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Article

Clinical Kinesiology and Posturology Applied to a Group of Italian Students. A Morphological Observational Study.

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Abstract: The percentage of children who develop postural deviations during their teens is constantly growing. Many hours of study in a sitting position, poor physical activity, and inadequate information become crucial factors leading to a wrong posture. The aim of this study was to investigate the prevalence of untreated structural alterations, ascribed to incorrect posture (paramorphisms or dysmorphisms), in the adolescent growth phase of students at high school. The anthropometric and postural analyses of a sample of adolescents allowed the correct evaluation of their structural situation in order to establish the presence of conditions different from an ideal posture. The presence of scoliotic deviations was ascertained in 36% of students. Almost half of the students showed a non-physiological curve of the cervical and lumbar spine. A consistent part of examined students showed a non-physiological condition of shoulders (28%), scapulas (>50%), pelvis (≈50%), and hips (36.25%). A prominent malleolus was observed in 17.5% of students; 6.25% had an asymmetry between the ankles; and 18.75% had a foot deformity. If we consider that 65% of students showed a non-physiological musculoskeletal condition, we can consequently hypothesize that during the primary and middle school no one bothered to correct these

children under the postural profile. The lack of postural education in the Italian school system should be addressed, in order to prevent postural defects that, if detected in time, can still be re-educated.

Keywords: kinesiology; posture; spine; school; adolescent health

1. Introduction

"*Keep your shoulders back, chest out, back straight!*" This is a sentence that is constantly repeated to children; but straight compared to what? And how? The fear that deviations of the spine can interfere with the development of children, becomes an exasperation for parents who berate them because they maintain a bad posture [1]. Especially during school age, the percentage of children that develop spine disorders increases more and more. Bad posture during study, at home or at school, the backpack, the load of books, are all factors that slowly force the child to assume a bad posture [1]. It has been confirmed by another study [2] that a heavy backpack determines a forward head posture, a rounded shoulder posture, or even an increased lateral tilting of the shoulders. But what is being done in this regard? Little or nothing. Only a small percentage of parents are seriously concerned about the posture of their children; and the outcome is that when these children reach adolescence, they show paramorphisms and dysmorphisms that are difficult to correct. The high percentage of adolescents with a poor posture may derive from a lack of postural education at home or at school [3]. Modulation of postural tone is managed by a complex system that can regulate and adapt itself, the so-called *tonic postural system*. The reflexes collaborate in the maintenance of the posture, among them stretch reflex, vestibular, and neck reflexes coordinating the movements of the head and the upper limbs. The postural chains represent a contiguous muscle circuit through which they propagate the forces of the body. The standard posture in the upright position is given by a vertical line which, on the sagittal plane, must pass through the apex of the skull, the spinous process of the second cervical vertebra (C2), the vertebral body of the third lombar vertebra (L3), the calcaneo-cuboid joint that is projected on the support polygon. The *postural evaluation* of a subject starts with the past medical history of physical traumas and surgery, daily activities, physical activity and work. In the latter field, nowadays work, especially office work, can mean a long period behind a computer screen, which can provoke postural disorders [4]. Then a static evaluation on the three planes is performed by analyzing the existing symmetries. The task of the *postural tests* is to verify the presence of certain dysfunctions, asymmetries, or problems of the receptors. Some of the most common tests are: dominant eye test, examination of dysmorphic facial features, Romberg test for balance and vestibular apparatus, Bernard Autet test which measures the internal rotation of the foot, and others. The kinesiologist has a main role in prevention and motor re-education. The kinesiatric intervention during adolescence, could improve the quality of adult life, preventing diseases related to postural defects [5,6].

The aim of this study was to investigate the prevalence of untreated structural alterations, ascribed to a bad posture (paramorphisms or dysmorphisms), in the adolescent growth phase of Italian high school students.

2. Materials and Methods

In this observational study we analyzed under the terms of posture, a group of 80 students aged between 14 and 19 years old (31 males and 49 females), attending high school. The postural analysis of this study, has been performed within the "*Liceo Classico Megara Sezione Scientifica Annessa*" in the city of Augusta (SR)—Italy. The examinations included physical examination (Figure 1) and X-ray imaging (Figure 2). The study included the observation of the students in the classroom, their habits during the school hours and the behavior during the class assignments, followed by the postural analysis of the students. Postural analyses were conducted during the final quarter of the school year, from April to June 2015. The aim of this evaluation was to verify the presence of untreated paramorphisms or dysmorphisms in the growth phase of these students, and if necessary, recommending postural exercises to correct any conditions. The management of these patients was multidisciplinary involving orthopaedics, radiologists, physiatrists, kinesiologists, and research assistants. Informed consent was obtained from each student; the research conformed to the ethical guidelines of the Declaration of Helsinki.

