Influence of kinanthropometric characteristics on spinal health among Peruvian university students

Influencia del perfil cineantropométrico en la salud de la columna vertebral en universitarios peruanos

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Abstract

Introduction: Spinal health is a fundamental aspect of quality of life for university students. Factors such as a sedentary lifestyle, poor posture, and body composition can influence the onset of musculoskeletal disorders.
Objective: To determine the influence of the kinanthropometric profile on spinal health in Peruvian university students.
Method: A cross-sectional study was conducted with a sample of 150 university students in their second to fifth year of physical therapy and rehabilitation at a national university in Lima, Peru. The kinanthropometric profile was assessed using the ISAK Protocol, and spinal health was evaluated using the Neck Disability Index (NDI) and the Oswestry Low Back Disability Index (ODI) questionnaires.
Results: Endomorphic somatotype, fat percentage, and muscle mass percentage were found to be significantly associated with spinal disability (p < 0.05). Significant predictors of overall spinal disability were adiposity percentage (OR = 1.25; 95%CI: 1.03–1.52; p = 0.025) and BMI (OR = 1.37; 95%CI: 1.01–1.86; p = 0.042). For cervical disability, ectomorphic somatotype (OR = 4.86; 95%CI: 1.78–13.26; p = 0.002) and BMI (OR = 1.65; 95%CI: 1.22–2.24; p = 0.001) were identified as significant predictors. Lumbar disability was predicted by muscle mass percentage (OR = 1.57; 95%CI: 1.13–2.18; p = 0.007) and the acromio-iliac index (OR = 0.96; 95%CI: 0.92–1.00; p = 0.043).
Conclusion: This study shows that certain components of the kinanthropometric profile predict spinal health in university students.

Keywords

Anthropometry; body composition; kinanthropometric profile; spinal disability; university students

Resumen

Introducción: La salud espinal es un aspecto fundamental de la calidad de vida de los estudiantes universitarios. Factores como el estilo de vida sedentario, la mala postura y la composición corporal pueden influir en la aparición de trastornos musculoesqueléticos. Objetivo: Determinar la influencia del perfil cineantropométrico en la salud espinal de estudiantes universitarios peruanos.
Método: Se realizó un estudio transversal con una muestra de 150 estudiantes universitarios de segundo a quinto año de la carrera de terapia física y rehabilitación en una universidad nacional de Lima, Perú. El perfil cineantropométrico se evaluó utilizando el Protocolo ISAK, y la salud espinal se evaluó mediante los cuestionarios *Neck Disability Index* (NDI) y *Oswestry Low Back Disability Index* (ODI).
Resultados: Se encontró que el somatotipo endomórfico, el porcentaje de grasa y el porcentaje de masa muscular se asociaron significativamente con la discapacidad espinal (p < 0.05). Los predictores significativos de la discapacidad espinal global fueron el porcentaje de adiposidad (OR = 1.25; IC95%: 1.03–1.52; p = 0.025) y el IMC (OR = 1.37; IC95%: 1.01–1.86; p = 0.042). Para la discapacidad cervical, se identificaron como predictores significativos el somatotipo ectomórfico (OR = 4.86; IC95%: 1.78–13.26; p = 0.002) y el IMC (OR = 1.65; IC95%: 1.22–2.24; p = 0.001). La discapacidad lumbar fue predicha por el porcentaje de masa muscular (OR = 1.57; IC95%: 1.13–2.18; p = 0.007) y el índice acromio-ilíaco (OR = 0.96; IC95%: 0.92–1.00; p = 0.043).
Conclusión: Este estudio muestra que ciertos componentes del perfil cineantropométrico predicen la salud espinal en estudiantes universitarios.

Palabras clave

Antropometría; composición corporal; perfil cineantropométrico; discapacidad espinal; estudiantes universitarios

Introduction

Spinal health is a determining factor in the quality of life and academic performance of university students (López, 2020; Krifa et al., 2025). In the present study, spinal health is defined as the optimal functional state of the vertebral column, including postural alignment, mobility, absence of disabling pain, and preservation of spinal curves, which distinguishes it from broader concepts such as general musculoskeletal health or isolated low back pain (El Choueiri et al., 2025; Kumar et al., 2025). During this stage, changes in lifestyle habits, longer study hours, poor posture, and decreased physical activity are causing changes in anthropometric characteristics, which can influence the onset of musculoskeletal disorders (Curotto-Winder, 2022; Espí-López, 2019; Javier-Rivera, 2023). In this context, kinanthropometry, a discipline that studies the relationship between body structure and human movement, is a key tool for assessing risk factors associated with spinal disorders (Kurten et al., 2021).

Musculoskeletal disorders have a high prevalence among university students worldwide, with studies reporting rates ranging from approximately 41% to over 90%, depending on the population and the evaluation period (Agatha et al., 2022; Kandasamy et al., 2024). For example, a study in Saudi Arabia found that 41.6% of students had a history of musculoskeletal disorders (Kandasamy et al., 2024), while research conducted in Egypt and Indonesia reported prevalence rates of 82% and 90.3%, respectively, within the past year or during lectures (Agatha et al., 2022; Mohamed, 2021). In Brazil, a study involving 792 undergraduate health students revealed a prevalence of 74.9% of musculoskeletal pain, particularly in the spine, with higher rates among women, younger students, and those with intensive mobile phone use or limited leisure time (Morais et al., 2019). In Peru, a study of 149 final-year dentistry students reported that 95.2% experienced musculoskeletal pain in the previous year, although only 27.7% sought treatment; the pain was mainly attributed to poor posture and body positioning during academic activities (Vidal et al., 2020). Another Peruvian study among male university students in Lima found a prevalence of 1.3% of muscle dysmorphia, a specific type of musculoskeletal disorder, but this figure is much lower than the overall prevalence of musculoskeletal disorders (Sanchez-Castro et al., 2019). These findings reflect lifestyle patterns among Peruvian university students, such as prolonged sitting during lectures, high academic workload, and limited physical activity, which directly compromise spinal health and increase the risk of long-term postural and musculoskeletal dysfunctions.

Several studies have shown that the kinanthropometric profile, which includes variables such as body mass index (BMI), body fat distribution, body biotype (endomorph, mesomorph, and ectomorph), proportionality, postural alignment, and flexibility, may be related to the development of spinal pathologies such as scoliosis, hyperlordosis, hyperkyphosis, or alterations in spinal mobility (Baek, 2024; Grabara & Witkowska, 2024; Guzmán-Muñoz et al., 2019; 2023; Matiichuk et al., 2021; Taspinar et al., 2017; Zerf, 2017).

