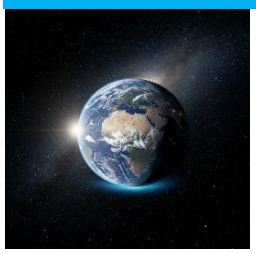
NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ



Journal of Education, Health and Sport. eISSN 2391-8306.

Journal Home Page
https://apcz.umk.pl/JEHS/index

GAŁUSZKA, Maja, GAŁUSZKA, Aleksandra, KRYCIA, Kamila, MAZUR, Karolina, RÓŻYCKA, Karolina, MULAWA, Magdalena, PIASZCZYŃSKA, Emilia, MATACZ, Dominika, DRABIK, Sandra and ADAMCZYK, Adrianna. The role of early assessment of body posture in preventing musculoskeletal deformities and stomatognathic system dysfunctions. Journal of Education, Health and Sport. 2026;90:70550. eISSN 2391-8306. https://doi.org/10.12775/JEHS.2026.90.70550

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).
Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).
The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 02.04.2026. Revised: 20.04.2026. Accepted: 20.04.2026. Published: 23.04.2026.

The role of early assessment of body posture in preventing musculoskeletal deformities and stomatognathic system dysfunctions

Maja Gałuszka[1], ORCID https://orcid.org/0009-0003-2659-0811
E-mail am.galuszka@wp.pl
[1]Medical University of Lublin, Polska

Aleksandra Gałuszka[1] ORCID https://orcid.org/0000-0003-1749-0811
E-mail aleksandra.galuszka@interia.pl
[1]Medical University of Lublin, Polska

Kamila Krycia[1] ORCID https://orcid.org/0009-0007-2586-1746
E-mail kamilakrycia27@gmail.com
[1]Medical University of Lublin, Polska

Karolina Mazur[1] ORCID https://orcid.org/0009-0001-9827-2084
E-mail mazurinka2001@gmail.com
[1]Medical University of Lublin, Polska

Karolina Różycka[1] ORCID https://orcid.org/0009-0004-0505-3280
E-mail karar11@onet.pl
[1]Medical University of Lublin, Polska

Magdalena Mulawa[1] ORCID https://orcid.org/0009-0004-2515-9533
E-mail magdalena.mulawa123@gmail.com
[1]Medical University of Lublin, Polska

Emilia Piaszczyńska[1] ORCID https://orcid.org/0009-0009-1416-6566
E-mail piaszczynskaemilia@gmail.com
[1]Medical University of Lublin, Polska

Dominika Matacz[1] ORCID https://orcid.org/0009-0005-1975-3795
E mail dominikam011@gmail.com
[1]Medical University of Lublin, Polska

Sandra Drabik[1] ORCID https://orcid.org/0009-0003-9708-4625
E mail sandradrabik01@gmail.com
[1]Medical University of Lublin, Polska

Adrianna Adamczyk[2] ORCID https://orcid.org/0009-0009-3462-7972
E mail ada.adamczyk@onet.pl
[2]"Nowa Europa", Łódź, Polska

Corresponding Author
Maja Gałuszka E-mail am.galuszka@wp.pl

Abstract

Body posture plays a significant role in the functioning of the musculoskeletal system and can also affect the stomatognathic system. Postural disturbances can lead to changes in the head and neck, contributing to dysfunction in this area. Research indicates a correlation between body posture and the functioning of the stomatognathic system, which includes structures responsible for chewing, articulation, emotional expression, and breathing. Early detection of postural abnormalities allows for the implementation of appropriate corrective measures aimed at limiting secondary compensatory changes. A significant aspect is the fact that these abnormalities are increasingly occurring in children and adolescents. The aim of this study was to assess the importance of early diagnosis of postural defects in preventing abnormalities in the functioning of the stomatognathic system. The latest scientific research was analyzed, with a detailed focus on those concerning the early diagnosis of postural defects and early diagnostic and therapeutic intervention. Studies from 1984 to 2025 were included. They indicate a correlation between poor posture and abnormalities in the stomatognathic system. The most common approach is posture analysis, which is performed in basic anatomical planes. Additional diagnostic tests include the Dual Scale Posture Test and the Adams Test, as well as anthropometric measurements. Posture assessment, diagnosis, and appropriate therapy require an integrated approach encompassing various clinical areas.