GENERAL EXAMINATION

Body composition: Healthy □ _____ **Age:**_____ **Weight:**_____ **Height cm**: _____

Dental arches: _____ Malocclusion _____

Eyes: In axis □ _____

Skin: Healthy □ _____ Tattoo or scars _____

Subcutaneous fat: Normal □ _____

Muscles: Regular trophism □ _____

MUSCOLOSKELETAL AND JOINT SYSTEM

SPINE

Scoliosis: _____

Hump: _____

Lordosis: _____

Kyphosis: _____

Shoulders: Symmetry □ _____ **Scapulas:** _____

Waist triangles: Symmetry □ _____

Pelvis: _____ **Abdomen:** _____

Acupressure of the somites: Painless □ _____ **Hernia:** Absent □ _____

LOWER LIMBS

Joints: Healthy □ _____ **Hip:** _____

Knee: _____ **Ankle:** _____

Feet: _____

Romberg Test: Negative □ _____

DIAGNOSTIC SUMMARY:

_____

_____

Date: ___/___/____

The undersigned, having read the present medical record, informed about the rights and limitations of law 675/96 concerning the *"protection of persons and other subjects regarding the processing of personal data"*, **hereby consent and authorize** the use of personal data, to the medical purposes.

Signature

_____

Figure 1. Postural examination data sheet used for the kinesiology study.