The spine performs essential functions such as support, load transmission, postural control, and adjustment of the center of gravity (Busquet, 2007; Dufour & Pillu, 2018). Changes in body composition, specifically an increase in the endomorphic component of the somatotype, can increase the load on the lumbar region of the spine (Baek, 2022; Bayartai et al., 2023; Prat-Luri, 2023). On the other hand, a predominance of the ectomorphic component, characterized by longer and thinner body segments, can increase the moment of force that muscles must withstand, generating additional tension in regions such as the cervical, dorsal, and lumbar areas (Pacheco et al., 2023; Penna et al., 2023). This muscular imbalance and compensation, caused by variations in the length and thickness of the segments, affects the normal curvature of the spine and produces changes and interdependence with adjacent curves (Parsons & Marcer, 2007).

Good spinal health requires better condition and balance between the different structural components, particularly the muscles, which improve support and load-bearing capacity, preserve functionality, and protect the spinal curves (Kapandji, 2011). This characteristic optimizes metabolic and physiological adaptations to inflammatory and degenerative processes in the spine (Okifuji, 2015). Therefore, knowledge of morphological dimensions and body proportions is essential for understanding the alignment of the body's center of gravity and the biomechanics of movement, which are key aspects in the prevention of postural disorders and musculoskeletal dysfunctions.

Morphostructural and biomechanical analysis in university students is of particular interest because they tend to adopt sedentary behaviors, with problems in regions of the spine resulting from prolonged postures and low physical activity (Janc et al., 2023). Based on the above, the present study aims to analyze the influence of the cineanthropometric profile on spinal health in Peruvian university students. Through this research, it seeks to generate evidence that contributes to the development of preventive strategies and intervention programs that promote better postural health and long-term awareness in university students.

Method

Participants

Sampling was stratified by sex and age for a population of 204 university students (112 women and 92 men) in the physical therapy and rehabilitation department of a public university in Lima. The sample size was obtained using a priori sample size calculator for structural equation models, which considered the following parameters: expected effect size (0.25), statistical power level (0.80), and probability level (0.05). This analysis found that the minimum sample size was 134. Therefore, the sample size achieved was 150 participants. The criteria for participation included being a university student enrolled in the 2nd to 5th year and over 18 years of age. Students with recent spinal trauma, previous surgery, use of a cervical collar, current treatment, pregnancy, endocrine diseases, tuberculosis, and ligamentous hyperlaxity syndrome were excluded.

Procedure

Data collection was carried out using a digital questionnaire (Google Forms) administered in an academic setting at a national university in Peru. The estimated time to complete the survey was approximately 10 to 15 minutes per participant. Data collection took place in January and February 2025.

Ethical Considerations

The study was approved by RESOLUTION No. 0355-2025-EP WPR-UNE of the postgraduate thesis project and authorized by OFFICIAL LETTER No. 0051/FM-EPTM/2025 of the School of Medical Technology of the Faculty of Medicine of the National University of San Marcos. In addition, respondents signed and confirmed their participation through informed consent.

Instrument

Kinanthropometric measurements

Kinanthropometric assessments were performed using 42 measurements from the International Society for the Advancement of Kineanthropometry (ISAK, 2024) protocol. The anthropometrists who collected the data were an evaluator certified at ISAK Level 3, with experience in anthropometric assessments. To minimize information bias, the evaluators were blinded to the disability status of the participants during data collection. All measurements were carried out in person, during morning hours (8:00–11:00 a.m.), in a standardized order: body mass and height, followed by skinfolds, perimeters, and bone diameters. Participants were evaluated barefoot and in light clothing, following ISAK recommendations.

Basic measurements were obtained, including somatotype, body composition, and proportionality. In the basic measurements, body mass was measured using a Taylor Model 7558 scale, Lima, Peru, with an accuracy of 0.00 kg ± 0.01kg; height and seated height were measured using a Seada 212 stadiometer (20-205 cm ± 5mm) and an anthropometric bench (40 cm in height, 50 cm in length, and 30 cm in width). BMI was calculated using the World Health Organization formula (body mass kg/height cm). Skin fold measurements were taken using the Slim Guide skinfold caliper (0 ± 0.1 mm, amplitude 80 mm, and closure pressure 10 g/mm2 ± 0.2 g/mm2); triceps, subscapular, biceps, iliac crest, supraspinatus, abdominal, thigh, and leg skinfolds were measured. For perimeters, a metal anthropometric tape measure (0-200 cm ± 0.2 mm, Lufkin) was used to measure the head, relaxed arm, flexed arm, forearm, chest, waist, hips, thigh (1 cm from the buttocks), mid-thigh, and leg. For small bone diameters, the Tommy 3 Rosscraft small branch anthropometer (0 to 144 mm ± 1 mm) was used to measure the humerus and femur bicondyles, and for large diameters, the biacromial, biiliocrestal, transverse of the thorax and anteroposterior of the thorax with the large-branch Campbell 20, Rosscraft (0 to 55 cm ± 1 mm). For somatotype, Carter and Heath's three-component analysis (Villanueva, 2010) was used: endomorph, mesomorph, and ectomorph, and their categories based on the predominance of numerical quantification. For body composition, the five-compartment method was used, estimating muscle mass, fat mass, bone mass, residual mass, and skin (Kerr, 1988; Ross et al., 1999; Ross and Kerr, 1993).

The quality control of anthropometric data was evaluated in 68 university students during the first week of data collection; technical measurement errors (TME) and intraclass correlation coefficients R based on ANOVA were used to estimate the degree of accuracy and the proportion of variation in measurements. These were 0.2 cm, 0.90 height; 0.1 kg, 0. 95 body mass; 0.2 mm, 0.92 body skinfold thickness; 0.3 cm, 0.94 perimeters; 0.2 cm, 0.95 lengths; and for bone diameters, 0.2 mm, 0.92 (Norton and Olds, 1996).

Spinal health assessment

Two freely available questionnaires (Shirley Ryan AbilityLab, 2013; 2015) were used to assess spinal health. The first was the Neck Disability Index (NDI, Vernon & Mior, 1991), which aims to assess disability due to neck pain. The Spanish version by Andrade et al. (2008) was used. It consists of 10 questions with six answer options ranging from 0 to 5, expressing progressive levels of pain or limitation in activities. To obtain your score, the scores obtained are doubled to give a percentage rating out of 100 (0-20 normal, 21-40 mild disability, 41-60 moderate, 61-80 severe, and 80+ complete/exaggerated).