Key words

body posture, defects of the stomatognathic system, prevention of posture defects, posture defects in children, posture defects in adults

Content

1. Introduction

Postural defects constitute a significant, multifactorial public health problem observed in populations of all ages. Their prevalence has steadily increased in recent decades, reflecting both lifestyle changes in modern society and the impact of environmental factors, including low levels of physical activity and prolonged sedentary behavior. Both in Europe and Poland, research indicates a high prevalence of postural defects in children and adolescents (Skorupka & Asienkiewicz, 2014; Puszczałowska-Lizis et al., 2025). At the same time, public health awareness is increasing, which supports more frequent diagnostic procedures and earlier detection of postural disorders. Environmental factors, such as a predominantly sedentary lifestyle and limited physical activity, are significant determinants of the risk of developing postural defects in children and adolescents (Kubička et al., 2023; MDPI, 2024). The scientific literature is also paying increasing attention to the relationship between posture and the functioning of other body systems, including the stomatognathic system. Research reviews indicate statistically significant associations between malocclusions and other masticatory dysfunctions and postural disorders, although the mechanisms underlying these relationships

require further clarification (Różańska-Perlińska et al., 2024; Kawęcka, 2024). In the population of children and adolescents, the most frequently diagnosed are spinal deformities – such as scoliosis, round back or flat feet - and abnormalities in the lower limbs (Wawrzyniak et al., 2017). One significant factor contributing to the development of these defects is hypokinesia, defined as insufficient physical activity, which is often associated with a predominantly sedentary lifestyle and the intensive use of electronic devices. Epidemiological studies have shown that a lifestyle characterized by low physical activity predisposes children to the development of postural disorders. In the adult population, the development of postural defects is often a consequence of incorrect postural habits established during development, as well as the impact of environmental and occupational factors. Studies on sedentary behavior at work and beyond indicate that low physical activity can contribute to back pain and other musculoskeletal disorders (Wilkinson et al., 2022). Moreover, systematic literature draws attention to the relationship between increased body weight and the more frequent occurrence of postural disorders, especially in the lumbar spine and foot structures, which further emphasizes the complex nature of the problem (Wang et al., 2017). The high prevalence of postural defects in the population poses a significant challenge for healthcare systems. Early diagnosis of postural disorders, including functional assessment, followed by implementation of appropriate preventive and therapeutic measures—including postural education and improved ergonomics in school and work environments—can significantly limit the progression of deformities and reduce the risk of health complications in adulthood (Antczak-Komoterska & Lewińska, 2022). Due to the awareness of the importance of the relationship between body posture and the functioning of the masticatory system, as well as broadly defined environmental factors, the need for an interdisciplinary diagnostic and therapeutic approach is increasingly emphasized, encompassing the collaboration of specialists in physiotherapy, dentistry, orthodontics, and family medicine. Basic functional assessments are crucial for early diagnosis and initiation of early therapeutic interventions. Therefore, knowledge of basic assessment methods allows for rapid diagnosis, which, if abnormalities are identified, allows for referral of patients with musculoskeletal abnormalities for further, more thorough and reliable assessment and treatment.

2. Research objective

The aim of the paper is to present, based on the analysis of the literature, the importance and techniques of early diagnostics of body posture in detecting abnormalities of the

musculoskeletal system that may contribute to the development of disorders within the stomatognathic system.

3. Research materials and research methods

This chapter presents a literature review of the most commonly used diagnostic tools for early detection of postural defects. The methods discussed are applicable to screening tests, physical assessments, and physiotherapy assessments. The analysis was based on Polish and English-language sources, including scientific publications, review articles, and monographs. The literature was obtained through a systematic search of databases, including PubMed, ScienceDirect, Google Scholar, and a review of printed publications. Publications meeting the following criteria were included in the analysis: those relating to the diagnosis of postural defects, risk factors, prevention, and corrective therapy, originating from peer-reviewed scientific journals, or recommended by national and international health institutions, including the WHO. However, scientifically unverified sources, such as blogs or popular science websites without references to empirical research, as well as publications in languages other than Polish and English, were excluded.

4. Results

Based on the analysis of source materials, the following are basic assessments regarding the early detection of postural defects that lead to more serious postural deformities and the development of self-compensation (so-called uncontrolled) deformities and disorders in other body structures, including the stomatognathic system. Postural assessment is an important element of functional diagnostics of the musculoskeletal system and the early detection of abnormalities within the musculoskeletal system. One of the most commonly used methods in clinical practice is observational postural analysis conducted in basic anatomical planes, including assessment of the posture in the frontal and sagittal planes, using topographic markers or photographic methods (Pimentel do Rosário, 2014; Kowalski et al., 2014). Posture assessment should be performed in a standing position, with the subject's body positioned naturally, and with the load evenly distributed across both lower limbs. The analysis includes observation of posture in three basic anatomical planes: frontal, sagittal, and transverse (Mrozkowiak et al., 2014).