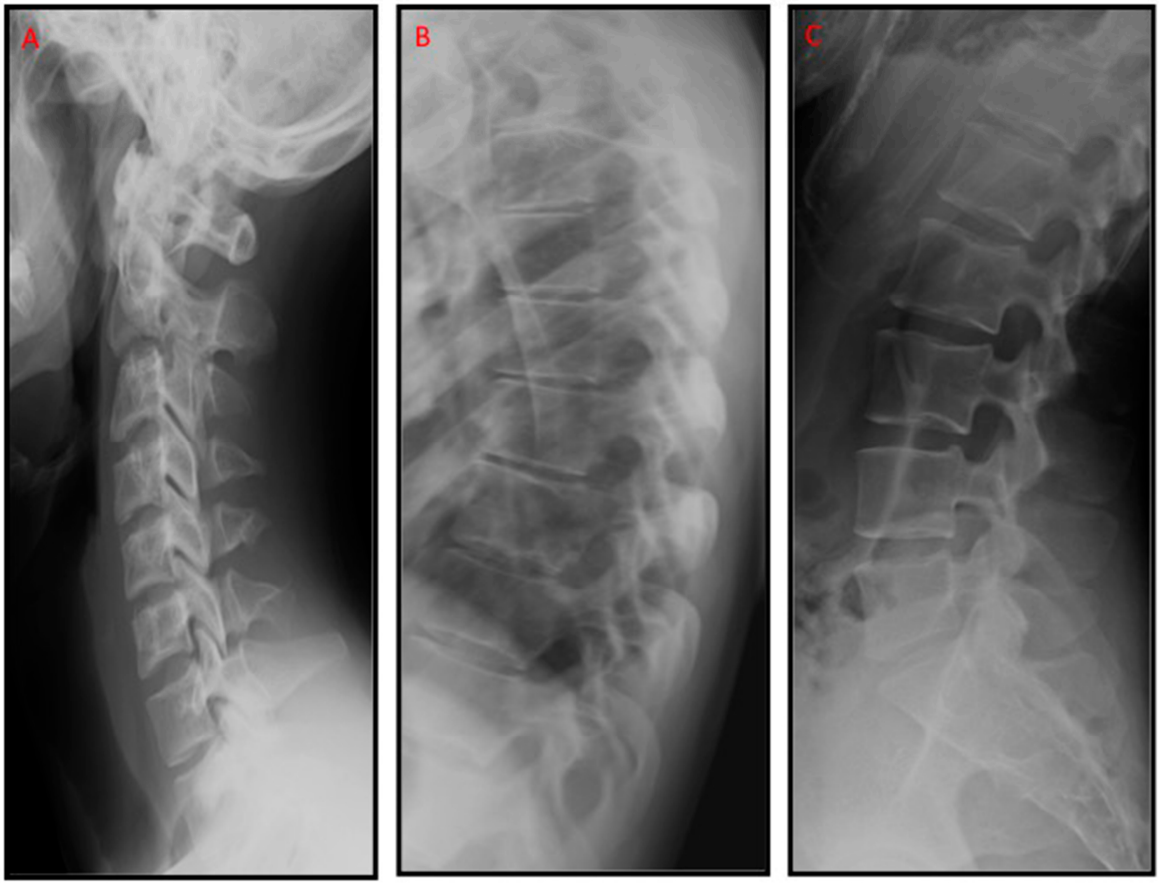

Figure 2. X-ray lateral projection of the spine. (**A**) Cervical curvature; (**B**) Thoracic curvature; and (**C**) Lumbar curvature.

2.1. Anthropometric Analysis

The study focused on the observation of the students' habits at school, followed by the anthropometric analyses. Body mass (kg) was measured without clothes, only with underwear. The obtained values, along with the stature, were used to calculate the body mass index (BMI = body mass/the square of their height; kg/m^2). Depending on the value, students were classified in several categories: "BMI ≤ 18.5" = underweight; "18.5 ≤ BMI < 25" = healthy; "25 ≤ BMI < 30" = overweight; "30 ≤ BMI < 40" = obese; "BMI ≥ 40" = extremely obese.

2.2. Postural Analysis

The postural analysis allows a visual evaluation of the subject in order to establish the presence or absence of conditions different from an ideal posture. The first point was the observation of the pupils to control the presence of heterophoria, visual axes deviations, classified into: exophoria, esophoria, hyperphoria, and hypophoria. Then we evaluated and detected the cases of malocclusion divided into three different classes; 1st degree malocclusion: the bite is normal, but the upper teeth slightly dominate those of the lower arch; 2nd degree malocclusion: the upper arch overhangs the lower one, along with an excessive interdental space; 3rd degree malocclusion: the lower teeth lean forward and protrude more than the upper ones (Figure 3). The condition of the complexion, the skin and its elasticity were examined. Moreover, the presence of scars or tattoos was checked, indeed surgical scars

can affect the whole fascia. The examination of the muscles provided a general idea about the conditions of the musculoskeletal system. By performing simple movements of flexion and extension front and side, we rated the muscle trophism of the students. Moreover, we tested the mobility of the spine various segments, observing both movements of flexion of the spine and lateral bending, so as to assess any differences in the range of movement.

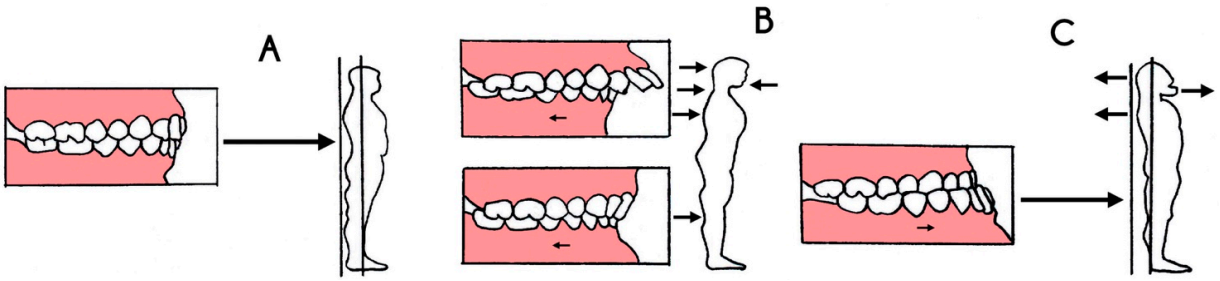

Figure 3. Graphic design of different malocclusion divided into three different classes. (**A**) Normal occlusion, which determines a correct posture; (**B**) Malocclusion where the upper teeth dominate those of the lower arc. It causes a forward leaning posture; and (**C**) Malocclusion where the upper arch overhangs the lower one. It causes a backward leaning posture.