The second measure was the Oswestry Disability Index (ODI, Fairbank et al., 1980), which aims to measure disability due to low back pain using 10 items. The version adapted into Spanish by Pomares et al. (2020) was used. The score ranged from 0 to 5 (0 for no disability and 5 for the most severe disability). The sum of all items has a maximum of 50. This total is doubled and expressed as a percentage of disability (0-20% minimum disability and 81-100% represents maximum disability) (Sheahan et al., 2015).

The validity of the NDI and ODI questionnaires was obtained through the judgment of three judges with experience in pain rehabilitation, spinal management, and instrument validation methodology, who evaluated the clarity, consistency, and relevance of each question item on a 4-point scale (0 = does not meet, 1 = low level, 2 = moderate level, and 3 = high level). The Aiken test yielded a value of 0.86 for NDI and 0.90 for ODI, which are adequate and excellent ratings, respectively. To assess internal consistency reliability, a pilot study was conducted with 68 participants; Cronbach's alpha (α) and McDonald's omega (ω) estimators were used for the NDI ($\alpha = 0.77$, $\omega = 0.70$) and the ODI ($\alpha = 0.80$, $\omega = 0.82$). It was concluded that the psychometric properties of both questionnaires were good and reliable for application.

Data analysis

Data analysis was carried out in different stages. First, descriptive data from the sample evaluated was reported using the mean and standard deviation for quantitative variables and frequencies with percentages for qualitative variables. Second, the bivariate association analysis of categorical variables was calculated using Fisher's exact test in the case of non-normal distribution and the Chi-square (X2) test in cases of normal distribution; in both tests, the significance was set at $p < 0.05$. Third, multivariate analysis was performed using multiple logistic regression, using odds ratio (OR), which is interpreted as a positive prediction (OR > 1), a negative prediction (OR < 1), and no predictive ability (OR = 1) (Tamargo, 2019). These prognostic values were accompanied by the level of statistical significance (p) defined as less than 0.05. Also, 95% confidence intervals were reported for these reasons, highlighting those that do not include the value 1, indicating a statistically significant association. Descriptive data, bivariate association data, and multivariate logistic regression data were analyzed using Microsoft Office Excel 2019 and the open-source statistical software Jamovi (v.2.3.28).

Results

A total of 150 university students who met the selection criteria participated in the study (47.3% women and 52.7% men), aged between 18 and 31 years (M = 22.24; SD = 2.53). Similarly, descriptive values for weight and height were recorded. Likewise, for somatotype, the endomorphic component (M = 4.38; SD = 1.30), mesomorphic (M = 5.08; SD = 1.62), and ectomorphic (M = 1.60; SD = 1.12) were recorded. Body composition was recorded through the percentage of fat (M = 27.9; SD = 6.57), muscle mass (M = 41.2;

SD = 4.43), and bone mass (M = 11.95; SD = 2.17). The descriptions of body proportions were detailed for the waist-to-hip ratio (M = 0.84; SD = 0.09), BMI (M = 23.9; SD = 3.04), skinfold index (M = 52.41; SD = 4.46), skeletal index (M = 91.85; SD = 12.48), acromion-iliac index (M = 82.88; SD = 10.63), and relative wingspan (M = 99.87; SD = 4.75). For more details on the percentage values for each variable, see Table 1.

Table 1. General characteristics of university students

General characteristics	Female (n = 71, 47.3%)	Male (n = 79, 52.7%)	Total f (%)
Year of study			
2nd year	31 (54.4%)	26 (45.6%)	57 (38.0%)
3rd year	17 (50.0%)	17 (50.0%)	34 (22.6%)
4th year	16 (51.0%)	15 (49.0%)	31 (20.6 %)
5th year	15 (53.5%)	13 (46.5%)	28 (18.8%)
BMI			
Underweight	2 (50.0%)	2 (50.0%)	4 (2.7%)
Normal	52 (54.2%)	44 (45.8%)	96 (64.0%)
Obesity I	6 (66.6%)	3 (33.4%)	9 (6.0%)
Overweight	19 (46.3%)	22 (53.7%)	41 (27.3%)
Somatotype categories			
Endomorphic–Mesomorphic	21 (65.6%)	11 (34.4%)	32 (21.3%)
Endomorphic–Mesomorph	8 (53.3%)	7 (46.7%)	15 (10%)
Endomorphic–Ectomorphic	2 (66.6%)	1 (33.4%)	3 (2%)
Balanced Endomorph	2 (40%)	3 (60%)	5 (3.3%)
Mesomorphic–Endomorphic	39 (54.2%)	33 (45.8%)	72 (48%)
Mesomorphic–Endomorph	2 (100%)	0 (0%)	2 (1.3%)
Mesomorphic–Ectomorphic	2 (66.6%)	1 (33.4%)	3 (2%)
Balanced Mesomorph	2 (14.3%)	12 (85.7%)	14 (9.3%)
Ectomorphic–Endomorphic	1 (100%)	0 (0%)	1 (0.7%)
Ectomorphic–Mesomorphic	2 (100%)	0 (0%)	2 (1.3%)
Central	1 (100%)	0 (0%)	1 (0.7%)
Waist–hip ratio			
Poor	13 (81.3%)	3 (18.7%)	16 (10.7%)
Good	27 (56.3%)	21 (43.7%)	48 (32.0%)
Excellent	39 (45.3%)	47 (54.7%)	86 (57.3%)
Cormic index			
Short trunk	33 (50.7%)	32 (49.3%)	65 (43.3%)
Medium trunk	27 (49.1%)	28 (51.9%)	55 (36.7%)
Long trunk	19 (63.3%)	11 (36.7%)	30 (20.0%)
Skeletal index			
Short legs	15 (62.5%)	9 (37.5%)	24 (16.0%)
Medium legs	20 (80.0%)	5 (20.0%)	25 (16.7%)
Long legs	44 (43.5%)	57(56.5%)	101 (67.3%)
Acromio–iliac index			
Rectangular type	63 (55.7%)	50 (44.3%)	113 (75.3%)
Intermediate type	11 (55%)	9 (45%)	20 (13.3%)
Trapezoidal type	5 (29.4%)	12(70.6%)	17 (11.3%)
Relative arm span			
Greater span	49 (62.0%)	30 (38%)	79 (52.7%)
Smaller span	29 (44.6%)	36 (55.4%)	65 (43.3%)
Equal span	1 (16.6%)	5 (83.4%)	6 (4.0%)

Detailed distributions by sex and severity for cervical (NDI) and lumbar (ODI) disability are shown in Table 2. Of the 150 students, 76 (50.7%) presented cervical disability according to the NDI: 54 (36%) with mild disability, 21 (14%) with moderate disability, and 1 (0.7%) with severe disability. In contrast, 74 (49.3%) had no cervical disability. Regarding the lumbar spine, 57 students (38%) presented disability according to the ODI: 42 (28%) with mild disability, 14 (9.3%) with moderate disability, and 1 (0.7%) with severe disability, while 93 (62%) reported no lumbar disability.

