.30).
- Correlations among other variables, including head, chest, abdomen, and shoulders, showed correlation coefficients close to zero, indicating minimal or no linear association between these factors.

Discussion

Although our study did not evaluate results for the categories of overweight and obesity, it is important to highlight several studies that have examined the relationship between posture and elevated BMI levels. For instance, Viester et al. (2013), in a sample of 44,793 respondents, found that overweight and obesity significantly increase the prevalence of musculoskeletal symptoms, with the lower limbs being most affected. The association between high BMI and symptoms was most pronounced in employees with low physical workloads, where excess weight contributed to increased joint stress. Obesity also slowed recovery from symptoms, with obese individuals less likely to experience symptom resolution compared to those with normal weight. Underweight participants were excluded from the analysis due to insufficient sample size.

Miranda et al. (2021) conducted a study focusing on the relationship between posture, body mass index (BMI), gender, and physical activity in adolescents. The study included 217 adolescents aged 11 to 15 years and employed various methods, including photogrammetry and the Foot Posture Index, to assess posture. The results showed that adolescents with obesity exhibited a greater lumbar lordosis angle, while those classified as overweight displayed a more pronounced forward head posture compared to their peers with normal weight. Gender also influenced posture, with girls tending to exhibit greater forward head positioning and increased pelvic tilt angles, whereas boys demonstrated more forward trunk projection. Additionally, sedentary adolescents with lower physical activity levels exhibited increased scapular abduction, aligning with our findings where over 50% of students showed slightly winged scapulae or asymmetrical shoulders.

Kasović et al. (2022) investigated longitudinal associations between sports participation, body fat percentage, and posture in children, analyzing data from the Czech ELSPAC project on participants aged 11, 13, and 15 years. Their findings revealed that poor posture was

observed in 35.6% of children and adolescents, with prevalence increasing with age—from 28% at age 11 to 41% at age 15. This trend is consistent with our findings, which recorded weak posture in an average of 54% of students. The authors further emphasized the critical role of sports participation, noting that children not engaged in club or competitive sports had a significantly higher risk of poor posture, with risk increases ranging from 61% to 68%, depending on the intensity of sports activity. Moreover, children classified as obese had a higher likelihood of poor posture compared to their peers with normal body weight.

Several intervention programs have been implemented to improve posture across various age groups. For example, a study by Mandzáková and Slováková (2023) examined the impact of an 18-week physical activity program on posture improvement in younger school-age children (n=102). The program included music-based movement and dance activities conducted twice a week during physical education lessons. The results demonstrated significant improvements in posture for both boys and girls, particularly in the areas of head and neck alignment, chest positioning, abdominal and pelvic tilt, spinal curvature, and scapular positioning. Notably, these improvements were independent of baseline BMI, suggesting that physical activity can positively influence posture regardless of children's body weight.

Yiu et al. (2020) explored a 10-week resistance exercise program aimed at improving posture and strengthening neck and shoulder muscles in a group of 23 students. The program involved daily two-minute exercises performed five days a week. The results showed an improvement in posture, as indicated by a 1.88-point reduction in RULA scores ($p<0.01$), and an increase in isometric neck muscle strength by 17.2% to 23.2%. However, no significant reduction in neck and shoulder pain symptoms was observed.

A study by Ohlendorf, Wanke, and Filmann et al. (2017) provided valuable insights into posture and sitting positions among professional musicians, aiming to identify factors contributing to musculoskeletal disorders. The research utilized three-dimensional back scanning to precisely quantify upper body posture without direct contact with the subjects. Musicians were tested on various chair types, and their sitting positions were evaluated. The findings highlighted significant differences in posture depending on the type of chair used, which influenced spinal load distribution and the risk of musculoskeletal issues. The study proposed ergonomic interventions, including adjustments to chair designs and the use of specialized cushions, to improve postural stability and reduce injury risks among musicians.

Ergonomic interventions were also explored in a two-year study by Koskelo et al. (2007), which examined the effects of adjustable school furniture—height-adjustable desks and chairs—on sitting and standing posture among high school students. The results demonstrated significant improvements in posture and reductions in muscle tension in the trunk and neck, which were also associated with enhanced academic performance.

Conclusion

Based on the results of our study, several key conclusions can be drawn regarding the postural alignment of students in relation to their BMI categories. A slight forward head posture was observed in both groups, with only minor differences in its distribution. More pronounced variations were identified in the assessment of chest, abdominal, and pelvic alignment, as well as in the overall evaluation of posture.

One of the main findings is that underweight students achieved a higher proportion of correct to nearly perfect posture compared to students with optimal weight. This difference was statistically significant ($p<0.05$), emphasizing the need for a tailored approach to different BMI groups in the context of physical interventions. Underweight students also exhibited significant spinal curvature more frequently, suggesting a predisposition to postural abnormalities. A strong positive correlation was observed between spinal condition and overall posture, confirming the close relationship between these two variables.

Based on these findings, we propose the following recommendations for practical application:

- *Regular Postural Assessments:* Systematic monitoring and evaluation of posture can facilitate the early detection of abnormalities and provide opportunities for preventive measures aimed at improving postural habits.
- *Educational Activities:* Raising awareness and educating students on the importance of proper posture and its impact on overall health are essential. These activities can promote increased awareness and encourage a proactive approach to improving postural habits.
- *Targeted Postural Interventions:* Specialized exercise programs focused on correcting the alignment of the head, chest, and spine are recommended. These programs should also include exercises to strengthen the deep stabilizing muscles (core), thereby improving abdominal and pelvic alignment.

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