Skeletal and Articular System

The physical examination included spine, shoulders, scapula, pelvis, lower limbs, and the feet, in orthostatism, in a relaxed position, trying to minimize movements, arms at sides, feet slightly overshifted and eyes to the horizon. Initially from the back, inclinations of twisting of the head and the position of the ears were noted; then we evaluated the biacromial line; shoulder position to understand which one is the upper one and the lower one, since the lower one in physiology is the one of laterality. Then we analyzed the alignment of the inferior angle and the styloid process of the scapulas. Then we checked if the gluteal folds were at the same level and at the end we observed the Achilles tendon to evaluate if the back foot has a valgus or varus attitude. The spine was then evaluated in the sagittal plane. Spinal curves are influenced by the support foot; so a flat foot increases the lordosis and kyphosis, instead a cavus foot decreases the kyphosis and lumbar lordosis. After positioning a plumb line at head level, in order to touch the occipital bone and the spinous process of the seventh thoracic vertebra (T7), we checked the *Cervical arrow* (the distance between the plumb line and the lordosis should be about 6–8 cm) and the *Lumbar arrow* (the distance between the plumb line and the lordosis should be about 4–6 cm). This allows us to highlight the presence of accentuated lordosis or kyphosis and scoliosis. If the presence of suspected scoliotic posture or scoliosis, we performed the *forward bending test*. In this way, the students join their hands and flex their spine forward and the operator placed behind them assesses: the presence of rib or lumbar hump, the quality of the range of movement of the hip joint during the flexion of the torso, the tropism of the posterior muscles of the thighs, the direction assumed by the spinous processes, since it can be a sign of scoliosis. Moreover, we checked the symmetry of the waist triangles. The subject, standing in orthostatism, places the hands at his/her sides and the operator looks at the space located between the profile of the side and the inside of the arm. These two triangles should be physiologically symmetric; when one of the two is slightly smaller than the other, we can deduce that the spine is more shifted to one side, caused by a scoliotic posture

or scoliosis. By observing the shoulders, we checked the symmetry and the position, if these are forward-shifted there is a good possibility of hypokyphotic spine. The inferior angle of the scapulas should be symmetrical. Through analysis of the scapular plane we can understand if the subject tends to fall forward or backward. To check this we evaluated if the plumb line positioned on the scapula touched the gluteal muscle. When the wire did not touch the gluteus, the scapula was backward-shifted; while when it rested too much on the gluteus, the scapula was forward-shifted. We evaluated the posterior superior iliac spine, available on the iliac crest, down near the sacroiliac joint. By performing the forward bending test with the thumbs on the posterior superior iliac spine, physiologically the thumbs should appear symmetrical as when we placed them before the flexion of the torso; otherwise the thumb remaining higher than the other one is an index of imbalance on the ipsilateral side. We can control also the symmetry of the iliac crests by putting the *hands to cut* on the iliac crests, from this condition we can see if our hands prove to be symmetrical or if one looks lower than the other one.

The analysis of the lower limbs was based on the analysis of symmetry, after checking past history of trauma or injury involving the joints. Subsequently the analysis of the major joints (hips, knees, ankles, and feet) was done. For each of them symmetry and valgus or varus deformities, were evaluated; the foot analysis showed if it was normal, hollow, or flat. The Romberg test was used to check the tonic postural balance and the function of the vestibular apparatus.

3. Results

In our group of students (Table 1), the majority of subjects, 77.50% (62/80), both male and female, had normal weight. There was still a percentage of students, 10% (8/80), who had a BMI lower than the value of 18.5 and were therefore underweight; there were also overweight students 11.25% (9/80), whose BMI was between 25 and 30. Only 26.25% (21/80) of subjects showed a malocclusion: 8.75% type 1 (7/80), 10% type 2 (8/80), and 7.50% type 3 (6/80). Ninety-one percent (73/80) of the students showed excellent skin condition; only a minority, 4%, had a lower elasticity of skin (3/80), and scars or tattoos 5% (4/80), although the presence of these had not proved to be a point of tension for the muscle chains. Only 14% (11/80) showed a lower-trophism of muscles, this condition was confirmed by the subjects themselves who declared they did not play sports or engage in physical activity. The presence of scoliotic deviations was ascertained in 36% (29/80) of students, all had a hump, for 62% of them it was positioned to the right (18/80) and for 38% to the left (11/80). Almost half of the subjects, 47.50% (38/80), showed a non-physiological curve of the cervical and lumbar spine. Exactly 10% (8/80) had a pathological condition of the cervical spine, such as the presence of the typical swan neck where the curve is accentuated, or a situation of the plate neck, namely a reduced cervical curve. The remaining 37.50% (30/80) showed a pathologic condition of the lumbar spine, most frequently a flat or excessive lumbar curvature (hyperlordosis). The latter was prevalent in women who practiced artistic gymnastics during the growth phase. Of the examined sample, 33.75% (27/80) showed a pathologic kyphosis, 17.50% (14/80) hyperkyphosis, and 16.25% (13/80) hypokyphosis.