Palpation of the spine is an essential element of the clinical examination. It allows for direct analysis of the bony structures and soft tissues within the trunk. It includes examination of the

spinous processes of the vertebrae, paraspinal muscle tension, and tenderness on pressure, which allows for the identification of abnormalities in the alignment and function of the spine. During the examination, the spinous processes are assessed, noting any deviations from the vertical axis, which may suggest the presence of scoliosis or other structural deformities. Palpation also allows for the detection of segmental displacements and asymmetries in the position of individual vertebrae (Magee, 2014). An important element of the examination is the assessment of paraspinal muscle tone, including the spinal erectors and the deep muscles that stabilize the spine. Increased muscle tone may indicate overload, the body's defense reactions, or chronic pain syndromes, while decreased tone may indicate weakened segmental stabilization. The examination also considers the presence of trigger points, which are characteristic of myofascial pain syndromes and can radiate pain to distant areas of the body (Simons, Travell, & Simons, 1999). Palpation of tenderness upon pressure allows for localization of the source of pain and differentiation of its origin—muscular, ligamentous, or joint. Pain caused by pressure on the spinous processes may suggest overload or trauma changes within the bony structures, while tenderness in the soft tissues more often indicates myofascial dysfunction. This examination is also important in assessing segmental mobility of the spine, as gentle movement of the structures allows for assessment of their flexibility and response to mechanical stimulation (Kendall, McCreary, Provance, Rodgers, & Romani, 2005). Palpation, although subjective and dependent on the experience of the examiner, remains an essential element of functional spine diagnostics. It allows for the rapid detection of abnormalities and the guidance of further diagnostic and therapeutic procedures. Combined with other examination methods, such as posture assessment, functional testing, and imaging studies, it forms the basis of a comprehensive assessment of the musculoskeletal system.

Frontal posture assessment involves observing the patient's posture from both the front and back. This analysis allows for the identification of asymmetries in the shoulder girdle, chest, pelvis, and lower limbs. Particular attention is paid to possible differences in shoulder height, scapular asymmetry, iliac crest misalignment, and axial deviations in the lower limbs, such as knock knees (genu valgum) or varus knees (genu varum) (Mrozkowiak et al., 2014). The anterior assessment also analyzes the symmetry of the waist triangles, which form between the lateral surface of the trunk and the medial surface of the upper limbs – differences in these may indicate lateral curvatures of the spine or muscular asymmetry. Assessment of the head position relative to the body axis is also important, as its tilt or shift may indicate compensatory postural changes. In the posterior view, particular attention is paid to the position of the scapulae, their protrusion,

rotation, or height differences, which may indicate muscle imbalances or the presence of structural deformities. The course of the spinous processes of the spine is also analyzed, which should normally form a straight line; any deviations may suggest scoliosis. Assessment of pelvic position includes comparing the height of the posterior superior iliac spines and the symmetry of the gluteal folds, which allows for the detection of limb shortening or functional asymmetry. In the lower limbs, not only the knee axis is assessed but also the position of the ankle joints and any possible heel valgus or varus. Another important element is the assessment of body weight distribution and lower limb loading, which can be observed by analyzing foot position and ground contact. Frontal plane abnormalities are often complex and can result from both structural and functional causes, requiring comprehensive interpretation. Although clinical assessment is qualitative in nature, it is a fundamental screening tool and allows for early detection of abnormalities requiring further diagnostics or therapeutic intervention.

Assessment in the sagittal plane allows for the analysis of physiological spine curvatures, including cervical lordosis, thoracic kyphosis, and lumbar lordosis. Under normal conditions, these curvatures remain in biomechanical balance, ensuring optimal distribution of loads acting on the spine during standing. Research indicates that clinical assessment of posture in the sagittal plane is more subjective and less precise than instrumental methods; however, indirect clinical observation is still widely used in screening (Kowalski et al., 2014). In clinical practice, this assessment involves analyzing the position of the head, spine, and pelvis relative to the body's vertical axis, most often using a plumb line drawn from the external auditory canal. Correct posture is characterized by the alignment of body segments so that this line runs through the center of the shoulder joint, vertebral bodies, hip, knee, and ankle joints. Deviations from this pattern may indicate a deepening or shallowing of physiological curvatures, which has significant clinical significance. Excessive thoracic kyphosis can lead to respiratory dysfunction and cervical overload, while increased lumbar lordosis is often associated with lower spine pain. The assessment also considers the position of the pelvis, whose anterior or posterior tilt directly affects the shape of the lumbar lordosis. The position of the lower limbs is also analyzed, including hyperextension of the knee joints, which can be a compensatory element for postural disturbances. A crucial aspect is the assessment of muscle tone, particularly the spinal erectors, hip flexors, and abdominal muscles, which are essential for maintaining normal curvatures. Muscle imbalances can lead to the entrenchment of incorrect postural patterns. Despite limited precision, clinical assessment in the sagittal plane remains an important diagnostic tool, particularly in screening and initial qualification for further diagnostics. In cases of doubt or