Table 2. Cervical Disability (NDI) and Lumbar Disability (ODI) in University Students

Presence of Disability	NDI			ODI		
	Women n (%)	Men n (%)	Total n (%)	Women n (%)	Men n (%)	Total n (%)
No disability	4 (26.67%)	3 (22.67%)	74 (49.3%)	5 (33.33%)	43 (28.6%)	93 (62.0%)
Mild disability	2 (15.3%)	3 (20.67%)	54 (36.0%)	12 (46.67%)	30 (20.0%)	42 (28.0%)
Moderate disability	6 (40.0%)	1 (10.0%)	21 (14.0%)	7 (4.67%)	7 (4.67%)	14 (9.3%)
Severe disability	1 (1.0%)	0 (0.0%)	1 (0.7%)	1 (0.67%)	0 (0.0%)	1 (0.7%)
Total	13 (100%)	7 (100%)	150 (100%)	25 (100%)	80 (100%)	150 (100%)

Note. NDI = Cervical Disability, ODI = Lumbar Disability

Regarding the bivariate analysis, Table 3 shows that there are significant differences between the endomorph somatotype and the presence of lumbar disability ($p < 0.05$). Likewise, there were significant differences in body composition in terms of fat percentage and muscle mass.

Table 3. Mean differences between the presence of disability and anthropometric variables

Variable	Disability		DM [95% CI]	*p*	*d*
	Without M (SD)	With M (SD)			
Somatotype					
Endomorphic	3.99 (1.23)	4.58 (1.31)	-0.59 (-1.03, -0.15)	0.009ª	-0.46
Mesomorphic	4.85 (1.60)	5.21 (1.62)	-0.36 (-0.92, 0.15)	0.153ª	0.14
Ectomorphic	1.69 (0.81)	1.57 (1.26)	0.13 (-0.25, 0.51)	0.508	0.11
Body composition					
Fat percentage	24.97 (7.44)	29.47 (5.54)	-4.50 (-6.63, -2.36)	< .001	-0.72
Bone percentage	12.10 (1.59)	11.89 (2.41)	0.21 (-5.27, 0.96)	0.566	0.09
Muscle mass percentage	42.19 (4.39)	40.69 (4.39)	1.50 (-0.00, 3.00)	0.050ª	0.34
Proportionality					
Waist–hip ratio	0.84 (0.80)	0.84 (0.10)	-0.07 (-0.04, 0.03)	0.658	-0.07
BMI	23.45 (2.18)	24.36 (3.83)	-1.11 (-2.27, 0.04)	0.059	-0.34
Cormic index	52.19 (3.62)	52.52 (4.84)	-0.03 (-0.76, 0.68)	0.900	0.01
Skeletal index	92.59 (10.68)	91.48 (13.33)	1.11 (-3.17, 5.40)	0.608	0.09
Acromio–iliac index	84.40 (11.35)	99.25 (7.06)	2.27 (-1.36, 5.91)	0.218	0.21
Relative arm span	99.25 (7.06)	100.17 (2.99)	-0.10 (-1.12, 0.67)	0.747ª	0.03

Note. M = Mean; SD = Standard deviation; DM = Mean difference; CI = Confidence interval; p = Statistical significance test; d = Cohen's effect size; [a] = Values obtained from Student's t-test due to normal distribution.

The predictors of spinal disability were body fat percentage (OR = 1.25, 95% CI: 1.03–1.52, p = 0.025) and BMI (OR = 1.37, 95% CI: 1.01–1.86, p = 0.042). For the cervical spine, the predictors were the ectomorphic component of the somatotype (OR = 4.86, 95% CI: 1.78–13.26, p = 0.002) and BMI (OR = 1.65, 95% CI: 1.22–2.24, p = 0.001). In the case of lumbar spine disability, muscle mass percentage (OR = 1.57, 95% CI: 1.13–2.18, p = 0.007) had a direct prediction, while the acromio-iliac index showed an inverse prediction (OR = 0.96, 95% CI: 0.92–1.00, p = 0.043) (Table 4).

Table 4. Multiple logistic regression between kinanthropometric profile and spinal disability

Variable	Spinal Disability			Cervical Disability			Lumbar Disability		
	β	OR (95% CI)	p	β	OR (95% CI)	p	β	OR (IC 95%)	p
Somatotype									
Endomorphic	-0.13	0.88 (0.36, 2.15)	0.773	0.14	1.16 (0.50, 2.70)	0.739	-0.01	0.99 (0.44, 2.22)	0.979
Mesomorphic	0.45	1.57 (0.97, 2.54)	0.064	0.42	1.53 (0.98, 2.37)	0.060	0.13	1.15 (0.77, 1.71)	0.509
Ectomorphic	0.92	2.53 (0.94, 6.82)	0.067	1.58	4.86 (1.78, 13.26)	0.002	0.10	1.11 (0.49, 2.51)	0.796
Body composition									
Fat percentage	0.22	1.25 (1.03, 1.52)	0.025	0.12	1.13 (0.95, 1.35)	0.159	0.17	1.19 (0.99, 1.44)	0.070
Bone percentage	-0.02	0.98 (0.90, 1.06)	0.56	-0.03	0.97 (0.90, 1.05)	0.419	-0.01	0.99 (0.90, 1.08)	0.739
Muscle mass percentage	0.13	1.15 (0.84, 1.58)	0.396	-0.06	0.94 (0.71, 1.25)	0.675	0.45	1.57 (1.13, 2.18)	0.007
Proportionality									
Waist–hip ratio	0.06	1.06 (0.85, 1.34)	0.596	0.02	1.02 (0.83, 1.26)	0.850	0.08	1.09 (0.87, 1.37)	0.465
BMI	0.31	1.37 (1.01, 1.86)	0.042	0.50	1.65 (1.22, 2.24)	0.001	0.07	1.07 (0.83, 1.38)	0.586
Cormic index	-0.11	0.89 (0.59, 1.33)	0.567	-0.04	0.96 (0.65, 1.43)	0.842	-0.08	0.92 (0.64, 1.33)	0.665
Skeletal index	-0.05	0.95 (0.82, 1.10)	0.496	-0.03	0.96 (0.84, 1.11)	0.615	-0.03	0.97 (0.85, 1.11)	0.618
Acromio–iliac index	-0.01	0.98 (0.94, 1.02)	0.334	0.01	1.02 (0.98, 1.05)	0.457	-0.04	0.96 (0.92, 1.00)	0.043
Relative arm span	0.07	1.07 (0.98, 1.18)	0.127	0.04	1.05 (0.96, 1.15)	0.311	0.07	1.08 (0.97, 1.20)	0.152