In this way, 23.75% (19/80) of the subjects studied showed a pathological spine condition involving both lordosis and kyphosis. Ten percent (8/80) of subjects showed a non-physiological condition of the right shoulder; 12.5% (10/80) of the left shoulder, and 5% (4/80) of both shoulders. Usually an asymmetry regarding the height of the shoulders was present; when both shoulders were involved, the forward- or backward-shift of both shoulders was observed. More than half of the examined subjects

showed a pathologic condition of the scapulas; 23.75% (19/80) concerned the left scapula, 22.50% (18/80) the right scapula, and 13.75% (11/80) both scapulas. The most frequent situation was that one scapula was shifted forward or backward compared to the other one, and this was observable even when both shoulders had a pathological condition. We also observed the presence, although minimal, of winged scapulas. Almost half of the subjects had a pathological pelvis, the rotation of the pelvis, such as the anteversion or the retroversion, or the possible asymmetry of posterior superior iliac spine or anterior superior iliac spine. Of the examined subjects, 36.25% (29/80) showed an asymmetry of the hips. One more prominent malleolus was observed in 17.5% (14/80), while 6.25% (5/80) of students had an asymmetry between the ankles. Of the studied subjects, 18.75% (15/80) had a foot deformity; in particular 15% (12/80) of those had flat feet, while the remaining 3.75% (3/80) had hollow feet. Three subjects had been operated on because of flat feet, but on examining those subjects, the feet were normal. Only 20% (16/80) of the analyzed subjects showed appreciable fluctuations that could be recorded as positive in the Romberg test.

Table 1. Anatomical and morphological characteristics of the studied sample.

Parameters	Total (*n* = 80)	Female (*n* = 49)	Male (*n* = 31)
General examination			
Underweight	8 (10%)	6 (7.5%)	2 (2.5%)
Healthy	62 (77.5%)	39 (48.75%)	23 (28.75%)
Overweight	9 (11.25%)	4 (5%)	5 (6.25%)
Obese	1 (1.25%)	0 (0%)	1 (1.25%)
1st Degree malocclusion	7 (8.75%)	5 (6.25%)	2 (2.5%)
2nd Degree malocclusion	8 (10%)	5 (6.25%)	3 (3.75%)
3rd Degree malocclusion	6 (7.5%)	4 (5%)	2 (2.5%)
Hypoelastic skin	3 (3.75%)	1 (1.25%)	2 (2.5%)
Scars or Tattoo	4 (5%)	3 (3.75%)	1 (1.25%)
Low muscle trophism	11 (13.75%)	9 (11.25%)	2 (2.5%)
Muscoloskeletal and joint system			
Scoliosis	29 (36.25%)	18 (22.5%)	11 (13.75%)
Right hump	18 (22.5%)	12 (15%)	6 (7.5%)
Left hump	11 (13.75%)	6 (7.5%)	5 (6.25%)
Pathologic cervical lordosis	8 (10%)	5 (6.25%)	3 (3.75%)
Pathologic lumbar lordosis	30 (37.5%)	17 (21.25%)	13 (16.25%)
Hyperkyphosis	14 (17.5%)	6 (7.5%)	8 (10%)
Hypokyphosis	13 (16.25%)	8 (10%)	5 (6.25%)
Pathologic right shoulder	8 (10%)	5 (6.25%)	3 (3.75%)
Pathologic left shoulder	10 (12.5%)	6 (7.5%)	4 (5%)
Pathologic both shoulders	4 (5%)	2 (2.5%)	2 (2.5%)
Pathologic right scapula	18 (22.5%)	10 (12.5%)	8 (10%)
Pathologic left scapula	19 (23.75%)	14 (17.5%)	5 (6.25%)
Pathologic both scapulas	11 (13.75%)	8 (10%)	3 (3.75%)
Pathologic pelvis	39 (48.75%)	26 (32.5%)	13 (16.25%)
Asymmetry of hips	29 (36.25%)	22 (27.5%)	7 (8.75%)
Prominent malleolus	14 (17.5%)	9 (11.25%)	5 (6.25%)