requiring more detailed analysis, instrumental methods such as photogrammetry, inclinometry, or radiological examination are used to objectively assess the extent of curvatures. A comprehensive approach combining clinical assessment with objective methods allows for a more accurate diagnosis and more effective planning of corrective and therapeutic procedures. Assessment in the transverse plane focuses on analyzing the rotational positioning of individual body segments, including the rotation of the shoulder and pelvic girdles, as well as the spatial relationships between these structures, which is crucial in identifying scoliosis and trunk asymmetry (Pimentel do Rosário, 2014). A key element of this assessment is detecting vertebral rotation, which is a key component of structural scoliosis and distinguishes it from functional postures. The examination also considers rib position, as spinal rotation leads to the development of a rib hump, particularly visible during the Adams test. The symmetry of the scapulae is also analyzed, as protrusion or height differences may indicate muscle imbalances and rotational trunk deformities. It is also important to simultaneously compare the position of the shoulder girdle relative to the pelvis, as their relative rotation may indicate compensatory postural mechanisms. Pelvic rotation assessment includes analysis of the position of the anterior superior iliac spines, which allows for the detection of asymmetries that may affect gait biomechanics and spinal loading. In the transverse plane, the tone and length of the trunk rotator muscles, such as the abdominal obliques and the paraspinal muscles, which play a significant role in segmental stabilization, are also assessed. Disturbances in this plane often coexist with limitations in the rotational mobility of the spine, which can be assessed through a functional examination. Objective methods, such as a scoliometer, are also used in diagnosis, allowing for a quantitative assessment of the angle of trunk rotation. Dynamic analysis, which includes observation of trunk rotation during gait and other functional activities, is also important. A comprehensive assessment in the transverse plane allows not only for early detection of deformities but also for monitoring the progress of therapy and the effectiveness of corrective interventions.

Viewing body posture in various anatomical planes is a non-invasive, quick and easy method to use in clinical settings and in screening tests, providing a lot of important diagnostic information regarding body symmetry, segmental alignment and possible postural disorders (Mrozkowiak et al., 2014; Kowalski et al., 2014).

5. Instrumental assessment using a scoliometer

A scoliometer is a commonly used diagnostic tool for assessing spinal deformities in the coronal plane by measuring trunk rotation. This device is widely used primarily in scoliosis screening, both in school settings and in clinical and physiotherapy practice. A scoliometer is a simple, non-invasive diagnostic tool used to assess trunk rotation, particularly in scoliosis screening. This device, most often in the form of a gravity inclinometer, measures the angle of trunk rotation (ATR), which is an indirect indicator of vertebral rotation and thoracic deformity. It is important to emphasize that a scoliometer measures the angle of trunk rotation, not direct vertebral rotation, which can only be assessed based on imaging studies, particularly spine radiography (Bunnell, 1984; Grivas, Wade, Negrini, O'Brien, Maruyama, & Hawes, 2007). The scoliometer is widely used in clinical practice due to its simplicity of use, low cost and the possibility of quick assessment of large population groups, especially children and adolescents (Bunnell, 1984). Scoliometer measurement methodology is most often based on the Adams test (a forward bending test where the fingers attempt to touch the floor). The subject assumes a standing position with their feet parallel and then slowly bends their torso forward with their knees straight and their arms relaxed. In this position, the examiner places the scoliometer transversely to the spine, at the level of the greatest deformity, usually in the thoracic or lumbar spine. The ATR reading is taken in degrees, and the result indicates the degree of rotational asymmetry of the trunk. ATR values of 5°-7° are usually considered borderline, above which further diagnostics are recommended, including radiological examination to determine the Cobb angle. The measurement should be repeated several times to increase its reliability, and the final result is the average of the obtained values. Standardized testing conditions are essential, including proper patient positioning and precise scoliometer placement, which influences the repeatability and accuracy of the measurement. A measurement taken during the forward bend test, which reveals rotational deformity of the thoracic or lumbar region, characteristic of structural scoliosis. The scoliometer is placed transversely on the subject's back to determine ATR values at various levels of the spine. The test is usually performed at several points, allowing for the identification of areas of greatest rotational deformity. Typically, measurements are taken in at least three segments: the proximal thoracic spine, the mid-thoracic spine, and the lumbar spine. The obtained values can then be summed, allowing for the determination of the global trunk rotation parameter (STR), used to assess the degree of trunk asymmetry (Grivas et al., 2007). The test procedure includes the following steps:

1. The examined person stands with his/her back to the examiner, barefoot and in underwear, which allows full visualization of the dorsal surface of the torso.
2. The patient moves the upper limbs forward and joins the hands, which causes a slight abduction of the shoulder blades and facilitates the assessment of the course of the spine.
3. The patient then slowly bends the trunk forward until the shoulder joints are level with the hip joints. In this position, the scoliometer is placed transversely on the spine, with its central part positioned above the potential apex of the curve, and the value is read from the measurement scale.