Note. β = log-odds coefficient; OR = odds ratio; 95% CI = 95% confidence interval. Significant p-values are bolded.

Discussion

Currently, long hours of study, limited physical activity, and prolonged postures have led to an increase in sedentary lifestyles among university students (López, 2020; Krifa et al., 2025). (Krifa et al., 2025). As a result, there is an increased risk of complications such as musculoskeletal disorders, pain, and spinal disability (Curotto-Winder 2022; Javier-Rivera, 2023). Characteristics such as sex, age, height, weight, trunk shape, somatotype, body composition, or proportionality lead to variations in body mass distribution, which can affect posture mechanics and functional compensation in the spine (Espí-López, 2019). Therefore, the objective of this research is to determine the influence of the kinanthropometric profile on spinal health in Peruvian university students.

General spinal disability. The study findings showed a significant association between the endomorphic component of somatotype, percentage of adiposity, and percentage of muscle mass with spinal disability. These results are consistent with other studies showing that somatotype endomorphism is associated with postural profile, such that an increase in this component would result in altered spinal posture (Guzmán-Muñoz et al., 2023; Matiichuk et al., 2021). Similarly, Shariati (2018) found a significant inverse relationship between endomorphism and lumbar lordosis; therefore, the greater the tendency to accumulate body fat and gain weight more easily, the lower the tendency toward a less pronounced lumbar curvature. This would demonstrate that endomorphism does not automatically compensate for postural deficiencies like other body types. In contrast, the study by Penna et al. (2023) identifies that the endomorphic component has better control of postural balance and static balance in the sagittal plane of the spine due to greater mass.

Various studies show that a high percentage of body fat suggests the presence of postural abnormalities such as increased lumbar lordosis and thoracic kyphosis angle (Grabara & Witkowska, 2024; Taspinar et al., 2017; Zerf, 2017). Therefore, this increase may lead to the risk of developing spinal curvature abnormalities, low back pain, and negatively influence spinal health, whether due to mechanical or metabolic factors (Baek, 2022). Clinically, this means that overweight students may experience chronic lumbar overload, higher risk of disc degeneration, and earlier onset of back pain, which directly affects their functional performance and quality of life. However, muscle mass plays an important role in stabilizing, protecting, and moving the spine, so a decrease in muscle volume may be associated with increased disc degeneration in the lumbar region. From a preventive perspective, strengthening trunk and paraspinal muscles should be emphasized in young adults, as it enhances load-bearing capacity and reduces vulnerability to spinal disability. In addition, a high proportion of body fat may indicate an increased risk to spinal health (Baek, 2022).

Within the predictive model of all variables evaluated in the kinanthropometric profile, body fat percentage (adipose) and BMI were predictors of the presence of spinal disability. Each unit increase in adiposity raised the odds of spinal disability by 25%, while each unit increase in BMI raised the odds by 37%, underscoring the clinical relevance of even modest changes in body composition. These results are consistent with the study by Maciałczyk-Paprocka (2017), which evaluated 2,732 overweight and obese children and adolescents between the ages of 3 and 18 and found that these variables predispose individuals to a higher incidence of certain postural abnormalities that lead to incorrect alignment of the shoulders and a prominent abdomen. For their part, Bayartai et al. (2022) used technology for postural analysis in adolescents, where they identified that increased BMI and obesity led to greater thoracic kyphosis, reduced thoracic flexion mobility, and greater lateral flexion in the lumbar region, compared to young people of normal weight. Based on the above analysis, Bayartai et al. (2023) conducted a comparative study between overweight and normal-weight adults, finding that a higher BMI and the presence of obesity were associated with alterations in posture and spinal mobility, evidenced by a greater predisposition to thoracic kyphosis and reduced mobility in the lumbar region, compared to normal-weight adults. According to Prat-Luri (2023), lumbar spine disability is related to greater body mass and increased pain in that area. It can therefore be understood that excessive accumulation of fat in the body and adipose tissue increases the mechanical load and misalignment of the spine, as it forms part of a passive component of body stability. These findings justify the inclusion of anthropometric screening (BMI, adiposity, and somatotype) in preventive health evaluations of university students, as early identification of at-risk profiles could guide lifestyle interventions to mitigate future musculoskeletal complications.

Cervical disability. To better understand spinal health, it is important to mention that the spine is composed of primary and secondary curves, which serve to support, transmit load, control posture, and adjust the center of gravity (Kapandji, 2011). Following an embryological, anatomical, and biomechanical analysis, secondary curvatures develop after birth and form areas of lordosis, which are characterized by high mobility and constant use; therefore, they are at greater risk of injury due to excessive use, sudden movements, or poor posture (Busquet, 2007; Dufour & Pillu, 2018; Parsons & Marcer, 2007). That is why the main focus of the research is to determine the presence of disability in these secondary curvatures (cervical and lumbar).