Table 1. *Cont.*

Parameters	Total (*n* = 80)	Female (*n* = 49)	Male (*n* = 31)
Muscoloskeletal and joint system			
Asymmetry of malleolus	5 (6.25%)	3 (3.75%)	2 (2.5%)
Flat feet	12 (15%)	6 (7.5%)	6 (7.5%)
Hollow feet	3 (3.75%)	2 (2.5%)	1 (1.25%)

4. Discussion

Puberty is one of the most important phases in growth, characterized by morphological, physiological, and functional changes. In this period, it is important to pay attention to the musculoskeletal development, in order to allow a correct growth of the locomotor apparatus. The best prevention of paramorphisms is the correct movement. The continuous increase of postural defects and dysmorphic features is closely related to the reduction of the possibility of engaging in physical activity for children. This study was based on the postural analysis of students who are close to concluding the puberty phase; so essentially we observed the presence of dysmorphic features or paramorphisms that with time can become hard to correct. Correcting posture is an important aim for physical therapy since people with postural alteration can have muscular modifications which can cause movement problems or change joint alignment. These impairments can lead to problems in everyday life [7]. The lack of convergence movements can be determined by a cervical trauma, spinal fractures, or malocclusions. These deficits can lead to headaches, instability, and motor incoordination. There are a lot of correlations between the motor and the visual systems, indeed the importance of visual function in motor coordination, maintenance of posture, and ambulation has been widely demonstrated [8,9]. According to some posturology studies, the stomatognathic system plays a particular role. It has been shown that the body creates a posture apparently "correct" according to the occlusal class present. The situation in which the dental arches have no anomalies is called normal occlusion (Figure 3A). The condition in which the upper teeth are not perfectly aligned with the lower ones is called malocclusion. The tension created by the malocclusion, determines a muscle contraction which leads to postural modifications. In the literature, the correlation between the incidence of malocclusion and orthopedic problems has an increasingly high percentage [8]. So cooperation between orthodontics and orthopedics becomes crucial in order to determine a correct development of the stomatognathic system and the upper cervical spine [10]. Moreover, good condition of the skin is a symptom of physical wellness and proper nutrition. Authors showed how the presence of post burn scars causes a lateral cervical flexion contracture [11]. In our study the observation of the classrooms provided relatively negative results, since the percentage of students with a correct posture was low (data not shown). The school desk, defined by Descovich like "the mold of paramorphisms", had a significant importance (Figure 4). Obviously not all the students sitting at the desks are predisposed to develop paramorphisms, but the percentage is quite high. The long time spent sitting at the school desk can cause frequent pain, resulting from a wrong sitting posture or static body posture [12].