Interpretation of results is based on the trunk rotation angle. A result exceeding 7° is considered clinically significant and indicates the need for in-depth specialist diagnostics, including radiological examination to determine the Cobb angle. Values in the 4–6° range indicate the need for periodic observation and re-evaluation after several months. However, results below 2–3° typically reflect minor physiological asymmetries that do not require therapeutic intervention (Negrini et al., 2018).

6. Anthropometric measurements

Anthropometric methods include measuring lengths, distances, and angles between selected anatomical points of the body, performed using tools such as an anthropometric tape, an anthropometer, or a goniometer. They constitute an essential element of objectively assessing somatic structure and body proportions, enabling the identification of potential structural asymmetries and misalignments in body segments (Norton & Olds, 1996). In the context of body posture diagnostics, anthropometric analysis allows for the assessment of, among other things, the height and width of the shoulder girdle, pelvis, and rib cage, the length of the upper and lower limbs, the relationship between bony points defining the position of the shoulder girdle and pelvis, the angles of the scapulae, and the tilt of the pelvis. These measurements are performed in relation to precisely defined anthropometric points, such as the acromions, the anterior superior iliac spines, and the spinous processes of the vertebrae. The obtained data enable a quantitative analysis of body symmetry and serve as an important complement to the clinical examination and visual assessment of posture. In clinical practice, the results of anthropometric measurements allow for a more objective assessment of morphological changes within the musculoskeletal system and monitoring the effects of therapeutic treatment (Kendall, McCreary, Provance, Rodgers, & Romani, 2005; Norton & Olds, 1996).

7. Assessment using a plumb line and a spirit level

Assessing spine posture using a plumb line involves comparing the alignment of selected anatomical points of the body with a vertical reference line, defined by a freely suspended weight placed on a thin string. The plumb line is a simple yet useful diagnostic tool for identifying deviations from the body's vertical axis, particularly in the sagittal plane. This method allows for a preliminary assessment of the physiological curvatures of the spine and global postural balance in a standing position (Kendall, McCreary, Provance, Rodgers, & Romani, 2005). The test begins with proper preparation of the subject. The patient stands barefoot in a relaxed position, with even weight bearing on both lower limbs, while maintaining a natural body posture. It is recommended that the subject wear minimal clothing or underwear, which allows for precise observation of the body and identification of anatomical landmarks. A plumb line is then placed behind the subject, so that its line runs along the theoretical gravity line of the body, which serves as a reference for assessing the alignment of body segments (Kendall et al., 2005). During the clinical procedure, the position of selected anatomical points relative to the vertical line is analyzed. The most frequently assessed points include the spinous process of the C7 vertebra, the peak of thoracic kyphosis, the spinous processes in the lumbar spine (e.g., L3), and the sacrum area near the S2 level. The distances of these points from the vertical line can be assessed qualitatively or quantitatively, allowing for the identification of postural abnormalities such as forward head posture, increased thoracic kyphosis or lumbar lordosis, as well as trunk imbalance (Kendall et al., 2005; Magee, 2014). In the sagittal plane, the plumb line allows for the assessment of the relationship between individual body segments, including the position of the head, shoulder girdle, pelvis, and lower limbs relative to the vertical axis of gravity. In normal posture, the plumb line should run approximately through the external auditory canal, shoulder joint, greater trochanter of the femur, and slightly anterior to the ankle joint axis. Deviations from this course may indicate postural imbalance and compensatory positioning of body segments (Kendall et al., 2005; Magee, 2014). In the frontal plane, the plumb line can be used to assess the symmetry of the trunk, shoulder girdle, and pelvis. In this approach, the analysis includes, among other things, a comparison of shoulder height, scapular position, iliac crest symmetry, and any lateral deviations of the trunk from the vertical line. The presence of such deviations may suggest postural asymmetry or lateral curvature of the spine, requiring further diagnostics (Magee, 2014; Negrini et al., 2018). Assessment using a plumb line and spirit level is a quick and easy-to-use method that doesn't require specialized equipment. Therefore, it's widely used in screening tests and in the daily

clinical practice of physiotherapists and physicians. However, it's important to emphasize that this method is indicative and should be part of a comprehensive posture assessment, supplemented, if necessary, with more precise measurement techniques such as photogrammetry, scoliometry, or diagnostic imaging (Negrini et al., 2018).