The cervical vertebrae form the first secondary curvature of the spine. They are small structures that are highly vulnerable due to their great mobility, constant use, and, especially, their main function, which is to support the head (Busquet, 2007; Kapandji, 2011). One of the results of this study shows that the ectomorphic component of somatotype is a predisposing factor for the presence of cervical disability. This means that students with an ectomorphic build have almost five times the odds of suffering cervical disability compared with other somatotypes, which highlights their vulnerability to neck pain and functional limitations in academic contexts that require prolonged study hours. In line with this, the study by Pacheco et al. (2023) points out that the predominance of this component is associated with alterations in the postural profile of the spine, as well as the prevalence of musculoskeletal disorders in the neck, shoulders, and lower back. Similarly, other studies have shown that individuals with a higher ectomorphic proportion have variations in their biogeometric posture profile, as well as an increased lordotic angle and significantly higher postural inclination than other somatotypes (Matiichuk et al., 2021; Penna et al., 2023). From a physiological perspective, the lack of muscle mass and reduced capacity for stabilization in ectomorphs can generate chronic overload in cervical muscles, leading to forward head posture, tension-type headaches, and shoulder imbalance.

This can be understood because a person with a thinner build, low muscle mass, small joints, and a low percentage of body fat tends to have less muscle strength and difficulty gaining muscle mass. This favors the development of poor posture patterns in ectomorphs, who tend to have a forward head posture and slumped shoulders, especially in contexts involving prolonged work or sedentary activities. Therefore, from a preventive standpoint, specific strengthening programs for the cervical and scapular stabilizers should be prioritized in university populations with ectomorphic characteristics, to reduce the risk of disability and improve long-term spinal health.

Lumbar disability. On the other hand, the lumbar vertebrae are designed to support heavy loads due to their size and bone strength; however, they are also exposed to mechanical overload, postural changes such as postural asymmetries and pelvic tilt, and frequent degenerative processes (Kapandji, 2011; Sugavanam, 2024). Another finding of the present study indicated that muscle percentage and the acromio-iliac index were predictive factors of lumbar spine disability. Clinically, this means that each additional percentage point of muscle mass increased the odds of lumbar disability by 57%, whereas a more favorable shoulder–pelvis proportion (higher acromio-iliac index) reduced the odds of disability by approximately 4%. These results emphasize that both excess muscular development and disproportionate trunk morphology have tangible consequences for lumbar health.

In contrast to our findings, Ceballos-Gurrola et al. (2021) indicated that the predominance of upper limb muscle mass was not related to the risk of lower limb injuries or the presence of low back pain in university soccer players with high upper limb and trunk muscle asymmetry. Other studies find significant relationships between narrowing of the L4 and L5 disc space in the lumbar spine and total muscle mass, back muscle mass, psoas muscle mass, and abdominal muscle mass. Furthermore, a reduction in the muscle size of the lumbar multifidus at the L5 level and muscle asymmetry increased muscle resistance in the muscle area (Baek et al., 2022; Mirza et al., 2025).

In relation to the findings, it can be explained that an increase in muscle mass, especially in the trunk and upper extremities, can increase pressure on the lumbar spine. If this region lacks flexibility, its ability to adapt to movement is reduced, limiting the mobility of the spine and pelvis (Prat-Luri 2023). This suggests that students who develop excessive trunk muscle mass without concurrent flexibility training may experience chronic lumbar overload, stiffness, and functional limitations in bending and lifting tasks. A high acromioclavicular index, i.e., a shoulder segment that is wider than the pelvis, is often found in people with an elongated thorax whose center of gravity is higher, which affects balance and posture and, in turn, causes postural imbalances between the upper and lower body due to functional asymmetry caused by postural deviations (Dufour & Pillu, 2018; Parsons & Marcer, 2007). This proportion can predispose students to postural instability and recurrent lumbar discomfort, underscoring the need for postural correction and balance training in this group.

Limitations

This study also had some limitations. First, not all spinal curvatures were assessed, with priority given to secondary curvatures, which have evidence of a higher prevalence of musculoskeletal injury. Second, there was no physical location on the university campus for the cineanthropometric assessment of students. Third, the sample size did not allow for stratified regression models by sex, which could have provided additional insights into sex-specific predictors of spinal disability. Although kinanthropometric characteristics differ between men and women and may influence spinal biomechanics differently, our models were adjusted at the global level. Future research with larger and more diverse samples should address this aspect to provide more tailored preventive and clinical strategies. Finally, first-year students did not participate, as they were at another university campus. Based on the above, it is recommended that evaluations of the physical condition of the entire spine be carried out, as well as other conditions such as flexibility, strength, and balance. In addition, it is suggested that studies with a larger sample size and in other university contexts be carried out in order to obtain more evidence of the reported findings.

Conclusions

In conclusion, a greater influence of adiposity, BMI, and muscle percentage on spinal health was found. For the cervical spine, the predictive factors were the ectomorphic component of the somatotype and BMI; and for the lumbar spine, muscle percentage and the acromio-iliac index. With the identification of the morphological components related to spinal health, it will be possible to assess the physical condition of students from the vocational training stage onwards.

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References

Agatha, S., Thanaya, S. A. P., Sundari, L. P. R., & Nugraha, M. H. S. (2022). Overview of Musculoskeletal Disorders in Undergraduate Students. *Physical Therapy Journal of Indonesia*, *3*(2), 49–53. https://doi.org/10.51559/PTJI.V3I2.54

Andrade, J. A., Delgado, A. D., & Almécija, R. (2008). Validación de una versión española del Índice de Discapacidad Cervical. *Medicina Clínica, 130*(3), 85–89. https://doi.org/10.1157/13115352

Baek, S., Park, H. W., & Kim, G. (2022). Associations between trunk muscle/fat composition, narrowing lumbar disc space, and low back pain in middle-aged farmers: A cross-sectional study. *Annals of Rehabilitation Medicine, 46*(3), 122–132. https://doi.org/10.5535/arm.21201

Bayartai, M. E., Luomajoki, H., Tringali, G., De Micheli, R., Abbruzzese, L., & Sartorio, A. (2023). Differences in spinal posture and mobility between adults with obesity and normal weight individuals. *Scientific Reports, 13*(1), 13409. https://doi.org/10.1038/s41598-023-40470-5

Bayartai, M. E., Schaer, C. E., Luomajoki, H., Tringali, G., De Micheli, R., & Sartorio, A. (2022). Differences in spinal posture and mobility between children/adolescents with obesity and age-matched normal-weight individuals. *Scientific Reports, 12*(1), 15570. https://doi.org/10.1038/s41598-022-19823-z

Busquet, L. (2007). *Las cadenas musculares. Tomo I: Tronco y columna cervical.* Paidotribo.