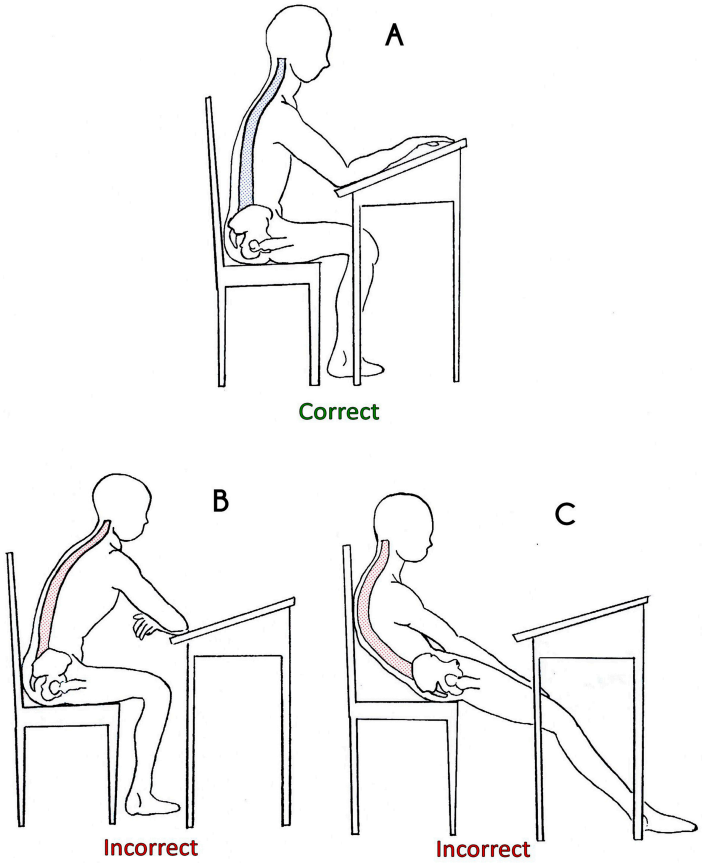

Figure 4. Graphic design of correct or incorrected posture at the school desk. (**A**) Correct posture while sitting on the school desk; (**B**) Wrong posture at the school desk; and (**C**) Wrong posture on the chair.

In the correct sitting posture (Figure 4A) the subject is placed with the spine slightly inclined forward with the load on the hip joint instead of the spine, which must remain straight, supported by the arms resting over the school desk. Most of students tended to be lying on the chair (Figure 4C) or even lying on the school desk (Figure 4B). To avoid this problem, some useful tips have been proposed to the teacher to improve this condition, such as letting the students periodically change their place in the classroom; planning some free minutes to let the students relax for a while at the beginning of every lesson; arranging the desks in an amphitheater shape. Moreover, the backpack plays a negative role in posture. Nowadays the students tend to carry it with one shoulder instead of two, creating a posture of compensation from the attempt to rebalance the center of gravity of the body. When the backpack's load is heavy, this tends to bend the backs of the students; for this fact, literature recommends using backpacks with wheels, thus avoiding carrying it on the shoulders. Pathological deviations that affect the spine are divided between congenital and acquired. The deviations are due to a formation or segmentation congenital defect, and often are associated with scoliosis. When the vertebrae bodies are fused together there is a kyphotic deformity; while we talk about lordotic deformity when the fusion refers to vertebral arches. Acquired deviations are pathological conditions of increase or decrease of the curvature over the physiological limits, such as dorsal hyperkyphosis, lumbar hyperlordosis, and thoracolumbar kyphosis. The *structural shapes* are the idiopathic rounding spine and Scheuermann's disease, which is a form of osteochondrosis of the spine with structural deformity of the vertebral elements and increased posterior rounding of the thoracic spine [13].

The non-structural shapes are reversible postures presenting just a condition of flexion of the vertebral bodies, and not a physiological modification of them. The *mixed shapes* are situations in which both modifications may be present. Spinal deformity in addition to modifying the shapes of the trunk, changes the relation between muscles, bones, and the whole structure of the body [14]. S*coliosis* is an alteration of the spine with an unknown etiology, characterized by a deflection on the three-dimensional plane [15]. A distinction is made between unstructural scoliosis defined as "attitude", and a structural scoliosis which is the real one in the strict sense. The scoliotic posture is characterized by a lateral deviation of the spine not associated with a rotation of the vertebrae. While the proper scoliosis with a rotation on the three-dimensional plane is divided in idiopathic, secondary, and congenital. When the scoliosis regards the thoracic spine, the ribs attached to the transverse processes follow the direction of the apophyses and form the typical overhang called hump. The presence of the hump is essential for the diagnosis of scoliosis (except congenital scoliosis), and is indicative of vertebrae rotation. Idiopathic scoliosis can occur throughout life, although the higher percentage of occurrence is during growth. Obviously scoliosis interferes with other skeletal elements like the scapulas or the pelvis. A study [16] has already proven the relationship between the scapulas, the pelvis, and the structural deviations during quiet standing. The different curvatures of idiopathic scoliosis can be observed through *radiological examination*; the most prominent features are in the transverse plane for the right thoracic scoliosis, in the frontal plane for the left thoracolumbar one, and in the frontal and transverse plane for the right thoracic-left lumbar one [17].