8. Test on two scales in the diagnosis of body posturę

The dual-scale test is a simple clinical method used to assess lower limb load symmetry in a standing position. Analyzing body weight distribution between the right and left lower limbs allows for the initial identification of postural imbalances, functional asymmetries, and musculoskeletal abnormalities. Uneven lower limb load may be related to factors such as pelvic alignment abnormalities, foot defects, leg length discrepancies, or compensatory muscle tone (Kendall, McCreary, Provance, Rodgers, & Romani, 2005; Magee, 2014). During the test, the subject stands in a relaxed, natural position, resting each foot on a separate scale. The lower limbs should be parallel, and body weight should be distributed naturally, without consciously shifting the load to one side or the other. The pressure exerted by each lower limb is then recorded. Based on the obtained data, it is possible to determine the percentage distribution of body weight between the right and left sides. Under normal conditions, the load on the lower limbs in a standing position should be similar on both sides of the body. Significant differences between the scale readings may indicate asymmetric load distribution, which is sometimes observed in individuals with postural disorders, back pain, or lower limb dysfunction. Clinical literature emphasizes that significant load asymmetry may indicate the need for in-depth functional diagnostics of the musculoskeletal system (Magee, 2014; Kendall et al., 2005). The dual-scale test is useful both in diagnosing postural defects and in monitoring the effects of physiotherapy. It can also be used as part of a functional assessment in cases of lower limb strain, gait disturbances, or chronic spinal pain. It should be noted, however, that this method does not provide information on pelvic rotation or spinal curvatures, and therefore should be used as part of a broader, comprehensive postural assessment (Magee, 2014).

9. Adams Functional Test

The Adams test, also known as the forward bend test, is one of the most commonly used screening methods for scoliosis. It was introduced into clinical practice in the 19th century and remains a fundamental screening tool for pediatric and adolescent populations. Its primary purpose is to identify the rotational trunk deformity characteristic of structural scoliosis

(Bunnell, 1984; Negrini et al., 2018). The test involves the subject slowly bending their torso forward with their lower limbs straight and their upper limbs relaxed. The head remains in extension of the spine, and the subject flexes their torso until their upper body is approximately parallel to the ground. This position reveals any asymmetries in the spine resulting from the rotational positioning of the vertebrae and ribs (Bunnell, 1984). During the test, the examiner visually assesses the symmetry of the dorsal structures. Particular attention is paid to:

asymmetry of the shoulder blade position,

the course of the spinous processes of the spine,

presence of a muscle ridge on one side of the spine,

presence of a rib hump in the thoracic region or a bulge in the lumbar region.

The characteristic sign of structural scoliosis observed during the Adams test is a rib hump resulting from vertebral rotation and secondary rib displacement. This phenomenon leads to an asymmetrical bulge of one side of the rib cage when the trunk is bent forward (Negrini et al., 2018). The movement pattern of individual spinal segments during trunk flexion is also analyzed. Normal movement should be smooth and uniform throughout the spine. The presence of segments with limited mobility or an unnatural course of motion may indicate rotational vertebral misalignment. A segment undergoing rotation, as occurs in structural scoliosis, often appears stiff and lacks the typical arched flexion, but instead forms a flatter and less mobile segment (Kendall et al., 2005; Negrini et al., 2018). The Adams test is a quick, non-invasive, and easy-to-use method in clinical settings and for screening purposes in children and adolescents. However, it should be emphasized that it is a preliminary and screening method, so if abnormalities are detected, further diagnostics are necessary, including measurement of the trunk rotation angle using a scoliometer or radiological assessment of the spine (Bunnell, 1984; Negrini et al., 2018).