Ceballos-Gurrola, O., Bernal-Reyes, F., Jardón-Rosas, M., Enríquez-Reyna, M. C., Durazo-Quiroz, J., & Ramírez-Siqueiros, M. G. (2021). Composición corporal y rendimiento físico de jugadores de fútbol soccer universitario por posición de juego. *Retos: Nuevas Tendencias en Educación Física, Deporte y Recreación, 39*(1), 52–57. https://doi.org/10.47197/retos.v0i39.75075

Curotto-Winder, D. A., Becerra- Bravo, G., & Bravo-Cucci, S. (2022). Asociación entre el nivel de actividad física, sedentarismo y dolor de espalda en estudiantes de nutrición y dietética de una universidad de Lima en contexto de Pandemia por COVID-19 (Association between the level of physical activity, sedentary lifestyl. *Retos*, *45*, 1019-1030. https://doi.org/10.47197/retos.v45i0.90979

Dufour, M., & Pillu, M. (2018). *Biomecánica funcional. Miembros, cabeza, tronco.* Elsevier Health Sciences.

Espí-López, G. V., Muñoz-Gómez, E., Arnal-Gómez, A., Fernández-Bosch, J., Balbastre-Tejedor, I., Ramírez-Iñiguez, M. V., & Vicente-Herrero, M. T. (2019). La obesidad como factor determinante en el dolor lumbar. *Revista Asociación Española Especializada de Medicina del Trabajo, 28*(3), 176–235. https://scielo.isciii.es/pdf/medtra/v28n3/1132-6255-medtra-28-03-217.pdf

Fairbank, J. C. T., Couper, J., Davies, J. B., & O'Brien, J. P. (1980). *Oswestry Low Back Pain Disability Questionnaire (ODI)*. APA PsycTests. https://doi.org/10.1037/t04205-000

Grabara, M., & Witkowska, A. (2024). Sagittal spinal curvatures of young adults in the context of their self-reported physical activity and somatic parameters. *Scientific Reports, 14*(1), 12221. https://doi.org/10.1038/s41598-024-62929-9

Guzmán-Muñoz, E., Méndez-Rebolledo, G., Núñez-Espinosa, C., Valdés-Badilla, P., Monsalves-Álvarez, M., Delgado-Floody, P., & Herrera-Valenzuela, T. (2023). Anthropometric profile and physical activity level as predictors of postural balance in overweight and obese children. *Behavioral Sciences, 13*(1), 73. https://doi.org/10.3390/bs13010073

International Society for the Advancement of Kineanthropometry. (2024). *La Sociedad Internacional para el Avance de la Cineantropometría.* https://www.isak.global/

Javier-Rivera, L. S., Escalante-García, Y., Canté-Cuevas, X. C., & Kent-Sulú, M. P. (2023). Prevalencia de lesiones musculoesqueléticas en estudiantes de Fisioterapia. *Revista Transdisciplinaria de Estudios Sociales y Tecnológicos, 3*(1), 80–87. https://doi.org/10.58594/rtest.v3i1.67

Janc, M., Jozwiak, Z., Jankowska, A., Makowiec-Dabrowska, T., Kujawa, J., & Polanska, K. (2023). Ergonomics of E-Learning Workstations and the Prevalence of Musculoskeletal Disorders—Study among University Students. *International Journal of Environmental Research and Public Health, 20*(4), 3309. https://doi.org/10.3390/ijerph20043309

Kandasamy, G., Almanasef, M., Almeleebia, T., Orayj, K., Shorog, E., Alshahrani, A. M., Prabahar, K., Veeramani, V. P., Amirthalingam, P., Alqifari, S. F., Alrashidi, F., Aldurum, M., Almutiri, F., Alzaidi, A., & Almutairi, F. (2024). Prevalence of musculoskeletal pain among undergraduate students. *Frontiers in Medicine*, *11*. https://doi.org/10.3389/FMED.2024.1403267

Kapandji, A. I. (2011). *Fisiología articular. Tomo 3: Tronco y raquis* (6ª ed.). Editorial Médica Panamericana.

Kerr, D. A. (1988). An anthropometric method for fractionation of skin, adipose, bone, muscle and residual tissue masses, in males and females age 6 to 77 years (Master's thesis). Simon Fraser University.

Krifa, M., Zagdod, N. E., & Elnaas, H. (2025). The Effects of Social Media on Spinal Health. *Attahadi Medical Journal*, *2*(2), 75–79. https://doi.org/10.69667/AMJ.25202

Kurten, M., Ellapen, T. J., & Paul, Y. (2021). The impact of cranial loading on sagittal plane posture, kinanthropometry and muscle activity of South African female youth. *Occupational Health Southern Africa, 27*(5), 46-49. https://journals.co.za/doi/epdf/10.10520/ejc-ohsa_v27_n5_a6

López, A., & Vacio Muro, M. D. L. Á. (2020). La etapa universitaria y su relación con el sobrepeso y la obesidad. *Revista Digital Universitaria, 21*(5), 1–9. https://doi.org/10.22201/cuaieed.16076079e.2020.21.5.7

Maciałczyk-Paprocka, K., Stawińska-Witoszyńska, B., Kotwicki, T., Sowińska, A., Krzyżaniak, A., Walkowiak, J., & Krzywińska-Wiewiorowska, M. (2017). Prevalence of incorrect body posture in children and adolescents with overweight and obesity. *European Journal of Pediatrics, 176*(5), 563–572. https://doi.org/10.1007/s00431-017-2873-4

Matiichuk, V., Vypasniak, I., Ivanyshyn, I., Aloshyna, A., Ivanyshyn, Y., Rymyk, R., & Bychuk, I. (2021). Morpho-biomechanical characteristics of female students as a basis for the development of differentiated health-related programs. *Journal of Physical Education and Sport, 21*(5), 2880–2889. https://doi.org/10.7752/jpes.2021.s5383

Mirza, Y., Sari, F., Yılmaz, P. D., & Küçük, A. (2025). Evaluation of abdominal and lumbar multifidus muscles thickness and relation to endurance, pain, fatigue and functional mobility in patients with Fibromyalgia syndrome: A case-control study. *Rheumatology International, 45*(3), 56. https://doi.org/10.1007/s00296-025-05813-7

Mohamed, H. S. (2021). Prevalence of Musculoskeletal Disorders among Kasr-Alainy Hospital Medical Students. *The Egyptian Journal of Hospital Medicine*, *85*(2), 4246–4252. https://doi.org/10.21608/EJHM.2021.208102

Morais, B. X., Dalmolin, G. de L., Andolhe, R., Dullius, A. I. dos S., & Rocha, L. P. (2019). Musculoskeletal pain in undergraduate health students: prevalence and associated factors. *Revista Da Escola de Enfermagem Da U S P*, *53*. https://doi.org/10.1590/S1980-220X2018014403444

Norton, K., Olds, T., Olive, S., & Craig, N. (1996). Antropometría y performance deportiva. En K. Norton & T. Olds (Eds.), *Antropométrica* (pp. 188–236). BIOSYSTEM Servicio Educativo.