From our data, it is possible to observe that only 35% of the subjects showed a good posture or at least the absence of relevant data. Every time we carried out a postural assessment, we asked those students if they practiced sport on a regular basis or if they have ever done it; what is surprising is that only half of them played a sport when young, and a small part of them continued. The absence of movement during the growth phase, resulted in postural defects or aggravation of pre-existing conditions. In addition, several students who had a severe condition of the spine stated that they were not examined by a specialist, since they did not know that they had scoliosis, or that they used a corset as a child, but it was annoying and they left it at that or they did re-educative gymnastics, but it was boring and so they did not do it anymore. What was missing then, is the prevention when aged between 7 and 12 years; it is useful since, with some early corrective intervention, the development of possible anomalies could be prevented [18]. Moreover, malocclusion [19] is associated with postural system dysfunctions; like a forward or backward-shift of the shoulder. In 26.25% of students with a malocclusion, it was possible to observe the forward-shift of the shoulder. In accordance with other studies, the protracted and the forward shoulder are common postural disorders among adolescents [20]. A slouched posture over a long time at the desk could lead to rounded shoulder posture; and the rounded shoulder posture is a factor that can determine upper back pain [21]. Moreover, observing the lower limbs and the ankles, an asymmetry was often noticed, both by measuring the thigh length and the protruding malleoli. Another important element was the muscular tropism. By asking some questions, it was found again that sport or even just physical activity, was poorly practiced. This condition decreased further in maturity, indeed the percentage of them who still play a sport was really low [3]. Anyway the ones who showed a reduced tropism represented the minority. Regarding the spine, it was shown that 36% of the examined subjects present a scoliotic deviation. To verify this condition, the spine was initially observed in orthostatism, and some subjects showed a spine with a lateral deviation,

not accompanied by a rotation or deformation of the vertebral bodies; so it was clear that this was a scoliotic posture, a paramorphism therefore. The clear difference between scoliosis and scoliotic posture is that the latter is a stance with no anatomical abnormality, since the curve disappears on flexion [22]. To be sure to deal with a paramorphism and not a dysmorphism, it is crucial to perform a forward bending test, and it was possible to appreciate the presence of a hump. The total absence of an accurate examination during childhood, has led to an increased percentage of subjects with scoliosis. Also on the sagittal plane, the thoracic and lumbar spine showed some pathological conditions, in particular thoracic hyperkyphosis, usually compensated by an accentuated lumbar lordosis. In an interesting study [23] it was shown that the sagittal configuration of the spine changes during growth; anyway the relation between kyphosis and lordosis becomes more pronounced in men than women. The early approach to a subject with a kyphotic problem includes kinesiatric methods, like aerobic activity and exercise conditioning programs [24]. Moreover, biofeedback can help to reduce the problems of the spine by fixing the curvatures of it [25]. Many countries have established school screening programs for scoliosis. The first screening for scoliosis began in 1963 in Minnesota [26]. In USA 21 States had legislated school screening; 11 states just recommended school screening and the remaining either had volunteer screenings or recommended not to conduct screening in the schools [27]. While there has been controversy nationally regarding the cost-effectiveness of school screening for scoliosis, most physician groups continue to support the principle of school screening. The American Academy of Pediatrics suggests spinal screening as part of a preventive health visit at 12, 14, and 16 years of age [27]. In Japan, school-screening program for scoliosis is mandatory by law, but an actual program depends on local educational committees [27]. The British Orthopaedic Association and the British Scoliosis Society, instead, concluded that it should not be a national policy to routinely screen children for scoliosis throughout the United Kingdom [28]. In Italy, school screening was introduced sporadically and to a variable extent in most regions and towns. So the school screening programs for scoliosis and other posture alterations remain a subject of considerable controversy.

5. Conclusions

This observational study demonstrates how adolescents show paramorphisms and dysmorphisms of which they are not aware. This is a critical point because, since they do not know that they have postural deviations correctable or not, they keep growing, and then they exacerbate these dysfunctions, which with the progress of time can get worse or lead to further paramorphisms or even worse to dysmorphism. Our results probably reflect the lack of prevention in Italian primary school. If we consider that 65% of students showed a non-physiological musculoskeletal condition, we can consequently hypothesize that during primary and middle school no one bothered to correct these children under the postural profile. The lack of postural education in the Italian school should be addressed, in order to prevent postural defects that, if detected in time, can still be re-educated. The limit of the present study was that no comparative evaluation after early postural prevention through kinesiatric treatment has been done. Further clinical studies are needed to show the benefits of postural prevention at school.

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Author Contributions

All authors have made substantial intellectual contributions to the conception and design of the study. All authors have approved the final version submitted.

Conflicts of Interest

The authors declare no conflict of interest.

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