10. Discussion

The literature review confirms that early assessment of body posture plays a key role in preventing and limiting the progression of musculoskeletal deformities. Studies emphasize that postural abnormalities developing in childhood tend to persist into adulthood, leading to chronic pain and functional impairments (Kendall et al., 2005; Magee, 2014). In this context, the

importance of screening tests and systematic posture monitoring seems unquestionable, especially in children and adolescents, where the musculoskeletal system is still in a phase of intensive development. A significant finding from the literature review is the relationship between lifestyle and the prevalence of postural defects. Numerous studies indicate that a sedentary lifestyle, limited physical activity, and prolonged use of electronic devices contribute to the development of postural disorders, including the exacerbation of thoracic kyphosis and weakened core stability (WHO, 2020; Tremblay et al., 2011). These phenomena are global in nature and affect both children and adults, emphasizing the need to implement preventive measures at various stages of life. In the context of the relationship between body posture and the stomatognathic system, the literature indicates the existence of functional connections, although their nature is not clearly defined. Research suggests that disorders of the cervical spine and head position can affect the function of the masticatory muscles and the position of the mandible (Cuccia & Caradonna, 2009). In turn, other studies indicate the possibility of a feedback loop in which dysfunctions of the masticatory system may affect muscle tone and body posture (Michelotti et al., 2011). This indicates the need for further research and cautious interpretation of cause-and-effect relationships. Analysis of available diagnostic methods confirms that, despite the development of instrumental techniques such as photogrammetry and radiological examinations, basic clinical examination remains the foundation of posture assessment. Methods such as three-dimensional observation, the Adams test, and palpation are widely used due to their availability and the potential for rapid implementation in practice (Bunnell, 1984). At the same time, the need to supplement these assessments with more objective diagnostic tools is emphasized when abnormalities are detected. The literature also highlights the importance of an interdisciplinary approach to the problem of postural defects. Collaboration between physiotherapists, physicians, orthodontists, and family medicine specialists allows for a comprehensive patient assessment and the implementation of effective therapeutic measures (Sahrmann, 2002). This is particularly important in cases of coexisting postural and stomatognathic disorders, where an isolated therapeutic approach may prove insufficient. Early postural diagnosis is a key element in the prevention of musculoskeletal disorders and potentially related stomatognathic dysfunctions. Despite technological advances, the importance of basic clinical assessment methods remains high, and their proper use can help reduce the development of postural defects and improve patients' quality of life.

11. Summary

Early assessment of body posture is a key element in the prevention of musculoskeletal defects and stomatognathic system dysfunctions.

1. Regular posture diagnostics allow for early detection of spinal deformities, asymmetry of the shoulder girdle, pelvis and lower limbs.
2. Screening methods such as scoliometer, palpation assessment and functional tests enable quick and non-invasive examination of the child and adolescent population.
3. Early detection of abnormalities allows for the implementation of corrective measures, such as physiotherapy, postural education, and physical activity programs.
4. There is a significant relationship between body posture and the functioning of the stomatognathic system, which emphasizes the importance of an interdisciplinary diagnostic approach.
5. Environmental factors, including a sedentary lifestyle and low physical activity, are key determinants of the development of postural defects.
6. Systematic posture assessment combined with lifestyle monitoring and therapeutic interventions can reduce the risk of chronic musculoskeletal disorders in adulthood.
7. A comprehensive approach, including collaboration between physiotherapists, physicians, and dental specialists, increases the effectiveness of preventive and therapeutic measures.

Disclosure
Author Contribution Statement

Conceptualization: Maja Gałuszka, Aleksandra Gałuszka
Methodology: Maja Gałuszka, Kamila Krycia, Karolina Różycka
Formal analysis: Maja Gałuszka, Magdalena Mulawa, Emilia Piaszczyńska
Investigation: Maja Gałuszka, Adrianna Adamczyk
Data curation: Sandra Drabik, Aleksandra Gałuszka
Writing—original draft preparation: Maja Gałuszka
Writing—review and editing: Maja Gałuszka, Aleksandra Gałuszka, Karolina Różycka, Magdalena Mulawa, Emilia Piaszczyńska, Dominika Matacz, Karolina Mazur, Kamila Krycia, Adrianna Adamczyk, Sandra Drabik
Visualization: Maja Gałuszka, Karolina Różycka
Supervision: Aleksandra Gałuszka, Maja Gałuszka, Dominika Matacz
project administration: Maja Gałuszka
All authors have read and agreed to the published version of the manuscript

References

Antczak- Komoterska, A., & Lewińska, A. (2022). Wady postawy u dzieci – profilaktyczna rola pielęgniarki. Innowacje w Pielęgniarstwie i Naukach o Zdrowiu, 7(3), 105–120.

Bunnell, W. P. (1984). An objective criterion for scoliosis screening. The Journal of Bone and Joint Surgery. American Volume, 66(9), 1381–1387.

Cuccia, A. M., & Caradonna, C. (2009). The relationship between the stomatognathic system and body posture. Clinics, 64(1), 61–66.

Grivas, T. B., Wade, M. H., Negrini, S., O'Brien, J. P., Maruyama, T., & Hawes, M. C. (2007). SOSORT consensus paper: School screening for scoliosis- Where are we today? Scoliosis, 2, 17.