Okifuji, A., & Hare, B. D. (2015). The association between chronic pain and obesity. *Journal of Pain Research, 8*(1), 399–408. https://doi.org/10.2147/JPR.S55598

Pacheco, M. P., Carvalho, P. J., Cavalheiro, L., & Sousa, F. M. (2023). Prevalence of postural changes and musculoskeletal disorders in young adults. *International Journal of Environmental Research and Public Health, 20*(24), 7191. https://doi.org/10.3390/ijerph20247191

Parsons, J., & Marcer, N. (2007). *Osteopatía: Modelos de diagnóstico, tratamiento y práctica*. Elsevier España.

Penna, G., Zecca, G., Altavilla, G., D'Isanto, T., & Russo, L. (2023). Can somatotype influence the static postural control? A new proposal of investigation. *Journal of Human Sport and Exercise, 18*(3), 586–595. https://doi.org/10.14198/jhse.2023.183.07

Pomares, A. J., López Fernández, R., & Zaldívar Pérez, D. F. (2020). Validación de la escala de incapacidad por dolor lumbar de Oswestry en pacientes con dolor crónico de la espalda. Cienfuegos, 2017–2018. *Rehabilitación, 54*(1), 25–30. https://pesquisa.bvsalud.org/portal/resource/pt/ibc-196637

Prat-Luri, A., de Los Ríos-Calonge, J., Moreno-Navarro, P., Manresa-Rocamora, A., Vera-García, F. J., & Barbado, D. (2023). Efecto de los ejercicios centrados en el tronco sobre el dolor, la discapacidad, la calidad de vida y la condición física del tronco en la lumbalgia: Una revisión sistemática con metaanálisis. *Journal of Orthopaedic & Sports Physical Therapy, 53*(2), 64–93. https://doi.org/10.2519/jospt.2023.11091

Ross, W. D., & Kerr, D. A. (1993). Fraccionamiento de la masa corporal: Un nuevo método para utilizar en nutrición clínica y medicina deportiva. *Apunts: Medicina de l'esport, 18*(1), 175–187.

Ross, W. D., Carr, R. V., & Carter, J. E. L. (1999). *Anthropometry illustrated* [CD-ROM]. Turnpike Electronic Publications Inc.

Sanchez-Castro, A. E., Cook-Del Águila, L., Huaman, G. A. Y., Caminiti, R. A. T., Bossio, M. A. R., & Mayta-Tristán, P. (2019). Prevalence of muscle dysmorphia symptomatology and related factors in male university students / Prevalencia de sintomatología de dismorfia muscular y factores asociados en estudiantes universitarios varones. *Revista Mexicana de Trastornos Alimentarios/Mexican Journal of Eating Disorders*, *10*(2), 185–195.

Shariati, M., & Zilaie Bori, S. (2018). Relación entre la flexibilidad y el somatotipo con la lordosis lumbar en niñas. *Revista Científica de Medicina de Rehabilitación, 7*(4), 208–216. https://doi.org/10.22037/jrm.2018.111067.1733

Sheahan, P. J., Nelson-Wong, E. J., & Fischer, S. L. (2015). A review of culturally adapted versions of the Oswestry Disability Index: The adaptation process, construct validity, test-retest reliability and internal consistency. *Disability and Rehabilitation, 37*(25), 2367–2374. https://doi.org/10.3109/09638288.2015.1019647IF: 2.1 Q1

Shirley Ryan AbilityLab. (2013, November 27). *Oswestry Disability Index.* https://www.sralab.org/rehabilitation-measures/oswestry-disability-index

Shirley Ryan AbilityLab. (2015, September 10). *Neck Disability Index*. https://www.sralab.org/rehabilitation-measures/neck-disability-index

Sugavanam, T., Sannasi, R., Anand, P. A., & Javia, P. A. (2024). Asimetría postural en el dolor lumbar: Una revisión sistemática y metaanálisis de estudios observacionales. *Disability and Rehabilitation, 47*(7), 1659–1676. https://doi.org/10.1080/09638288.2024.2385070

Tamargo, T., Gutiérrez, A., Quesada, S., López, N., & Hidalgo, T. (2019). Algunas consideraciones sobre aplicación, cálculo e interpretación de odds ratio y riesgo relativo. *Revista Cubana de Medicina, 58*(3), e497. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0034-75232019000300008

Taspinar, F., Saracoglu, I., Afsar, E., Okur, E. O., Seyyar, G. K., Kurt, G., & Taspinar, B. (2017). Assessing the relationship between body composition and spinal curvatures in young adults. *Archives of Sports Medicine and Physiotherapy, 2*(1), 10–15. https://doi.org/10.17352/asmp.000005

Vernon, H., & Mior, S. (1991). The Neck Disability Index: A study of reliability and validity. *Journal of Manipulative and Physiological Therapeutics, 14*(7), 409–415.

Vidal, W., Romero-Tapia, P., Mauricio, F., Mauricio-Vilchez, C., Alvítez-Temoche, D., Robles, G., & Mayta-Tovalino, F. (2020). Associated risk factors and prevalence of work-related musculoskeletal disorders in Peruvian undergraduate dental students: A multivariate analytical study. *Journal of International Oral Health*, *12*(6), 512–517. https://doi.org/10.4103/JIOH.JIOH_125_20

Villanueva, M. (2010). Heath Carter vs Sheldon Darnell: Falacias y realidades de las técnicas somatotipológicas. *Anales de Antropología, 22*(1). https://doi.org/10.22201/iia.24486221e.1985.1.15856
Zerf, M. (2017). Composición corporal versus porcentaje de grasa corporal como predictores de la movilidad y estabilidad en el control postural/equilibrio en futbolistas menores de 21 años. *Educación Física de Estudiantes, 21*(2), 96–102. https://doi.org/10.15561/20755279.2017.0208

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