Kendall, F. P., McCreary, E. K., Provance, P. G., Rodgers, M. M., & Romani, W. A. (2005). Muscles: Testing and function with posture and pain (5th ed., pp. 1–480). Lippincott Williams & Wilkins, 1-480.

Kowalski, I. M., Protasiewicz-Fałdowska, H., Dwornik, M., Pierożyński, B., Raistenskis, J., & Kiebzak, W. (2014). Objective parallel-forms reliability assessment of 3 dimension real time body posture screening tests. BMC Pediatrics, 14, 221–228.

Kubička, L., Mičková, J., & Řehulka, J. (2023). Physical activity, sedentary behavior, and postural defects in school children: A cross-sectional study. International Journal of Environmental Research and Public Health, 20(5), 4621.

Magee, D. J. (2014). Orthopedic physical assessment. Elsevier Saunders, 1-1100.

Michelotti, A., Buonocore, G., Farella, M., Pellegrino, G., & Piergentili, C. (2011). Postural stability and unilateral posterior crossbite: Is there a relationship? Neuroscience Letters, 392(1–2), 140–144.

Mrozkowiak, M., Szark-Eckardt, M., Żukowska, H., & Zukow, W. (2014). Review of methods for assessing body posture. Part 2 = Przegląd metod oceny postawy ciała. Część 2. Journal of Health Sciences, 4(11), 95–102.

Negrini, S., Donzelli, S., Aulisa, A. G., Czaprowski, D., Schreiber, S., de Mauroy, J. C., Diers, H., Grivas, T. B., Knott, P., Kotwicki, T., Maruyama, T., O'Brien, J., Parent, E., Rigo, M., Romano, M., Stikeleather, L., Wynne, J., & Zaina, F. (2018). 2016 SOSORT guidelines: Orthopaedic and rehabilitation treatment of idiopathic scoliosis during growth. Scoliosis and Spinal Disorders, 13, 3.

Norton, K., & Olds, T. (1996). Anthropometrica: A textbook of body measurement for sports and health courses. UNSW Press.

Pimentel do Rosário, J. L. (2014). Photographic analysis of human posture: a literature review. Journal of Bodywork and Movement Therapies, 18(1), 56–61.

Pokrywka, J., Fugiel, J., & Posłuszny, P. (2011). Prevalence of postural disorders in children from copper basin in Poland. Physiotherapy Studies, 19(4), 3–10.

Puszczałowska-Lizis, E., Szwed, K., Mikuľáková, W., & Dul, M. (2025). Częstość występowania nieprawidłowości postawy ciała u dzieci w okresie wczesnoszkolnym. Fizjoterapia Polska, 25(2), 6–13.

Różańska-Perlińska, D., Potocka-Mitan, M., Rydzik, Ł., Lipińska, P., Perliński, J., Javdaneh, N., & Jaszczur-Nowicki, J. (2024). The correlation between malocclusion and body posture and cervical vertebral, podal system, and gait parameters in children: A systematic review. Journal of Clinical Medicine, 13(12), 3463.

Simons, D. G., Travell, J. G., & Simons, L. S. (1999). Myofascial pain and dysfunction: The trigger point manual (Vol. 1, pp. 1–1038). Lippincott Williams & Wilkins.

Skorupka, E., & Asienkiewicz, R. (2014). Funkcja szkoły w zapobieganiu wad postawy ciała u dzieci. Rocznik Lubuski, 40(2), 177–187.

Tremblay, M. S., LeBlanc, A. G., Kho, M. E., Saunders, T. J., Larouche, R., Colley, R. C., ... Gorber, S. C. (2011). Systematic review of sedentary behaviour and health indicators in school-aged children and youth. International Journal of Behavioral Nutrition and Physical Activity, 8, 98.

Wang, Y., Chen, H., Shao, J., & Li, F. (2017). Overweight and obesity in children and adolescents and its association with postural deviations. European Journal of Pediatrics, 176, 1411–1420.

Wawrzyniak, A., Tomaszewski, M., Mews, J., Jung, A., & Kalicki, B. (2017). Wady postawy u dzieci i młodzieży jako jeden z głównych problemów w rozwoju psychosomatycznym. Pediatria i Medycyna Rodzinna, 13(1), 72–78.

Wilkinson, M., Brown, C., & Hamilton, J. (2022). Sedentary work, physical activity, and musculoskeletal disorders in adults: A systematic review. PMC Musculoskeletal Journal, 12(3), 110–124.

World Health Organization. (2020). Guidelines on physical activity and sedentary behaviour. Pobrane 4 maja 2025 z https://www.who.int/publications